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.

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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

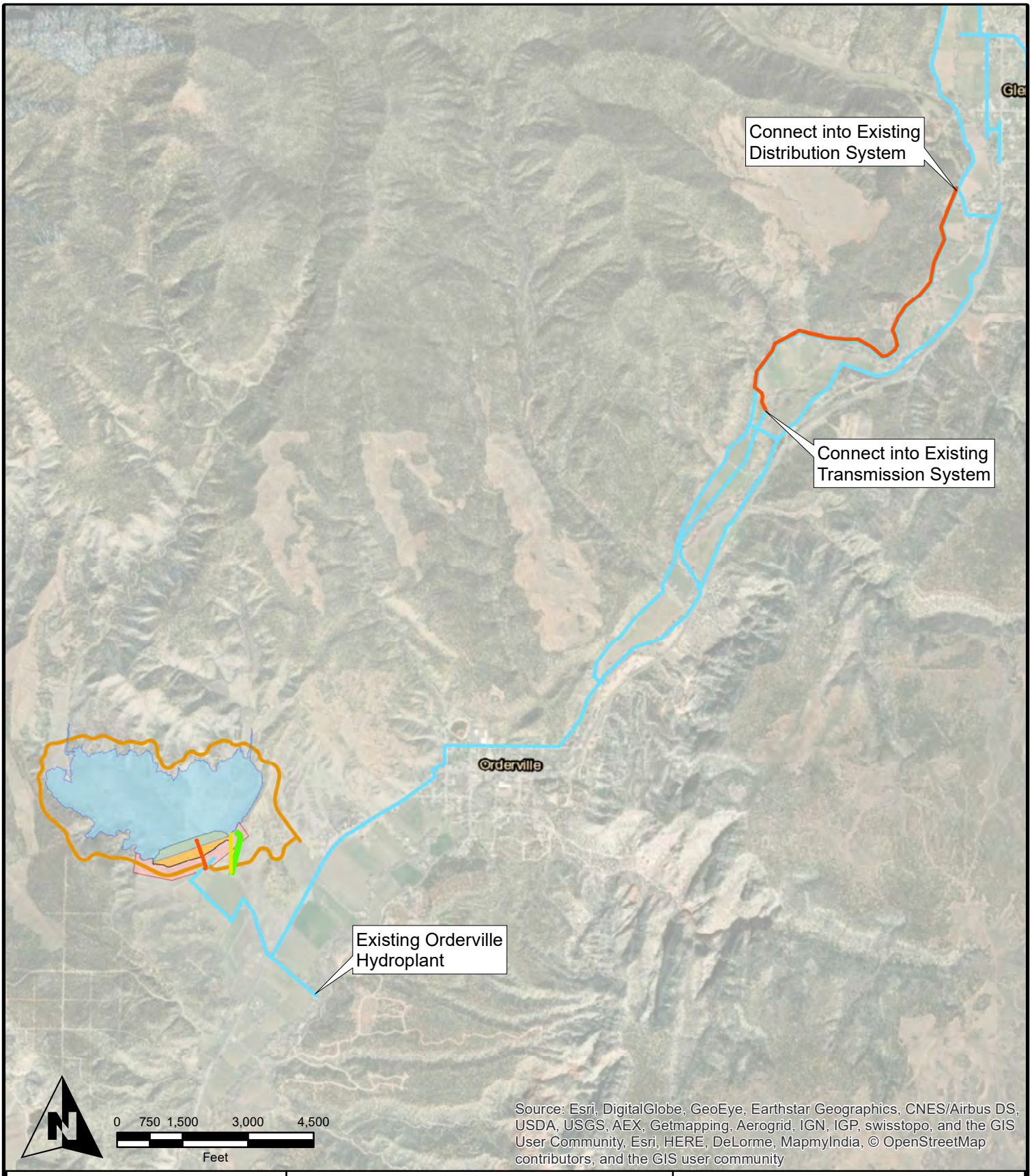
Exhibit 4. NWS Precipitation Points

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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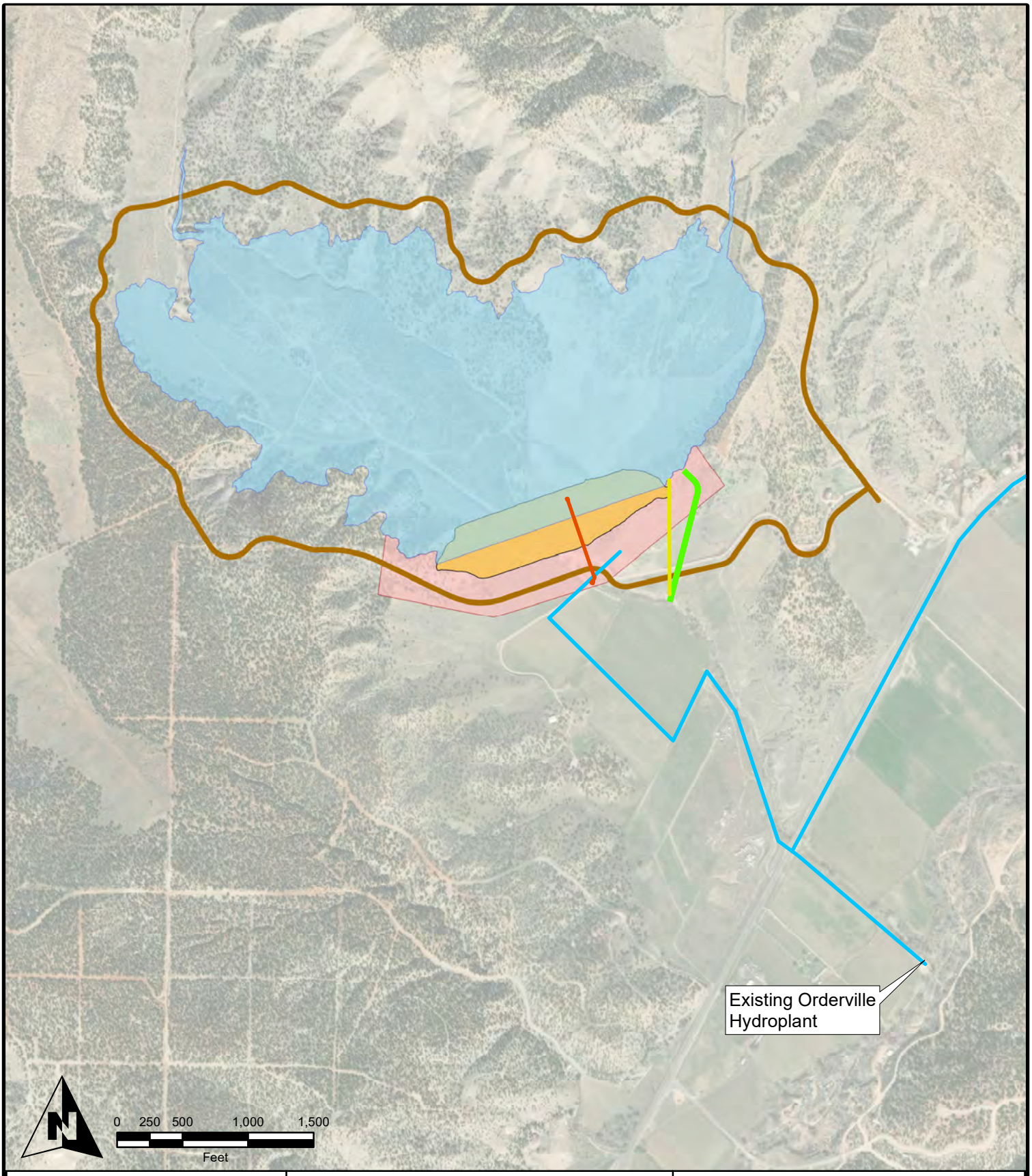

ALPHA ENGINEERING

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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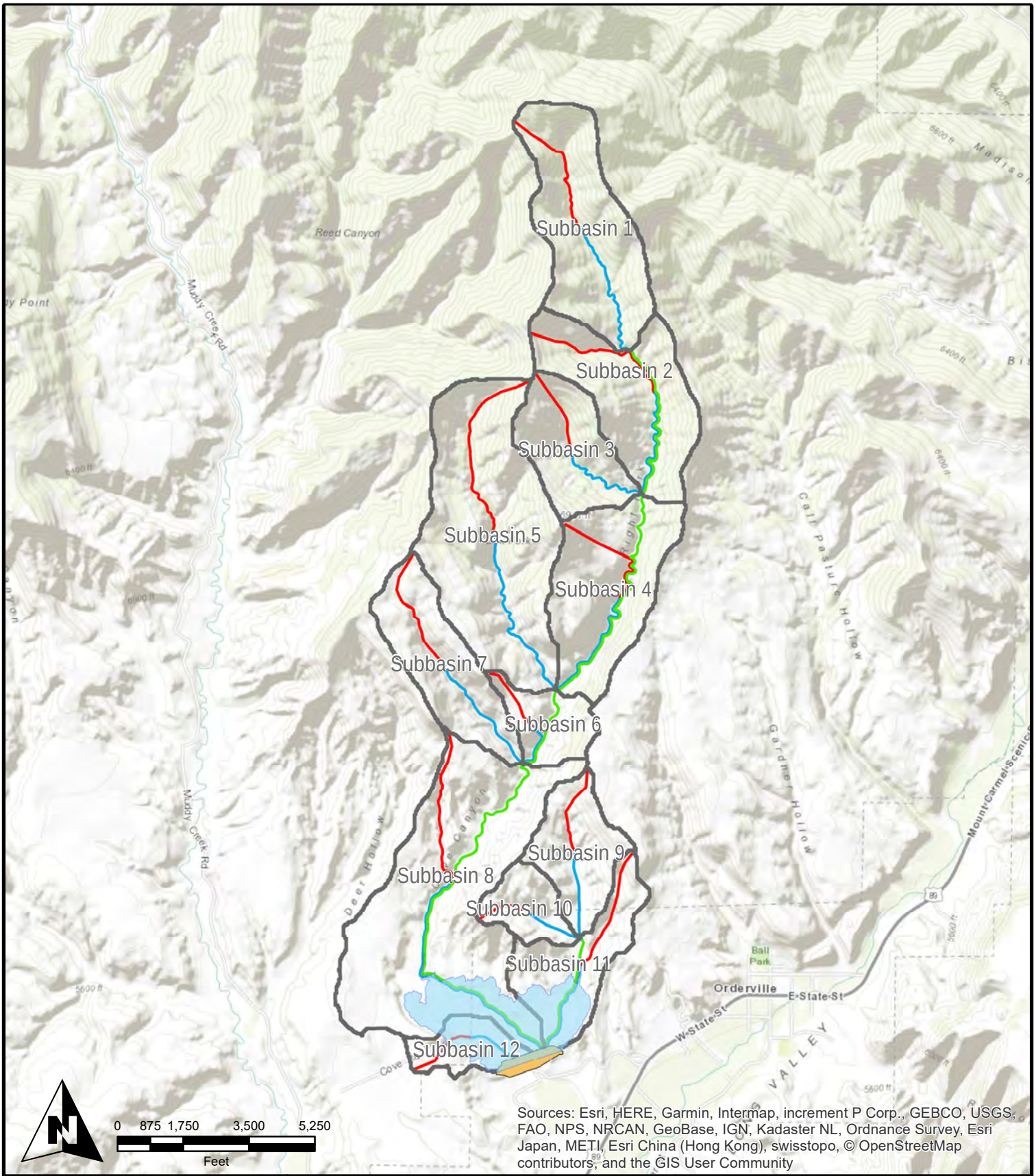

ALPHA ENGINEERING

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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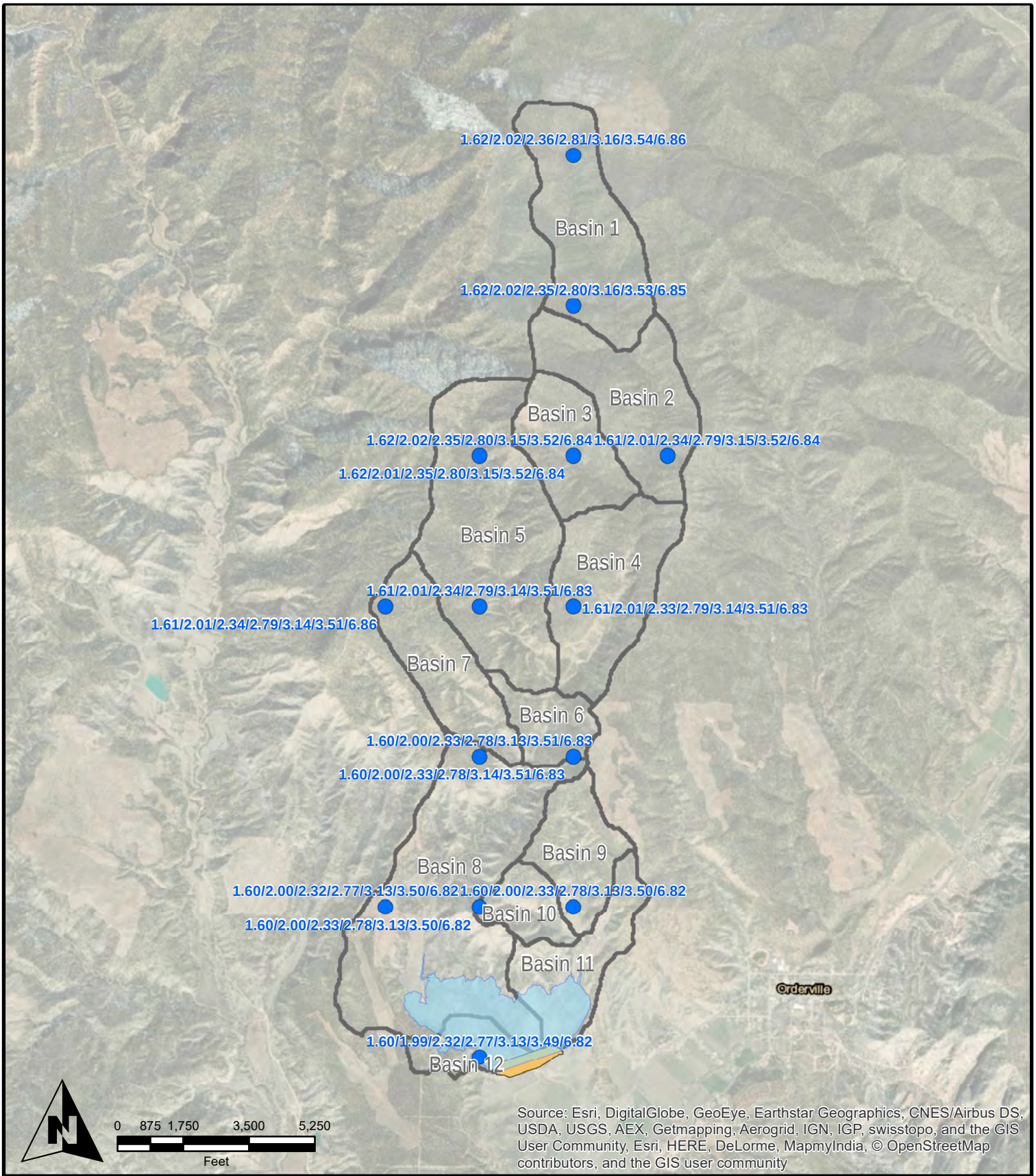

ALPHA ENGINEERING

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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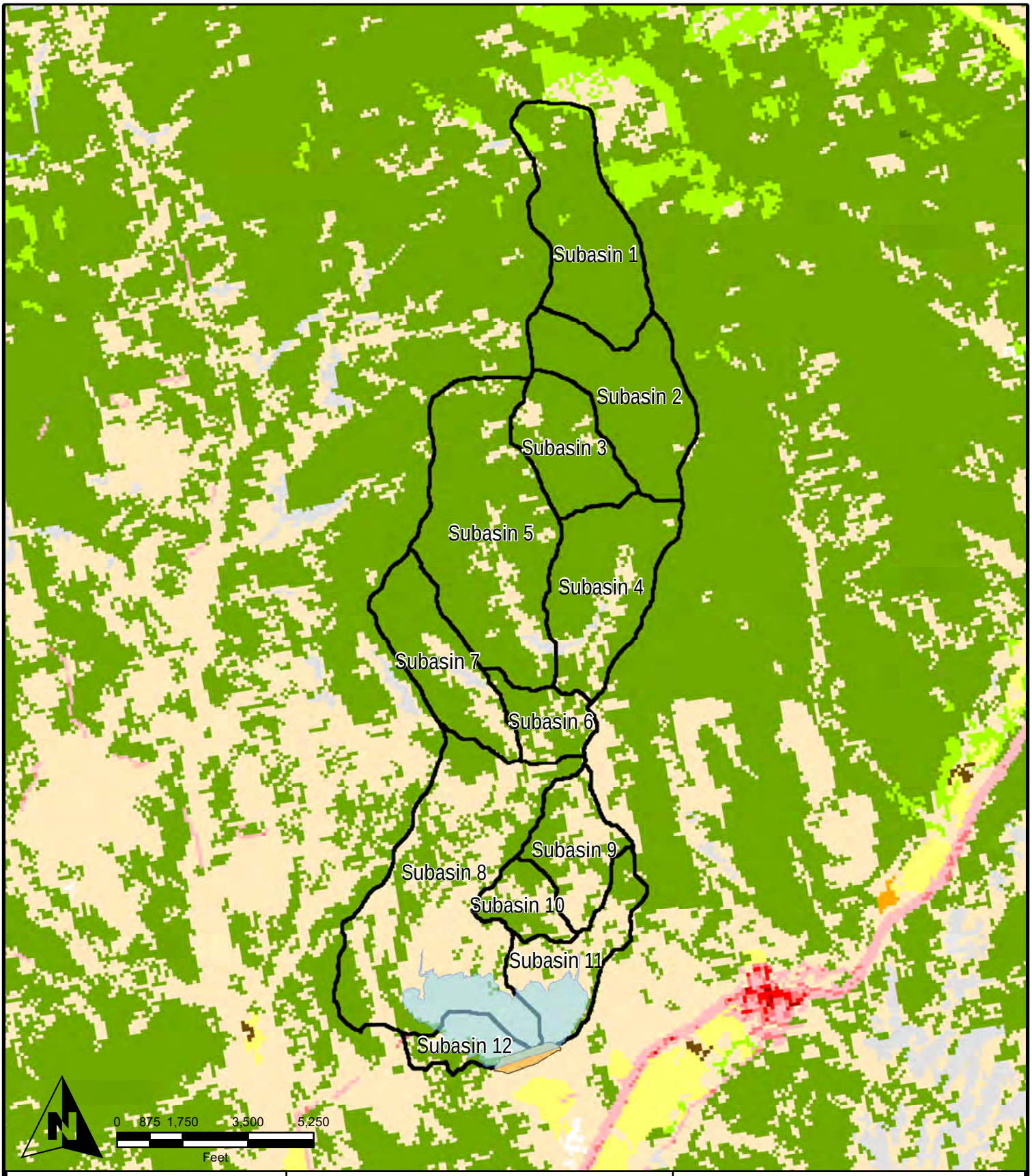


ALPHA ENGINEERING

RB&G ENGINEERING, INC.

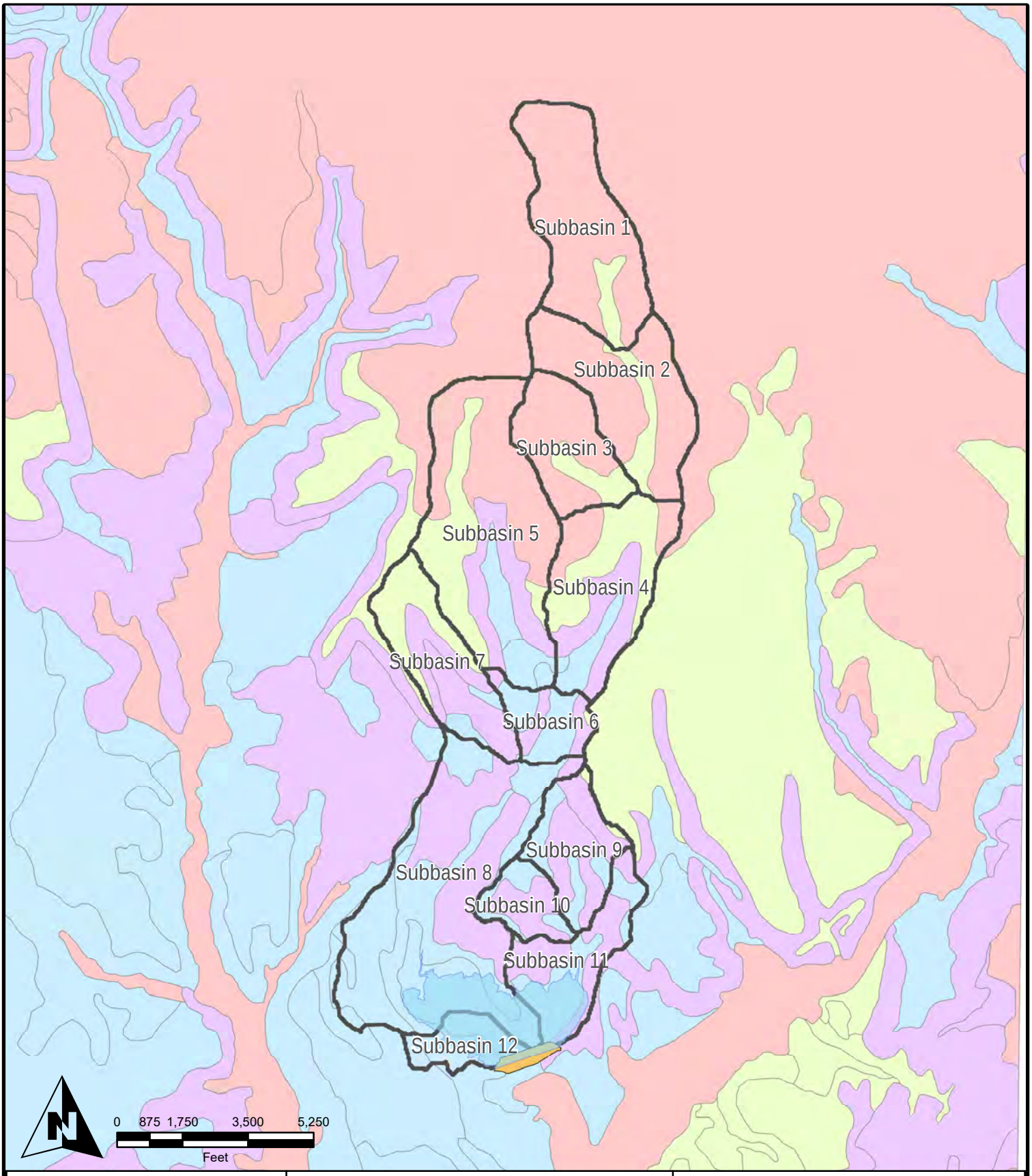
Cove Reservoir
Drainage Subbasins
NLCD Land Cover
21 - Developed, Open Space
22 - Developed, Low Intensity
23 - Developed, Medium Intensity
24 - Developed, High Intensity
31 - Barren Land (Rock/Sand/Clay)
41 - Deciduous Forest
42 - Evergreen Forest
43 - Mixed Forest
52 - Shrub/Scrub
81 - Pasture/Hay
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.

