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Managing Water in the West

Operation of Flaming Gorge Dam Final Environmental Impact Statement Executive Summary

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

September 2005

Note to the Reader

This Executive Summary provides an overview of the proposed action analyzed in the Operation of Flaming Gorge Dam Final Environmental Impact Statement (EIS). It is intended to provide a concise report of the proposed action, alternatives, and environmental consequences which are explained and analyzed in detail in the EIS. Because a number of those on the EIS mailing list asked only for a copy of this Executive Summary, it should be noted that if more information is desired, a paper or CD-ROM copy of the EIS is available upon request; contact information is provided in the transmittal letter and in the *Federal Register* Notice of Availability of the EIS. The complete EIS, comments and responses, and appendices are also viewable on the internet. Go to <**www.usbr.gov/uc/**>, click on "Environmental Documents" in the left hand column, and click on "Operation of Flaming Gorge Dam Environmental Impact Statement."

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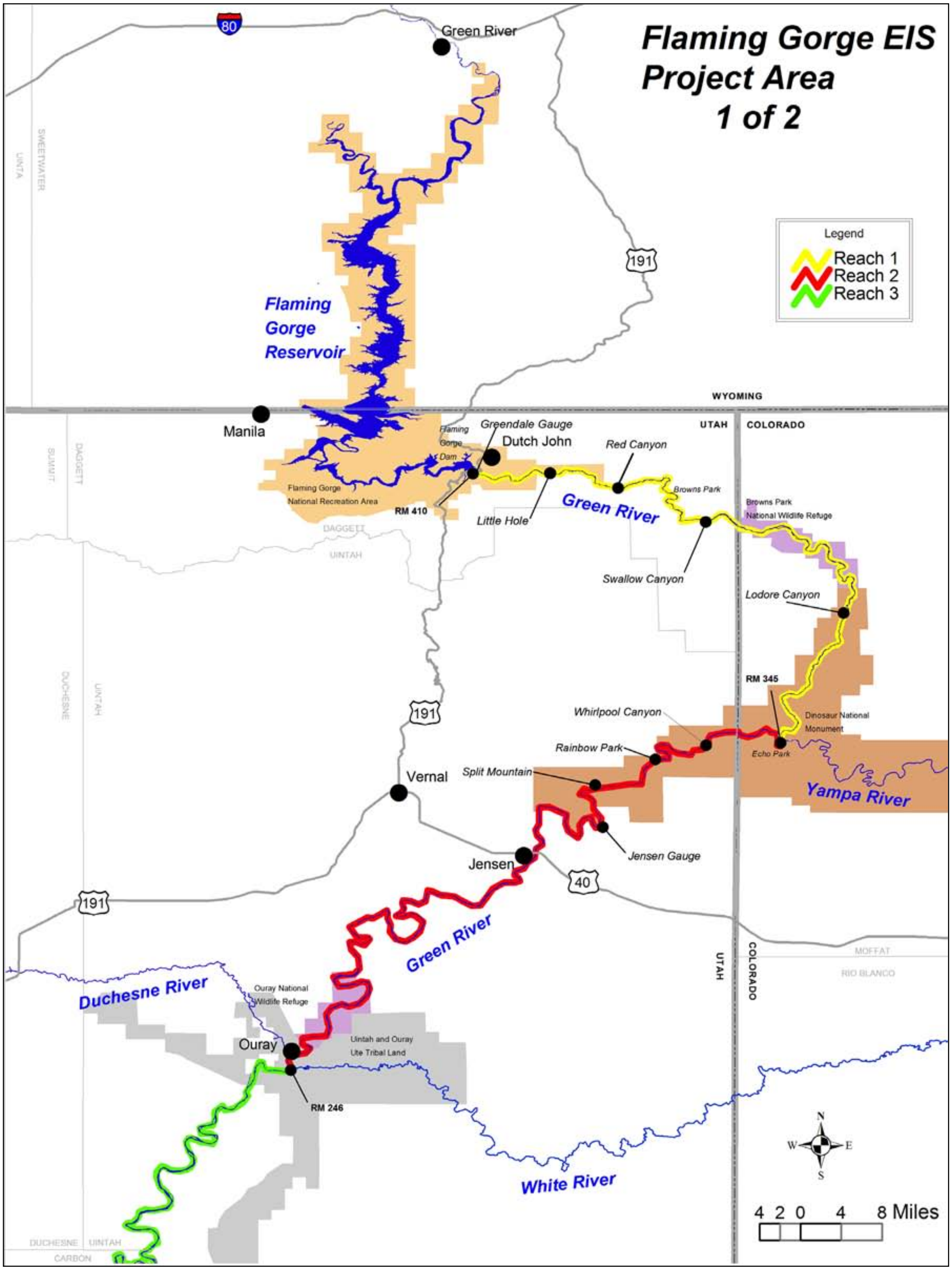
Flaming Gorge EIS
Project Area
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Reach 1
Reach 2
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Green River
Flaming Gorge Reservoir
Manila
WYOMING
UTAH
COLORADO
Flaming Gorge Dam
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Yampa River
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Green River
Duchesne River
Ouray National Wildlife Refuge
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Uintah and Ouray Ute Tribal Land
RM 246
White River
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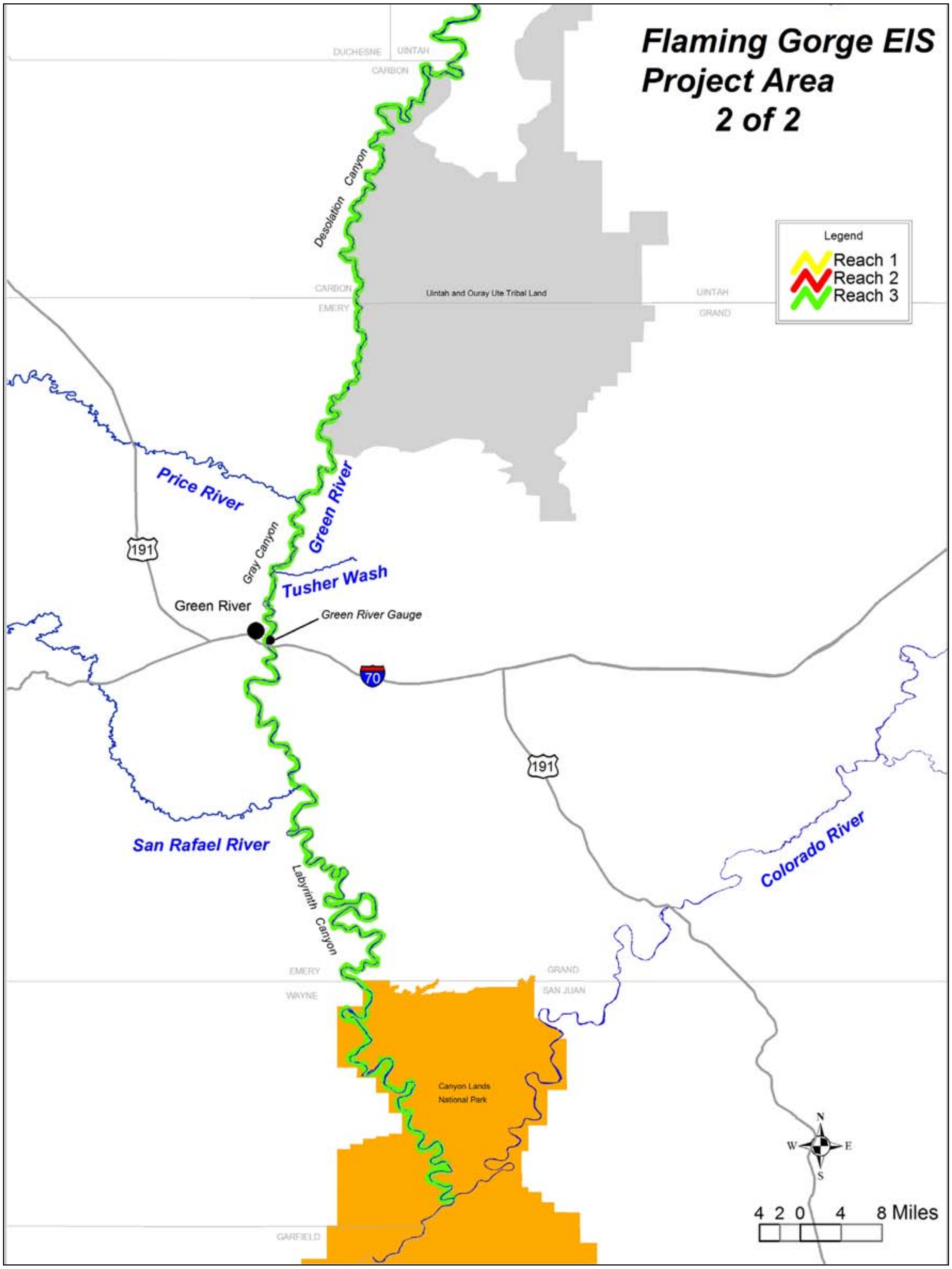

Flaming Gorge EIS
Project Area
2 of 2
Legend
Reach 1
Reach 2
Reach 3
DUCHESNE
UINTAH
CARBON
Desolation Canyon
CARBON
EMERY
Uintah and Ouray Ute Tribal Land
UINTAH
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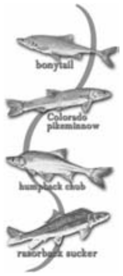

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Executive Summary

S.1 INTRODUCTION

The Secretary of the United States Department of the Interior (Secretary), acting through the Bureau of Reclamation (Reclamation), is considering whether to implement a proposed action under which Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the September 2000 report *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations), published by the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). The 2000 Flow and Temperature Recommendations specifically describe the peak flows, durations, water temperatures, and base flow criteria recommended to protect and assist in the recovery of endangered fish species.

A final environmental impact statement (EIS), of which this document is an executive summary, has been prepared pursuant to the National Environmental Policy Act of 1969 (NEPA), and the Council on Environmental Quality (CEQ) and Department of the Interior regulations implementing NEPA. The EIS addresses the environmental issues associated with, and analyzes the environmental consequences of, the one action alternative determined to meet purpose and need, as well as a no action alternative.

Reclamation is the lead agency in preparing the EIS. The eight cooperating agencies include the Bureau of Indian Affairs, Bureau of Land Management (BLM), National Park Service, State of Utah Department of Natural Resources, U.S. Fish and Wildlife Service, United States Department of Agriculture Forest Service (USDA Forest Service), Utah Associated Municipal Power Systems, and Western Area Power Administration (Western).

S.2 PROPOSED FEDERAL ACTION AND BACKGROUND

Reclamation proposes to take action to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes found in the Green and Colorado River Basins (proposed action). The four endangered fish species are Colorado pikeminnow *(Ptychocheilus lucius),* humpback chub *(Gila cypha),* razorback sucker *(Xyrauchen texanus),* and bonytail *(Gila elegans*). Reclamation would implement the proposed action by modifying the operations of Flaming Gorge Dam, to the extent possible, to achieve the flows and temperatures prescribed in the 2000 Flow and Temperature Recommendations. Reclamation's goal is to implement the proposed action and, at the same time, maintain and continue all authorized purposes of the Colorado River Storage Project (CRSP).

S.2.1 Purpose of and Need for the Proposed Federal Action

The purpose of the proposed action is to operate Flaming Gorge Dam to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact. The proposed action is needed for the following reasons:

- The operation of Flaming Gorge Dam, under its original operating criteria, jeopardized the continued existence of the endangered fishes in the Green River.
- Reclamation is required to comply with the Endangered Species Act (ESA) for the operation of CRSP facilities, including Flaming Gorge Dam. Within the exercise of its discretionary authority, Reclamation must avoid jeopardizing the continued existence of listed species and destroying or adversely modifying designated critical habitat.
- The Reasonable and Prudent Alternative (RPA) to the 1992 Biological Opinion on the Operation of Flaming Gorge Dam required modification of Flaming Gorge releases to benefit the endangered fish, a 5-year study period to evaluate winter and spring flows, and reinitiation of discussions with the U.S. Fish and Wildlife Service following the study period to further refine the flow recommendations. With the results of these studies, as well as other relevant information, the Recovery Program developed and approved the 2000 Flow and Temperature Recommendations for the Green River. These recommendations are an extension of the 1992 jeopardy Biological Opinion RPA. Reclamation committed to assist in meeting flow requirements through the refined operation of Flaming Gorge and other Federal reservoirs in the 1987 agreement that formed the Recovery Program.
- Flaming Gorge Dam and Reservoir is the primary water storage and delivery facility on the Green River, upstream from its confluence with the Colorado River. The storage capacity and ability to control water releases of Flaming Gorge Dam allow Reclamation flexibility in providing flow and temperature management, to protect and assist in the recovery of endangered fish populations and their critical habitat within specific reaches of the river. Thus, the refined operation of Flaming Gorge Dam is a key element of the Recovery Program.

- The refined operation will offset the adverse effects of flow depletions from the Green River for certain Reclamation water projects in Utah, as defined by existing jeopardy Biological Opinions. Modifying the operation of Flaming Gorge Dam will also serve as the RPA, as defined by the ESA, to offset jeopardy to endangered fishes and their critical habitat that could result from the operation of numerous other existing or proposed water development projects in the Upper Colorado River Basin.