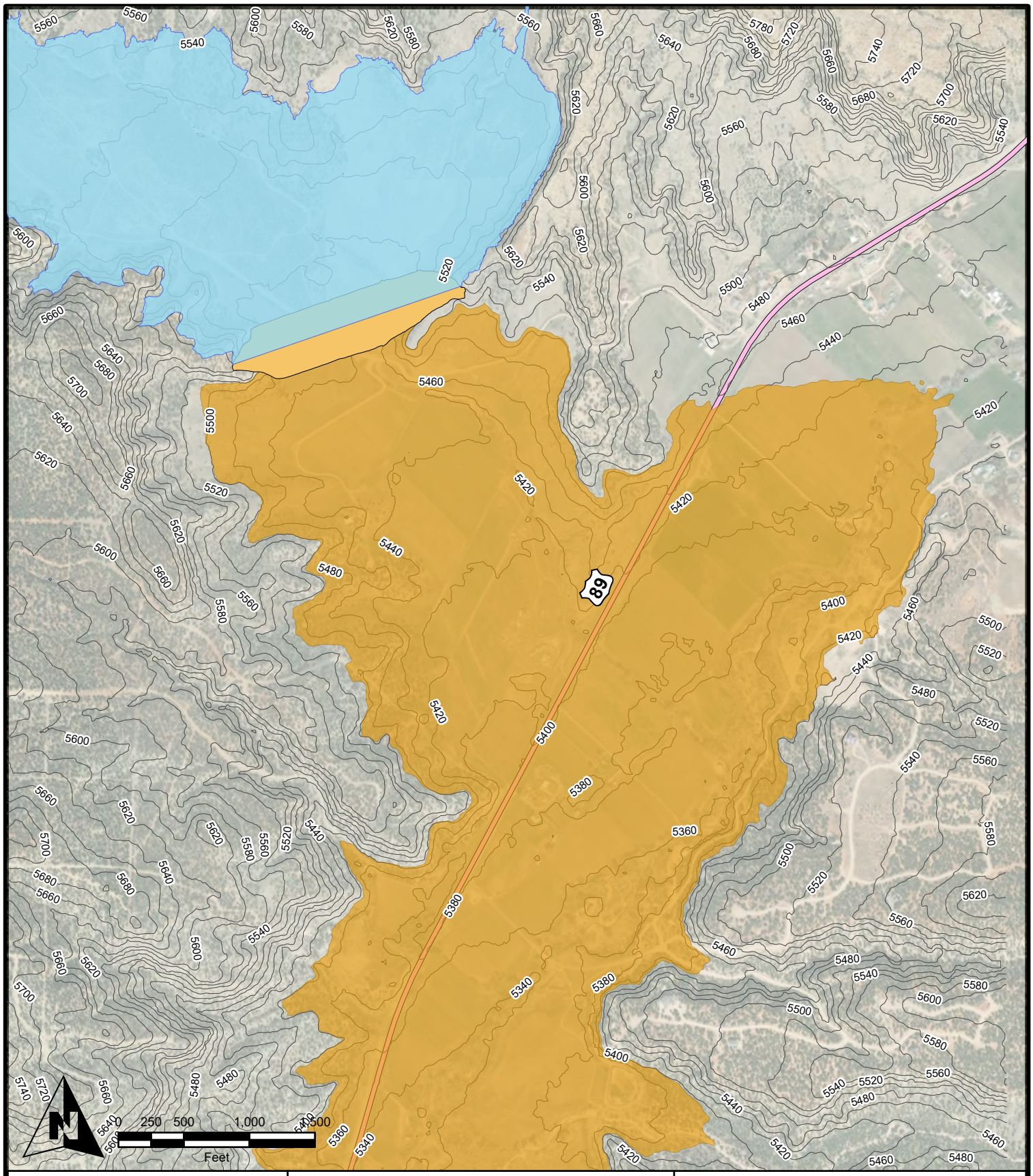
Cove Reservoir
Drainage Subbasins
Hydrologic Soil Group
A
B
C
D

Hydrologic Soil Groups

Exhibit 6 - Cove Reservoir

Spatial Reference:	UT83-SF
Drawn By:	JTM
Scale:	1 inch = 3,500 feet
Date:	September 17, 2019

P:\357-21 KCWCD Cove Reservoir Environmental and Design\Drawings\GIS\357-21 Design Report Exhibit 6 Hydro Soil Groups.mxd, 9/17/2019 11:48:45 AM jmadsen



ALPHA ENGINEERING

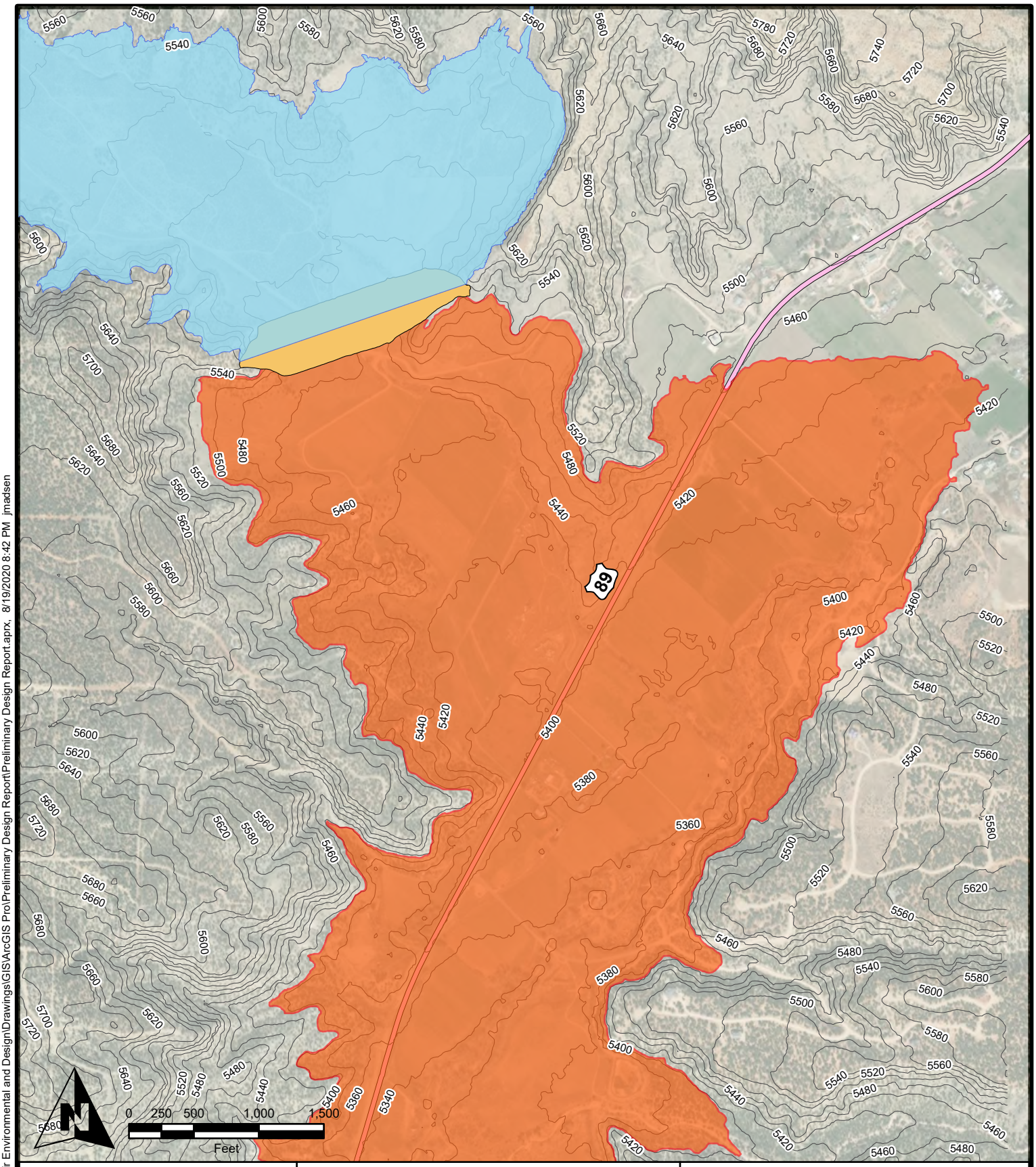
RB&G ENGINEERING, INC.

- 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

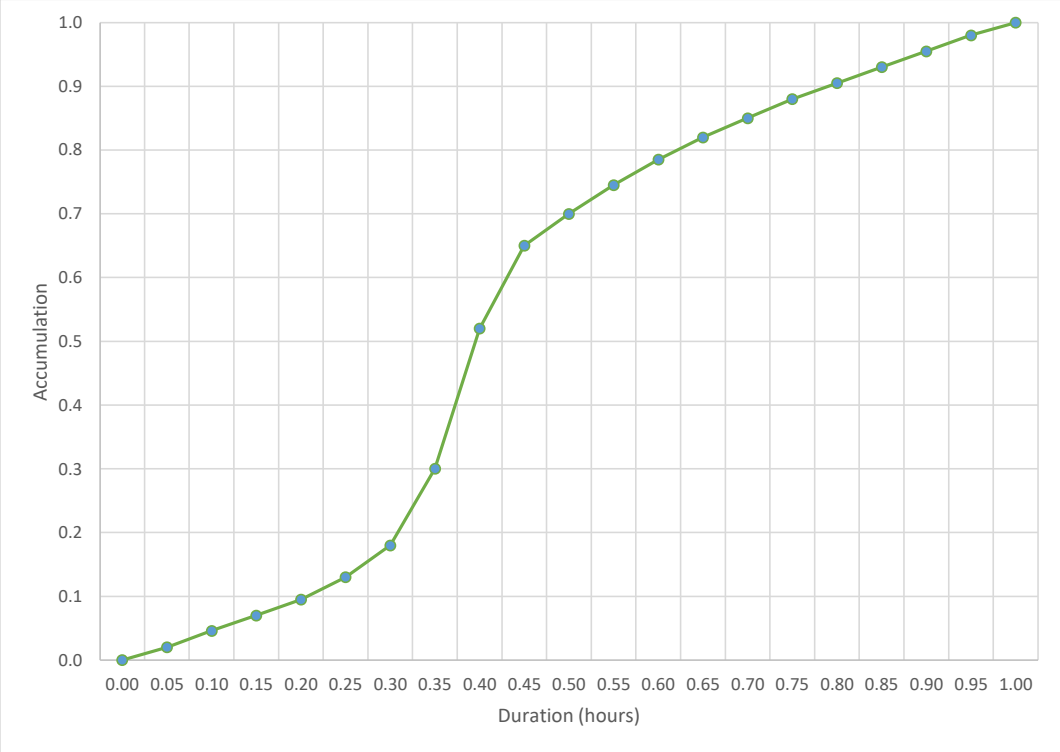
Composite CN = **81.2**

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

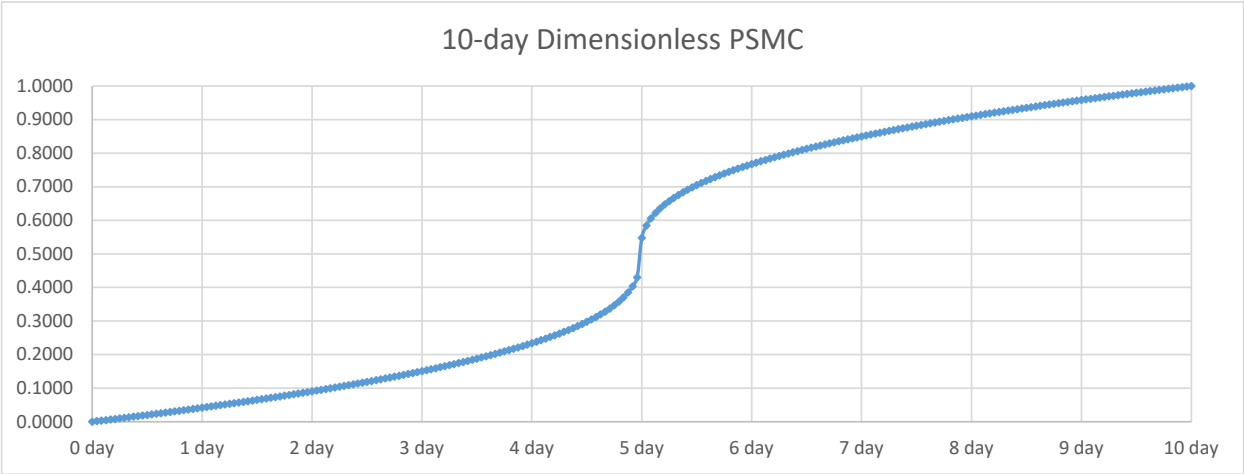
0.6667	1.0694	0.0266	16	0.0266	209	16	0.0055	0.0837	0.0272
0.7083	1.0950	0.0256	17	0.0256	207	17	0.0055	0.0892	0.0290
0.7500	1.1197	0.0247	18	0.0247	205	18	0.0055	0.0947	0.0308
0.7917	1.1436	0.0239	19	0.0239	203	19	0.0056	0.1003	0.0326
0.8333	1.1667	0.0231	20	0.0231	201	20	0.0056	0.1059	0.0344
0.8750	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

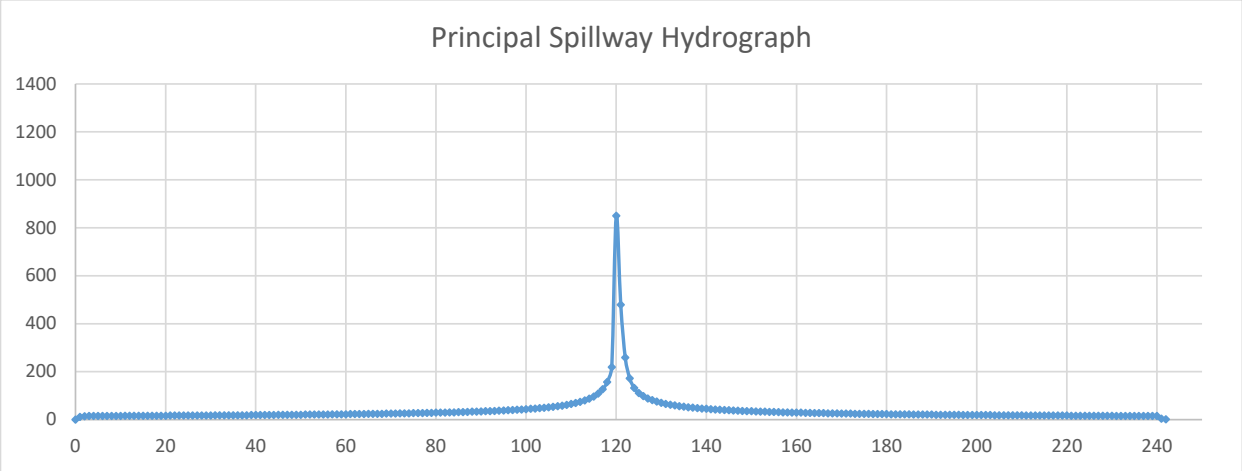
Time (hrs)	Inc. Volumes Rearranged	q (cfs)	Composite PSH (cfs)
0.0	0.0000	0	0
1.0	0.0050	2186	11
2.0	0.0051	612	14
3.0	0.0051	120	15
4.0	0.0051	24	15
5.0	0.0051	0	15
6.0	0.0052		15
7.0	0.0052		15
8.0	0.0052		15
9.0	0.0052		15
10.0	0.0053		15
11.0	0.0053		16
12.0	0.0053		16
13.0	0.0054		16
14.0	0.0054		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

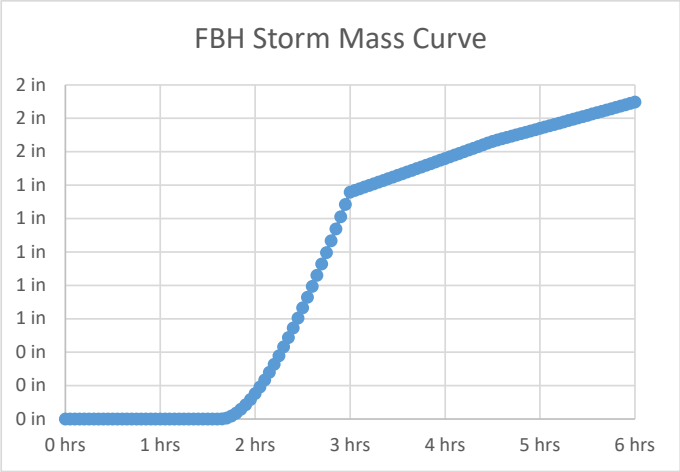
Time Increment	Incremental Rainfall	Rainfall Fractions for Each Time Increment	5 Point Rainfall Distribution
0 to 1.5	0.299 in	0.074	0.074
1.5 to 3	3.032 in	0.752	0.827
2 to 4.5	0.400 in	0.099	0.926
4.5 to 6	0.299 in	0.074	1.000

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%

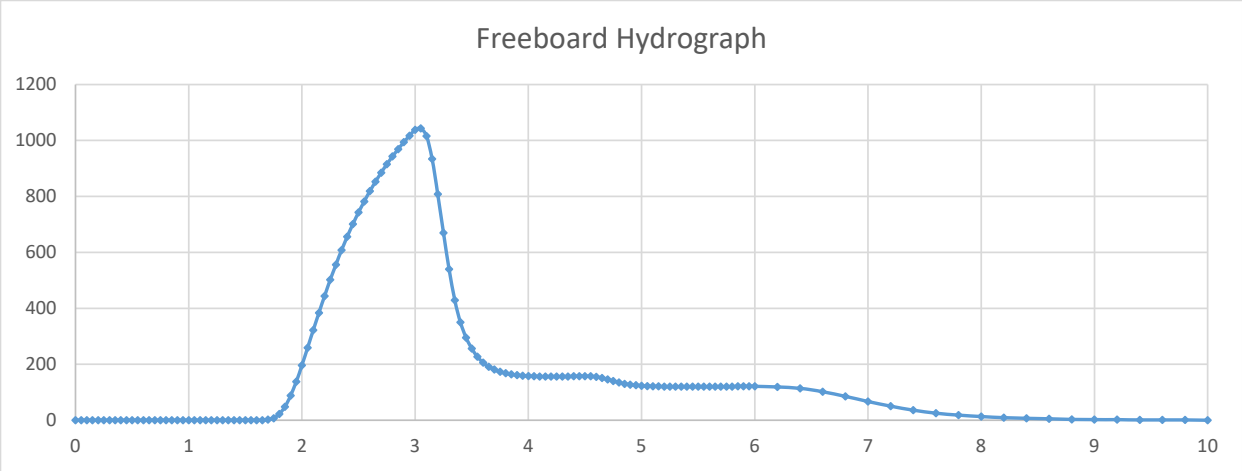
Freeboard Hydrograph

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

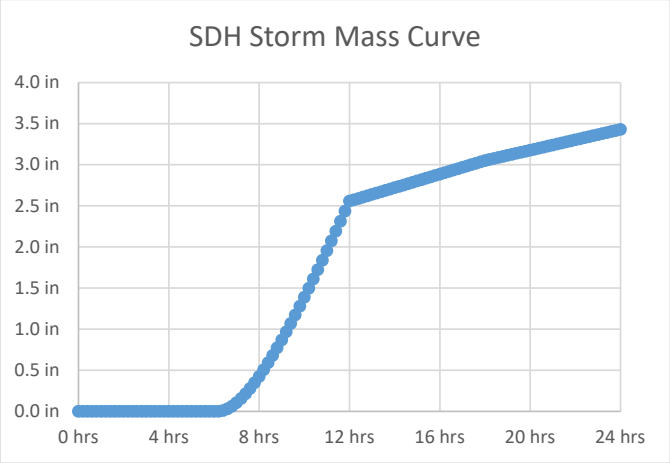
Time Increment	Incremental Rainfall		Rainfall Fractions for Each Time Increment		5 Point Rainfall Distribution	
0 to 6	0.436	in	0.075		0.075	
6 to 12	4.399	in	0.752		0.826	
12 to 18	0.580	in	0.099		0.926	
18 to 24	0.435	in	0.074		1.000	

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%

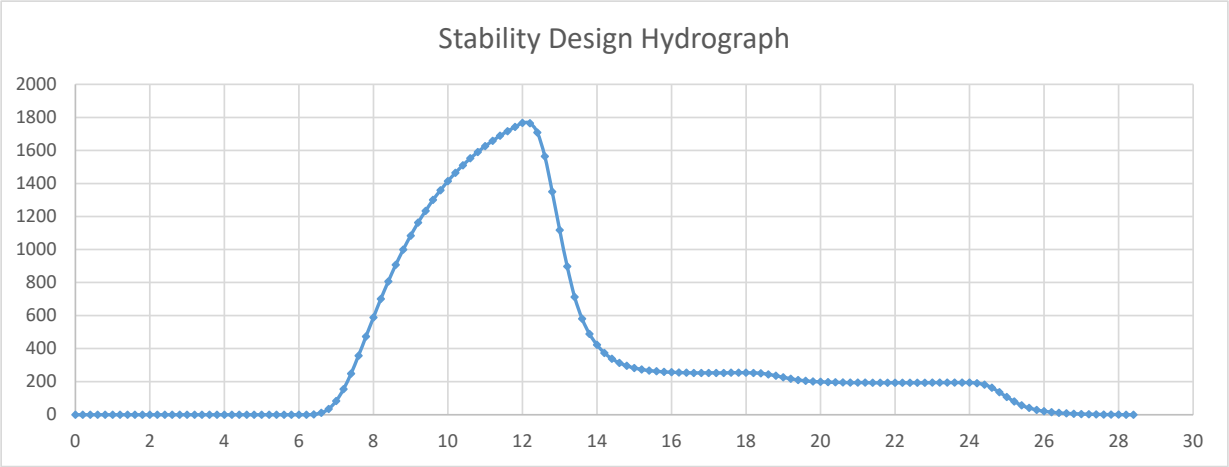
Stability Design Hydrograph

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	

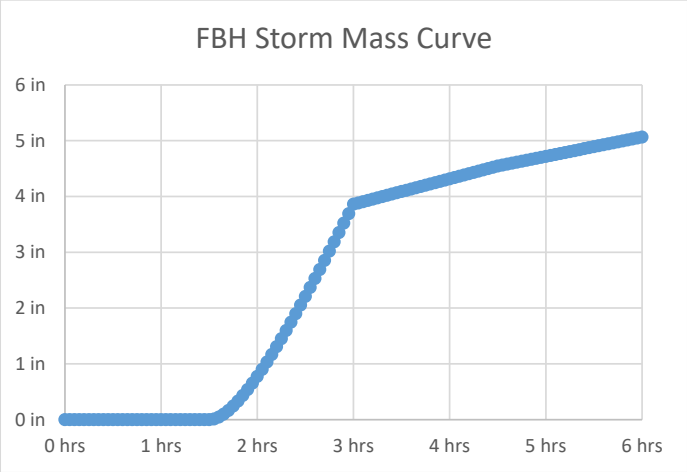
Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	1.50	0.074	3.00	0.827	4.50	0.926
0.05	0.002	1.55	0.099	3.05	0.830	4.55	0.928
0.10	0.005	1.60	0.124	3.10	0.833	4.60	0.931
0.15	0.007	1.65	0.150	3.15	0.837	4.65	0.933
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

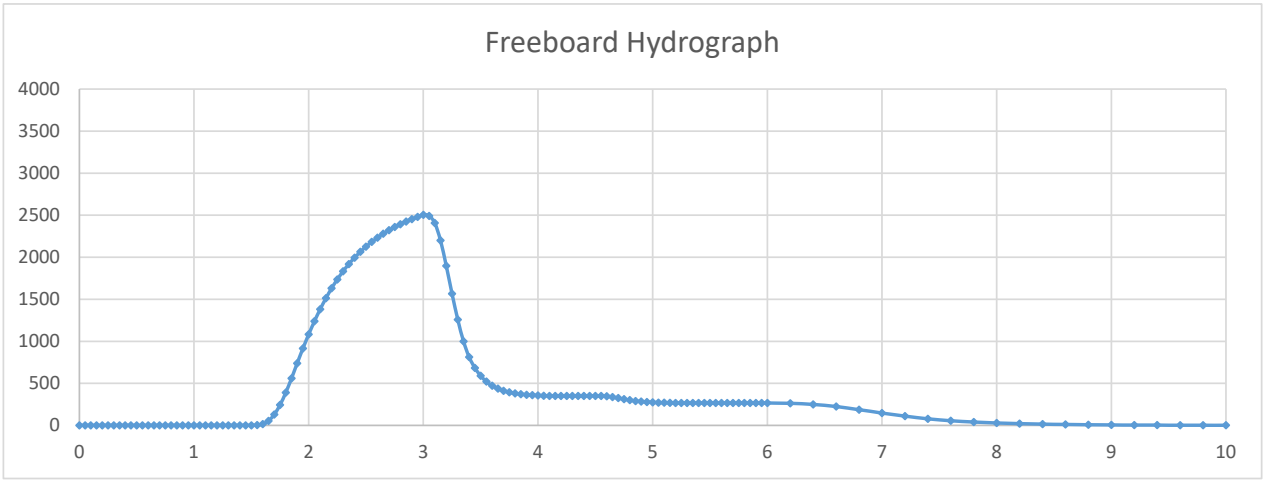
Unit Hydrograph (per 1 in. Unit Runoff)	3060.2
Variance	49.98%

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	

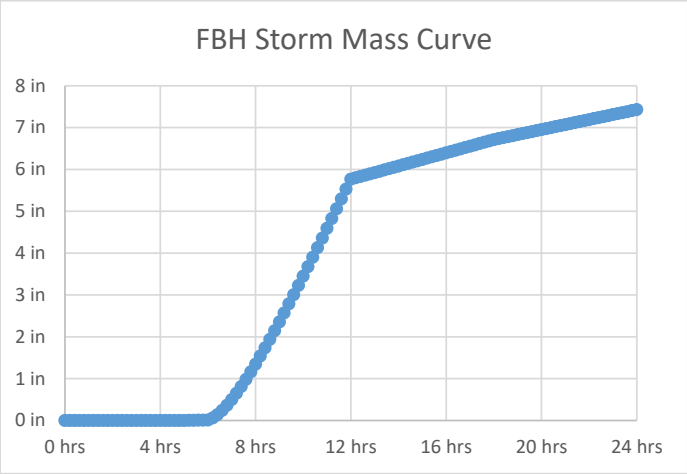
Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution	Time (hr)	Rainfall Distribution
0.00	0.000	6.00	0.075	12.00	0.826	18.00	0.925
0.20	0.002	6.20	0.100	12.20	0.830	18.20	0.928
0.40	0.005	6.40	0.125	12.40	0.833	18.40	0.930
0.60	0.007	6.60	0.150	12.60	0.836	18.60	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%

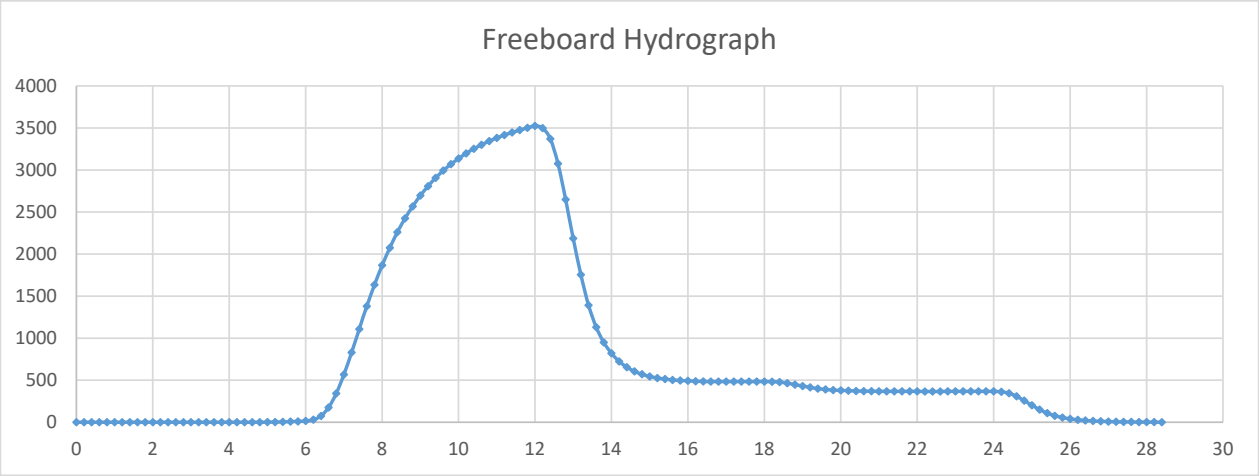
Freeboard Hydrograph

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.