S.3 BACKGROUND

Flaming Gorge Dam, located on the Green River in northeastern Utah about 200 miles northeast of Salt Lake City, is an authorized storage unit of the CRSP. Flaming Gorge Dam was completed in 1962, and full operation of the dam and reservoir began in 1967. The powerplant, located at the base of the dam, began commercial operation in 1963 and was completed in 1964. Reclamation operates the dam and powerplant, and Western markets the power.

S.3.1 Brief History of Flaming Gorge Dam and Reservoir

S.3.1.1 Authorized Uses of Flaming Gorge Dam and Reservoir and Colorado River Development

Flaming Gorge Dam was authorized for construction by the CRSP Act of 1956 (Public Law [P.L.] 84-485). The underlying project purposes are defined by Section 1 of the Act (43 United States Code [U.S.C.] Section (§) 620):

> *In order to initiate the comprehensive development of the water resources of the Upper Colorado River Basin, for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact, respectively, providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes, the Secretary of the Interior is authorized (1) to construct, operate, and maintain the following initial units of the Colorado River storage project, consisting of dams, reservoirs, powerplants, transmission facilities and appurtenant works [including] Flaming Gorge . . ..*

Section 7 of the CRSP Act of 1956 mandates the operation of CRSP powerplants to produce ". . .the greatest practicable amount of power and energy that can be sold at firm power and energy rates. . .." However, as described in the EIS in section 1.4.3, continued Upper Colorado River Basin development of water resources and implementation of the 2000 Flow and Temperature Recommendations may affect the practicable amount of power and energy generated. The EIS analyzes these effects in sections 4.4 and 4.16.1.

The Upper Colorado River Endangered Fish Recovery Program was developed in response to the request of Colorado, Wyoming, and Utah to facilitate the continued development of their compact apportionments in light of Endangered Species Act concerns. The 2000 Flow and Temperature Recommendations, which were developed by the Recovery Program, are specifically designed, in concert with other Recovery Program actions, to accomplish recovery. By implementing the 2000 Flow and Temperature Recommendations, Reclamation would be taking the steps necessary to facilitate recovery of the fish, which will make it possible for continued and further utilization of the States' compact apportionments. Thus, by "making it possible for the States of the Upper Basin to utilize…[their Compact] apportionments," the 2000 Flow and Temperature Recommendations, which are designed to facilitate further compact development through the recovery of listed species, are within the authorized purposes of CRSP Act. Moreover, that other authorized purposes of the unit may not be fully maximized for limited durations in certain year types does not invalidate the actions of the Secretary of the Interior, as long as the overall goals of the project are being met.

In addition to this authority, the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs (including Flaming Gorge Reservoir) mandated by Section 602(a) of the 1968 Colorado River Basin Project Act (43 U.S.C. § 1501 et seq.) requires that the Annual Operating Plan for Colorado River reservoirs ". . . shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife, and other environmental factors."

S.3.1.2 Authorized Uses of Flaming Gorge Dam and Reservoir: Flaming Gorge National Recreation Area

The Flaming Gorge National Recreation Area was established by the Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540). According to that act, the purposes of the Flaming Gorge National Recreation Area are to provide (1) public outdoor recreation benefits; (2) conservation of scenic, scientific, historic, and other values contributing to enjoyment, and (3) such management, utilization, and disposal of natural resources that will promote or are compatible with and do not significantly impair the purposes for which the recreation area was established. The act added about 123,000 acres to Ashley National Forest and assigned management of the entire recreation area to the USDA Forest Service. The Flaming Gorge National Recreation Area contains 207,363 acres of land and water that are almost equally divided between Utah and Wyoming.

S.4 OPERATIONAL MODIFICATIONS SINCE THE BEGINNING OF DAM OPERATIONS

Construction of Flaming Gorge Dam and Powerplant began in 1956. Filling of the reservoir began in 1962 when the dam was completed. Full operation began in November 1967. Until 1984, Flaming Gorge Dam was operated to provide for a full reservoir while maximizing power generation, providing associated ancillary services, and avoiding the use of the river outlet works or the spillway. From 1967 until 1984, flows were fluctuated as needed to meet system power demand, and consideration was given to known fish and wildlife needs.

The history of Flaming Gorge Dam operations can be divided into five phases. During the first phase, from 1962 to 1966, the reservoir was filling with water, and Green River flows downstream from the dam were reduced. The first full year of normal operations began in 1967. During the second phase, from 1967 to 1978, Flaming Gorge Dam was operated with few constraints, and water releases were made through the powerplant. The only constraint on releases during phase two began in 1974 when a 400-cubic-foot-per-second (cfs) minimum release was implemented to establish and maintain the tailwater trout fishery (1974 Interim Operating Criteria). This operating agreement between the Utah Division of Wildlife Resources and Reclamation stated:

> *A minimum flow of 400 cfs will be released from the reservoir at all times. However, for the foreseeable future and under normal conditions, a continuous flow of 800 cfs will be maintained as a minimum. To the extent the available water supply will permit and is compatible with multipurpose operations of all CRSP reservoirs, minimum flows in excess of 800 cfs will be maintained to enhance the use of the river for fishing, fish spawning, and boating.*

In 1978, the dam was retrofitted with a selective withdrawal structure to improve water temperatures for the tailwater trout fishery. During the third phase, from 1979 to 1984, operations were similar to those in the previous phase except for use of the selective withdrawal structure and the occurrence of spills in 1983 and 1984.

During the fourth phase, from 1985 to 1992, Reclamation began to constrain the operation of Flaming Gorge Dam to reduce negative impacts affecting endangered fishes in the Green River. Such constraints reduced operational flexibility and the ability to fluctuate flows to meet power system demands. In 1985, an interim flow agreement was established between Reclamation and the U.S. Fish and Wildlife Service to change Flaming Gorge Dam releases to protect critical nursery habitats for endangered fishes in the Green River downstream from Jensen, Utah. The recommended releases were based on observations made in 1985 that indicated "good" habitat conditions were available at lower flows. Reclamation also revised operational criteria at the dam to avoid spills. These changes were in place in the fourth phase, along with numerous research releases to support preparation of the Final Biological Opinion on the Operation of Flaming Gorge Dam issued on November 25, 1992. Significant financial impacts to hydropower generation, identified in the EIS, occurred mainly as a result of flow changes implemented during this fourth phase.

In the fifth phase, from 1993 to present, Reclamation began making releases from Flaming Gorge Dam in an attempt to meet the flow and temperature recommendations given in the 1992 Biological Opinion. Flows recommended in the 1992 Biological Opinion were intended to restore a more natural hydrograph and protect nursery habitats of endangered fishes downstream from the Yampa River confluence. At the same time, Reclamation continued to meet the authorized purposes of Flaming Gorge Dam.

The Green River flows recommended in the 1992 Biological Opinion were based on the most current scientific data available at the time. The opinion included several actions Reclamation could take to avoid jeopardizing the recovery of endangered fishes in the Green River. One of these actions was to collect more information about the flow and temperature needs of the endangered fishes and, subsequently, to refine or modify the flow and temperature recommendations of the 1992 Biological Opinion. A 5-year research study began in 1992, and the resulting data and refinements were included in the

2000 Flow and Temperature Recommendations. The study included periodic test flows to evaluate the effects of summer flows on endangered fishes or to test specific hypotheses.

S.5 COMPLIANCE WITH THE ENDANGERED SPECIES ACT

To comply with the ESA, an evaluation of the effects of any discretionary Federal action must be conducted by the action agency in consultation with the U.S. Fish and Wildlife Service.

During the late 1970s and early 1980s, the U.S. Fish and Wildlife Service rendered Jeopardy Biological Opinions for the Upalco, Jensen, and Uinta Units of the Central Utah Project stating that all relied on the operation of Flaming Gorge Dam to provide flows for endangered fishes. More recent Biological Opinions for the Duchesne River Basin, the proposed Narrows Project, the ongoing Price-San Rafael Salinity Control Project, and other water development-related projects in the Colorado River Basin also rely on the operation of Flaming Gorge Dam to provide flows for endangered fishes.

On February 27, 1980, the U.S. Fish and Wildlife Service requested consultation under Section 7 of the ESA for projects currently under construction in the Upper Colorado River Basin, and for the continued operation of all existing Reclamation projects in the basin (including the CRSP). Formal consultation on the operation of Flaming Gorge Dam began March 27, 1980. Issuance of a Final Biological Opinion by the U.S. Fish and Wildlife Service for the operation of Flaming Gorge Dam was delayed until data collection and studies related to habitat requirements for the endangered fishes could be completed and used to recommend specific flows in the Green River downstream from the dam. Dam operations were initially evaluated for potential effects on endangered fishes from 1979 to 1984. Reclamation served as the lead agency for this consultation, with Western becoming a party to the consultation in 1991.

Additionally, on February 27, 1980, the U.S. Fish and Wildlife Service issued a Final Biological Opinion for the Strawberry Aqueduct and Collection System, a major feature of the Central Utah Project. The Biological Opinion determined that Strawberry Aqueduct and Collection System flow depletions from the Duchesne and Green Rivers would likely jeopardize the continued existence of the endangered Colorado pikeminnow and humpback chub. This Biological Opinion included a Reasonable and Prudent Alternative stating that Flaming Gorge Dam and Reservoir would compensate for those depletions and be operated for the benefit of the endangered fishes in conjunction with its other authorized purposes.

Both the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations were designed to account for the impacts of depletions mentioned above. The 2000 Flow and Temperature Recommendations as implemented under the Action Alternative would offset the impacts of water depletions on these other projects.

S.5.1 Upper Colorado River Endangered Fish Recovery Program

The Recovery Program was initiated in 1987 as a cooperative effort among the States of Utah, Colorado, and Wyoming; environmental and water user organizations; Federal agencies including the National Park Service, Reclamation, U.S. Fish and Wildlife Service, and Western; and the Colorado River Energy Distributors Association. The goal of the Recovery Program is to protect and recover the endangered fish species of the Upper Colorado River Basin so they no longer need protection under the ESA, while the Upper Basin States continue to develop their 1922 Colorado River Compact entitlements.

Under the Recovery Program, five key elements are needed to recover the endangered fish species: (1) habitat management; (2) habitat development/maintenance; (3) native fish stocking; (4) nonnative species and sport fish management; and (5) research, data management, and monitoring. The operation of Flaming Gorge Dam is essential to successful implementation of two of these five elements: habitat management and habitat development/maintenance. Operation of the dam is one of many management actions described in the 1993 Recovery Implementation Program Recovery Action Plan (Recovery Action Plan). The plan is periodically revised to accommodate programmatic Biological Opinions and annual updates as well as the designation of critical habitat for the endangered fishes. Implementation of all Recovery Action Plan recommendations is expected to achieve recovery of the endangered fishes.

Reclamation began informing the Recovery Program Management Committee of the EIS timeline in 1999. Beginning in 2001, the Recovery Program Management Committee requested and received regular updates on EIS progress through early 2005. Additionally, throughout 1999–2003 the staff of the Recovery Program Director's office met regularly with Reclamation authors to clarify flow recommendation issues during development of the EIS document, and Reclamation also interacted with the Recovery Program biology committee on EIS matters periodically throughout this period.

S.5.2 Final Biological Opinion on the Operation of Flaming Gorge Dam and the Reasonable and Prudent Alternative

The U.S. Fish and Wildlife Service issued a Final Biological Opinion on the Operation of Flaming Gorge Dam on November 25, 1992, stating that the current operation of Flaming Gorge Dam was likely to jeopardize the continued existence of the endangered fishes in the Green River. The opinion also described elements of an RPA that, in the opinion of the U.S. Fish and Wildlife Service, would offset jeopardy to the endangered fishes. The RPA required implementing the following five elements:

(1) Refining the operation of Flaming Gorge Dam so flow and temperature regimes of the Green River more closely resemble a natural hydrograph.

(2) Conducting a 5-year research program, including implementation of winter and spring research flows, beginning in 1992, to allow for potential refinement of flows for those seasons. The research program was to be based on the Flaming Gorge Flow Recommendations Investigation and called for annual meetings to refine seasonal flows consistent with research findings and water year forecasts. Except for specific research flows during the 5-year research program, year-round flows in the Green River were to resemble a natural hydrograph described under element 1 of the RPA.

(3) Determining the feasibility and effects of releasing warmer water during the late spring/summer and investigating the feasibility of retrofitting the river bypass tubes to include power generation, thereby facilitating increased spring releases.

(4) Legally protecting Green River flows from Flaming Gorge Dam to Lake Powell.

(5) Initiating discussions with the U.S. Fish and Wildlife Service, after conclusion of the 5-year research program, to examine further refinement of flows for the specified endangered Colorado River fishes.

S.5.3 2000 Flow and Temperature Recommendations

The research program called for in the 1992 Biological Opinion concluded in 1996. At that time, the Recovery Program funded a synthesis of research and development of flow and temperature recommendations for the Green River. The final synthesis report contained the 2000 Flow and Temperature Recommendations, which provide the basis for Reclamation's Action Alternative analyzed in the EIS and for additional Section 7 consultation by Reclamation and Western with the U.S. Fish and Wildlife Service.