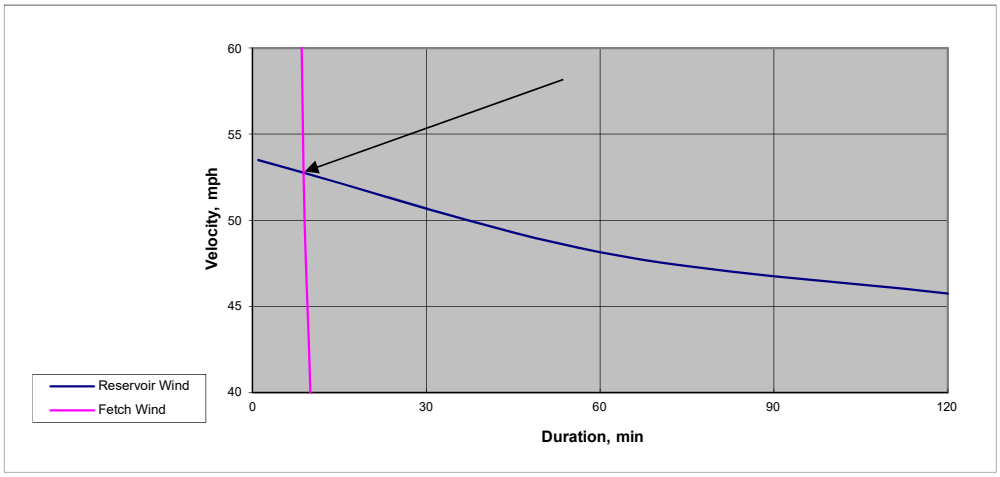
Reservoir Wind:

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.

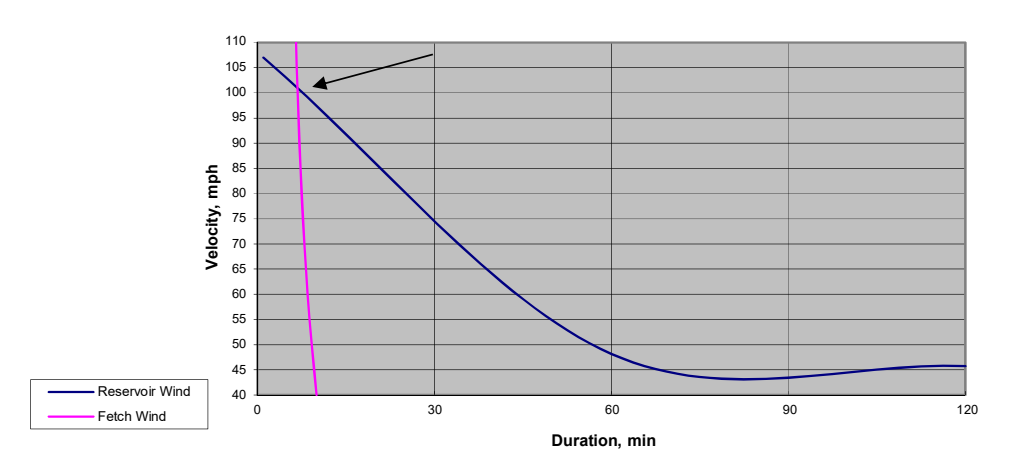
Reservoir Wind:

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

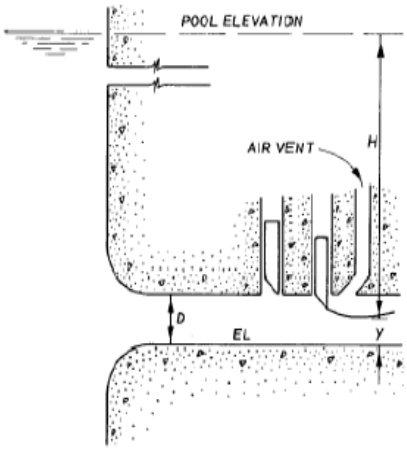
RESULTS	
Water Surface Elevation @ 24 Days	5497
Vol. Drained @ 24 Days (ac-ft)	5468
% Drained @ 24 Days	90%
Vol. Remaining @ 24 Days (ac-ft)	587
Average Flow Rate (cfs)	117

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             *
 *                                      *                                  *                                      *
 ****************************************                                  ****************************************

                                                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
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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

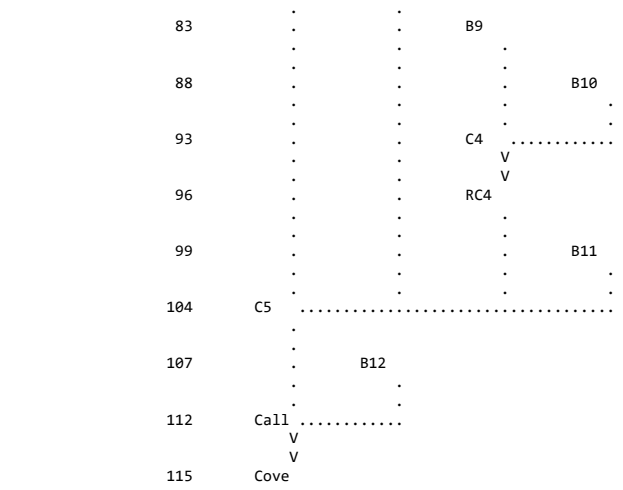

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

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1*****************************************                    *****************************************
 *                                       *                    *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *    U.S. ARMY CORPS OF ENGINEERS       *
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 *  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


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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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        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

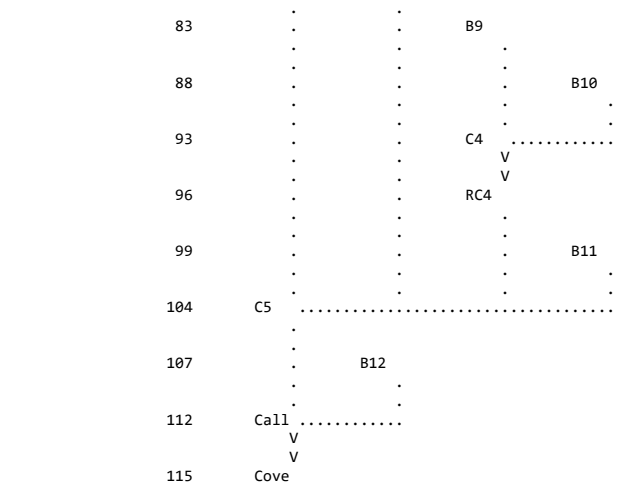

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

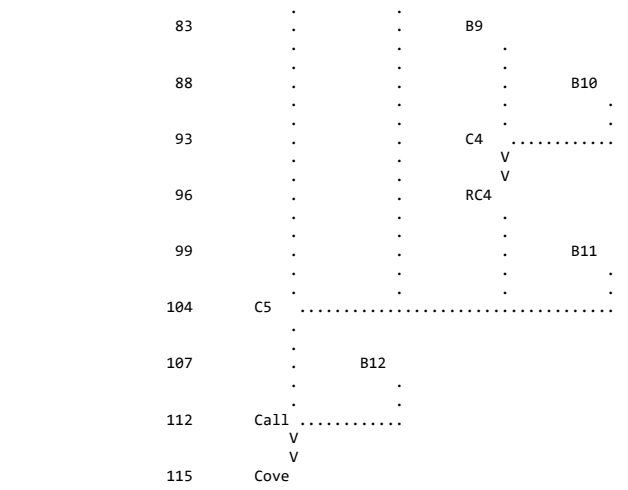

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

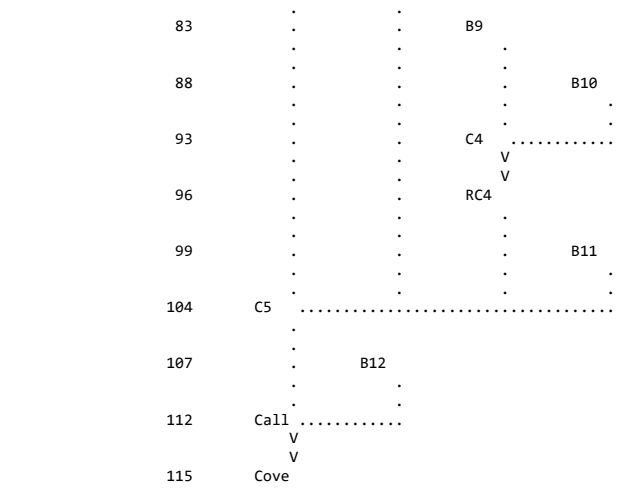

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

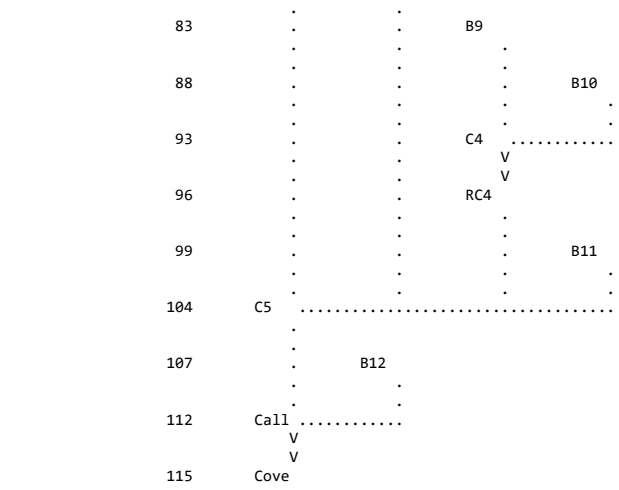

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

```
 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

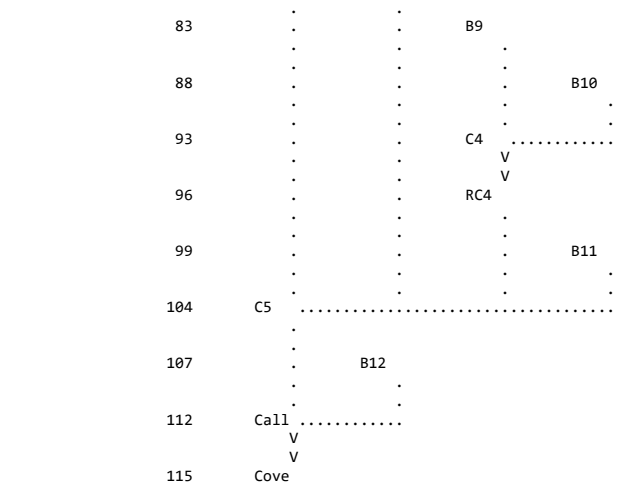

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

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

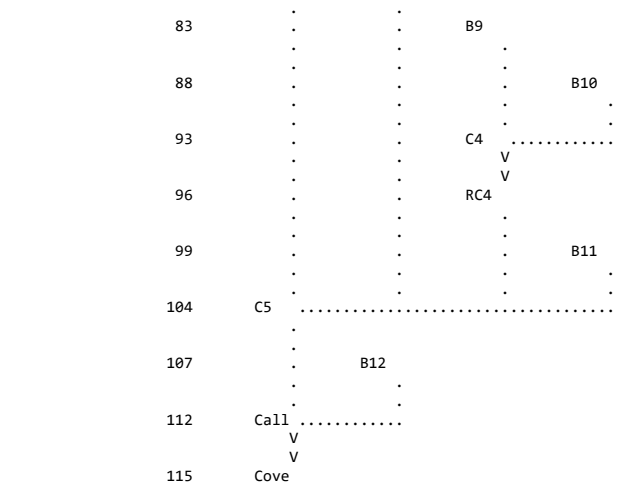

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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 ***
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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
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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    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

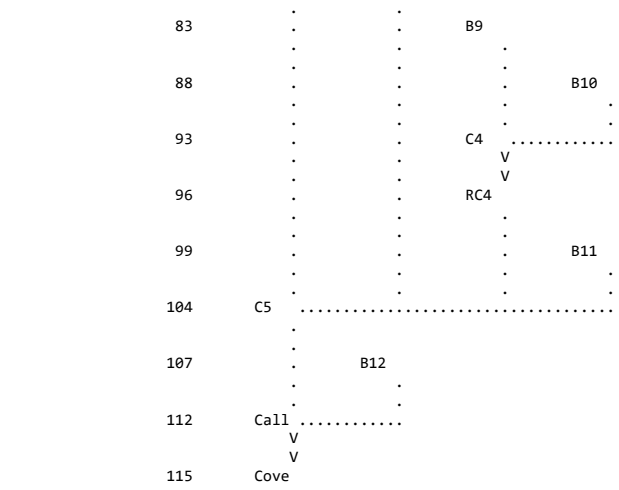

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

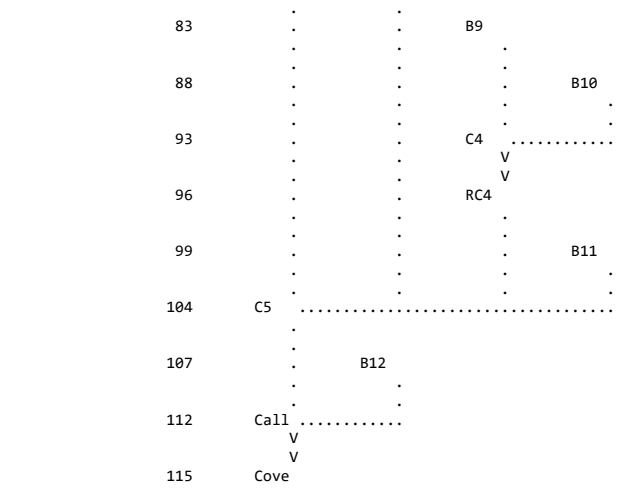

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

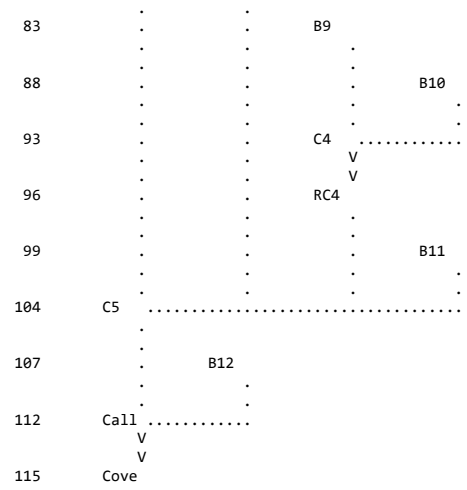

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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

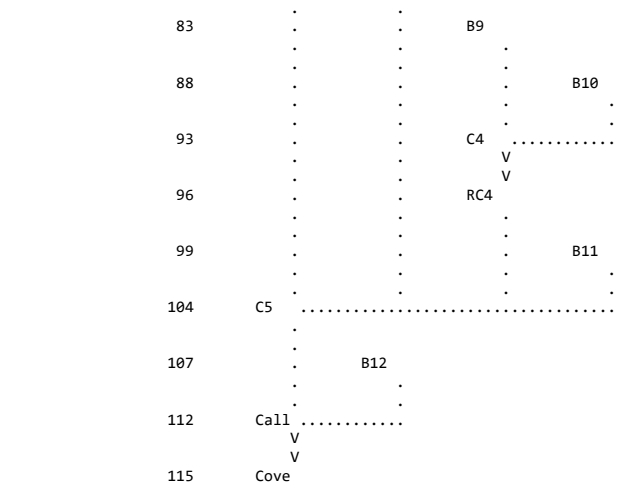

            112           KK   Call
            113           KM   Combine C5, B12
            114           HC       2
                          *

            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 ***
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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


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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
```

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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
```

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
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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

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 ***
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Storm Event 13. Local Auxiliary 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  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        *
```

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*  RUN DATE   06AUG20  TIME  03:33:46   *                                                    *           (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 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
```

```
             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
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```
+                 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
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