S.5.4 New Biological Opinion on the Operation of Flaming Gorge Dam

Reclamation and Western have consulted with the Fish and Wildlife Service, as required by Section 7 of the ESA, on the proposed action analyzed in the EIS. The Final Biological Opinion was issued on September 6, 2005, and may be found in the Final Biological Opinion Technical Appendix of the EIS.

S.6 OPERATIONAL DECISIONMAKING PROCESS AT FLAMING GORGE DAM

The process of developing an operational plan for Flaming Gorge Dam takes into consideration all resources associated with Flaming Gorge Dam identified by the Flaming Gorge Working Group. The Flaming Gorge Working Group was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operation of Flaming Gorge Dam. Among others, these interests include power marketing, sport fisheries, endangered species, white water rafting, farming, land ownership, reservoir recreation, national park resources, land management, flood control, and wildlife refuge management.

The Flaming Gorge Working Group generally meets twice a year (April and August/September). These meetings are open to the public, and participants are encouraged to comment. Operational decisions are not made during the Flaming Gorge Working Group meetings; rather, these meetings are a forum for information exchange about past, current, and proposed operations at Flaming Gorge Dam. They also serve as a forum through which stakeholders can share information about specific resources of interest and the relationship between the operation of Flaming Gorge Dam and these resources. The Flaming Gorge Working Group provides input to Reclamation as well as educating various constituencies on operations at Flaming Gorge Dam.

Reclamation has sole responsibility for operations at Flaming Gorge, although the needs and expectations of stakeholders are considered in operational planning. Reclamation's priorities are first, dam safety, and second, meeting project purposes in compliance with the ESA. When conflicts in operations arise, Reclamation's approach to conflict resolution and decisionmaking includes accepting input from all stakeholders and formulating a strategy that meets the most needs possible consistent with these established priorities.

Operational decisions for Flaming Gorge Dam are made through the Colorado River Annual Operating Plan process. A document, called the *24-Month Study*, is produced monthly and contains planned monthly releases from all CRSP reservoirs. In the 24-month study, reservoir inflows are revised to reflect forecasted inflow from the National Weather Service. These forecasted inflows are input into the 24-Month Planning Model. Planned releases from Flaming Gorge are adjusted monthly to reflect changing hydrology, to meet the requirements of the ESA, and to meet CRSP authorized purposes.

Operational details and changes are coordinated as necessary with other agencies, including Western, the U.S. Fish and Wildlife Service, and the Utah Division of Wildlife Resources. Generally, a variety of requests for short-term, temporary modifications in operations are often received, and such requests are accommodated if they are reasonable, necessary, and do not interfere with dam safety, other authorized project purposes, or operations for ESA compliance.

S.7 EMERGENCY POWERPLANT OPERATIONS

Normal dam and powerplant operations under the Action Alternative or any other alternative could be altered temporarily to respond to emergencies. These emergencies may be associated with dam safety, power system conditions, or personal safety of individuals or groups associated with recreation or other activities on the river. The North American Electrical Reliability Council and the Western Electricity Coordinating Council have established guidelines and requirements for emergency operations of interconnected power systems that apply to Flaming Gorge Dam operations. Examples of system emergencies include loss of generation capacity, transmission capability, or voltage control.

S.8 PUBLIC SCOPING PROCESS FOR THE ENVIRONMENTAL IMPACT STATEMENT

The scoping process for the EIS was initiated on June 6, 2000, with the publication in the *Federal Register* of a Notice of Intent to prepare an EIS. During the public scoping period, Reclamation received both written and oral comments (oral comments were received at five public scoping meetings in Utah, Colorado, and Wyoming) which were considered in determining the scope of the EIS. The formal scoping period ended on September 5, 2000.

S.9 Scope of Analysis for the Environmental Impact Statement

The purpose of the EIS is to identify and consider the impacts of developing and implementing dam operations guidelines that result in protecting and assisting in the recovery of the populations and designated critical habitat of the four endangered fishes living in the Green River downstream from Flaming Gorge Dam. The scope of analysis for the EIS focuses on responding to the following question:

> If Reclamation operates Flaming Gorge Dam to achieve the 2000 Flow and Temperature Recommendations needed to avoid jeopardy and to protect and assist in the recovery of the endangered fishes and their critical habitat in the Green River, consistent with CRSP purposes, then the effect(s) on other relevant resources/issues, both upstream and downstream from the dam, would be . . .

The geographic project area (as shown in the frontispiece maps), analyzed for possible impacts of the proposed action and alternatives includes Flaming Gorge Reservoir and the Green River downstream from Flaming Gorge Dam, to its confluence with the Colorado River. The Green River upstream of the reservoir would not be affected because the proposed action depends exclusively on the operation of Flaming Gorge Dam, which is dependent on inflow into Flaming Gorge Reservoir. The EIS provides full details on issues and resources that were analyzed.

S.10 Related and Ongoing Actions

This section describes laws and projects that affect the operation of Flaming Gorge Dam and may affect the potential impacts of the proposed action. Where applicable, these laws and projects are factored into the analysis of potential impacts under both alternatives, particularly in the cumulative impacts analysis of the EIS.

S.10.1 Regulatory Requirements

Federal statutes establish a number of responsibilities for the Secretary of the Interior. These legislated responsibilities relate to the management of numerous agencies, projects, and lands, all or some relating to the operation of Flaming Gorge Dam. In some cases, the statutes specifically require the Secretary to mandate responsibility for management of reservoirs; while in others, the statutes allow the Secretary to grant discretionary authority.

S.10.1.1 The Law of the River

As a tributary of the Colorado River, the Green River is managed and operated according to a collection of over 50 compacts, Federal and State laws, court decisions and decrees, contracts, treaties, and regulatory guidelines collectively known as the Law of the River. This collection of documents apportions the water among the seven Basin States and

Mexico and regulates and manages riverflows. Some of the statutes included within the Law of the River having a major impact on dam operations include the Colorado River Compact of 1922, the Upper Colorado River Basin Compact of 1948, the Colorado River Storage Project Act of 1956, and the Colorado River Basin Project Act of 1968.

S.10.1.2 National Parks and Recreation Areas

The affected environment for the EIS includes portions of Flaming Gorge National Recreation Area, Dinosaur National Monument, and Canyonlands National Park. Enabling legislation for these units includes:

- Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540)
- Antiquities Act of 1906, 16 U.S.C. 431-433. The Dinosaur National Monument was originally designated by President Wilson in October 1915 and was enlarged by President Roosevelt in 1938.

Management authorities include:

- National Park Service Organic Act (16 U.S.C. 1-4, 22, 43)
- National Park Service General Authorities Act of 1970 (16 U.S.C. 1a-1)
- Redwood National Park Act of 1978 (P.L. 95-250, 92 Statute 163, as amended)

S.10.1.3 Environmental Compliance

Laws and Executive orders that were designed to restore and protect the natural environment of the United States relating to air, water, land, and fish and wildlife include the following:

- National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
- Endangered Species Act of 1973 (16 U.S.C. 1532 et seq.)
- Wilderness Act of 1964 (16 U.S.C. 1131 et seq.)
- Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 et seq.)
- Clean Air Act (42 U.S.C. 7401 et seq.)
- Clean Water Act of 1972 (33 U.S.C. 1251 et seq.)
- Migratory Bird Treaty Act of 1918 (16 U.S.C. 703 et seq.)
- Executive Order 11988, Floodplain Management, 1977
- Executive Order 13112, Invasive Species, 1999
- Executive Order 11990, Protection of Wetlands, 1977

S.10.1.4 Cultural Resource Laws

Laws designed to protect and preserve historic and cultural resources under Federal control include the following:

- ❖ National Historic Preservation Act (16 U.S.C. 470 et seq., 1966)
- ❖ Archaeological Resources Protection Act (16 U.S.C. 470aa et seq., 1974)

S.10.1.5 Native American Laws

Laws and policies relating to Native American consultation include the following:

- ❖ American Indian Religious Freedom Act (42 U.S.C. 1996, 1973)
- ❖ Enhancing the Intergovernmental Partnership, Executive Order 12875 of October 26, 1993 (58 *Federal Register* [FR] 58093)
- ❖ Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)
- ❖ Consultation and Coordination with Indian Tribal Governments, Executive Order 13084 of May 14, 1998
- ❖ Protection of Indian Sacred Sites, Executive Order 13007 of May 24, 1996 (61 FR 26771)

S.10.2 Related Programs, Projects, and Activities

S.10.2.1 Recovery Program

As discussed in section S.4.1 above, the Recovery Program's goal is to protect and recover the endangered fish of the Upper Colorado River Basin, while allowing existing uses and future water development to continue in accord with the "Law of the River." The Recovery Program has a variety of programs and projects underway, concerning habitat acquisition or enhancement, levee removal, nonnative fish control, and native fish stocking, aimed at achieving that goal. The proposed action for which the EIS has been prepared—operating Flaming Gorge Dam as specified in the Recovery Program's 2000 Flow and Temperature Recommendations—would complement the other Recovery Program activities in moving toward endangered fish recovery.

S.10.2.2 Interim Surplus Guidelines and Colorado River Basin Project Act 602(a) Storage Requirement

Flaming Gorge is part of the Colorado Basin and is indirectly affected by decisions made under the December 2000 *Colorado River Interim Surplus Guidelines Final Environmental Impact Statement*. However, the effects are not measurable. In addition, Reclamation is currently preparing an environmental assessment on a proposed guideline to determine the amount of Upper Basin water required under Section 602(a) of the Colorado River Basin Project Act. This guideline could affect operations at Lake Powell but most likely would not influence operations at Flaming Gorge.

S.10.2.3 Relocation of Little Hole National Recreation Trail

The 7.2-mile segment of the Little Hole National Recreation Trail along the Green River between the Flaming Gorge Dam Spillway Recreation Complex (boat ramp launching and parking area) and Little Hole Recreation Complex (boat ramps, parking, and day use areas) will be relocated by the USDA Forest Service pending funding to prevent recurring trail damage and loss that has occurred from past high flows. Without relocation of the trail, further damage would be expected to occur under both the No Action Alternative and the Action Alternative.

This 7.2-mile trail segment provides access to the Green River for tens of thousands of annual visitors who participate in shore and boat fishing, scenic and recreational floating, hiking, and sightseeing activities. Several commercial operators also use the trail as part of their outfitting and guiding business. Annual trail use has ranged from 54,000 to 101,000 visitors over the past 11 years. Annual visitation numbers, types, and the economic value of uses along the trail are discussed and displayed in the EIS.

The USDA Forest Service completed a field assessment and report in July 2001 of trail locations along the 7.2-mile trail segment. This assessment identified trail damage and repairs that have occurred from 1979 to the present due to releases from the dam, either in response to extremely wet hydrologic years or to support endangered fish research studies. The assessment also addressed alternative trail designs, locations, and costs that would prevent recurring trail damage and loss. Depending on alternative trail locations, the design and construction cost estimates ranged from $135,000 to $308,000. The USDA Forest Service will evaluate and analyze the alternative trail designs and locations as part of a separate NEPA process and document. In addition, the USDA Forest Service will evaluate and analyze the designs and plans for reconstruction of other ramps, picnic sites, and campsites affected during high releases along the Green River. Such facilities will also be relocated, pending funding. The USDA Forest Service environmental document will tier to the EIS for the operation of Flaming Gorge Dam, as appropriate, relating to environmental, social, and economic resources and issues.

The USDA Forest Service, Reclamation, and other concerned Federal and State agencies will cooperate during the preparation of the referenced environmental document for the relocation of the trail and related facilities to ensure that issues are addressed for the operation of the dam, riverflows, user safety, and protection of natural and physical resources. Reclamation will support the USDA Forest Service in obtaining funding through the USDA Forest Service budgeting process that will be needed to complete the USDA Forest Service environmental document and the relocation of the trail and related facilities.

S.10.2.4 Browns Park Highway Environmental Impact Statement

An EIS is currently being prepared for a Daggett County, Utah, proposal to realign and pave Browns Park Road from its junction with U.S. 191 in Utah to Colorado Route 318. The existing, unpaved 16.8-mile long segment of road crosses BLM, State, and private lands. Scoping meetings were held by the Federal Highway Administration, Utah Department of Transportation, and BLM in December 1999.

S.10.2.5 Cedar Springs Marina Environmental Impact Statement

The Ashley National Forest in cooperation with the Cedar Springs Marina is currently preparing an EIS to upgrade the Cedar Springs Marina to include dedicated dry storage, maintenance shop, convenience store and restaurant, and adequate boat slippage. The upgrade will resolve the congested parking and allow the marina to fully serve the public. A Notice of Intent was published in the *Federal Register* on August 18, 2004.

S.10.2.6 Resource Management Plans and Wild and Scenic Rivers Eligibility Determinations

The BLM Vernal Field Office is preparing to scope the draft resource management plan (RMP)/EIS for approximately 1.8 million acres in northeastern Utah. This plan, known as the Vernal Resource Management Plan, will combine the existing Diamond Mountain and Book Cliffs RMPs into a single plan. The final EIS is scheduled to be completed in September 2005.