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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

```
********************************************************************************
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
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  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)
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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
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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
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58.80	0	66	5548.7	6674.1	0.0	0.00	.A
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59.70	0	65	5548.6	6669.3	0.0	0.00	.A
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60.60	0	64	5548.6	6664.6	0.0	0.00	.A
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62.70	0	62	5548.6	6653.8	0.0	0.00	.A
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63.30	0	62	5548.5	6650.8	0.0	0.00	.A
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65.10	0	60	5548.5	6641.8	0.0	0.00	.P
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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
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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

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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
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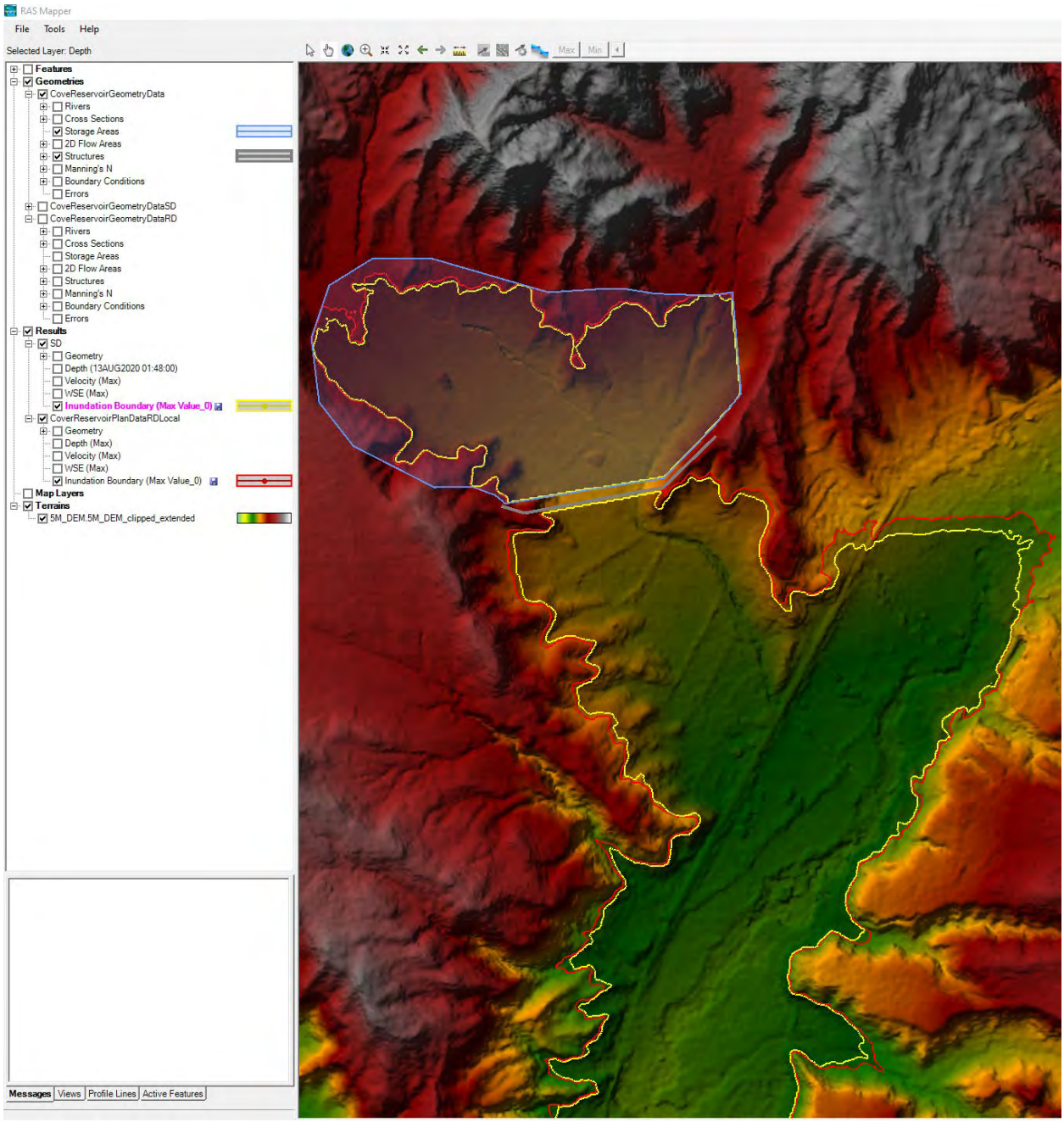
Breach Analysis



HEC-RAS Graphical Output with Inundation Boundaries - Sunny Day (yellow) and Rainy Day (red)

Sunny Day

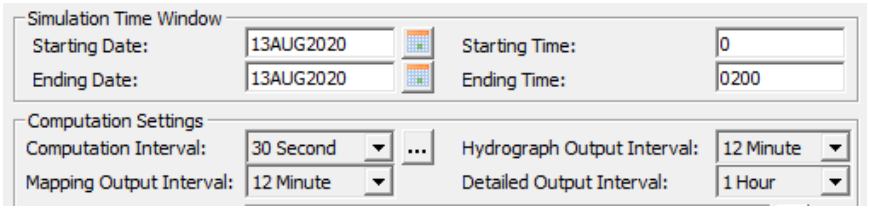
Unsteady Flow Data

Storage/2D Flow Areas		Boundary Condition
1	CoveReservoir BCLine: USBoundaryCondition	Flow Hydrograph
2	Downstream2D BCLine: DSBoundaryCondition	Normal Depth

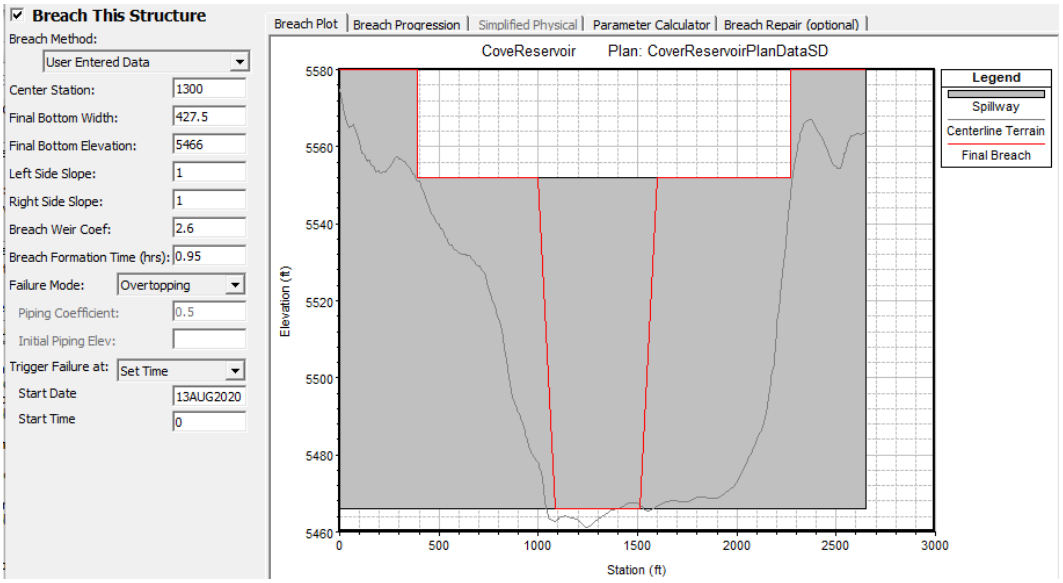
Flow Hydrograph = No Storm

	Storage Area/2D Flow Area	Initial Elevation
1	SA: CoveReservoir	5549
2	2D: Downstream2D	

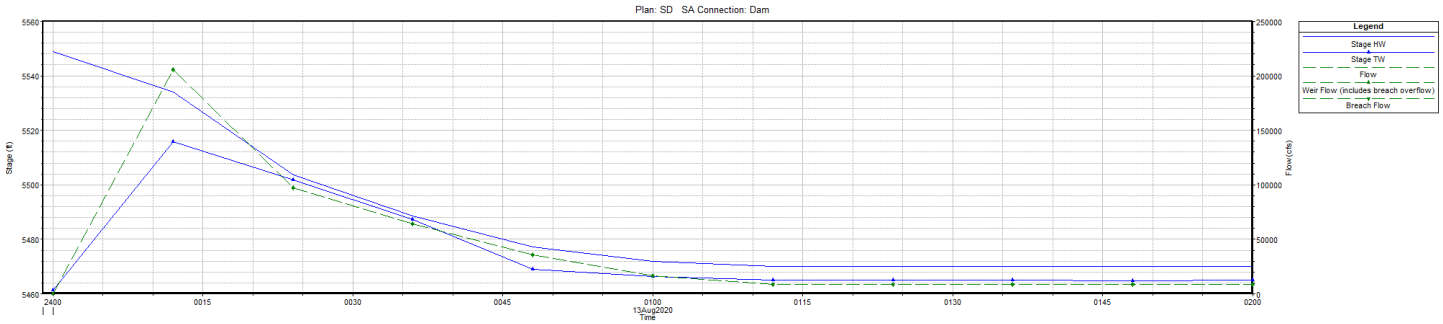
Unsteady Flow Analysis



Storage Area Connection Breach Data



Stage and Flow Hydrograph



Rainy Day

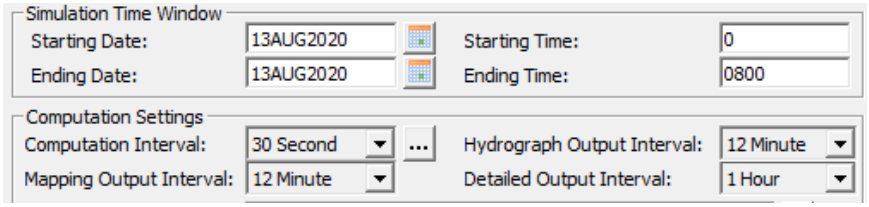
Unsteady Flow Data

Storage/2D Flow Areas		Boundary Condition
1	CoveReservoir BCLine: USBoundaryCondition	Flow Hydrograph
2	Downstream2D BCLine: DSBoundaryCondition	Normal Depth