The Ashley National Forest began revisions in March 2004 of its Land and Resource Management Plan, commonly referred to as Forest Plan. The process for revision of this plan, including NEPA compliance, is expected to take 4 to 5 years. The Ashley National Forest is also currently conducting an eligibility determination study pursuant to the Wild and Scenic Rivers Act of 1968. A final report is planned for August 2005.

S.10.2.7 Federal Reserve Water Rights

Canyonlands National Park and Dinosaur National Monument have inchoate (pending use) Federal water rights to the Green River. However, the National Park Service is not actively working with the State of Utah to quantify those rights. Future plans for quantification are uncertain.

S.11 DESCRIPTION OF ALTERNATIVES

Under the No Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended by the 1992 Biological Opinion on the Operation of Flaming Gorge Dam. Depending upon the hydrologic conditions of the upper Green River Basin, forecasted flows on the Yampa River would be supplemented by releases from Flaming Gorge Dam designed to achieve the peak flow, duration, and base flow (riverflows not associated with snowmelt runoff) recommendations described in the 1992 Biological Opinion.

Under the Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the 2000 Flow and Temperature Recommendations.

S.11.1 Development of Alternatives

S.11.1.1 Criteria Used to Select Alternatives

Potential alternatives analyzed in the EIS were studied to determine whether they could meet the purpose of and need for the proposed action. A number of scenarios for dam operation, originally thought to be viable alternatives, were determined to be more accurately described as possible subsets of the Action Alternative. Because of the inherent need for operational flexibility in dam operations, as acknowledged by and incorporated into the 2000 Flow and Temperature Recommendations, and because any potential impacts from discreet operational scenarios are already captured by analysis of the Action and No Action Alternatives, it was determined that analyzing subtle differences in dam operations as separate alternatives would not yield meaningful information for the public or the decisionmaker.

Alternatives that are included in this analysis are those which both:

- Meet flow and temperature recommendations as described in the 2000 Flow and Temperature Recommendations
- Maintain all authorized purposes of the Flaming Gorge Unit of CRSP

S.11.1.2 Alternatives Considered but Eliminated From Detailed Study

S.11.1.2.1 Modified Run of the River Alternative – During the scoping process, the National Park Service and others requested consideration of a Run of the River Alternative. Under such an alternative, dam releases would match the reservoir inflow (unregulated) to provide a more natural flow regime including more natural variations in the daily flows of the Green River below Flaming Gorge Dam. Further analysis of this alternative led to the establishment of a Modified Run of River Alternative, where dam releases equaled 87 percent (%) of the unregulated inflow to the reservoir. This provided reservoir operators the ability to store 13% of the spring inflow volume for release to meet project purposes and flow recommendations at other times of the year. The 87% level was chosen because it was the highest percentage that provided enough water storage to achieve the base flow ranges recommended in the 2000 Flow and Temperature Recommendations. Percentages higher than 87% could not achieve the recommended base flows of the 2000 Flow and Temperature Recommendations.

Preliminary analysis of the historic inflows into Flaming Gorge did show that it might be possible to operate Flaming Gorge using a "Modified Run of River" approach to achieve the 2000 Flow Recommendations during the spring. However, it was learned through this study that the effect of water consumption above Flaming Gorge played a much more significant role than was originally thought. The Flaming Gorge model did account for the inevitability that water consumption will increase in the future. The Consumptive Uses and Losses Report, published by Reclamation, estimates that current water consumption above Flaming Gorge Reservoir is about 450,000 acre-feet per year. This is about 25% of the mean annual unregulated inflow into Flaming Gorge Reservoir. In addition to the level of water consumed, irrigation diversions, which are not entirely consumed, occur most often during the months of May through August. Such diversions are not usually completely consumed as there is a lag period before the water returns to the river. Sometimes, this lag period can be as long as several months. Water consumption and diversions can significantly decrease the unregulated inflow peaks that occur during the spring. As a result, the "Modified Run of River" approach released less water than would have been released under natural conditions. For this reason, the "Modified Run of the River" could not achieve the spring flow objectives of the 2000 Flow and Temperature Recommendations.

Water consumption on the Green River has an ever increasing effect on the inflows (and unregulated inflows) to Flaming Gorge Reservoir. Consequently, water consumption will further complicate Reclamation's ability to achieve the 2000 Flow and Temperature Recommendations in the future. This modeling study indicated that, in the case of a "Modified Run of River" approach for operating Flaming Gorge Dam, the current level of water consumption in the Green River Basin already makes it too difficult to achieve the 2000 Flow and Temperature Recommendations without having significant negative impacts on the other resources associated with Flaming Gorge Reservoir. Based on these findings, the "Modified Run of River" approach was not considered a viable alternative that could be included for analysis in the Flaming Gorge Environmental Impact Statement.

S.11.1.2.2 Decommissioning and Removing Flaming Gorge Dam – During the scoping process, a request was made to consider decommissioning the dam as an alternative to allow endangered fish to recover. This alternative was not selected for detailed study in the EIS because it does not meet the purpose of and need for the proposed action. Specifically, decommissioning the dam would prevent continuing the authorized purposes of the dam under the Colorado River Storage Project and the Flaming Gorge National Recreation Area authorizing legislation, among others.

S.11.1.3 Summary of Alternatives Analyzed in the Flaming Gorge Environmental Impact Statement

S.11.1.3.1 No Action Alternative – Under the No Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the 1992 Biological Opinion. These flows were intended to mimic a more natural hydrograph than occurred under previous dam operations and to protect nursery habitats of endangered fishes downstream from the Yampa River confluence.

Under normal operations, reservoir releases through Flaming Gorge Powerplant range from 800 to 4,600 cfs. These flows adhere to the interim operating criteria for Flaming Gorge Dam established by Reclamation in September 1974. Under these criteria, Reclamation agreed to provide (1) a minimum flow of 400 cfs at all times, (2) flows of 800 cfs under normal conditions and for the foreseeable future, and (3) flows exceeding 800 cfs when compatible with other CRSP reservoir operations.

Temperature requirements under the No Action Alternative, specified in the Reasonable and Prudent Alternative of the 1992 Biological Opinion (page 30), include the following:

> *Releases from Flaming Gorge beginning July 1 and continuing until November 1 should be of the warmest water available, approaching 59 degrees F (15 degrees C)[1] (highest lake levels). By releasing the warmest water available during this period, water temperatures in the upper Green River should not differ*

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[1] Degrees Fahrenheit (°F); degrees Celsius (°C).

more than 9 degrees F (5 degrees C) in the Yampa River at Echo Park and should average near 72-77 degrees F (22-25 degrees C) in Gray Canyon from July 1 to August 15.

S.11.1.3.2 Action Alternative – Under the Action Alternative, releases from Flaming Gorge Dam would be patterned so that the peak flows, durations, and base flows and temperatures, described in the 2000 Flow and Temperature Recommendations for Reaches 1, 2, and 3 of the Green River, would be achieved.

- ❖ Reach 1 begins at Flaming Gorge Dam and extends 65 river miles to the confluence of the Green and Yampa Rivers. In this reach, the Green River meanders about 10 river miles into northwestern Colorado and then flows southward for about 30 river miles. This reach is almost entirely regulated by releases from Flaming Gorge Dam.
- ❖ Reach 2 begins at the confluence of the Green and Yampa Rivers in Colorado and extends 99 river miles southwest to the White River confluence near Ouray, Uintah County, Utah. In this reach, tributary flows from the Yampa River combine with releases from Flaming Gorge Dam to provide a less regulated flow regime than in Reach 1.
- ❖ Reach 3 begins at the confluence of the Green and White Rivers and extends 246 river miles south to the confluence of the Green and Colorado Rivers in Canyonlands National Park at the boundary of Wayne and San Juan Counties in southeastern Utah. In this reach, the Green River is further influenced by tributary flows from the White, Duchesne, Price, and San Rafael Rivers.

Table S-1 shows a summary of the recommended spring peak and summer-to-winter base flows from the 2000 Flow and Temperature Recommendations report for all three reaches of the Green River. Under the Action Alternative, Flaming Gorge Dam would be operated with the goal of achieving the 2000 Flow and Temperature Recommendations, while maintaining and continuing all authorized purposes of Flaming Gorge Dam and Reservoir.

The 2000 Flow and Temperature Recommendations for each reach are not integrated in such a way that a particular release from Flaming Gorge Dam could equally achieve the recommendations for all reaches simultaneously. The intent of the Action Alternative is first to meet the 2000 Flow and Temperature Recommendations for Reach 2 and then, if necessary, make adjustments to releases so that the 2000 Flow and Temperature Recommendations for Reach 1 could also be met. The Flaming Gorge Model assumes that the 2000 Flow and Temperature objectives in Reach 3 are met whenever the flow objectives are met in Reach 2.

The 2000 Flow and Temperature Recommendations focus primarily on the flow regimes in Reaches 2 and 3, which include flows from the Yampa River. However, since these river flow criteria are based solely on upper Green River hydrology, the 2000 Flow and Temperature Recommendations in Reaches 1 and 2 would most likely be achieved to varying degrees. For example, in years when the upper Green River Basin is wetter than the Yampa River Basin, meeting the 2000 Flow and Temperature Recommendations in Reaches 2 and 3 would most likely exceed the minimum target for the peak flow recommendations for Reach 1.

Table S-1.—Recommended Magnitudes and Duration of Maximum Spring Peak and Summer-to-Winter Base Flows and Temperatures for Endangered Fishes in the Green River Downstream From Flaming Gorge Dam as Identified in the 2000 Flow and Temperature Recommendations

Location	Flow and Temperature Characteristics	Hydrologic Conditions and 2000 Flow and Temperature Recommendations[1]				
		Wet[2] (0–10% Exceedance)	**Moderately Wet[3] (10–30% Exceedance)**	**Average[4] (30–70% Exceedance)**	**Moderately Dry[5] (70–90% Exceedance)**	**Dry[6] (90–100% Exceedance)**
Reach 1 Flaming Gorge Dam to Yampa River	Maximum Spring Peak Flow	$8,600 cfs (244 cubic meters per second [m^3/s])	$4,600 cfs (130 m^3/s)	$4,600 cfs (130 m^3/s)	$4,600 cfs (130 m^3/s)	$4,600 cfs (130 m^3/s)
	Peak flow duration is dependent upon the amount of unregulated inflows into the Green River and the flows needed to achieve the recommended flows in Reaches 2 and 3.					
	Summer-to-Winter Base Flow	1,800–2,700 cfs (50–60 m^3/s)	1,500–2,600 cfs (42–72 m^3/s)	800–2,200 cfs (23–62 m^3/s)	800–1,300 cfs (23–37 m^3/s)	800–1,000 cfs (23–28 m^3/s)
Above Yampa River Confluence	Water Temperature Target	$ 64 °F (18 °C) for 3-5 weeks from mid-August to March1	$ 64 °F (18 °C) for 3-5 weeks from mid-August to March 1	$ 64 °F (18 °C) for 3-5 weeks from mid-July to March 1	$ 64 °F (18 °C) for 3-5 weeks from June to March 1	$ 64 °F (18 °C) for 3-5 weeks from mid-June to March 1
Reach 2 Yampa River to White River	Maximum Spring Peak Flow	$26,400 cfs (748 m^3/s)	$20,300 cfs (575 m^3/s)	$18,600 cfs[7] (527 m^3/s) $8,300 cfs[8] (235 m^3/s)	$8,300 cfs (235 m^3/s)	$8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 22,700 cfs (643 m^3/s) should be maintained for 2 weeks or more, and flows 18,600 cfs (527 m^3/s) for 4 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for at 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance).
	Summer-to-Winter Base Flow	2,800–3,000 cfs (79–85 m^3/s)	2,400–2,800 cfs (69–79 m^3/s)	1,500–2,400 cfs (43–67 m^3/s)	1,100–1,500 cfs (31–43 m^3/s)	900–1,100 cfs (26–31 m^3/s)
Below Yampa River Confluence	Water Temperature Target	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.
Reach 3 White River to Colorado River	Maximum Spring Peak Flow	$39,000 cfs (1,104 m^3/s)	$24,000 cfs (680 m^3/s)	$22,000 cfs[9] (623 m^3/s)	$8,300 cfs (235 m^3/s)	$8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 24,000 cfs (680 m^3/s) should be maintained for 2 weeks or more, and flows 22,000 cfs (623 m^3/s) for 4 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance).
	Summer-to-Winter Base Flow	3,200–4,700 cfs (92–133 m^3/s)	2,700–4,700 cfs (76–133 m^3/s)	1,800–4,200 cfs (52–119 m^3/s)	1,500–3,400 cfs (42–95 m^3/s)	1,300-2,600 cfs (32–72 m^3/s)

[1] Recommended flows as measured at the United States Geological Survey gauge located near Greendale, Utah, for Reach 1; Jensen, Utah, for Reach 2; and Green River, Utah, for Reach 3.
[2] **Wet** (0% exceedance): A year in which the forecasted runoff volume is larger than almost all of the historic runoff volumes. This hydrologic condition has a 10% probability of occurrence.
[3] **Moderately Wet** (10–30% exceedance): A year in which the forecasted runoff volume is larger than most of the historic runoff volumes. This hydrologic condition has a 20% probability of occurrence.
[4] **Average** (30–70% exceedance): A year in which the forecasted runoff volume is comparable to the long-term historical average runoff volumes.
[5] **Moderately Dry** (70–90% exceedance): A year in which the forecasted runoff volume is less than almost all of the historic runoff volumes. This hydrologic condition has a 20% probability of occurrence.
[6] **Dry** (90–100% exceedance): A year in which the forecasted runoff volume is less than almost all of the historic runoff volumes. This hydrologic condition has a 10% probability of occurrence.
[7] Recommended flows $18,600 cfs (527 m^3/s) in 1 of 2 average years.
[8] Recommended flows $8,300 cfs (235 m^3/s) in other average years.
[9] Recommended flows $22,000 cfs (623 m^3/s) in 1 of 2 average years.