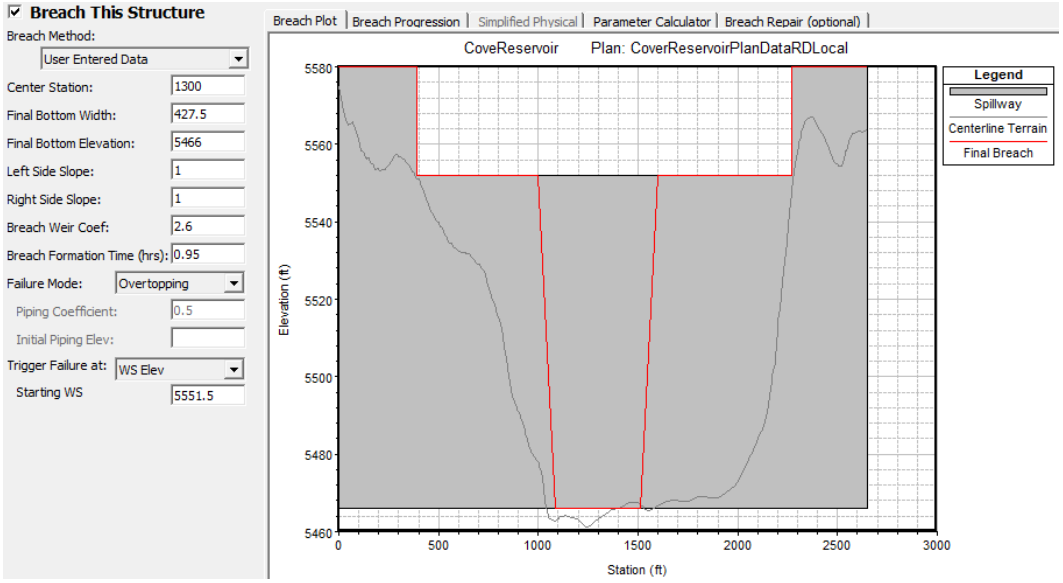
Flow Hydrograph = FBH-L

	Storage Area/2D Flow Area	Initial Elevation
1	SA: CoveReservoir	5549
2	2D: Downstream2D	

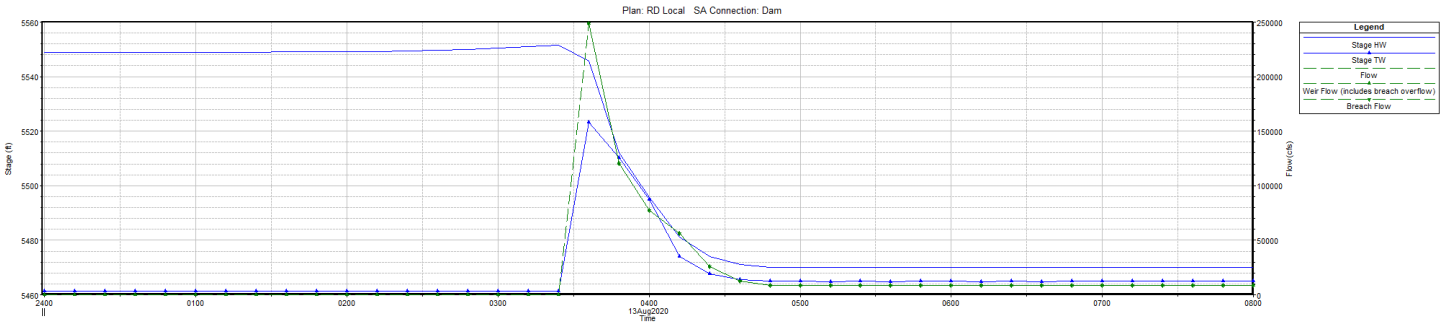
Unsteady Flow Analysis



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

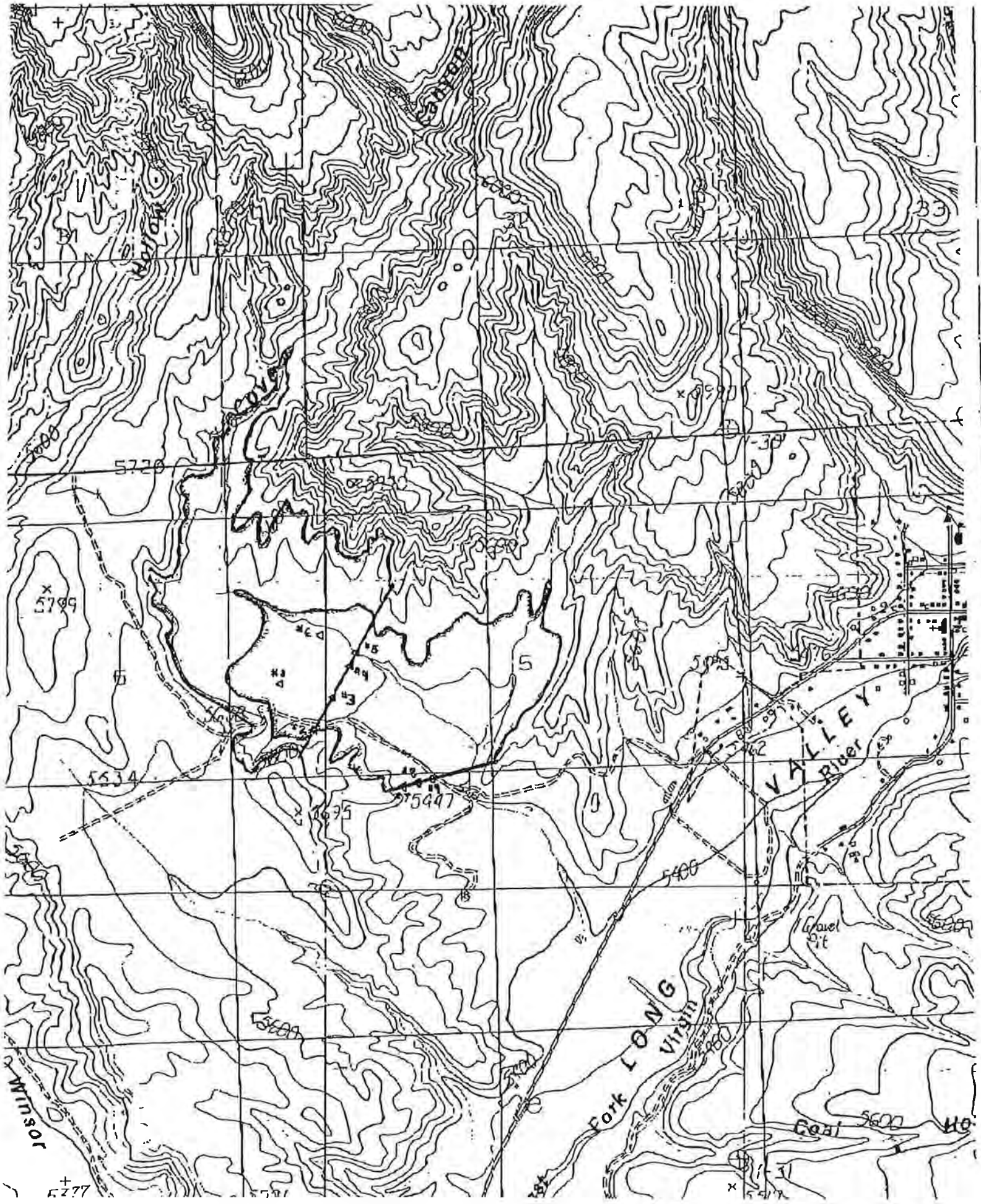
COVE DAMSITES

	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	

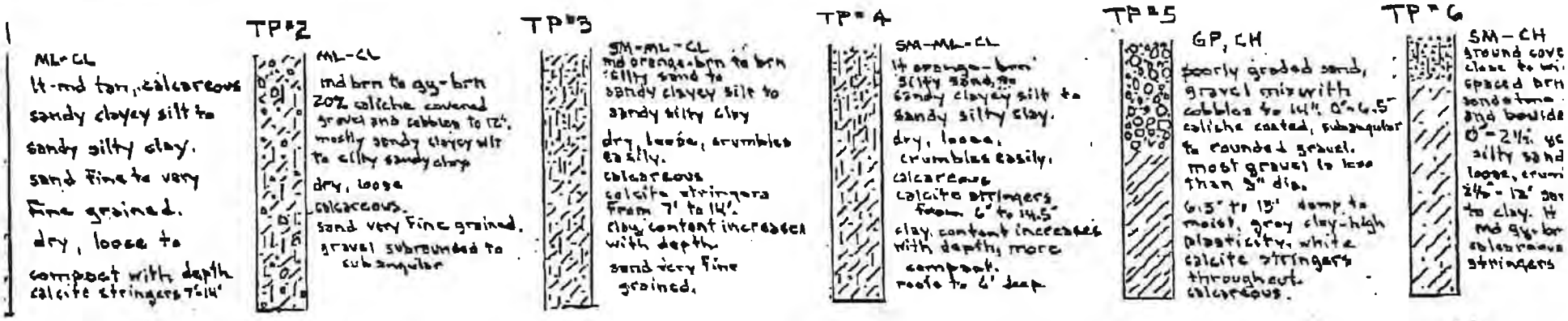
*Hazard Rating - Probable-evidence is strong that the hazard exists and mitigation measures should be taken. Possible-hazard may exist, but evidence is uncertain and further study is recommended. Unlikely-no evidence was found to indicate that the hazard is present.

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.

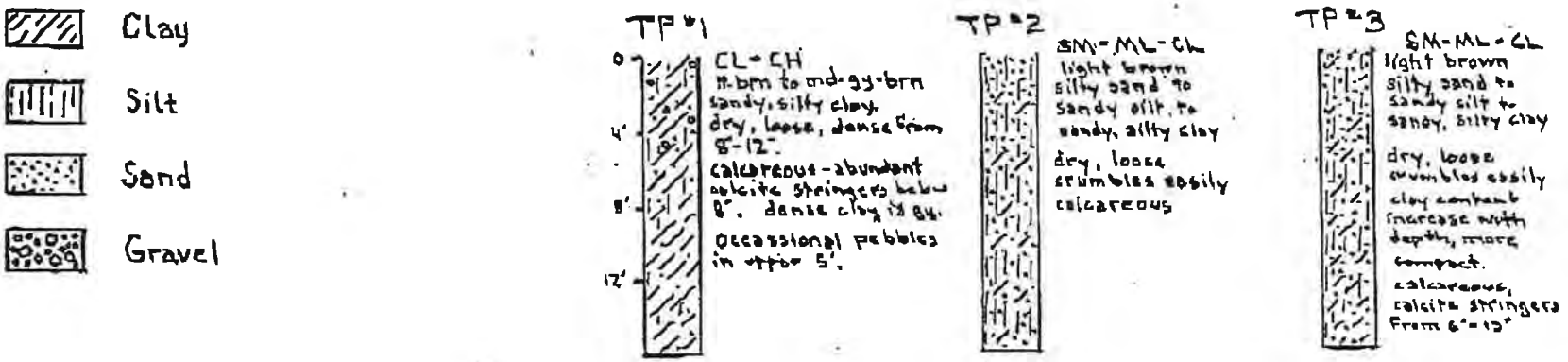
**Further Study (S-soil/foundation, G-geotecnical/engineering, H-hydrologic, SIP-study in progress, MIP-mitigation measures in progress) is recommended to address the hazard (see Conclusions and Recommendations).


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.

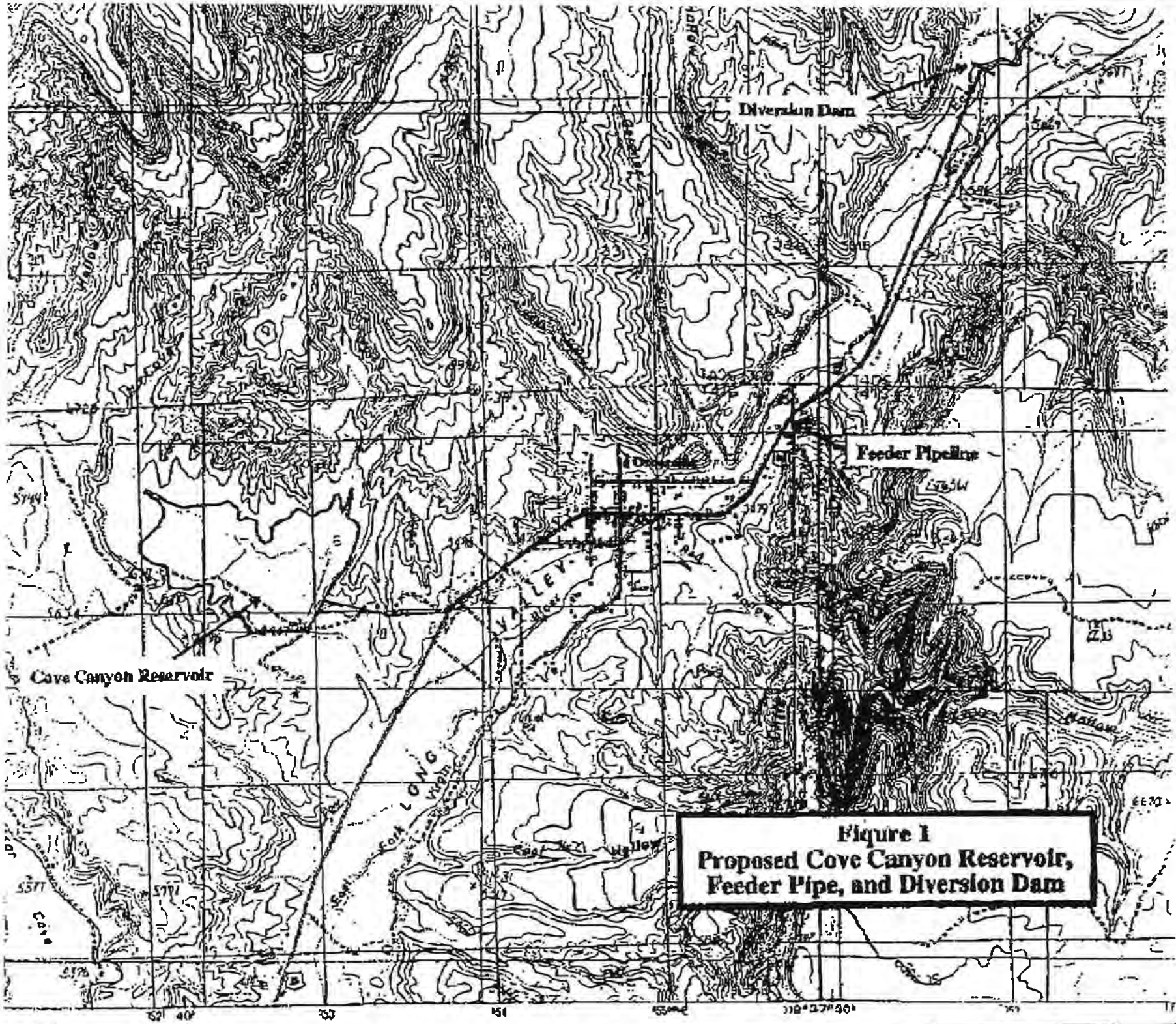


Figure 1
Proposed Cove Canyon Reservoir, Feeder Pipe, and Diversion Dam

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

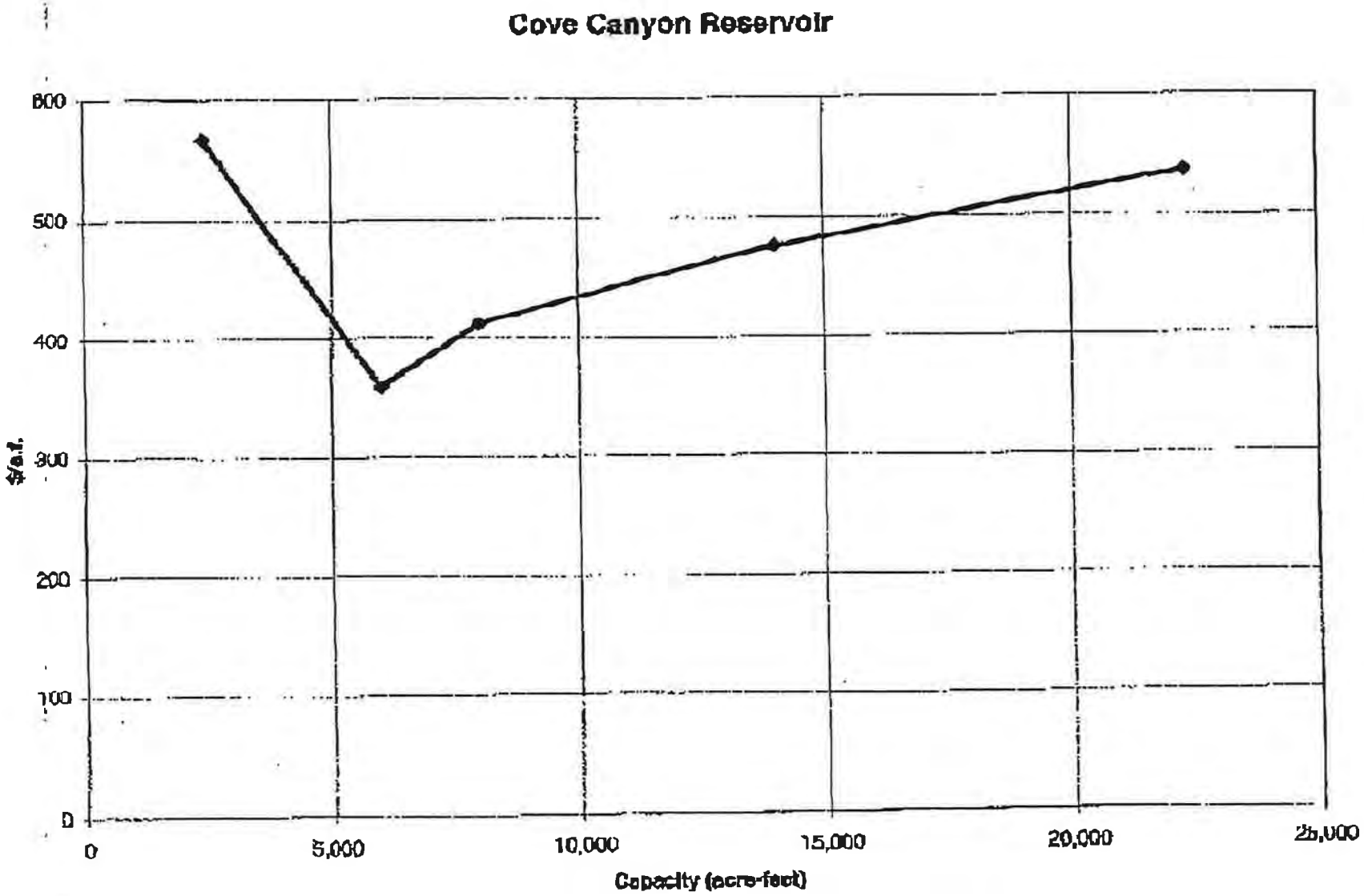
Irrigated Area	
Glendale	509 acres
Orderville	436 acres
Mt. Carmel	733 acres
Total	1,678 acres
Diversion requirement	7,358 acre-feet
Present irrigation supply	5,171 acre-feet
Remaining demand	2,187 acre-feet
Other demand	2,286 acre-feet
Cove Reservoir	
Storage capacity	22,300 acre-feet
Surface area when 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

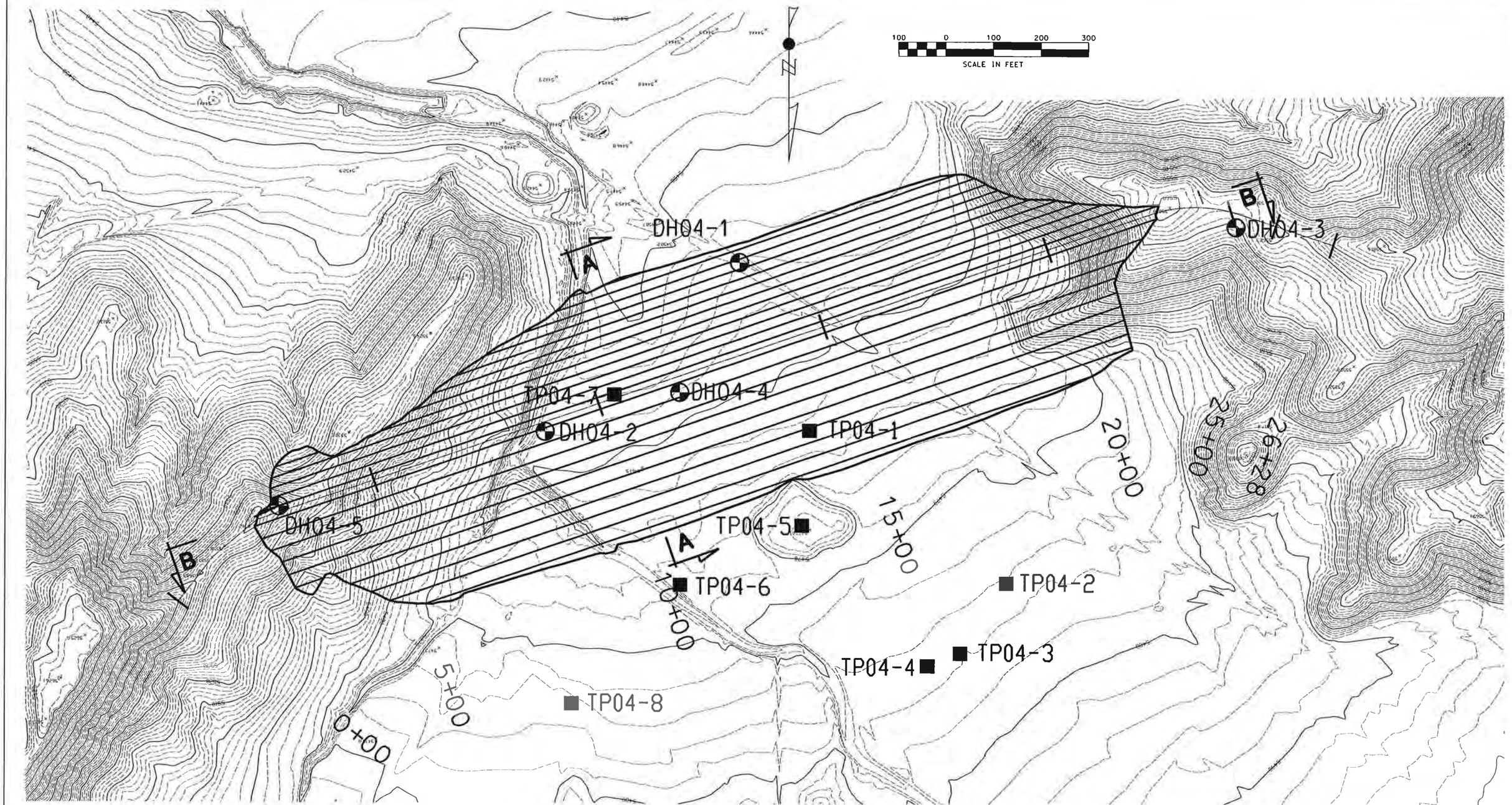
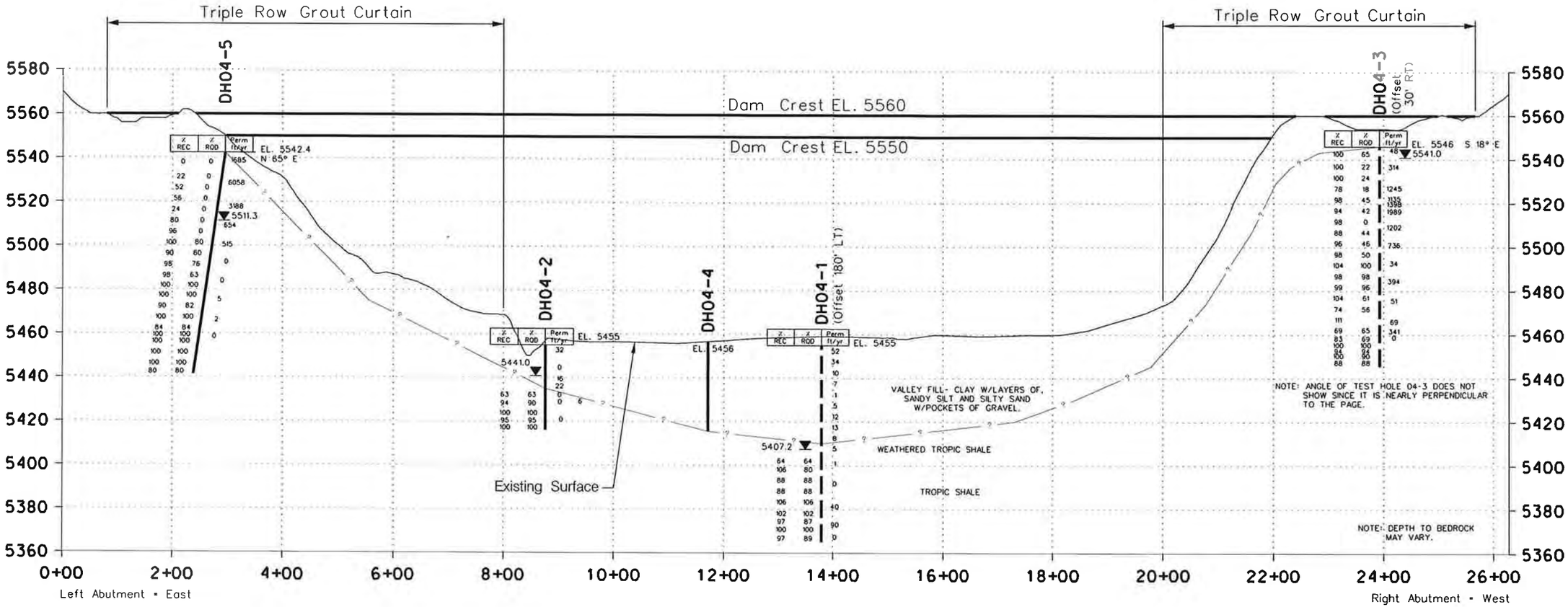


Figure 4

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															

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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.)	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															

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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	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	-											

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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

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															

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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. 04-5