Conversely, if the Yampa River Basin is wetter than the upper Green River Basin, meeting the 2000 Flow and Temperature Recommendations for Reaches 2 and 3 could result in falling short of the peak flow target for Reach 1. Under this scenario, the Action Alternative might require Flaming Gorge Dam releases to be increased so that the 2000 Flow and Temperature Recommendations in Reach 1 could also be met. Flows in Reaches 2 and 3 would then exceed their respective minimum 2000 Flow and Temperature Recommendations. Since only one release pattern can be selected each year, depending upon how water is distributed between the upper Green River and Yampa River Basins, each reach would achieve or exceed its respective minimum 2000 Flow and Temperature Recommendations to varying degrees.

Each year, Reclamation would work closely with the U.S. Fish and Wildlife Service and Western in developing a flow regime consistent with the 2000 Flow and Temperature Recommendations and CRSP purposes and would also consider input from the Flaming Gorge Working Group meetings. The overall effectiveness of implementing the Action Alternative would be measured by the long-term frequency of achieving flow thresholds described in the 2000 Flow and Temperature Recommendations. Consideration would be given to hydrologic conditions, operational limitations, and past operational conditions. An administrative record of the operational decisionmaking would be maintained and available to the public. This record would include analysis of previous operations and the effectiveness of achieving desired targets on a year-by-year basis.

Water release temperatures at the dam would be regulated with the objective of achieving target temperatures for upper Lodore Canyon and the confluence of the Yampa and Green Rivers during the first 2 to 5 weeks of the base flow period and/or when Colorado pikeminnow larvae are present at this confluence.

S.12 REVIEW OF FLAMING GORGE MODEL DEVELOPED FOR THE FLAMING GORGE DAM EIS

As detailed in the EIS, a river simulation model (Flaming Gorge Model) was developed for the Green River system to assess impacts of Flaming Gorge Dam operations. For both of the alternatives analyzed in the EIS, the model predicts the water surface elevation of Flaming Gorge Reservoir as well as the flows in the Green River at various points downstream from the dam.

Under the No Action Alternative, the bypass tubes would be used in 23% of all years, and the spillway would be used in 5% all of years. In comparison, for the Action Alternative, the Flaming Gorge Model predicts more frequent use of the bypass tubes and spillway at Flaming Gorge Dam. Under the Action Alternative, the Flaming Gorge Model predicts that the bypass tubes would be used in 50% of all years, and the spillway would be used in 29% of all years.

A review of the Flaming Gorge Model was performed by three authors of the 2000 Flow and Temperature Recommendations to evaluate whether the degree of bypass and spill predicted by the Flaming Gorge Model would be necessary. The main focus of the model review was the frequency of bypass and spillway use. The reviewers also examined the model's behavior and evaluated how the model simulated the year-round operation of Flaming Gorge Dam.

In most situations, the reviewers found that the Flaming Gorge Model properly simulates the operation of Flaming Gorge Dam. The reviewers found that the Flaming Gorge Model performs well in dry, moderately dry, and average years; however, the review showed that the model appeared to bypass or spill more water than may be necessary in some moderately wet and wet years.

The lack of flexibility within the operational rules of the model was the main reason bypasses and spills were higher than necessary in the Flaming Gorge model. While many model rules allow for decision trees, a model such as the Flaming Gorge Model cannot adjust to all situations or consider the balance of all available operating options.

Reclamation acknowledges that the Flaming Gorge Model may overstate bypasses and, therefore, may overstate potential effects that result from the bypassing of water. Reclamation also notes that while the Flaming Gorge Model provides good information to assess potential effects, details and flexibility that cannot be captured by modeling will be factored into operational decisionmaking each year.

S.13 OPERATIONAL DESCRIPTION

The following discussion provides further clarification on operations under the No Action Alternative and the Action Alternative, while maintaining the authorized purposes and ensuring safe operations of Flaming Gorge Dam under normal operational conditions. As noted in section S.6, operational plans could change due to malfunction of the dam and powerplant equipment and during public emergencies.

S.13.1 Safe Operation of Flaming Gorge Dam

Safe operation of Flaming Gorge Dam is of paramount importance and applies to both the No Action Alternative and Action Alternatives. To safely and efficiently operate Flaming Gorge Dam, forecasted inflows must be incorporated into the decisionmaking process. A description of this process is provided in section 1.5 of the EIS.

Inflow forecasts generated by the National Weather Service each month are used by Reclamation to plan future reservoir operations. These forecasts have some degree of error associated with them which can impact the safe operation of a reservoir. Forecast errors are attributable mostly to hydrologic variability and, to a much lesser degree, the forecasting procedure. For this reason, forecast errors will always be a factor associated with the operation of Flaming Gorge Reservoir.

Analysis of the historic forecast errors at Flaming Gorge provide the basis for estimating safe upper limit operating reservoir levels at various times of the year under varying hydrologic conditions. From this analysis, 1% exceedance forecast errors were generated and used in routing studies designed to establish safe upper limit reservoir levels. A 1% exceedance error can be expected to occur about 1% of the time or about 1 year out of every 100 years.

Safe operation of Flaming Gorge provides enough storage space in the reservoir at all times throughout the year, such that the volume of a 1% exceedance forecast error can be absorbed by the reservoir. In other words, the safe operation of Flaming Gorge Reservoir must assure that 99% of the foreseeable forecast errors can be successfully routed through the reservoir without uncontrolled spills occurring. For this reason, the reservoir elevation is intentionally drawn down during the fall and winter months.

The upper limit drawdown levels established as safe operating parameters for Flaming Gorge Reservoir under various hydrologic conditions were determined through the routing studies and are shown in table S-2. These upper limit drawdown levels apply to both the No Action and Action Alternatives.

Table S-2.—Upper Limit Drawdown Levels for Flaming Gorge Reservoir

Unregulated Inflow Forecast Percentage Exceedance Range	May 1 Upper Limit Drawdown Elevation Level
1 to 10	6023
10.1 to 30	6024
30.1 to 40	6025
40.1 to 59.9	6027

S.13.2 Reservoir Operations Process Under the No Action Alternative

S.13.2.1 Operations in May Through July (Spring Period)

Under the No Action Alternative, the April through July unregulated inflow forecast and the condition of the reservoir, would be used to establish the magnitude and duration of a spring peak release for the current year. The magnitude of the spring release would normally be from 4,000 cfs to powerplant capacity (about 4,600 cfs), unless hydrologic conditions indicated that bypasses or spills would be necessary for safe operations of the dam. Bypasses or spills would be timed to occur when the Yampa River peak flows and immediate post peak flows occur.

Reclamation would establish a range of spring operational scenarios, through consultation with the U.S. Fish and Wildlife Service and Western. These scenarios would achieve the objectives of the Reasonable and Prudent Alternative of the 1992 Biological Opinion on the Operation of Flaming Gorge Dam under one of three hydrologic conditions (dry, average, or wet). The range of scenarios would provide flexibility in operations to adjust to changing hydrologic conditions and would be based on the probable minimum and probable maximum inflow forecasts issued in April by the River Forecast Center. Timing of the spring peak release under the range of possible operational scenarios would occur with the peak flows and immediate post peak flows on the Yampa River.

When the hydrologic condition is determined to be dry, the spring peak duration would be 1 to 2 weeks. Most likely, the magnitude of the release during the spring peak in dry years would be limited to powerplant capacity and could be limited to 4,000 cfs to conserve reservoir storage. In dry years, the spring peak release would be completed no later than June 20.

When the hydrologic condition is determined to be average, the spring peak duration would be 2 to 5 weeks. The magnitude of the release during the spring peak most likely would be limited to powerplant capacity (about 4,600 cfs). The spring peak release in average years would be completed by July 10.

Wet hydrologic conditions would establish a spring peak duration of 5 weeks or greater. Peak releases in wet years could include bypass releases and possibly spillway releases, depending on conditions at Flaming Gorge Reservoir. The use of bypass tubes or the spillway would be based on the safe operating criteria for the dam. The magnitude of peak releases in wet years would be at least powerplant capacity (about 4,600 cfs), and the spring peak release in wet years would be completed by July 20.

S.13.2.2 Use of Bypass Tubes and Spillway at Flaming Gorge Dam

Under the No Action Alternative, the use of the bypass tubes or the spillway would occur only when hydrologically necessary to maintain safe operations of Flaming Gorge Dam, during emergency operations, or when the full release capacity of the powerplant is unavailable. For the No Action Alternative, under normal operations, the magnitude of peak releases for endangered fish would be limited to powerplant capacity (about 4,600 cfs). However, if Reclamation determines that bypass releases would be likely for hydrologic reasons, Reclamation would attempt to schedule these bypass releases to occur with the peak flows and immediate post peak flows of the Yampa River.

S.13.2.3 Summer and Fall Operations (Early Base Flow Period)

Under the No Action Alternative, after the spring peak release is completed, releases from Flaming Gorge Dam would be reduced so that flows of the Green River, measured at Jensen, Utah, would achieve a target flow ranging from 1,100 to 1,800 cfs. Daily average flows would be maintained as close to this target as possible until September 15. After September 15, releases from Flaming Gorge Dam could be increased so that the daily average flow measured at Jensen, Utah, would achieve a target ranging from 1,100 to 2,400 cfs while controlling the reservoir elevation within safe operating levels.

During the early base flow period (through the month of October), fluctuating releases for power production likely would occur. These fluctuating releases would be limited so that the hourly flow of the Green River, measured at Jensen, Utah, would be maintained at ±12.5% of the daily average flow of the Green River (measured at Jensen, Utah).[2]

[2] The daily average flow measured at Jensen, Utah, would be determined from the average of the instantaneous flow readings during a 24-hour period from midnight to midnight each day.

S.13.2.4 Winter Operations (Late Base Flow Period)

There are no specific flow recommendations provided by the 1992 Biological Opinion for the period from November to May. Beginning November 1, the 1992 Biological Opinion calls for releases to be low and stable near historic levels. Under the No Action Alternative, Flaming Gorge daily average releases from November through May potentially could range from 800 cfs to powerplant capacity (about 4,600 cfs). However, it is anticipated that in most years, releases during this period would range from 800 cfs to about 3,000 cfs. Releases from Flaming Gorge Dam during the late base flow period would be designed to reduce the reservoir elevation to maintain safe reservoir operations.

Under the No Action Alternative, releases would achieve an upper limit drawdown elevation on March 1 of 6027 feet above sea level. The upper limit drawdown elevations for May 1 under the No Action Alternative are the same as those under the Action Alternative.

During the late base flow period, fluctuating releases for power production could likely occur. The Reasonable and Prudent Alternative of the 1992 Biological Opinion does not specifically limit fluctuating releases during the late base flow period. Under the No Action Alternative, however, fluctuating releases would be limited, similar to the early base flow period, as they have been historically. The hourly flow of the Green River measured at Jensen, Utah, would be maintained from ±12.5% of the daily average flow measured at Jensen, Utah.

S.13.3 Reservoir Operations Process Under the Action Alternative

In general, implementation of the 2000 Flow and Temperature Recommendations into the operational plans for Flaming Gorge Dam would occur through coordination as described on pages 5-8 of the 2000 Flow and Temperature Recommendations. A Technical Working Group consisting of biologists and hydrologists involved with endangered fish recovery issues would be convened by Reclamation at various times throughout the year. Staff from Reclamation, Fish and Wildlife, and Western would be members of this group as well as other qualified individuals who choose to participate on a voluntary basis.

Reclamation would present an initial operational plan with balanced consideration of all resources associated with Flaming Gorge Reservoir and the Green River for discussion with the Technical Working Group. Reclamation would take into consideration the information described in table S-4 (page S-25) and any new information that may be available to refine the plan to best meet the needs of the endangered fish. Reclamation would comply with ESA Section 7 consultation requirements and may make refinements to the plan based on the Technical Working Group's recommendations. Reclamation could then present the new plan to the Flaming Gorge Working Group for additional discussion. Reclamation could further refine the plan based on information gathered at the Flaming Gorge Working Group Meeting. This process would ensure that the 2000 Flow and Temperature Recommendations and the authorized purposes of Flaming Gorge Dam are considered in a balanced and fair manner as each year's operational plan is developed.

Reclamation's meetings with the Technical Working Group would also provide an opportunity to discuss historic operations in terms of the accomplishments and shortcomings of meeting the 2000 Flow and Temperature Recommendations. Reclamation would maintain an administrative record of these meetings to document the planning process.

S.13.3.1 Operations in May Through July (Spring Period)

Under the Action Alternative, Reclamation would establish a hydrologic classification for the spring period (May through July) based on the April through July forecasted unregulated inflow volume. This forecast is issued by the River Forecast Center beginning in early January and is updated twice per month until the end of July. During the spring period, Reclamation would classify the current hydrology of the Green River system into one of the five hydrologic classifications described in the 2000 Flow and Temperature Recommendations (wet, moderately wet, average, moderately dry, and dry). Table S-3 describes the percent exceedance ranges that would be used for each classification under the Action Alternative.

Table S-3.—Percentage Exceedances and Hydrologic Classifications

Hydrologic Classification	Percentage Exceedance Range
Wet	<10
Moderately Wet	30 to 10.1
Average	70 to 30.1
Moderately Dry	90 to 70.1
Dry	>90

The hydrologic classification would be used to establish the range of flow magnitudes and durations that could potentially be targeted for the approaching spring release period. These targets would be incorporated into a spring operations plan. This plan would be prepared each year by Reclamation under consultation with the U.S. Fish and Wildlife Service and Western and in coordination with the Technical Working Group before the spring Flaming Gorge Working Group meeting. The factors listed in table 5.3 of the 2000 Flow and Temperature Recommendations (shown as table S-4), along with the established hydrologic classification, would be considered in the development of the operations plan.

In most years, it is expected that the flow magnitudes and durations achieved in Reach 2 each spring would be consistent with the flow magnitudes and durations described in the 2000 Flow and Temperature Recommendations for the hydrologic classification established in May of each year. However, because the factors listed in table S-4 are also considered, particularly runoff conditions in the Yampa River, there would be some years where the peak flows that occur in Reach 2 achieve the targets for either one or two classifications higher (wetter) or one classification lower (drier) than the actual classification established for the Green River.

It is anticipated that in some years, when the hydrologic classification for the Green River is average, factors listed in table S-4 could occur such that it would be possible to achieve the targets established for either the moderately wet or wet classifications. Conversely,

Table S-4.—Examples of Real-Time and Other Year-Specific Information To Be Considered in Determining Annual Patterns of Releases From Flaming Gorge Dam for Implementation of the 2000 Flow and Temperature Recommendations to Benefit Endangered Fishes in Downstream Reaches of the Green River

Onset of Spring Peak Flow	Magnitude of Spring Peak Flow	Duration of Spring Peak Flow	Onset of Summer-Winter Base Flow	Magnitude of Summer-Winter Base Flow
Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir
Water surface elevation of Flaming Gorge Reservoir	Forecasted and actual flow in the Yampa River and other large tributaries	Forecasted and actual flow in the Yampa River and other large tributaries	Forecasted and actual flow in the Yampa River	Forecasted and actual flow in the Yampa River
Forecasted and actual flows in the Yampa River	Desired area extent of overbank flooding in Reaches 2 and 3	Desired duration of overbank flooding in Reaches 2 and 3	Initial appearance of drifting Colorado pikeminnow larvae in the Yampa River	Elevation of sand bars in nursery areas
Presence of adult razorback sucker congregations on spawning bars	Flow conditions and extent of overbank flooding in Reaches 2 and 3 in previous year	Desired base flow magnitude	Status of endangered fish populations	Status of endangered fish populations
Initial appearance of larval suckers in established reference sites in Reach 2 (e.g., Cliff Creek)	Existing habitat conditions	Presence of razorback sucker larvae in the Green River	Temperature of water released from the dam	Temperature of water released from the dam
Existing habitat conditions (e.g., condition of razorback sucker spawning sites in Reach 2)	Status of endangered fish populations	Existing habitat conditions	Temperature differences between the Green and Yampa Rivers at their confluence	Temperature differences between the Green and Yampa Rivers at their confluence
		Status of endangered fish populations		

Source: 2000 Flow and Temperature Recommendations, table 5.3.

there would be some years classified as moderately wet when the conditions of these factors in table S-4 would be such that targets established for the wet or average classification would be met. There could also be years classified as wet where moderately wet targets would be achieved because of the conditions of these factors. It would be the responsibility of Reclamation to ensure that, over the long term, Flaming Gorge Dam and Powerplant are operated consistent with the 2000 Flow and Temperature Recommendations.

The operations plan would describe the current hydrologic classification of the Green River Basin and the hydrologic conditions in the Yampa River Basin, including the most probable runoff patterns for the two basins. The operations plan would also identify the likely Reach 2 flow magnitudes and durations that would be targeted for the upcoming spring release. Because hydrologic conditions often change during the April through July runoff period, the operations plan would contain a range of operating strategies that could be implemented. Flow and duration targets for these alternate operating strategies would be limited to those described for one classification lower or two classifications higher than the classification for the current year.

The spring operations plan would be presented to the Flaming Gorge Working Group each spring for discussion. Reclamation could modify the plan based on information gathered at the Flaming Gorge Working Group meeting.

In years classified as wet, bypass releases would usually be required both to operate the dam safely and to meet the 2000 Flow and Temperature Recommendations. Releases above powerplant capacity would be expected to be made for a period of about 4 to 9 weeks. The exact magnitude of the release and duration of the release would depend upon factors identified in table S-4. Wet years, high releases would be expected to occur from mid-May to early July (and, in very wet years, through July). The bypass and spillway releases, required in wet years, would be timed with the objective of meeting Reach 2 wet or moderately wet year targets, depending upon the hydrologic conditions in the Yampa River. The initiation of bypass and spillway releases would take place in mid- to late May coincident with the Yampa River peak. In extremely wet years, releases above powerplant capacity could be initiated in April or early May before the Yampa River peak.

In years classified as moderately wet, bypass releases usually (but not always) would be required for safe operation of the dam and to meet the 2000 Flow and Temperature Recommendations. Occasionally, some use of the spillway also might be required in moderately wet years for safe operation of the dam. The volume of the powerplant bypass in moderately wet years would be less than in wet years and would generally occur for a period of about 1 to 7 weeks. The timing of these releases would be from mid- to late May into June and sometimes extend into July. Releases from Flaming Gorge Reservoir in moderately wet years would be timed with the objective of meeting Reach 2 wet, moderately wet, or average year targets, depending upon the hydrologic conditions in the Yampa River Basin and the information contained in table S-4.

In years classified as average, bypass releases likely would not be required for safe operation of the dam but periodically would be required to meet the objectives of the 2000 Flow and Temperature Recommendations. In most average years, spring peak releases would be limited to powerplant capacity (about 4,600 cfs) with peak releases taking place for about 1 to 8 weeks, usually in the mid-May to late June (but occasionally extending into July) time period. In about 1 out of every 3 average years, bypass releases from Flaming Gorge Dam would be required to achieve the Reach 2 flow recommendation peak and duration targets. In these years, the objective would be to achieve targeted flows in Reach 2 of 18,600 cfs for 2 weeks. To conserve water, bypass releases in these average years would be made only to the extent necessary to achieve this target. It can be expected that bypass releases, when required to meet the 2000 Flow and Temperature Recommendations in average years, would be implemented for a period of less than 2 weeks. In some years classified as average, the targets achieved during the spring would be moderately wet or wet as a result of flows on the Yampa River that exceeded forecasted levels.

The objective in dry and moderately dry years would be to conserve reservoir storage while meeting the desired peak flow targets in Reach 2 as specified in the 2000 Flow and Temperature Recommendations. The bypass tubes and the spillway would not be used to meet flow targets in moderately dry and dry years but, on rare occasion, might be needed to supplement flows that cannot be released through the powerplant because of maintenance requirements. In dry years, a powerplant capacity release of 1 day to 1 week would occur during the spring, and this release would be timed with the peak of the Yampa River. In moderately dry years, a 1- to 2-week powerplant capacity release would occur during the spring and would be timed with the peak and post peak of the Yampa River.

S.13.3.2 Use of Bypass Tubes and Spillway at Flaming Gorge Dam

The bypass tubes and the spillway at Flaming Gorge Dam have been utilized historically, as needed, for safe operation of the dam. In years with high inflow, bypass releases, and sometimes spillway releases, may be required under the Action Alternative to meet the 2000 Flow and Temperature Recommendations. Bypass and spillway releases, required for safe operation of the dam and to meet the 2000 Flow and Temperature Recommendations, would be scheduled coincident with Yampa River peak and post peak flow (the mid-May to mid-June time period) with the objective of meeting flow recommendation targets in Reach 2.

There would be some years (moderately wet years and average years) when use of the bypass would not be required for safe operation but would be needed to meet the 2000 Flow and Temperature Recommendations. As part of the annual planning process discussed above, Reclamation would consult with the U.S. Fish and Wildlife Service and Western and coordinate with the Technical Working Group to make a determination whether bypasses should be attempted to achieve the targeted Reach 2 magnitudes and durations.

S.13.3.3 Operations in August Through February (Base Flow Period)

Under the Action Alternative, during the base flow period, Reclamation would classify the current hydrology of the Green River system into one of the five hydrologic classifications described in the 2000 Flow and Temperature Recommendations (wet, moderately wet, average, moderately dry, and dry). For the month of August, the hydrologic classification would be based on the volume of unregulated inflow during the spring period. For the months of September through February, the percentage exceedance would be based on the previous month's volume of unregulated inflow. If the unregulated inflow during the previous month falls into a different hydrology classification than the assigned hydrology classification for the previous month, then the classification could be shifted by one classification (up or down) to reflect the change in hydrology. A shift would only be made when the reservoir condition indicated that the shift would be necessary to achieve the March 1 drawdown level of 6027 feet above sea level. Otherwise, the hydrologic classification for the current month would remain the same as for the previous month.

The range of acceptable base flows for Reach 2 would be selected from the 2000 Flow and Temperature Recommendations for the hydrologic classification set for the current month. Reclamation would make releases to achieve flows in Reach 2 within the acceptable range and also ensure that the reservoir elevation on March 1 would be no higher than 6027 feet above sea level.

The 2000 Flow and Temperature Recommendations during the base flow period do allow for some flexibility, and the Action Alternative accommodates this flexibility. Under the Action Alternative, the flows occurring in Reach 2 during the base flow period would be allowed to vary from the targeted flow by ±40% during the summer to fall period (August through November) and by ±25% during the winter (December through February), as long as the day-to-day change is limited to 3% of the average daily flow and the variation is consistent with all other applicable 2000 Flow and Temperature Recommendations. Reclamation would utilize the allowed flexibility to the extent possible, to efficiently manage the authorized resources of Flaming Gorge Dam. Flaming Gorge Reservoir would be operated through the base flow period so that the water surface elevation would not be greater than 6027 feet above sea level on March 1.

During the base flow period, hourly release patterns from Flaming Gorge Dam would be patterned so that they produce no more than a 0.1-meter stage change each day at the Jensen gauge, except during emergency operations.

S.13.3.4 Operations in March and April (Transition Period)

From March 1 through the initiation of the spring peak release (typically, this occurs in mid- to late May), there are no specific flow requirements specified in the 2000 Flow and Temperature Recommendations. For the Action Alternative, releases during this transition period would be made to manage the reservoir elevation to an appropriate drawdown level based on the forecasted unregulated inflow. Appropriate drawdown levels under normal operations during the transition period are those that would allow for safe operation of the dam through the spring. The upper limit drawdown levels for varying percentage exceedances are described earlier in table S-2 (page S-21). These drawdown levels apply for both the Action and the No Action Alternatives.

Table S-2 implies that upstream regulation above Flaming Gorge Reservoir remains relatively consistent with historic regulation.[3] In the event that less storage space would be available above Flaming Gorge Reservoir during the spring, these drawdown levels may have to be lower than those specified in table S-2 for safe operation of Flaming Gorge Dam. In extreme wet years, the drawdown level for May 1 could potentially be lower than that specified to maintain safe operation of the dam.

Reclamation would determine the appropriate reservoir drawdown based on the percentage exceedance of the forecasted inflow volume during the spring (April through July). The forecast is issued twice during March and twice during April. Under normal operations during the transition period, releases would be limited to a range from 800 cfs to powerplant capacity (4,600 cfs).

Hourly releases during the transition period would be patterned so that they are consistent with the hourly release patterns established during the preceding base flow period. The 2000 Flow and Temperature Recommendations do not address hourly patterns during the transition period. During the transition period, Reclamation would maintain the same fluctuation constraints as in the preceding base flow period to provide operational consistency as has been done historically.

[3] Historically (1988-2003), there generally has been about 200,000 acre-feet of available space at Fontenelle Reservoir (above Flaming Gorge) on May 1.

S.14 ENVIRONMENTAL CONSEQUENCES

This section summarizes the EIS analyses and comparisons of predicted environmental effects under both the Action and No Action Alternatives.

S.14.1 Hydrology

Tables S-5, S-6, and S-7 present the key flow parameters and ranges described in both the 1992 Biological Opinion (No Action Alternative) and the 2000 Flow and Temperature Recommendations (Action Alternative) under dry, average, and wet hydrological conditions. The 2000 Flow and Temperature Recommendations report also provides recommended flow regimes for moderately wet and moderately dry hydrologic conditions; however, because the 1992 Biological Opinion does not address these conditions, they have been omitted from this comparative analysis.

The 1992 Biological Opinion does not specifically define the differences between wet, average, and dry hydrological conditions but, rather, suggests that Reclamation and the U.S. Fish and Wildlife Service consult each year to make this determination. The 2000 Flow and Temperature Recommendations are more specific about how the hydrology of the upper Green River Basin is to be characterized.