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

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	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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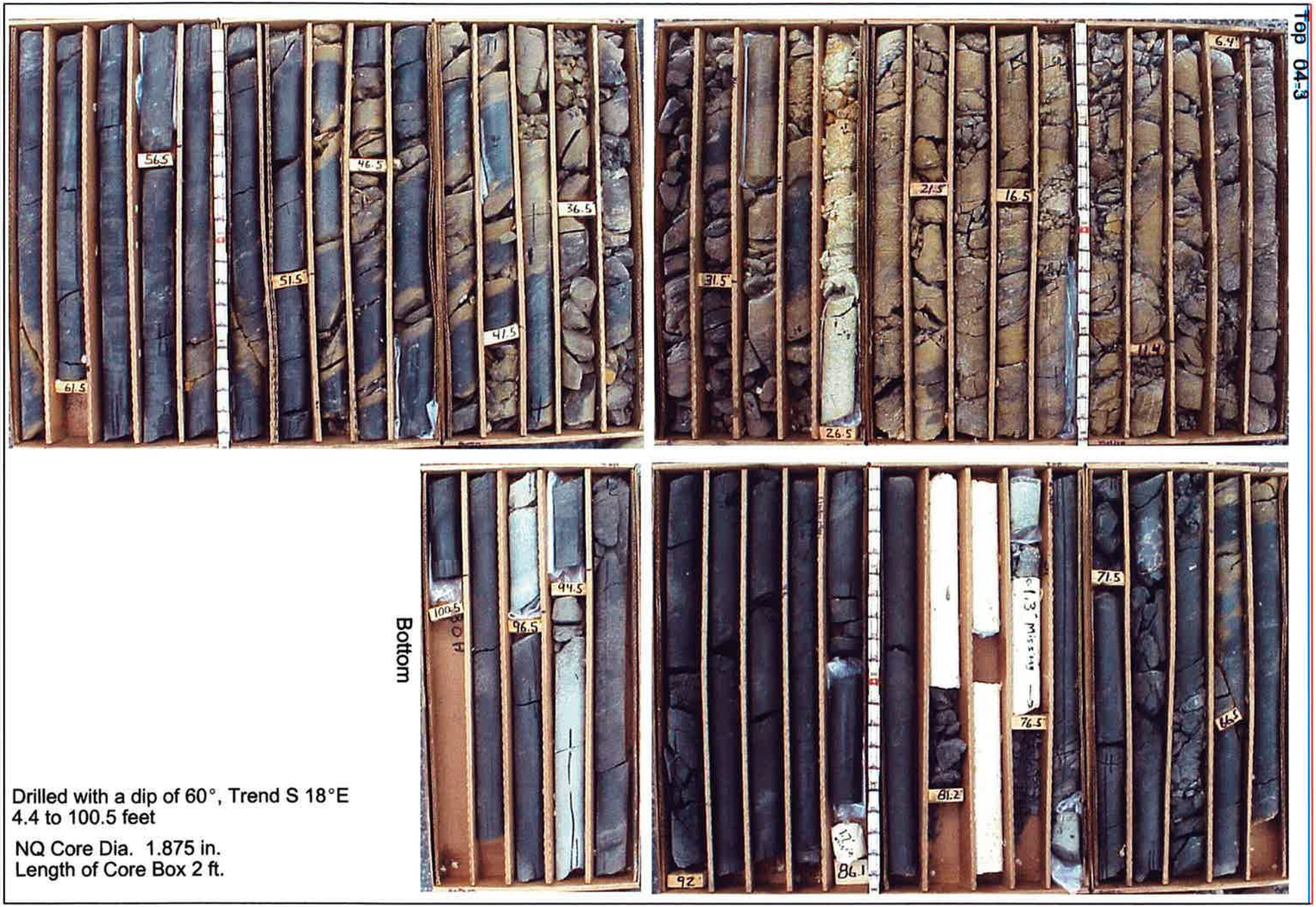
Provo, Utah

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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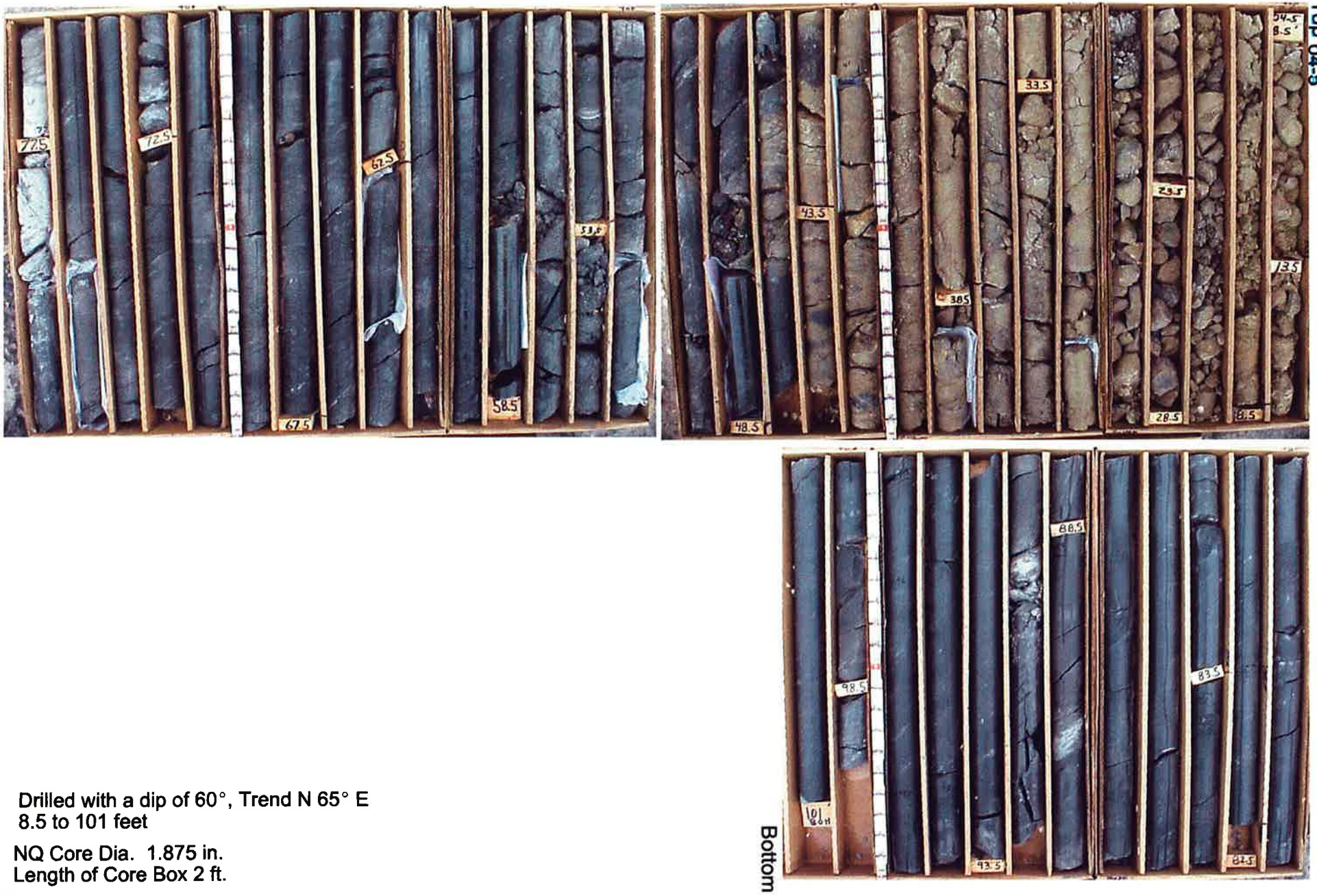
Provo, Utah

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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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	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
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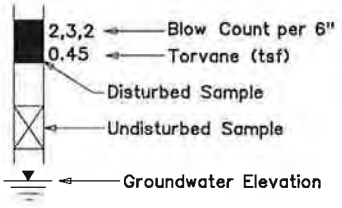
LEGEND



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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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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

RB&G ENGINEERING INC.
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

RB&G ENGINEERING INC.
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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

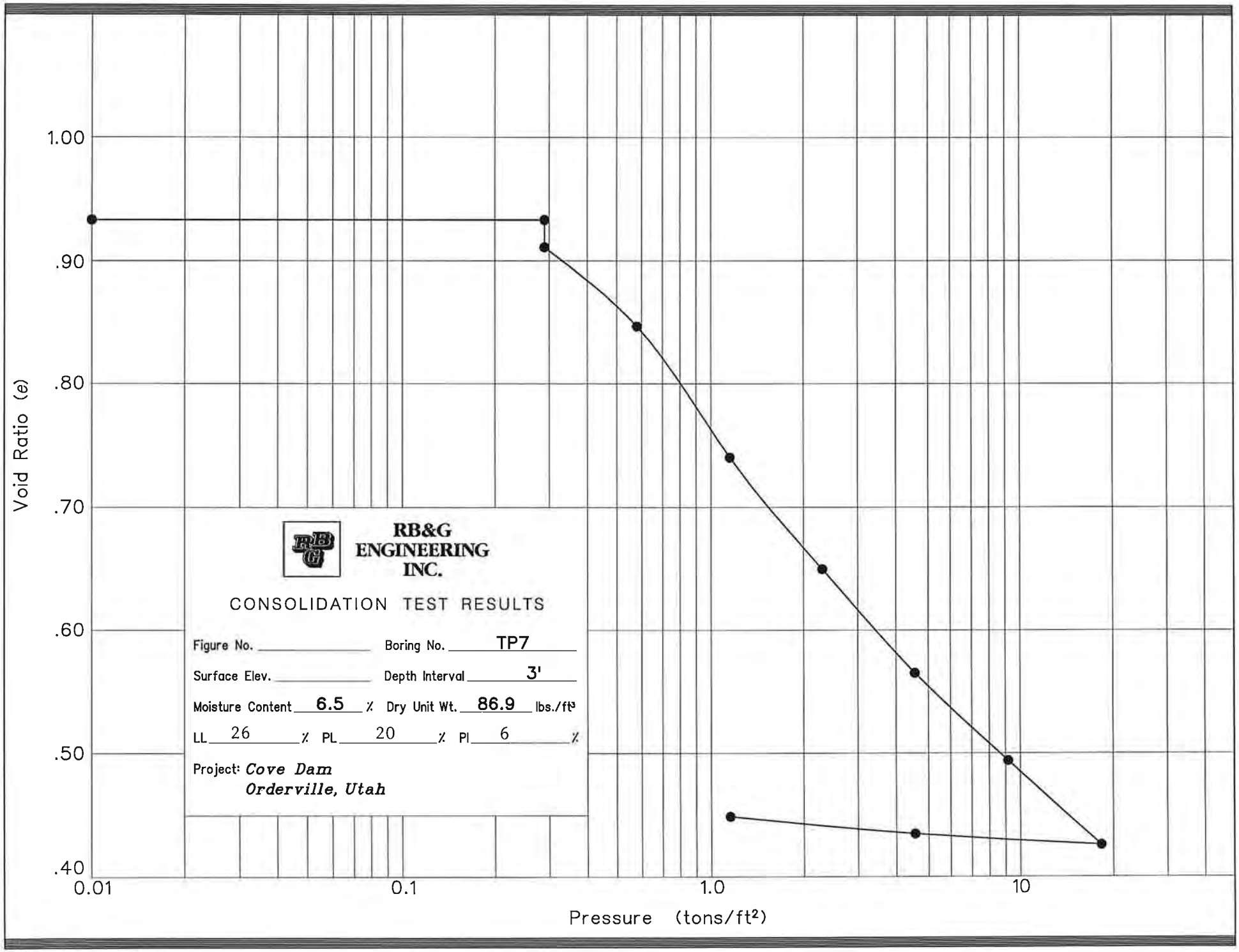
SUMMARY OF TEST DATA

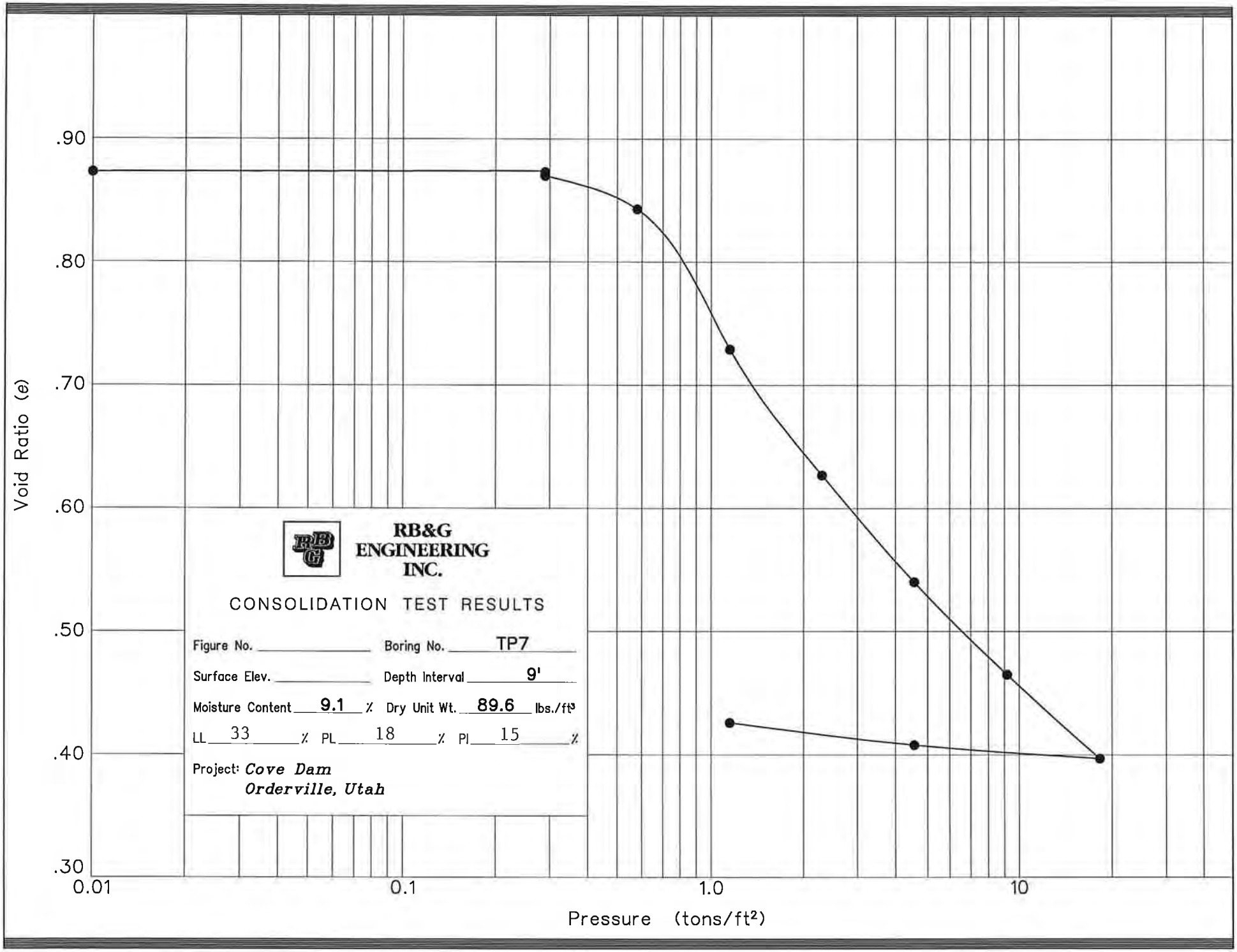
PROJECT Cove Dam
LOCATION Kane County, Utah

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


1.00
.90
.80
.70
.60
.50
.40
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 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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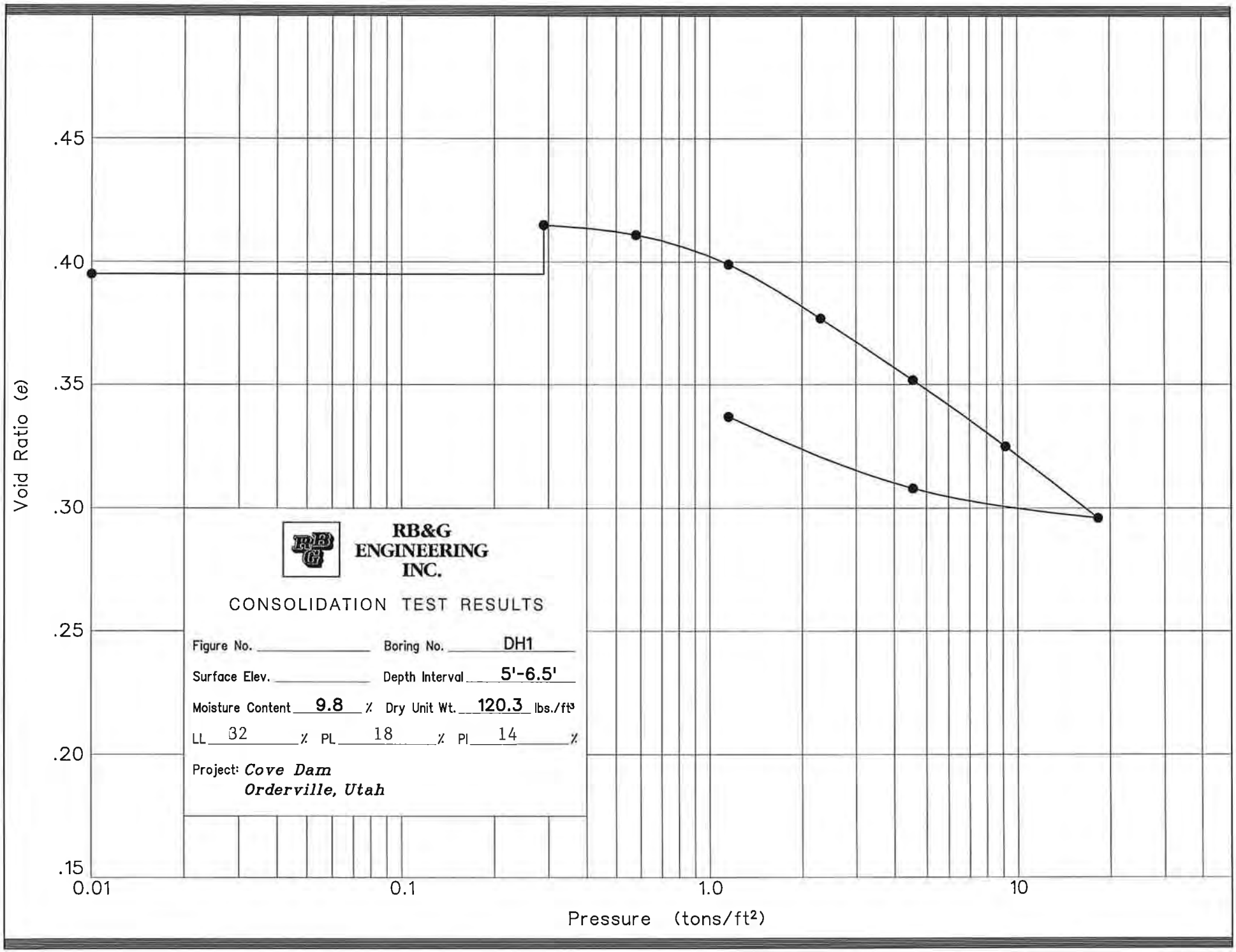
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. TP7
Surface Elev. _____ Depth Interval 9'
Moisture Content 9.1 % Dry Unit Wt. 89.6 lbs./ft³
LL 33 % PL 18 % PI 15 %
Project: Cove Dam
Orderville, Utah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Void Ratio (e)
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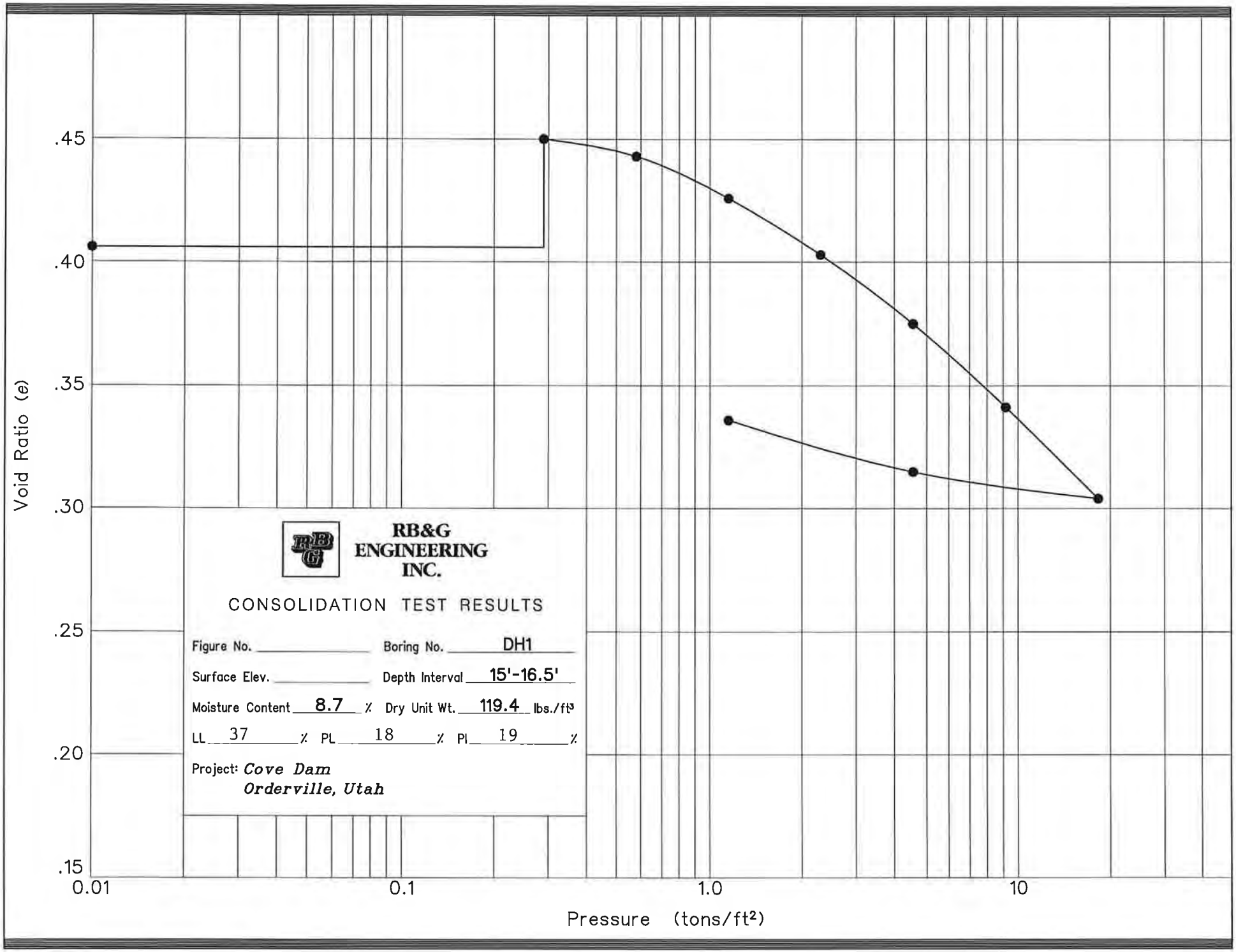
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 5'-6.5'
Moisture Content 9.8 % Dry Unit Wt. 120.3 lbs./ft³
LL 32 % PL 18 % PI 14 %
Project: Cove Dam
Orderville, Utah



RB&G ENGINEERING INC.

CONSOLIDATION TEST RESULTS

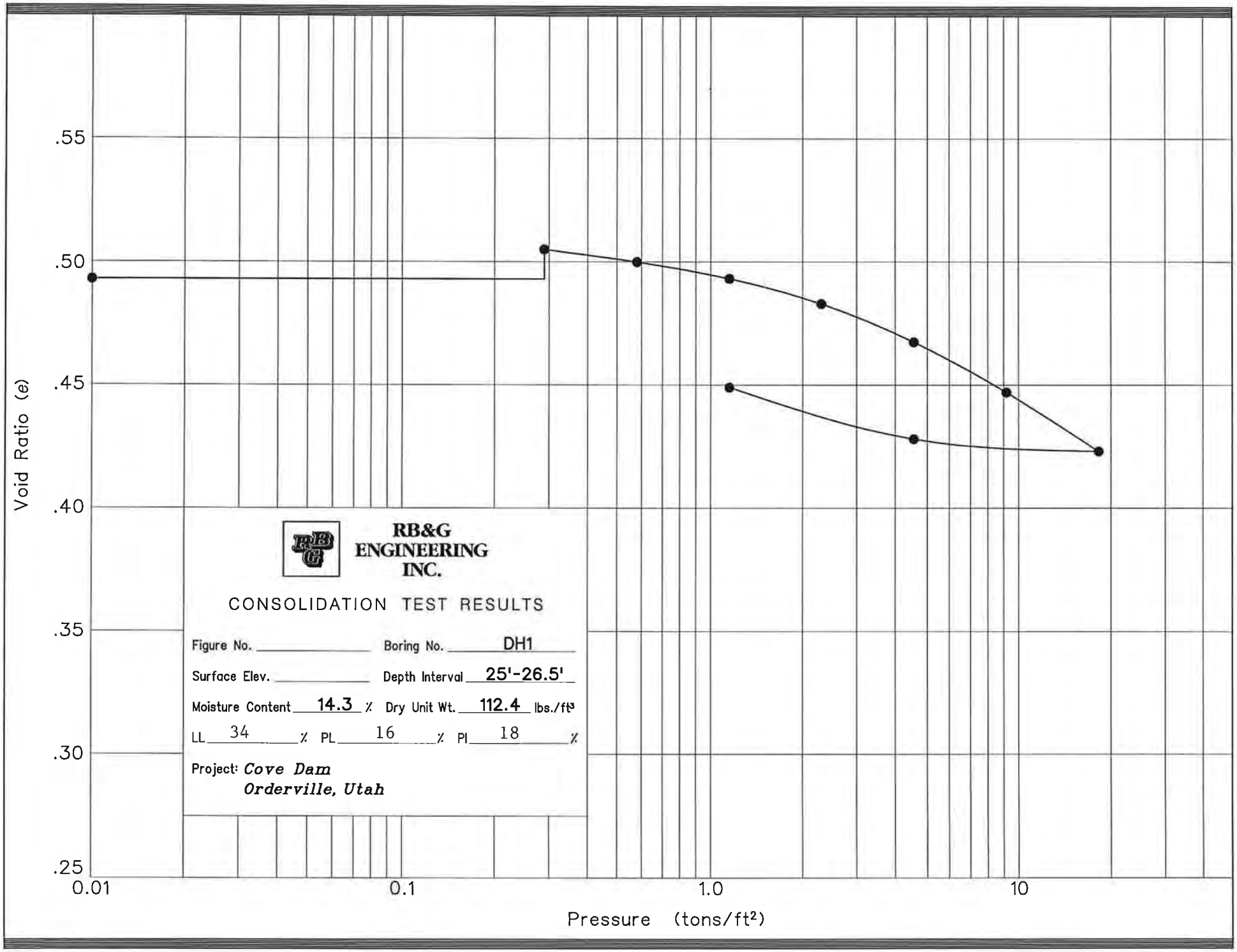
Figure No. _____ Boring No. DH1

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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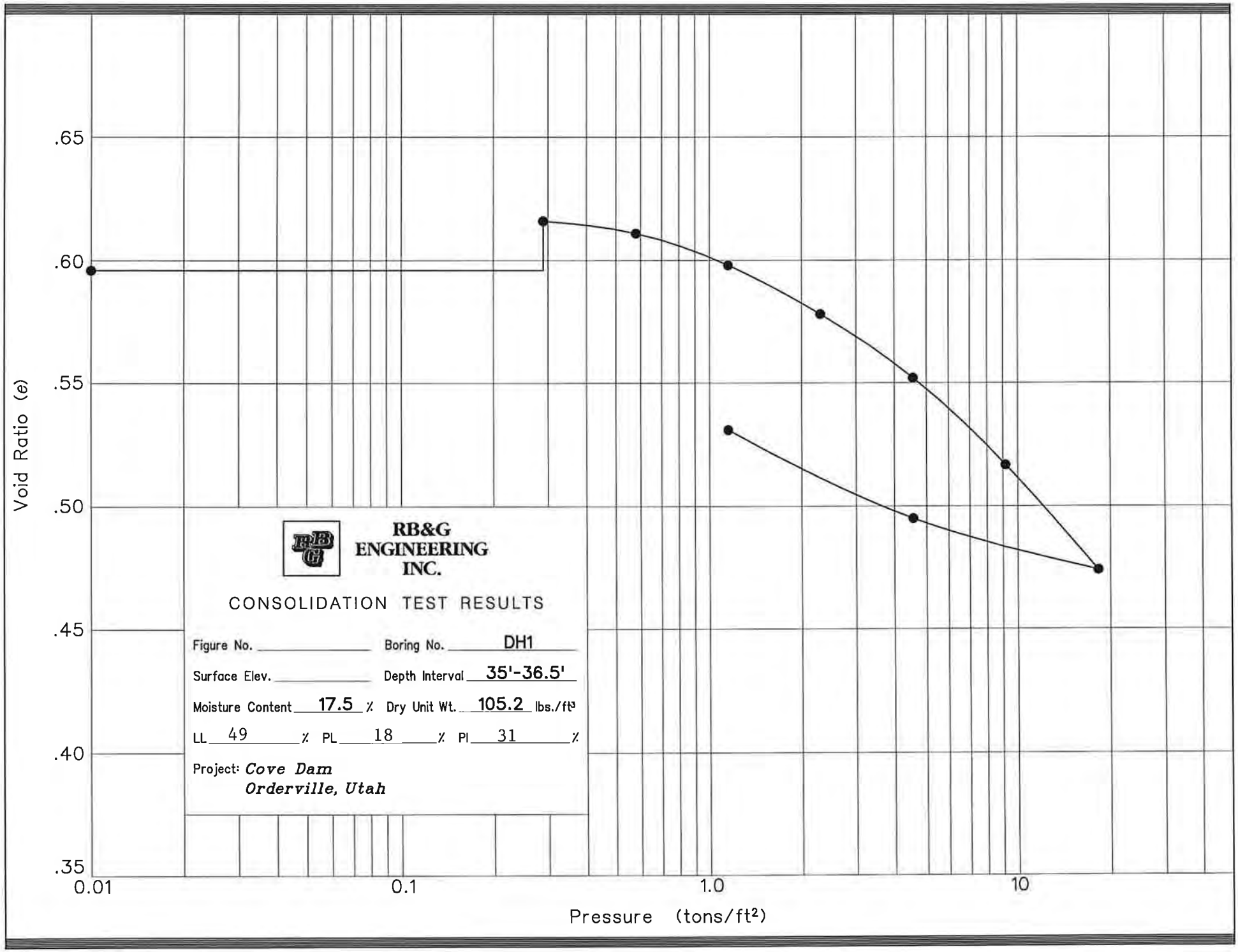
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 25'-26.5'
Moisture Content 14.3 % Dry Unit Wt. 112.4 lbs./ft³
LL 34 % PL 16 % PI 18 %
Project: Cove Dam
Orderville, Utah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Void Ratio (e)
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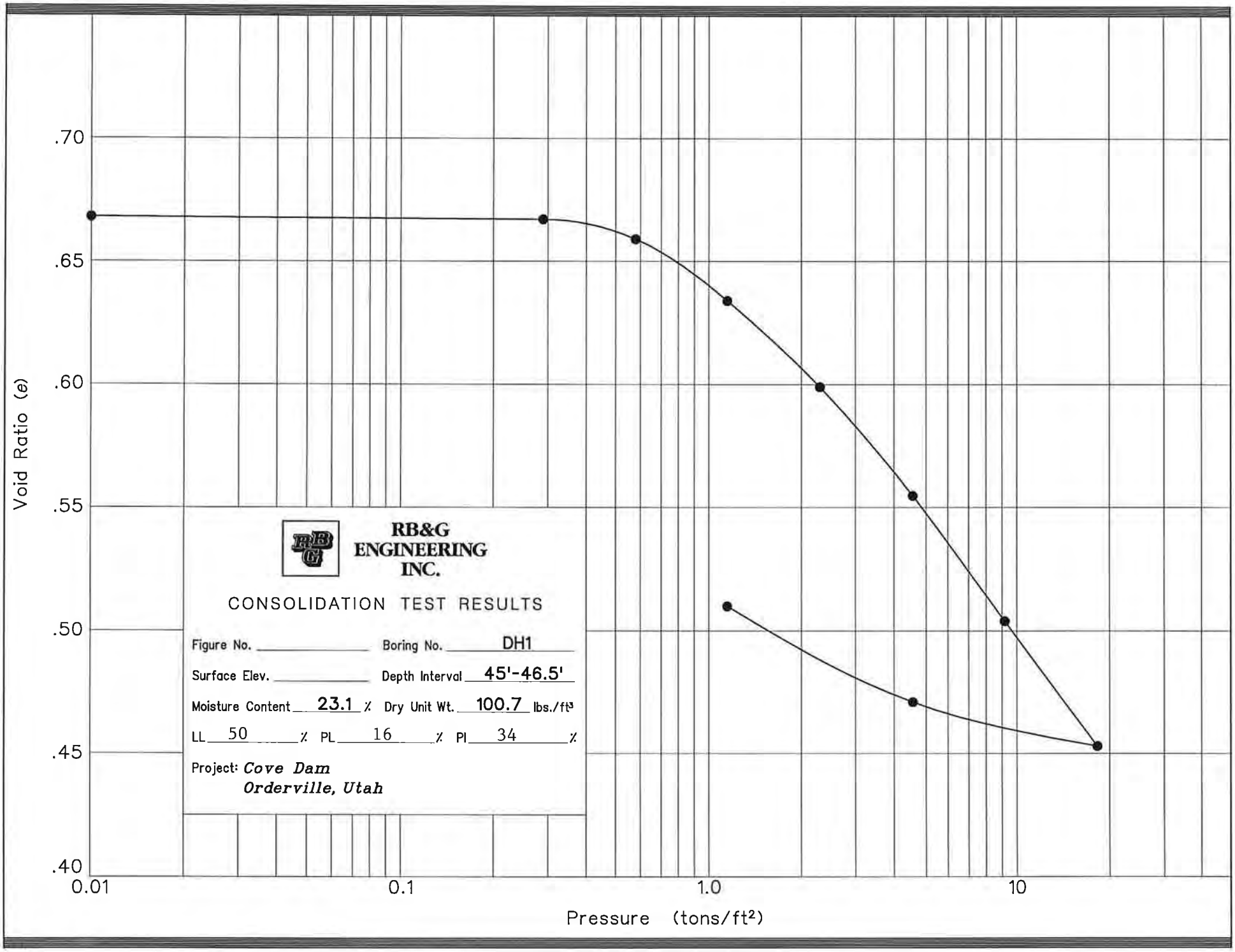
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No.
Boring No. DH1
Surface Elev.
Depth Interval 35'-36.5'
Moisture Content 17.5 % Dry Unit Wt. 105.2 lbs./ft³
LL 49 % PL 18 % PI 31 %
Project: Cove Dam
Orderville, Utah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.40
Void Ratio (e)
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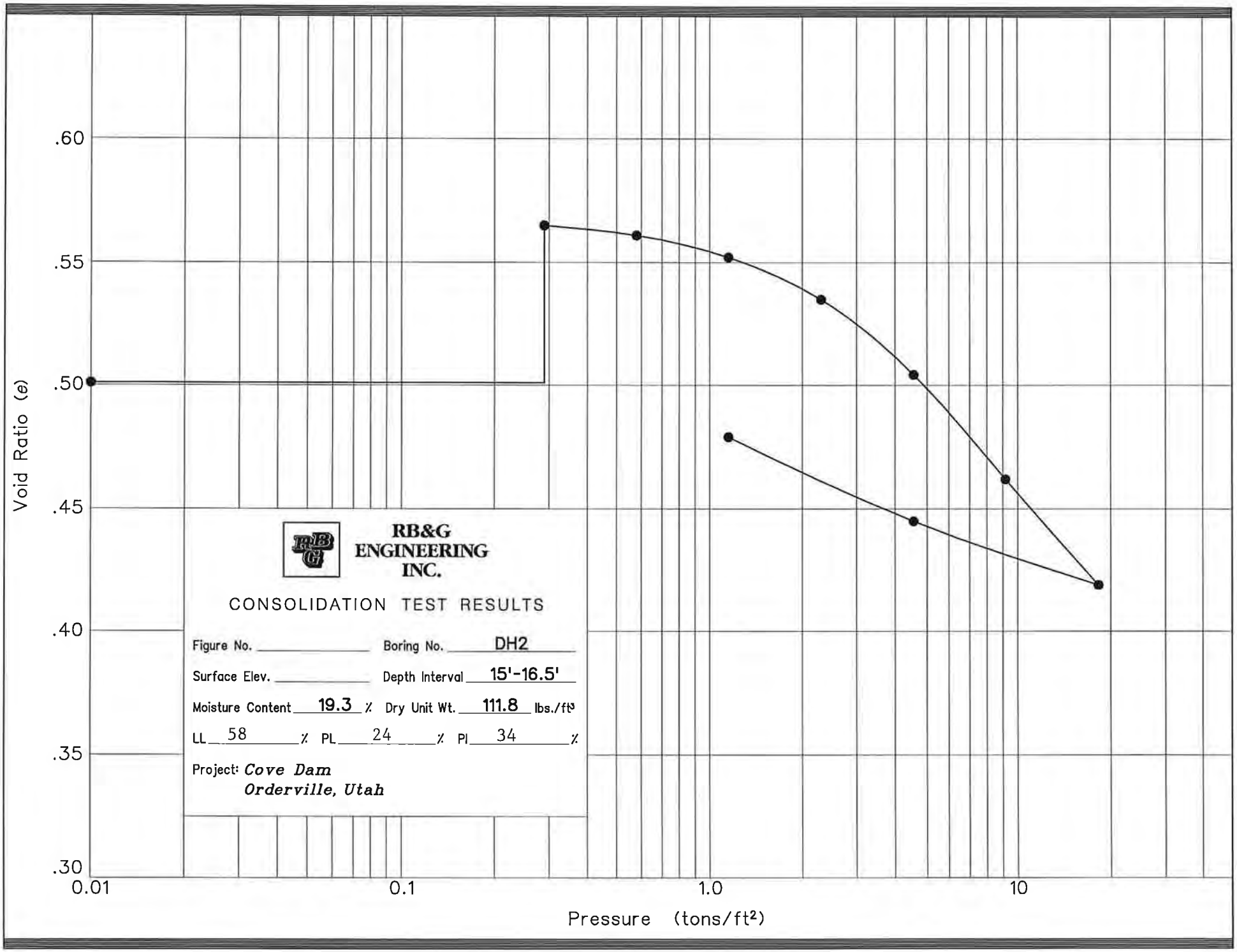
0.1
1.0
10
Pressure (tons/ft²)
RB&G ENGINEERING INC.
CONSOLIDATION TEST RESULTS
Figure No. _____ Boring No. DH1
Surface Elev. _____ Depth Interval 45'-46.5'
Moisture Content 23.1 % Dry Unit Wt. 100.7 lbs./ft³
LL 50 % PL 16 % PI 34 %
Project: Cove Dam
Orderville, Utah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Void 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

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

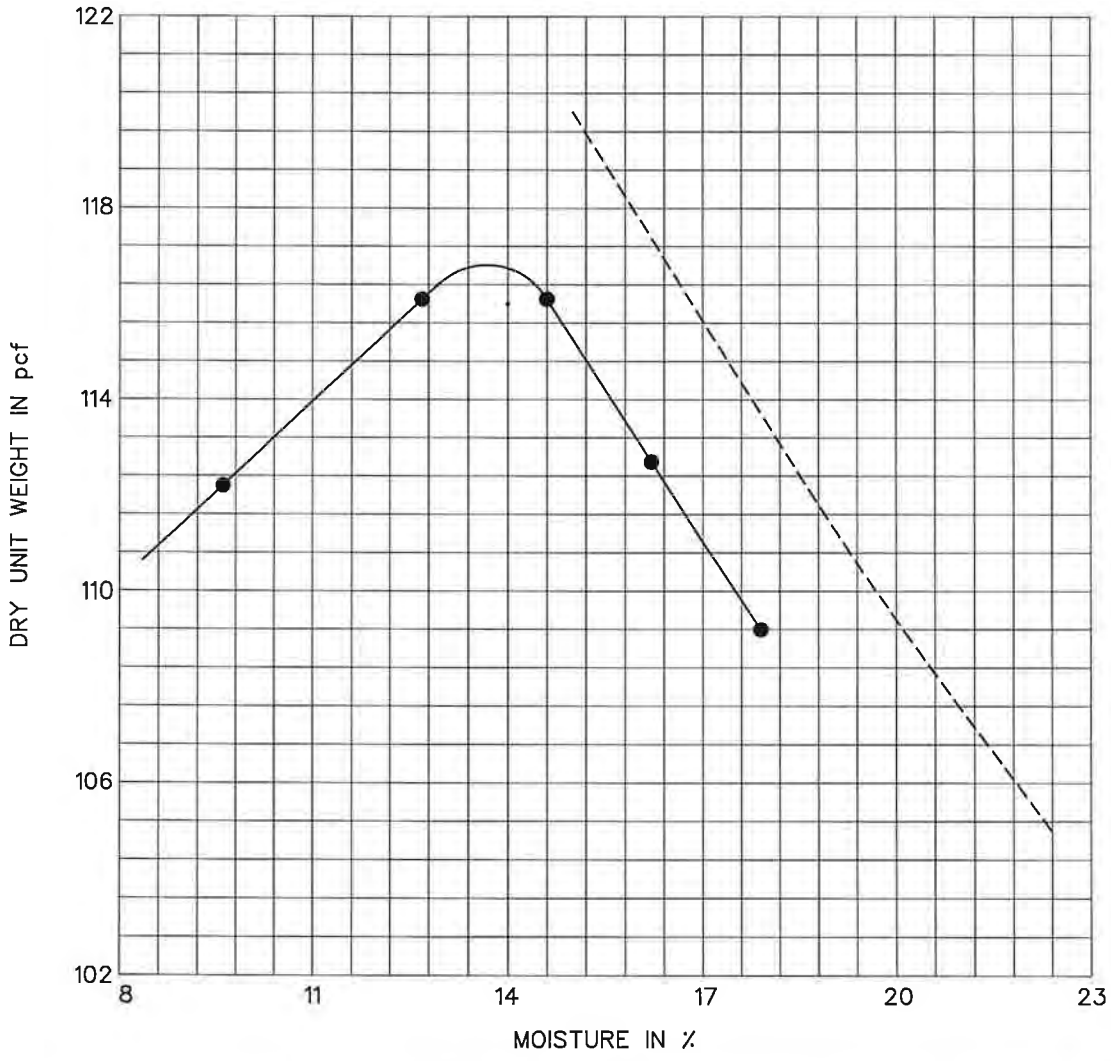
MOISTURE-DENSITY RELATION (PROCTOR)

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

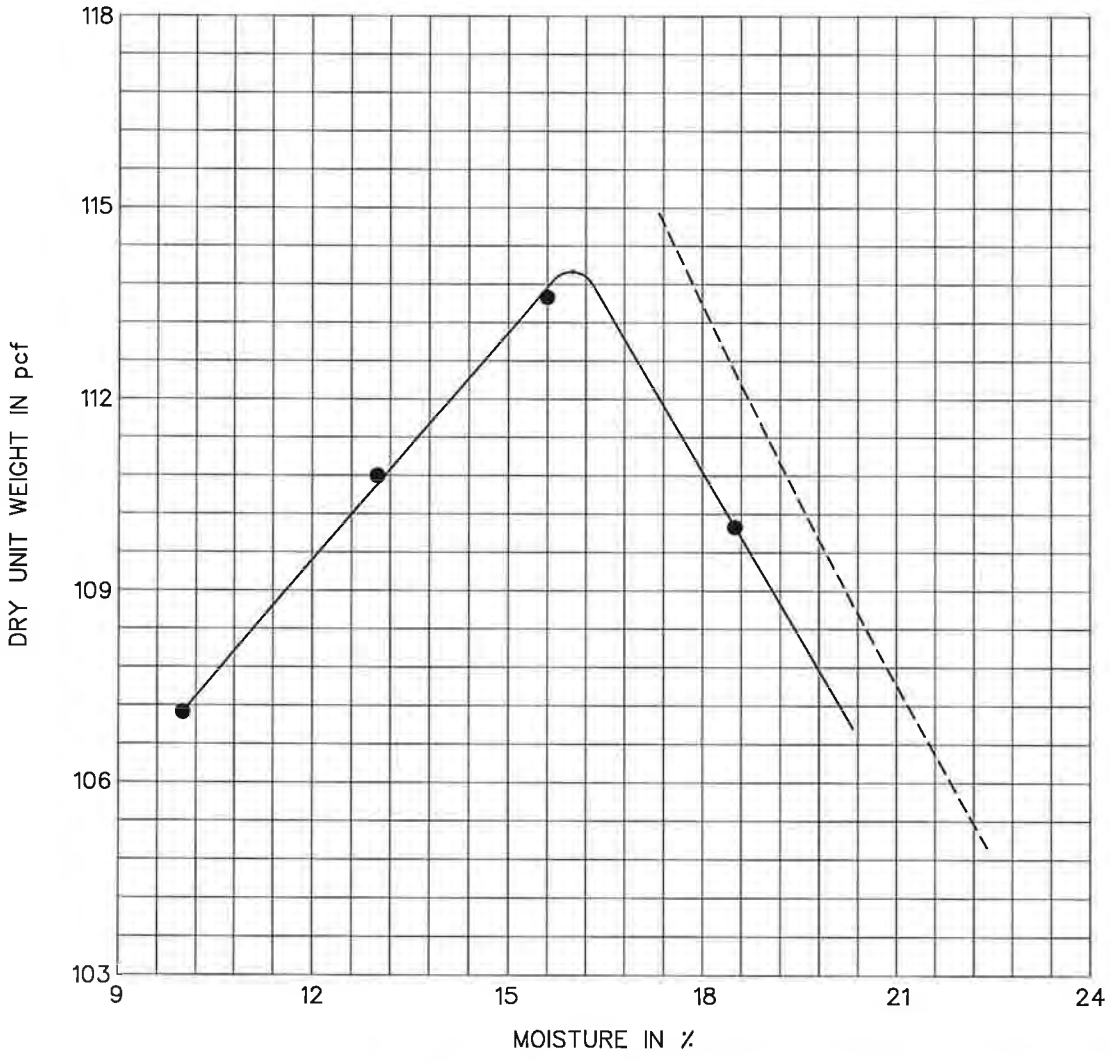
MOISTURE-DENSITY RELATION (PROCTOR)

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

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801 374-5771 Provo
801 521-5771 Salt Lake City

PROJECT NO.	200401.025

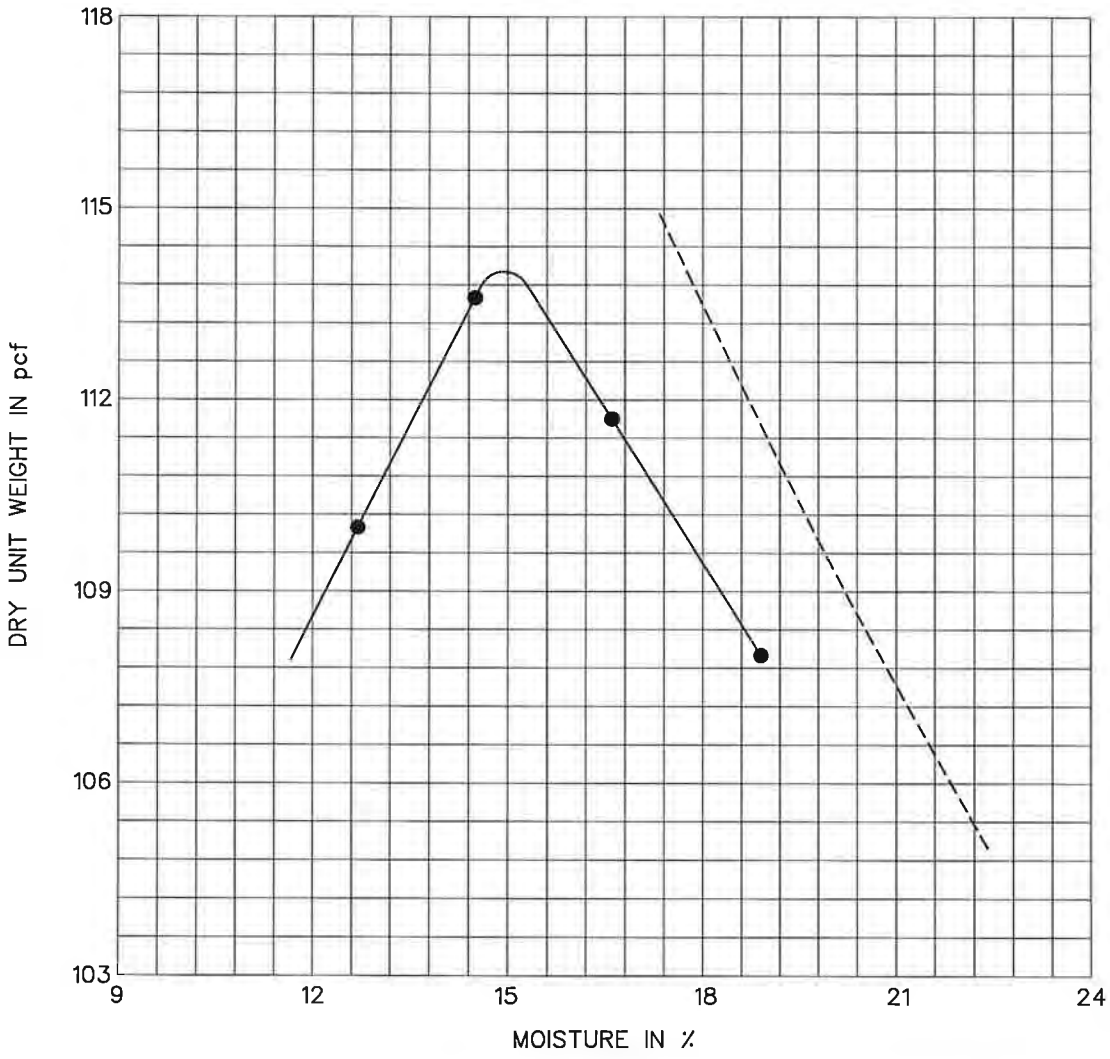
MOISTURE-DENSITY RELATION (PROCTOR)

Project	COVE DAM			Date	6/9/04
Location	ORDERVILLE, UTAH / TEST PIT NO. 7 AT 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 (%)	

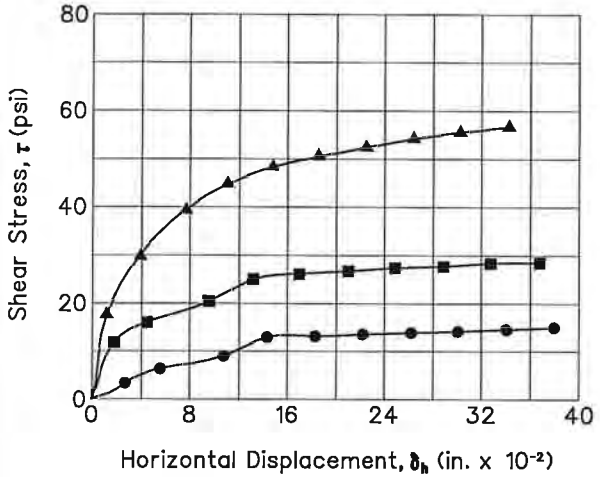
– – – – – 100% Saturation Curve

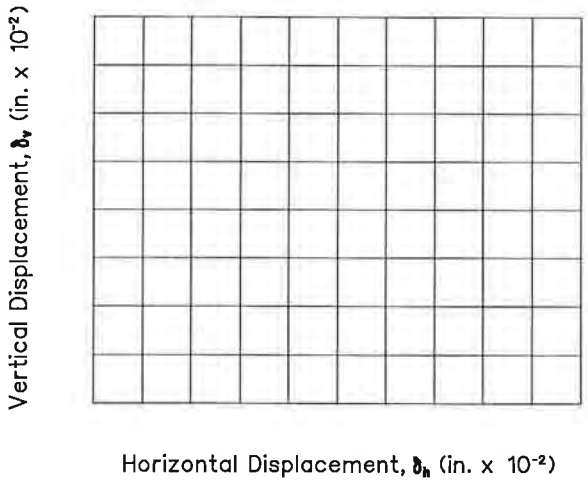
Specific Gravity of Soil	2.70	Est.

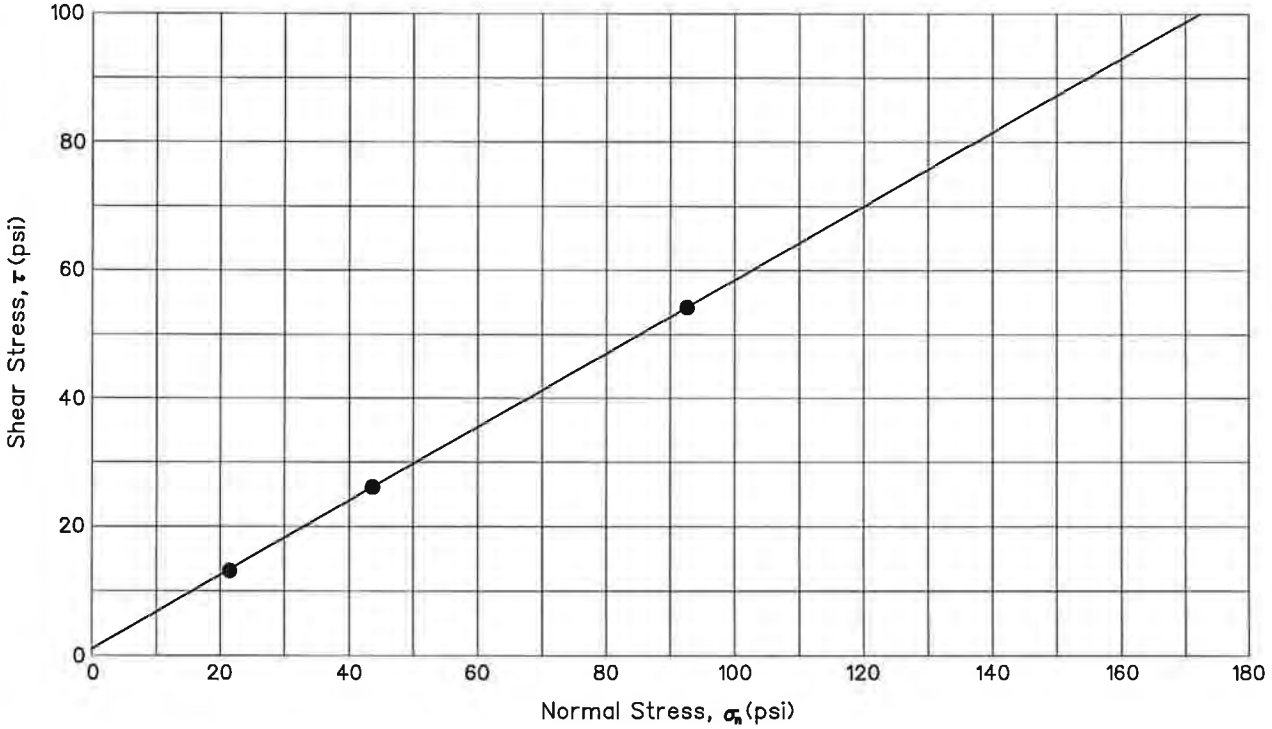
OVERSIZE CORRECTION-ASTM D 4718

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

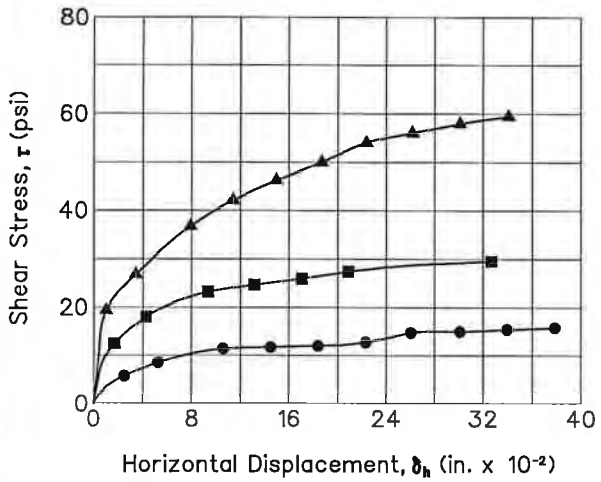
DIRECT SHEAR TEST

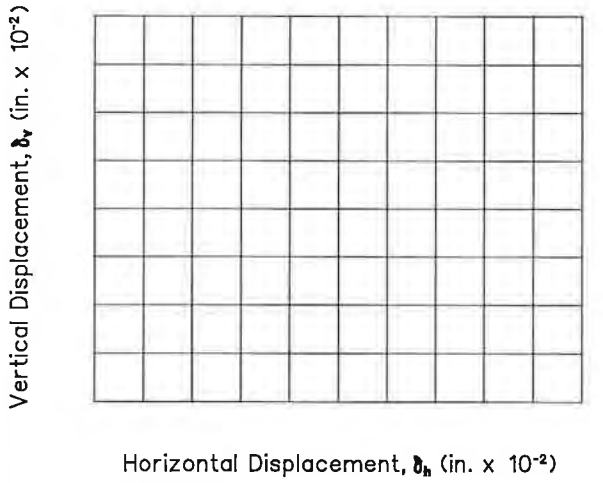
Project: *Cove Dam*
Orderville, Utah

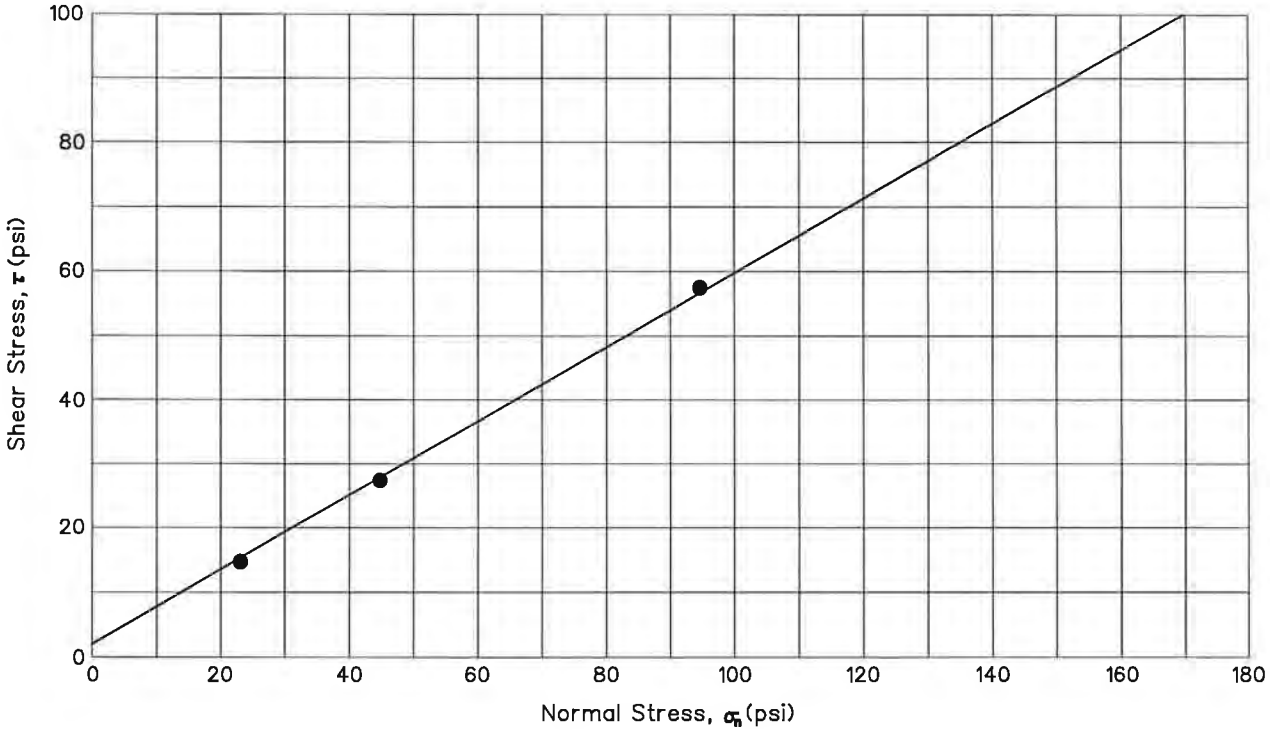
HOLE NO.: TP7

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

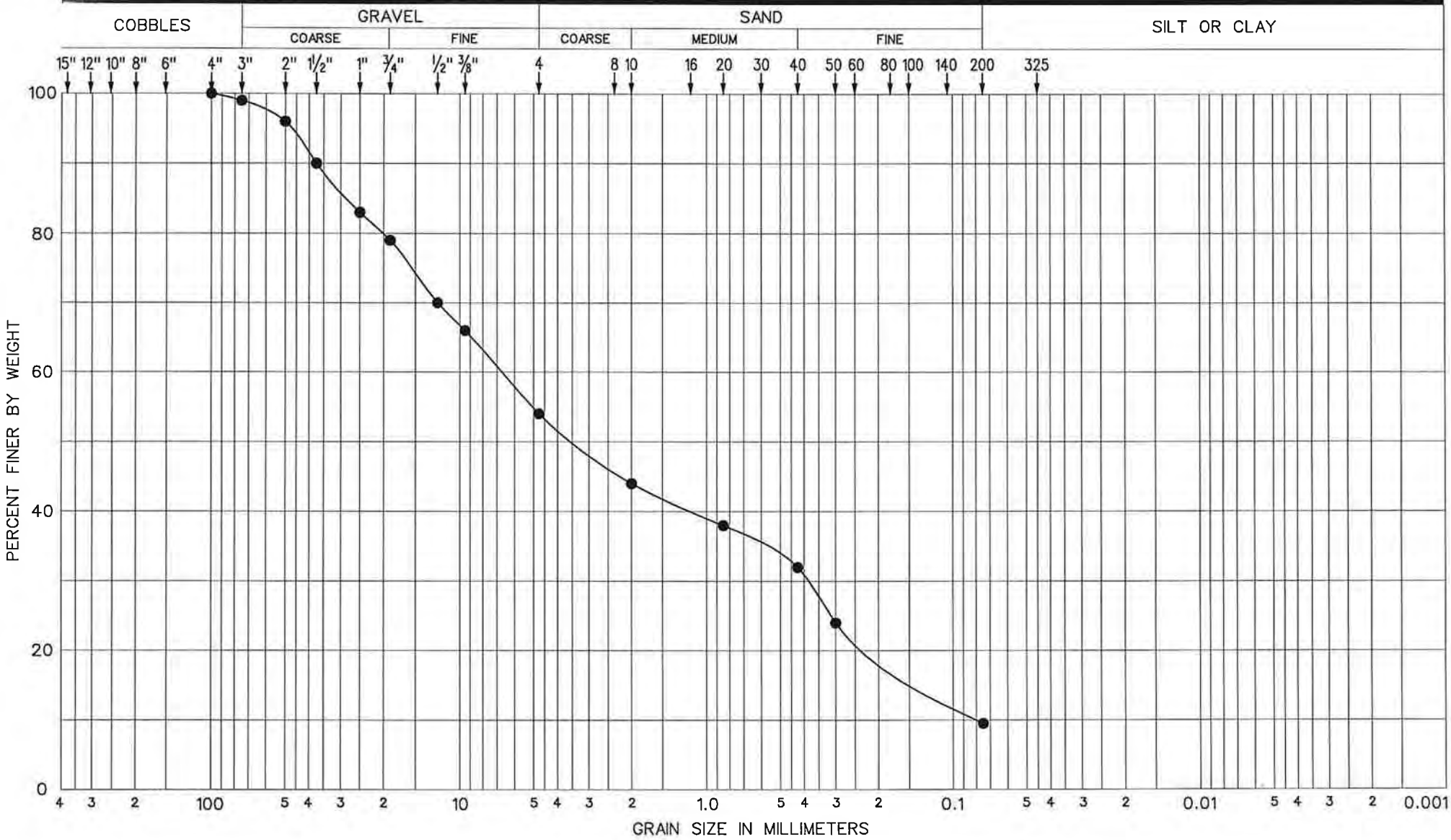