The hydrologic conditions of the upper Green River Basin, as described in the 2000 Flow and Temperature Recommendations, are based on the forecasted or actual volume of unregulated inflow (adjusted for storage in upstream reservoirs) into Flaming Gorge Reservoir during the period from April through July. During the spring and early summer, operational decisions would be based on forecasted inflows. After August 1, operational decisions would be based on the measured inflows that occurred during the previous month as well as on the previous April through July period.

For purposes of this analysis, and as defined by the 2000 Flow and Temperature Recommendations, dry conditions in the upper Green River Basin are identified as unregulated April-July inflow volumes that are exceeded in 9 out of every 10 years (90% exceedance value). The year 1977 was historically dry at which time the unregulated April through July inflow measured only 254,000 acre-feet. In contrast, wet conditions in the upper Green River Basin are identified as unregulated April through July inflow volumes that are exceeded in only 1 out of every 10 years (10% exceedance value). For example, 1986 was a historically wet year at which time the unregulated April through July inflow measured 2,224,000 acre-feet.

S.14.2 Water Quality, Water Temperature, and Sediment Transport

When the operation of Flaming Gorge Dam was changed to meet the requirements of the RPA of the 1992 Biological Opinion, the frequency of summer and fall reservoir drawdowns that produced algal blooms was reduced. This operational change improved the water quality of Flaming Gorge Reservoir. The analysis of the effects of the Action and No Action Alternatives shows that the frequency of reservoir drawdowns likely would not differ from drawdown conditions observed since 1992. Under either alternative, reservoir drawdowns during drought conditions would cause larger algal blooms. As an example, such a condition occurred in the fall of 2002.

Table S-5.—Dry Hydrology Scenario (Runoff Volume Exceeded 90 to 100% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Release Peak Determination	***Release Peak Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. ▪ The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 1 week in dry years. ▪ Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River.	In dry years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: ▪ The combined flows of the Green and Yampa Rivers should provide a peak flow in Reach 2 that exceeds 8,300 cfs for at least 2 days. ▪ The minimum peak release from Flaming Gorge Dam should be 4,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for a dry year should be 350 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by June 20 in dry years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 900 cfs and 1,100 cfs during dry years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (18 °C) for the first 2 to 5 weeks during the base flow period (mid-June to March 1) for dry years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period.

Table S-6.—Average Hydrology Scenario
(Runoff Volume Exceeded 30 to 70% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Peak Flow Determination	***Peak Flow Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. ▪ The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 2 to 4 weeks in average years. ▪ Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River. Bypass releases, if necessary for hydrologic reasons, would be made before or during the Yampa River peak flow.	In average years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: ▪ The peak release should provide a peak flow in Reach 2 that exceeds 18,600 cfs in 1 out of 2 average years. ▪ In 1 out of 4 average years, the peak flow in Reach 2 should exceed 18,600 cfs for at least 2 weeks. ▪ In all average years, the peak flow in Reach 2 should exceed 8,300 cfs for at least 2 weeks. ▪ The minimum peak release from Flaming Gorge Dam should be 4,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for an average year should be 500 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by July 10 in average years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 1,500 cfs and 2,400 cfs during average years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (18 °C) for the first 2 to 5 weeks during the base flow period (mid-July to March 1) for average years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period.

Table S-7.—Wet Hydrology Scenario (Runoff Volume Exceeded Less than 10% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Peak Flow Determination The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. ▪ The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 6 weeks in wet years. ▪ Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River. Bypass releases, if necessary for hydrologic reasons, would be made before or during the Yampa River peak flow.	***Peak Flow Determination*** In wet years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: ▪ The peak release should provide a peak flow in Reach 2 that should exceed 26,400 cfs. ▪ Flows in Reach 2 should exceed 22,700 cfs for at least 2 weeks. ▪ Flows in Reach 2 should also exceed 18,600 cfs for at least 4 weeks. ▪ The minimum peak release from Flaming Gorge Dam should be 8,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	***Ramp Rate Determination*** The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for a wet year should be 1,000 cfs per day or less.
Base Flow Determination Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by July 20 in wet years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	***Base Flow Determination*** The base flow target at Jensen, Utah, should be between 2,800 cfs and 3,000 cfs during wet years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	***Hour-to-Hour Fluctuation Determination*** Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	***Release Temperature Determination*** Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (8 °C) for the first 2 to 5 weeks during the base flow period (mid-August to March 1) for wet years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period (the 2000 Flow and Temperature Recommendations indicate that this may not be possible in wet years).

For the Green River below Flaming Gorge Dam, the only water quality issue of concern with respect to the Action Alternative is water temperature. The No Action Alternative would result in future water temperatures based on the recommendations of the 1992 Biological Opinion. Under the Action Alternative, release temperatures and river temperatures in Reach 1 would be somewhat warmer to meet the temperature recommendation of 64 °F (18 °C) or greater in upper Lodore Canyon. Reaches 2 and 3, because of their distance from Flaming Gorge Dam, would likely have similar water temperatures under either of the alternatives.

Sediment transport is presented in the Water Quality section of the EIS because it is an important function in the river system, with the potential to affect both riverine and riparian habitat. Table S-8 illustrates the average annual sediment transport under the No Action and the Action Alternatives as well as the estimated percent of tonnage increase under each of these alternatives for the May, June, July period.

Table S-8.—Weight and Percent Increase in Sediment Transport Under the Action Alternative Compared to the No Action Alternative

Reach Number	Time Period	No Action Alternative	Action Alternative	
		Estimated sediment load (tons)	Sediment Load Increase (tons)	Increase (percent)
Reach 1	Average Annual	92,000	+13,000	+14
	May-June-July	45,000	+25,000	+56
Reach 2	Average Annual	1.2 million	+800,000	+ 7
	May-June-July	970,000	+110,000	+11
Reach 3	Average Annual	3.5 million	+280,000	+ 8
	May-June-July	3.3 million	+290,000	+ 9

S.14.3 Hydropower

Hydropower analysis focuses on the potential impacts of the alternatives on powerplant operations at Flaming Gorge Dam. This analysis used a computer model developed by Argonne National Laboratory in collaboration with Reclamation. The model uses an estimate of the quantity of energy injected into the power grid along with a forecasted hourly electricity spot price (market price) to determine the economic value for each alternative. The model determined the revenue generated as a result of operating Flaming Gorge Powerplant to achieve each alternative over the period from 2002 to 2026. The revenues for each alternative were then discounted by 5.5% per year so that they reflected their net present value. The total net present value of the revenue generated under each alternative was then compared to determine the economic impacts to power production under the proposed alternatives. The results are summarized in table S-9 and show that

Table S-9.—Table of Comparisons of the Alternatives for Hydropower

	No Action Alternative	Action Alternative	Comparison of Action to No Action
Net Present Value	$403.1 million	$423.1 million	$20 million (5.0%)
Generation in GWh	11,904.1	11,374.3	-529.8 (-4.5%)
Wholesale Electricity Price Composite	20.72 mills/KWh[1]	20.57 mills/KWh	-0.15 mills/KWh (-0.73%)

[1] Mill per kilowatthour (KWh).

the net present value of economic benefits for the No Action Alternative simulation was $403.1 million while generating about 11,904 gigawatthours (GWh) of energy. The Action Alternative showed a net present value of about $423.1 million for the 25-year simulation, an increase of $20.0 million (5.0%) over the estimate for the No Action Alternative.

The Action Alternative would generate about 11,374 GWh of energy, about 4.5% less, compared to the No Action Alternative generation. The Action Alternative generates less energy but is able to generate more of this energy during the seasons when market prices are higher, leading to a slightly greater net present value. The Action Alternative has greater benefits with fewer GWh due to the fluctuations in the market price of energy. The Action Alternative calls for more generation in the summer months when energy sells at higher prices than in the fall when the No Action Alternative generates more power. Given recent volatility in historic prices, there is uncertainty associated with future prices. Because there is less total annual power generation with the Action Alternative, use of an alternative price set that does not assume as large a relative seasonal price difference could result in a negative rather than a positive impact. In any case, the impact is considered to be insignificant when the total value of Flaming Gorge generation is considered.

In addition to the economic analysis, a financial analysis was performed as described in the EIS. While an economic analysis shows the impacts on the national economy as a whole, the financial analysis describes the impacts to the customers who purchase wholesale electricity generated at Flaming Gorge Powerplant. The results of this analysis show that, compared to the No Action Alternative, the Action Alternative would not have a significant impact on the rate CRSP power users pay.

S.14.4 Agriculture

Under both the No Action and Action Alternatives, about 245 acres of cropland in the historic Green River flood plain could be flooded in nearly half of all years. On average, affected lands would be inundated 2 days longer under the Action Alternative, but since this incremental time would not do further crop damage compared with the No Action Alternative, there would be no differences in impacts between the two alternatives.

S.14.5 Land Use

There would be no impacts to land use around Flaming Gorge Reservoir under either alternative. In Reach 1 of the Green River, in wet years, the Action Alternative would have greater impacts to the use of campgrounds and other recreational facilities that have been built in the historic flood plain than would the No Action Alternative. In average hydrology years, the impacts to such facilities would be about the same under either alternative.

Under the No Action Alternative in Reach 2, the effects of the river on land use that have occurred over the past 10 years would continue. Under the Action Alternative, higher flows of longer duration would be expected to occur in wet years. This would result in inundation levels and durations in the historic flood plain that have not occurred in the recent past and, consequently, a temporary loss of land use in the flood plain on a more frequent basis. In Reach 3, there would not be a significant land use difference under either alternative.

S.14.6 Ecological Resources

Under the No Action Alternative, present conditions would be expected to continue for all flora and fauna around Flaming Gorge Reservoir and in the Green River.

Under the Action Alternative, both native and nonnative fish in Reach 1 would likely benefit from the 2000 Flow and Temperature Recommendations. There is the potential for both positive and negative effects to trout in the area immediately below Flaming Gorge Dam, though long-term negative effects are not expected. There is also a potential for negative impacts to trout in the Browns Park area if water temperatures in that area exceed 64 °F (18 °C).

Under the No Action Alternative, there would be continued proliferation of wetland plants and island marshes. Due to infrequent flooding, the flood plain forests of the old high water zone would continue to transition to desert. The old-growth cottonwoods would continue the trend of premature dieoff. There would be limited opportunity for establishment of cottonwoods and box elders. Under the Action Alternative, there may be erosion of wetland and riparian vegetation on islands and bars, followed by increased opportunity for cottonwood establishment. Larger floodflows may improve the health of mature cottonwoods.

Invasive species are present in all reaches and are expected to persist under the No Action Alternative. The Action Alternative could accelerate growth of some invasive species along the river. Tamarisk and giant whitetop are two such species that could increase in rate and acreage of invasion in higher flood plain settings under the Action Alternative.

In the short term, birds and animals along the Green River corridor could be negatively impacted by temporary loss of habitat due to increased flooding, but the potential impacts are not expected to be significant. In the long term, birds and animals are expected to benefit from enhancement of riparian vegetation and habitat.

S.14.6.1 Threatened and Endangered Fish

Under the No Action Alternative, existing conditions for the Colorado pikeminnow, humpback chub, and razorback sucker would be expected to continue. For both the No Action and Action Alternatives, conditions for the bonytail chub are assumed to be the same as for the other three endangered fish species. While these species would be expected to benefit from Recovery Program activities other than activities arising from implementation of the 2000 Flow and Temperature Recommendations, it is believed that continuation of No Action flow regimes would not provide enough benefit to support their recovery. Under the Action Alternative, river conditions are expected to benefit the endangered fish and their designated critical habitat.

S.14.6.2 Other Threatened, Endangered, and Special Status Species

Under the No Action Alternative, continued decline in acreage and health of native riparian vegetation would have negative effects on the southwestern willow flycatcher.

Under the No Action Alternative, continued decline in the acreage and health of native riparian vegetation would have negative effects on yellow-billed cuckoo and other State sensitive songbirds. Other threatened and endangered species are not expected to be affected under either alternative.

Under the Action Alternative, Ute ladies'-tresses could be lost in Reach 1. Suitable habitat may be lost or otherwise become unsuitable. However, additional sites of potentially suitable habitat would likely develop at new locations. Bald eagles and southwestern willow flycatcher would be benefited by long-term increases in cottonwood and native understory vegetation along the river corridor. The Action Alternative may reverse degradation of riparian vegetation in Reach 2 and upper Reach 3.

S.14.7 Cultural Resources

Adjacent to the reservoir and along the Green River, there would be no effects from dam operations to cultural resources under either alternative.

S.14.8 Paleontological Resources

Adjacent to the reservoir and along the Green River, there would be no effects from dam operations to paleontological resources under either alternative.

S.14.9 Indian Trust Assets

The No Action Alternative would not affect Indian (American Indian) trust assets. The Action Alternative would not affect agriculture and oil and gas production, or other Indian trust assets if advance notice is provided on the timing of spring peak flows. There would be no significant difference between effects on Indian trust assets under either the Action or No Action Alternatives.