DEPTH: 6'

Figure

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)



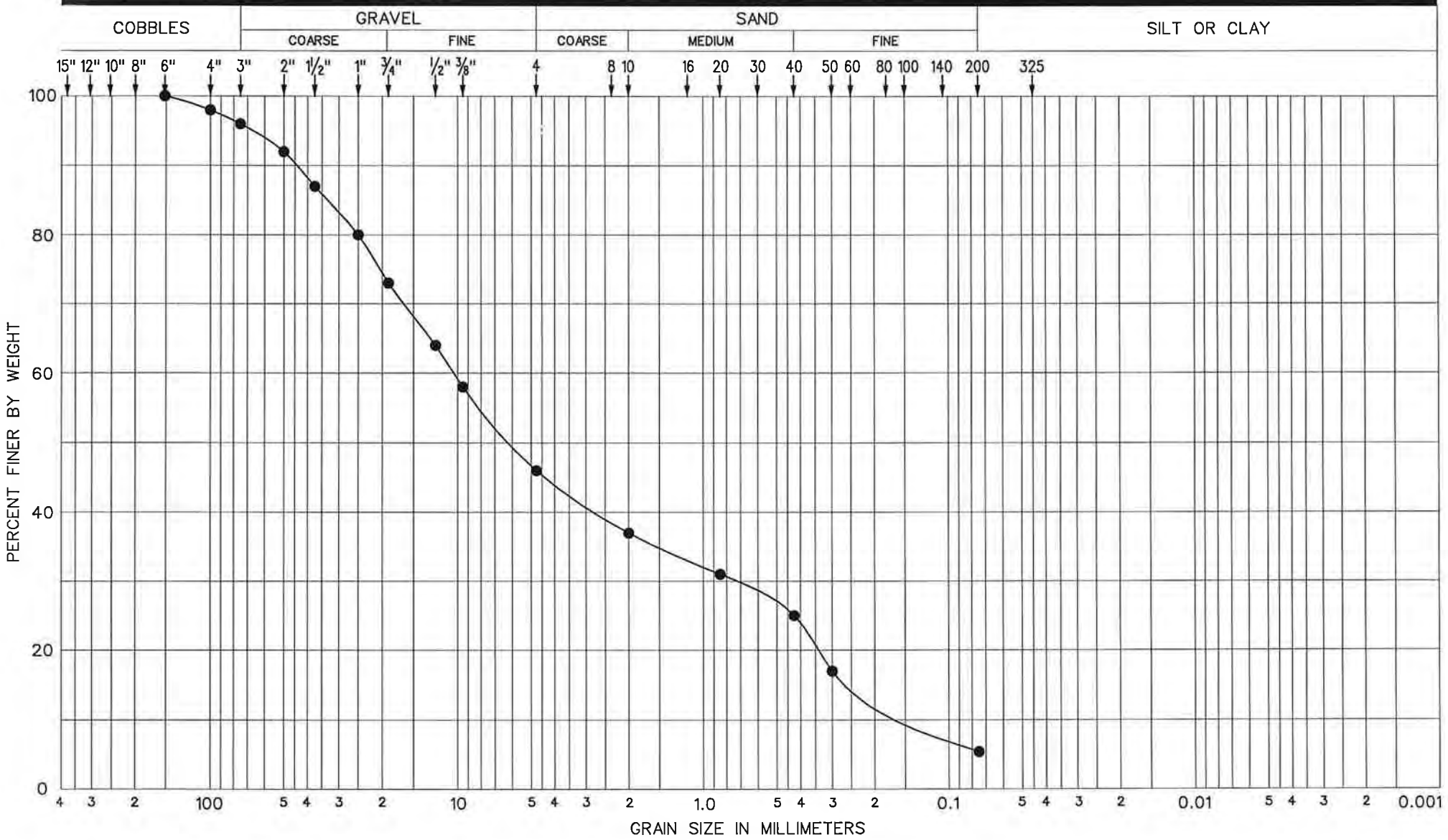
Project	COVE DAM		
Location	ORDERVILLE, UTAH		
Sample No./Depth	ROSE PIT		
Material Description	WELL GRADED GRAVEL W/SILT & SAND	USCS	GW-GM

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

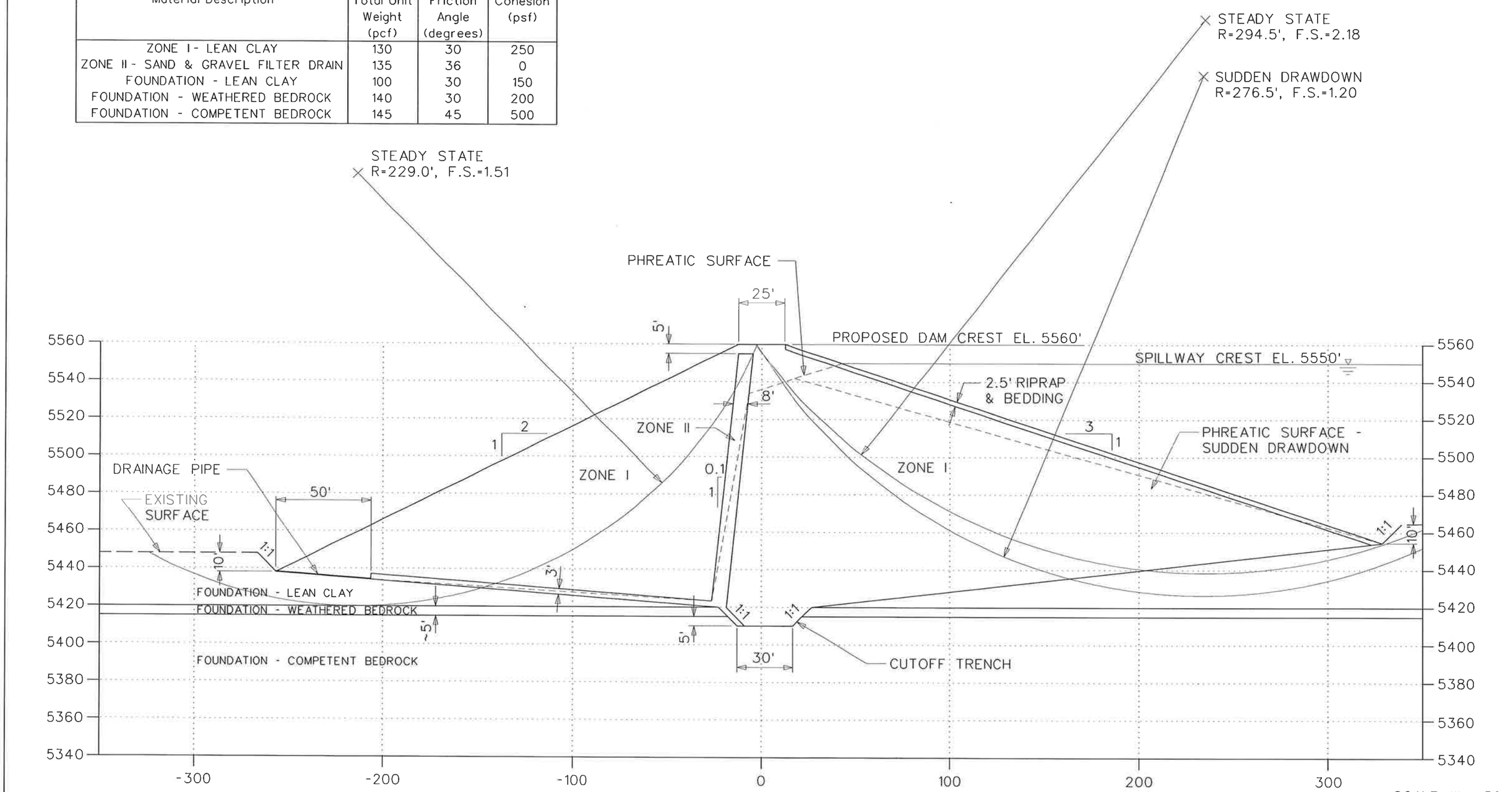


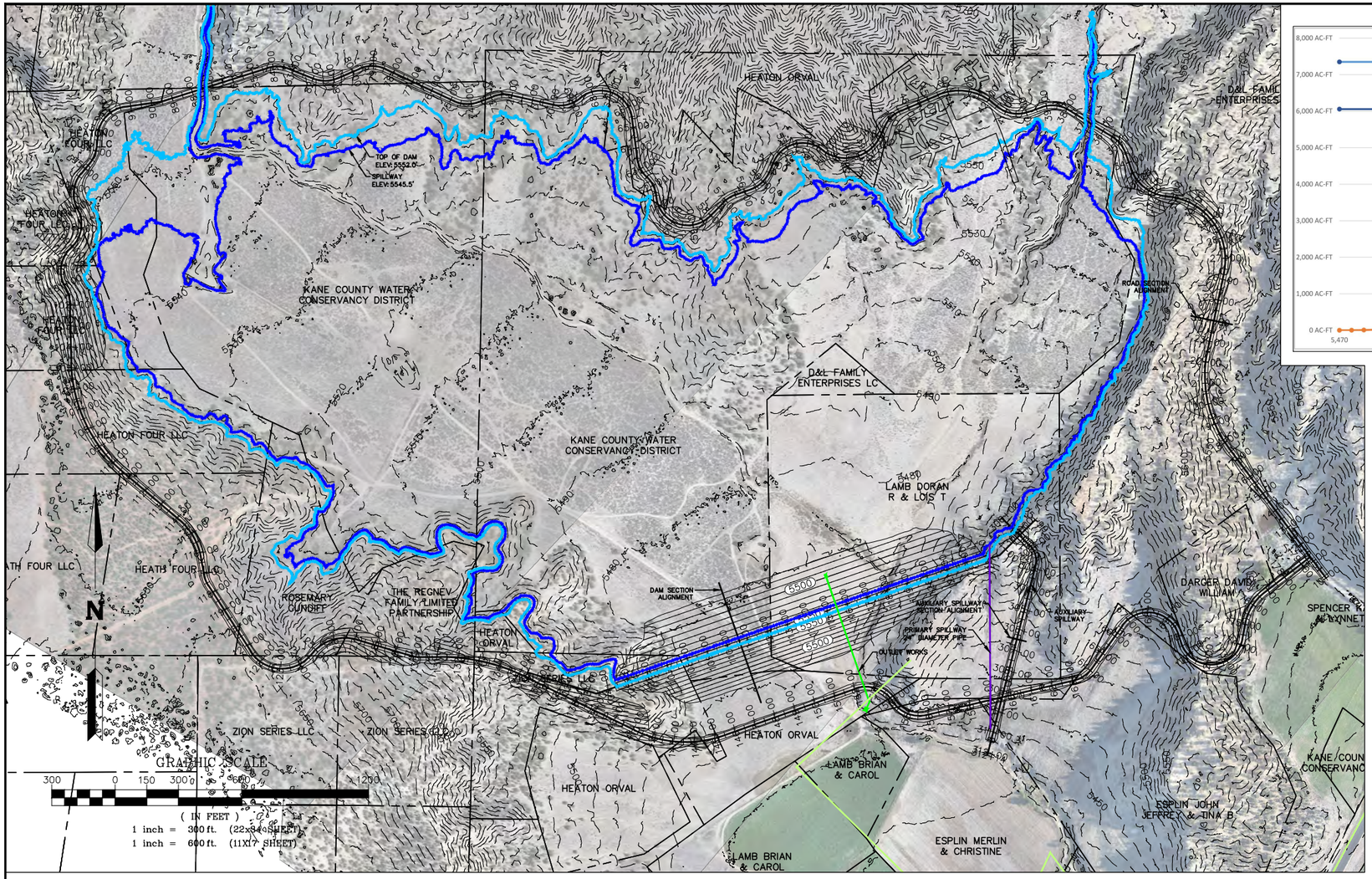
Figure 6

RB&G ENGINEERING INC.
Provo, Utah

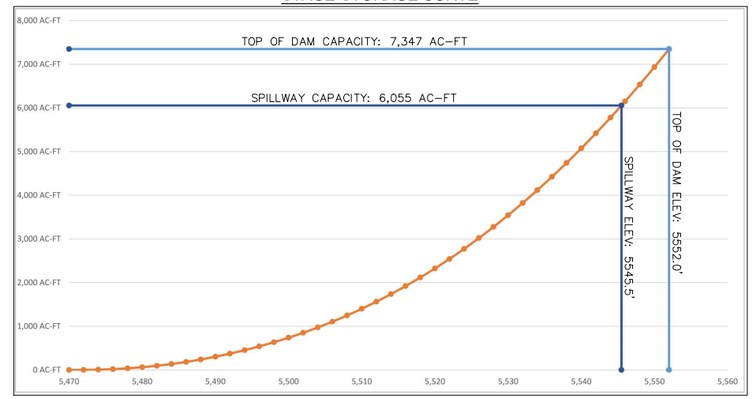
COVE DAM
Orderville, Utah

Maximum Dam Section – Station 10+40

Attachment 6 Concept Design Drawings

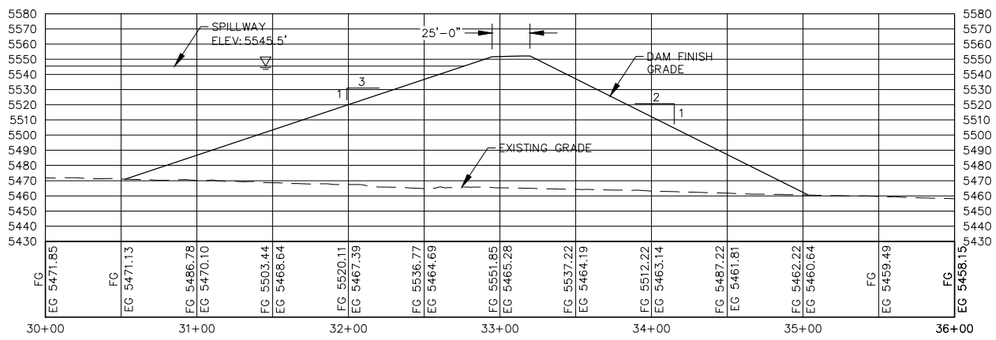


STAGE-STORAGE CURVE

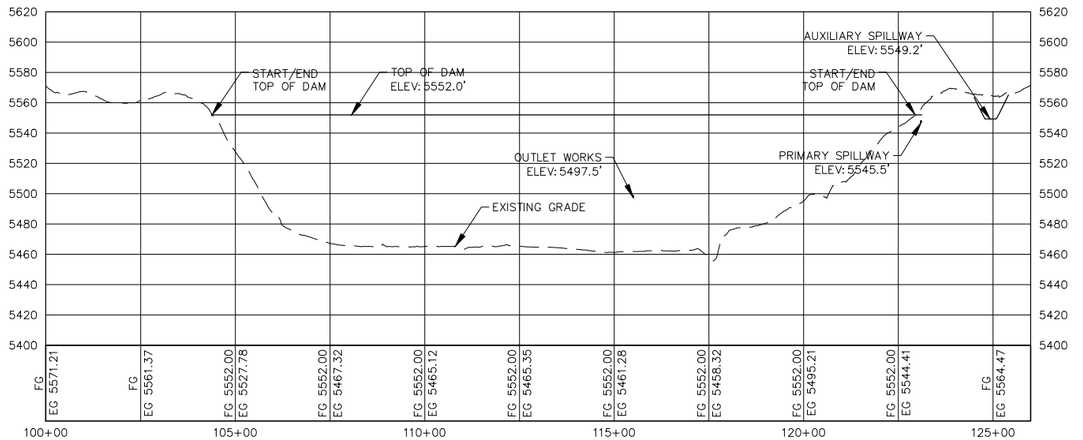


STAGE-STORAGE TABLE

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

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

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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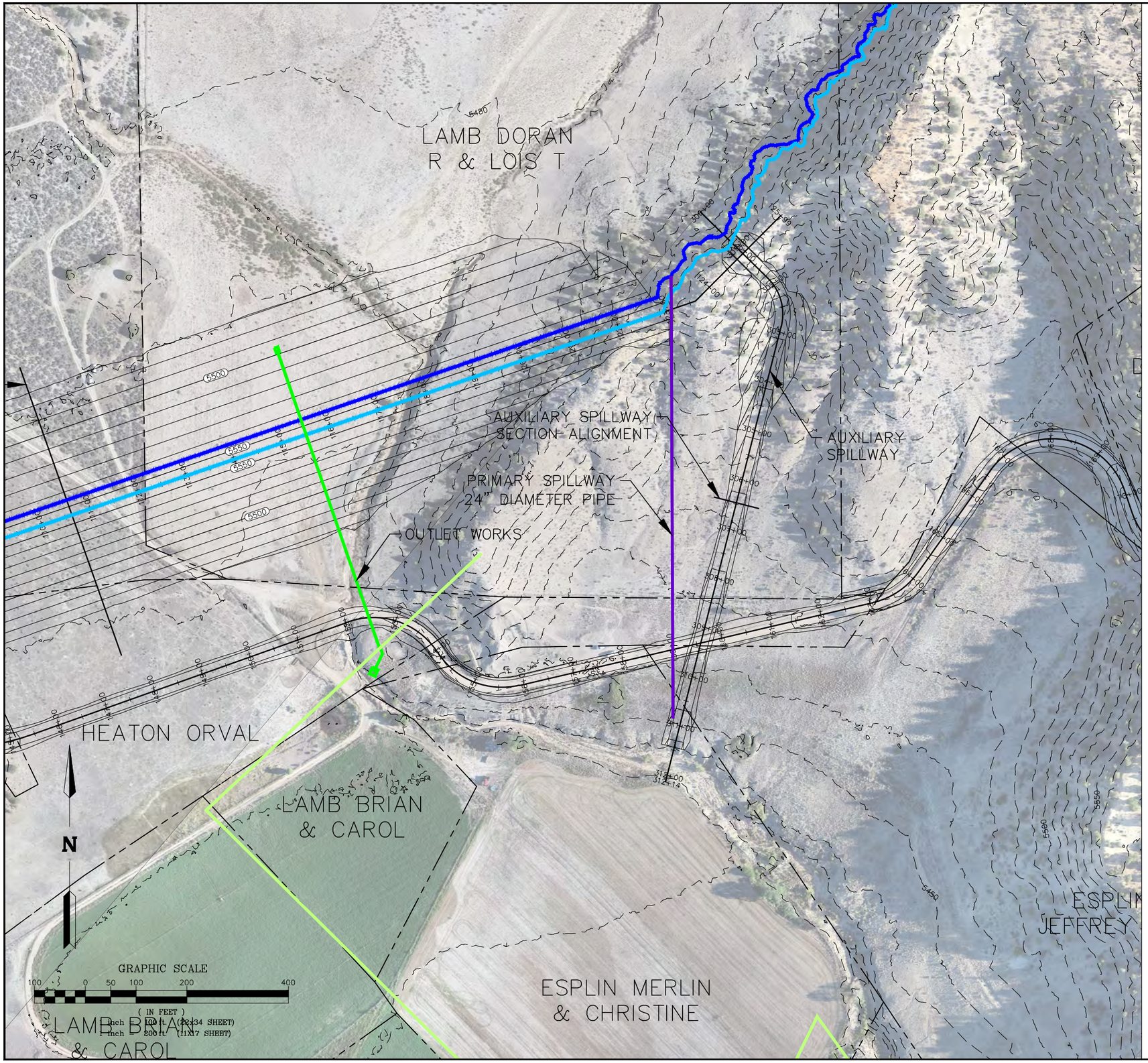
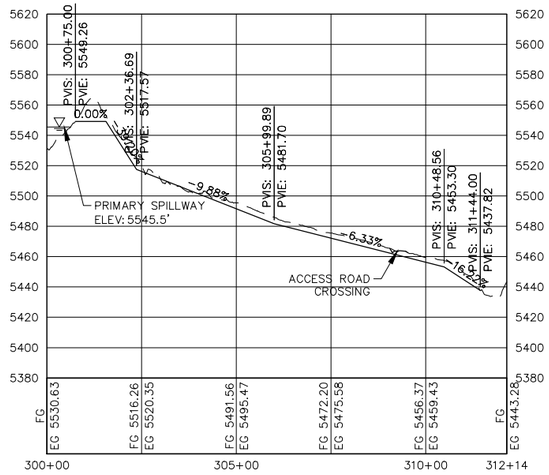
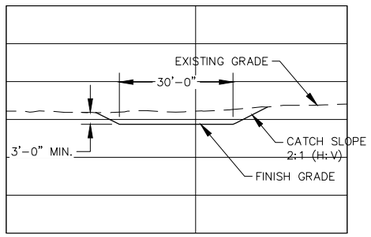




AUXILIARY SPILLWAY PROFILE
HORIZONTAL SCALE: 1" = 400'
VERTICAL SCALE: 1" = 100'



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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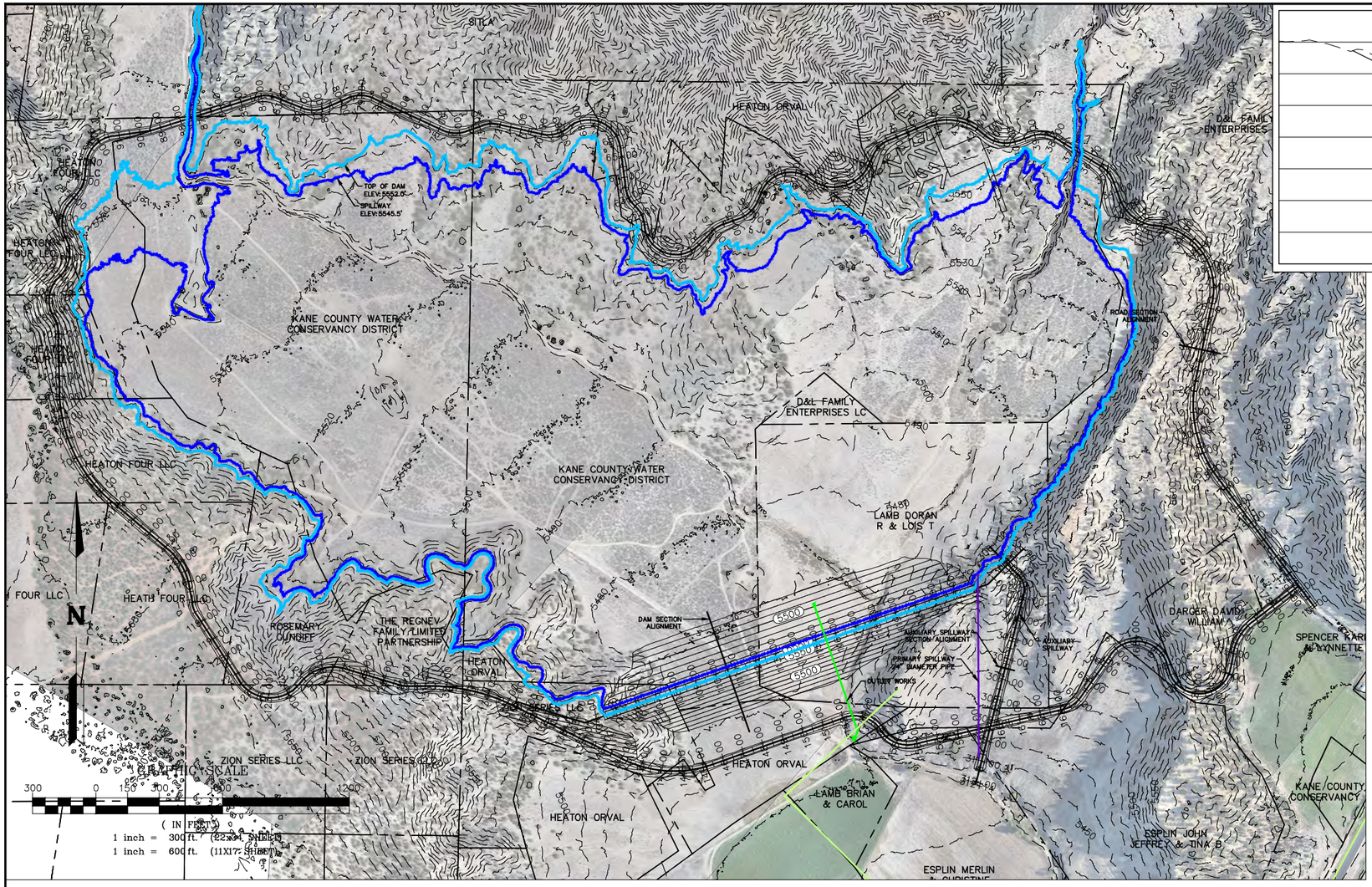
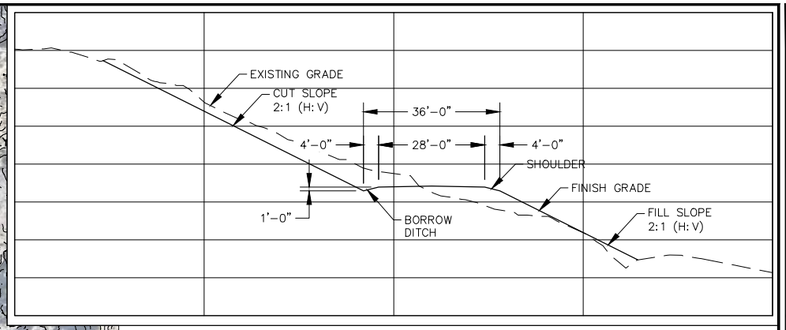
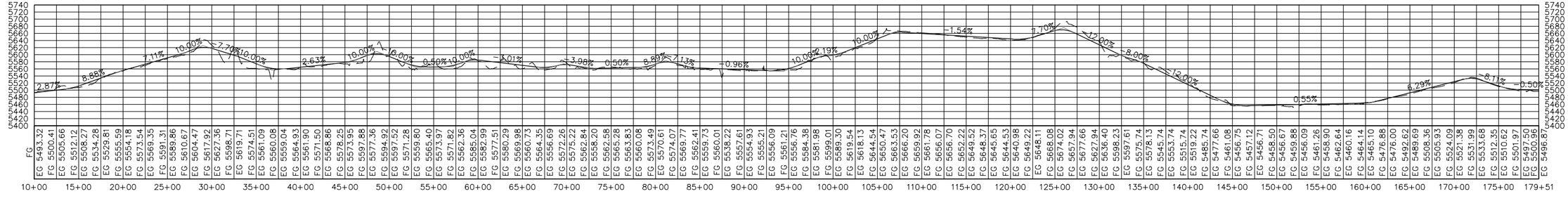




TYPICAL ROAD SECTION
HORIZONTAL SCALE: 1" = 40'
VERTICAL SCALE: 1" = 40'

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
FILE	357-21 Overall EXH.dwg

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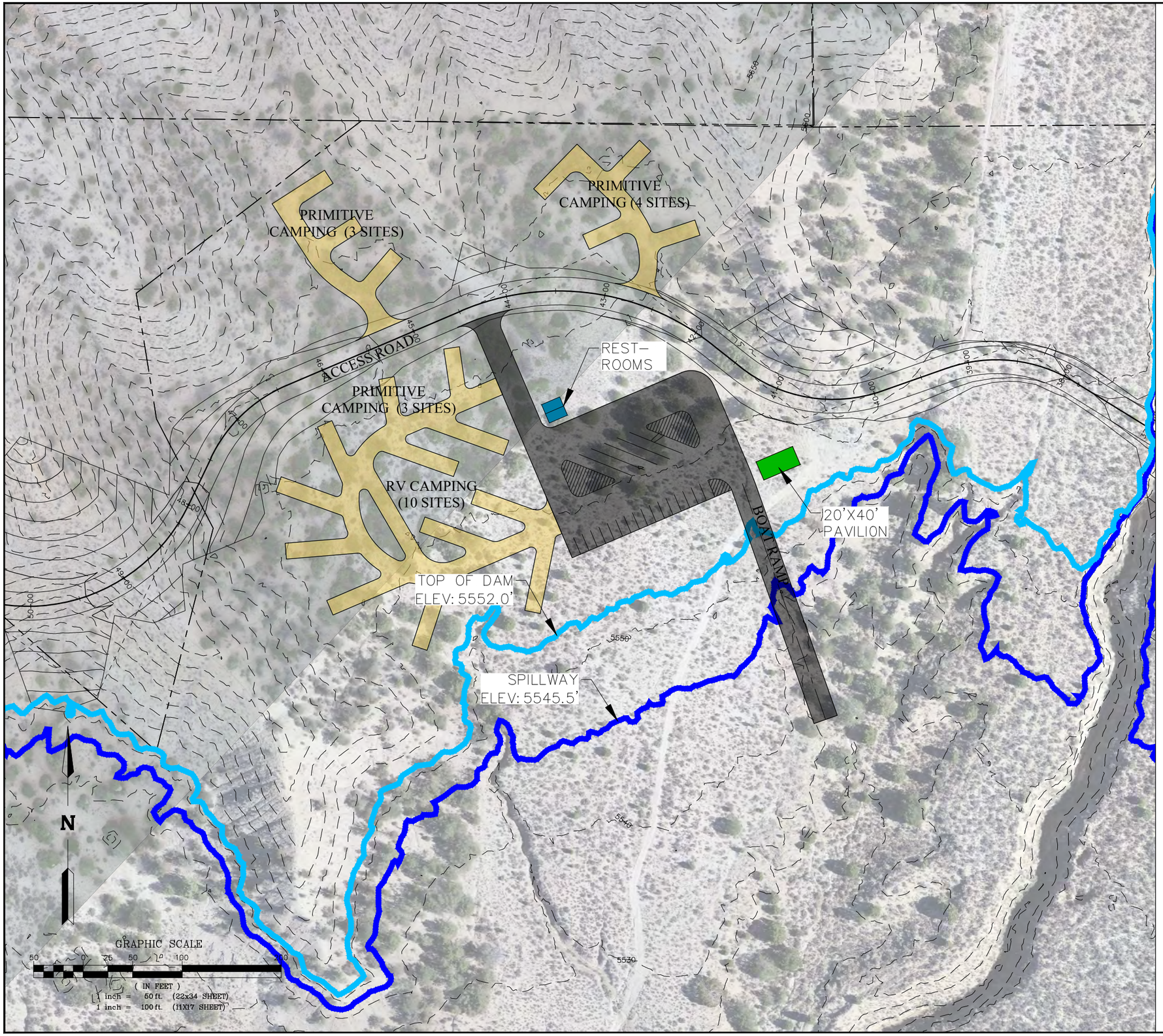

NO.	DATE	BY	DESCRIPTION

REVISIONS

ALPHA ENGINEERING
43 South 100 East, Suite 100 • St George, Utah 84770
T: 435.628.6500 • F: 435.628.6553 • alphaengineering.com

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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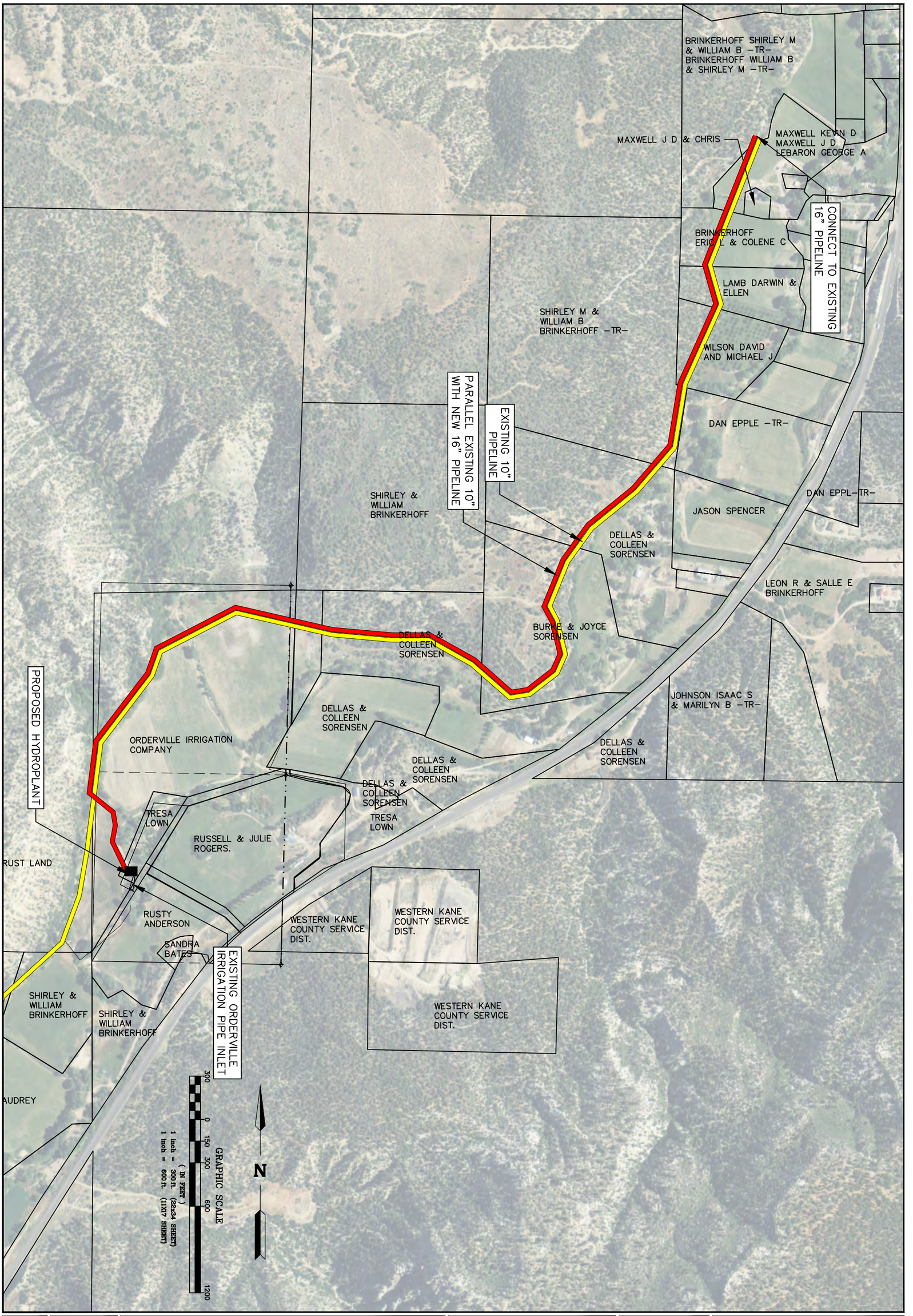

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SCALE: AS NOTED	DATE: MAY 16, 2018	NAME: JSB	PROJECT #: 357-18

TITLE: GLENDALE IRRIGATION EXHIBIT
COVE RESERVOIR

PROJECT: KANE COUNTY WATER CONSERVANCY DISTRICT

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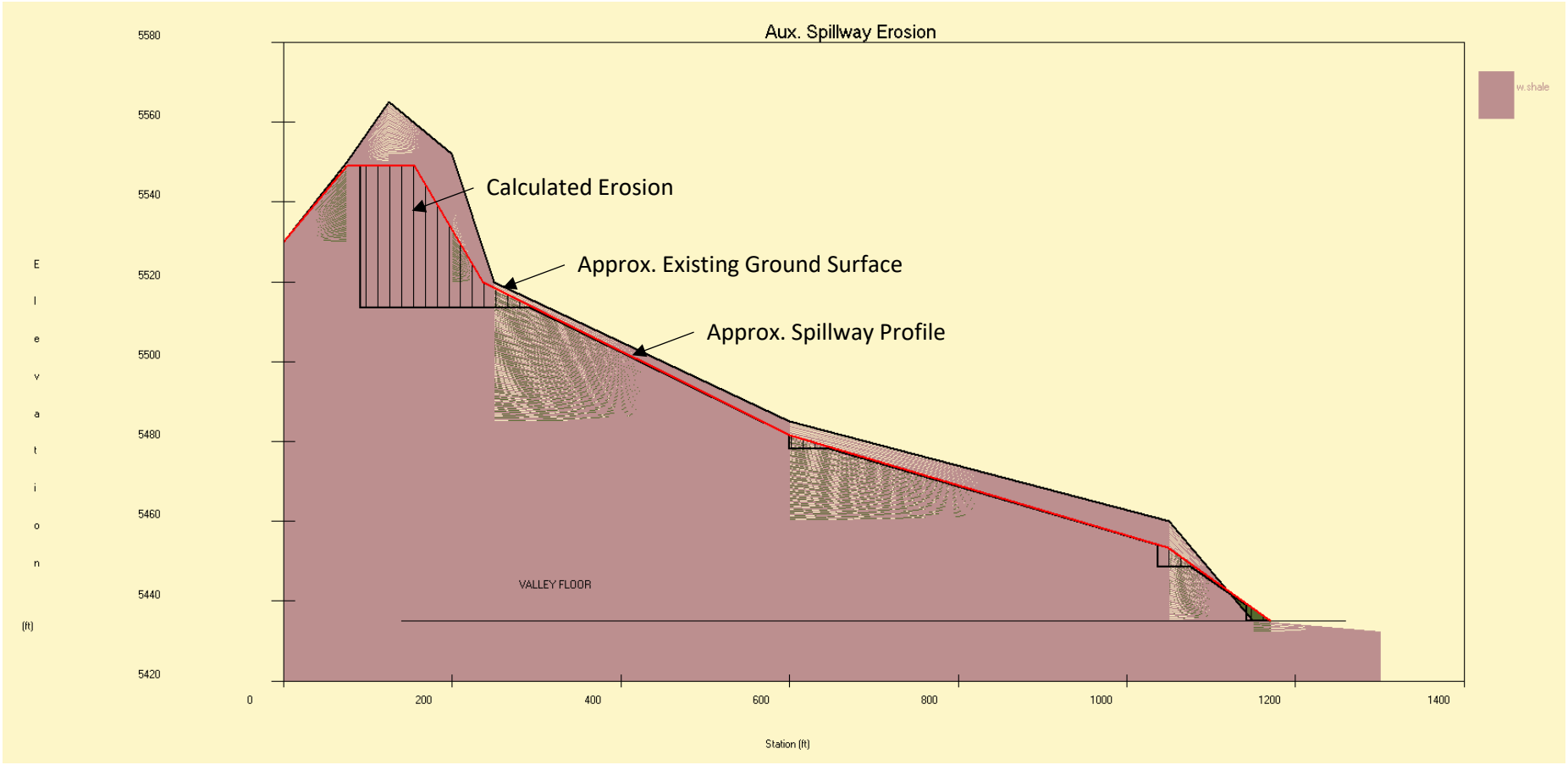
NO.	DATE	BY	DESCRIPTION

Attachment 7 SITES Erosion Analysis



RB&G ENGINEERING, INC.

SITES OUTPUT

Cove Reservoir
Kane County, Utah