S.14.10 Safety and Public Health

There is public concern over the creation of mosquito habitat along the Green River due to the flow regimes under either alternative, which are intended to inundate flood plain depressions for the benefit of endangered fish. Under the No Action Alternative, populations of mosquitoes along the river would not increase. In Reach 1, the Action Alternative could result in an increase in mosquito populations along the river. In Reach 2, the Action Alternative also could result in an increase in mosquitoes, though not as large or as often as in Reach 1. As in the past, under either alternative, Reclamation would continue to coordinate peak flow releases with State and county officials to help minimize the mosquito population in the Jensen, Utah, area to the extent possible. Under either alternative, mosquito abatement control by the county would continue. In Reach 3, there would be no significant difference for mosquito populations between the Action and No Action Alternatives.

Public safety on Flaming Gorge Reservoir is expected to be unchanged under either alternative. Public safety along the Green River could be affected under the Action Alternative due to the potential for higher flows for longer durations. Existing safety procedures for dam operations would continue to be followed, along with notification to the public of scheduled high flows.

S.14.11 Air Quality

There are no significant effects to air quality under either alternative.

S.14.12 Visual Resources

There are no significant effects on visual resources under either alternative.

S.14.13 Environmental Justice

No adverse effects to minority or low-income populations have been identified under either alternative.

S.14.14 Recreation

On average, total water-based river and reservoir visitation within Flaming Gorge National Recreation Area for the Action Alternative is not expected to measurably change compared to visitation under the No Action Alternative (only a +0.3% gain). Gains in economic value are expected to be higher (+9.5%) as a result of water levels moving closer to those under preferred conditions.

Under wet and dry conditions, each of which typically occur only 10% of the time, visitation under the Action Alternative and value on the river is expected to decline compared to that under the No Action Alternative, but the decline is more than offset by gains on the reservoir.

S.14.15 Socioeconomics/Regional Economics

The socioeconomic analysis evaluates the effect of changing expenditures on economic activity in the general vicinity of Flaming Gorge National Recreation Area. The economic impact region consists of Daggett and Uintah Counties in Utah and Sweetwater County in Wyoming. Given the minor effect on local expenditures from changes in hydropower and agricultural production, the analysis focuses exclusively on recreation expenditures. The combined river and reservoir recreation expenditure impacts of the Action Alternative appear to be positive, but minor, under all hydrologic conditions.

S.15 PREFERRED ALTERNATIVE

As a result of the analyses presented in the EIS, Reclamation considers the Action Alternative to be the preferred alternative.

S.16 CUMULATIVE IMPACTS

As defined at 40 Code of Federal Regulations 1508.7, a cumulative impact is an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. The Flaming Gorge EIS focuses on whether the proposed action, considered together with any known or reasonably foreseeable actions, could cause a cumulative effect for any resource.

Human use of the Green River began to have some impact on the riverine environment early in the 19^{th} century. Later, construction of Flaming Gorge Dam (1958 through 1964) resulted in a profound change to the riverine environment, which contributed to the decline of native fish species in the Green River and native vegetation along the Green River. Also, filling of the reservoir inundated cultural and paleontological resources.

The construction of Flaming Gorge Dam established hydropower generation to serve millions of homes in the West and to provide water storage capability. The creation of Flaming Gorge Reservoir, the establishment of the Flaming Gorge National Recreation Area, and the establishment of the trout fishery below Flaming Gorge Dam constitute significant benefits to recreation and the regional economy.

The conclusion of the resource analysis in the EIS is that the Action Alternative when compared to the No Action Alternative would have either a small effect or no effect at all. When added to the cumulative effects for each resource, effects were minor or nonexistent and not enough to change direction of any cumulative effect trends. The Action Alternative would have a positive effect for habitat development overall, which should help the four endangered native fish species and other fish species including trout, especially in combination with other actions initiated by the Recovery Program.

Negative cumulative effects could include an increased rate of invasion of tamarisk and giant whitetop and possibly the displacement of Ute ladies'-tresses in Reach 1. Cumulative effects to power generation have been negative due to past operational changes and would continue to be negative on balance.

S.17 UNCERTAINTIES

The analyses presented in chapter 4 of the EIS identify impacts to resources based on the best available data. Uncertainties associated with implementing the Action Alternative are discussed in the EIS and summarized here.

The authors of the 2000 Flow and Temperature Recommendations recognized uncertainties in their general approach and in specific recommendations (2000 Flow and Temperature Recommendations). Their recommendations are based on a model which assumes that the ecological integrity of river ecosystems is linked to their dynamic character (Stanford et al., 1996; Poff et al., 1997) and that restoring more natural flow and thermal regimes is a key element to rehabilitating an impaired system. The authors recognized as well that the response of the endangered fishes of the Green River to a more natural flow regime and water temperatures remains largely unmeasured and that factors other than modifications to physical habitat are also impacting these species.

S.17.1 Hydrology

Uncertainties regarding the hydrology of Flaming Gorge Dam necessarily involve assumptions the authors made for the Flaming Gorge Model regarding historical river flow patterns which in their best judgment most nearly represented real conditions, which therefore cannot be fully addressed because, as yet, such conditions may not have occurred.

Uncertainties associated with the Flaming Gorge Model include the following:

- Determining which years to attempt to achieve the higher-level springtime flow recommendations in Reach 2 of the Green River. Actual basin indicators such as snow levels, temperature, and climate will henceforth be used in making yearly decisions.
- Obtaining matching flows of the Yampa River to achieve precise target levels to within 300 cfs in Reach 2 of the Green River under normal springtime operations.
- Predicting what resource impacts would occur as a result of future water development in the Green River above and below Flaming Gorge Reservoir.
- Achieving the flow objectives for Reach 2 to provide flows high enough to achieve the flow objectives in Reach 3 of the Green River in the future, given the expected increase in water development affecting its tributaries.
- Accounting for the remote possibility that Flaming Gorge Dam could have a physical restriction that might prevent enough water from being released to achieve the 2000 Flow and Temperature Recommendations objectives.

S.17.2 Operational Limitations for Temperature of Water Released From the Dam

The capability of releasing warmer water through the Flaming Gorge Dam selective withdrawal structure is limited at times, because release water is used to cool turbine bearings. How much additional increase to current capabilities in release temperatures could be realized would have to be determined through testing and adjustment of powerplant instruments at Flaming Gorge Dam.

S.17.3 Uncertainties Associated With Increased Spillway Use

Increased spillway use under the Action Alternative would produce a greater likelihood for degradation of concrete in the spillway. Reclamation would inspect the spillway following each period of use and evaluate the need for repairs. If damage to the spillway were to become excessive, repairs would be made and usage could be limited to operations necessary to maintain the required hydrology.

S.17.4 Fish Responses to Flow and Temperature Modifications

Uncertainties regarding nonnative fish responses to flow and temperature modifications under implementation of the 2000 Flow and Temperature Recommendations include the following:

- ❖ Determining how nonnative fish would respond to implementation of proposed changes in Flaming Gorge Dam operations. Releases of warmer water could result in the expansion of cool water nonnative fish populations in Reach 1, an area where their current populations are comparatively low. Such releases could also benefit warm water nonnative species in flood plain habitats resulting from increased overbank flooding. Continued monitoring and nonnative fish controls would be required.
- ❖ Maintaining the necessary base flows to maximize nursery habitats, since base flows vary from year to year as a function of variation in tributary inputs. Also, the effects of within-day fluctuations on nursery habitat conditions warrant further investigation.
- ❖ Determining the extent to which an increased frequency of bypassing water could result in entrainment of reservoir nonnative species into the Green River. Monitoring could include evaluating the potential for undesirable reservoir fishes, such as smallmouth bass, becoming established in the tailwater (water below the dam).
- ❖ Attaining desired temperature thresholds could improve Colorado pikeminnow survivorship. Temperature modeling indicates that, during wet years, the river may not warm enough to provide suitable conditions for year-round Colorado pikeminnow use. If warmer water could be released at the dam during wet years, Colorado pikeminnow survivorship might improve due to higher growth rates and larger sizes of the fish.

If the Action Alternative is implemented, Reclamation would coordinate with the Recovery Program in developing the appropriate studies through an adaptive management process to evaluate fish response to flow and temperature modifications.

S.17.5 Uncertainties Associated With Flood Plain Inundation

Peak flows recommended for Reach 2 were intended to provide inundation of flood plain nursery habitats in wetter years and to promote access to those flood plains by newly hatched razorback sucker larvae drifting from upstream spawning areas. This would ensure that razorback sucker juveniles overwintering in flood plains were allowed an opportunity to return to the main channel in subsequent years. The 2000 Flow and Temperature Recommendations recognized that access to flood plain habitats could be achieved through a combination of increased peak flows, prolonged peak flow duration, lower bank or levee heights, and constructed inlets. The report indicated that substantially more flood plain habitat could be inundated with lower peak flows if levees were removed.

Recent information provided in Valdez and Nelson (2004) indicates the area of depression flood plains that are potentially inundated by 13,000-cfs and 18,600-cfs flows is identical (about 2,200 acres) for the first 52 miles downstream from the only known razorback spawning bar in Reach 2. At greater distances, 18,600 cfs flows would inundate an additional 1,186 acres of depression flood plains. On the basis of the Valdez entrainment model, very few larvae are likely to be entrained at these distances from the spawning bar, and survival is likely to be low with sympatric nonnative fish populations in these flood plains.

On the basis of this information and further research, including studies in May 2005, it may be possible that connection and inundation could potentially be achieved with lower peak releases from Flaming Gorge Dam and still occur in 30% more years than with a peak flow of ≥18,600 cfs.

To resolve uncertainties associated with flow and nonflow actions that may be required for flood plain inundation, Reclamation would coordinate studies to test this hypothesis through the Recovery Program (see section 4.19.5 in the EIS). These studies would be conducted using an adaptive management approach as described in section 4.20.

Resolving these uncertainties along with other uncertainties in flow recommendations is a priority of the Recovery Program. The above studies would be incorporated into the flow evaluation process of the Recovery Program.

S.17.6 Riparian/Vegetation

Uncertainties involving the response of invasive species and certain native plant communities to implementation of the Action Alternative include the following:

- The effects of floodflows on tamarisk establishment on post-dam flood plain surfaces in Lodore Canyon, and on new tamarisk establishment at higher elevations
- The effects of higher base flows, coupled with several years of drought, on tamarisk establishment along base flow elevations
- The duration and magnitude of floodflows necessary to stimulate a positive response in mature cottonwoods
- The response of wetland species to the higher base flows of late summer and lower base flows of winter and early spring

S.18 ADDRESSING UNCERTAINTIES THROUGH ADAPTIVE MANAGEMENT

Uncertainties associated with operating Flaming Gorge Dam under the Action Alternative, summarized above, would be monitored and addressed through an adaptive management process if the Action Alternative is implemented. Adaptive management consists of an integrated method for addressing uncertainty in natural resource management.

The use of adaptive management does not imply establishment of a separately funded and staffed program to oversee operations at Flaming Gorge Dam. Rather, the adaptive management process would be integrated into the current framework of dam operations, while maintaining the authorized purposes of the dam. It would involve using research and monitoring to test the outcomes of modifying the hydrology and temperature of releases from Flaming Gorge Dam. It is expected that such research and monitoring would be achieved within the framework of the ongoing Recovery Program with regard to native fish and undesirable nonnative fish species and related habitat issues. As a participant in the Recovery Program, Reclamation would be involved in any identification or discussion of the need for new tasks within the Recovery Program to address Flaming Gorge Dam operational considerations or experimental flows. Issues associated with the trout fishery would be monitored by the Utah Division of Wildlife Resources as part of their management of that fishery and with ongoing consultation and coordination with Reclamation through the Flaming Gorge Working Group and interagency communication. As has occurred in the past, proposed releases for experimental purposes that deviate from the prescribed flows would be disclosed to stakeholders, including the various publics, at Flaming Gorge Working Group meetings, and would be closely coordinated with the U.S. Fish and Wildlife Service and the Utah Division of Wildlife Resources.

S.19 ENVIRONMENTAL COMMITMENTS

This section summarizes Reclamation's future commitments related to the Action Alternative. Commitments 1 through 4 and 8 would apply under either the Action Alternative or the No Action Alternative.

(1) The Flaming Gorge Working Group, which meets two times per year, would continue to function as a means of providing information to and gathering input from stakeholders and interested parties on dam operations.

(2) The adaptive management process would rely on ongoing or added Recovery Program activities for monitoring and studies to test the outcomes of modifying the flows and release temperatures from Flaming Gorge Dam. It would rely on the Flaming Gorge Working Group meetings for exchange of information with the public.

(3) Reclamation would develop a process for operating the selective withdrawal structure consistent with the objective of improving temperature conditions for the endangered native fish. Such a process would include identification of lines of

communication for planning and making changes to selective withdrawal release levels, coordination with other agencies, recognition of equipment limitations that may affect the ability to release warmer water, and the costs and equipment impacts associated with operating at higher temperatures.

(4) Reclamation would continue to annually coordinate the peak flow releases from Flaming Gorge Dam with the appropriate Federal, State, and county officials. This would include continued communication with county officials to assist in their mosquito control activities.

(5) As recommended by the Wyoming State Historic Preservation Office, Reclamation would periodically inspect eligible historic properties around Flaming Gorge Reservoir to determine whether there are any effects from the Action Alternative.

(6) Reclamation would consult with Federal, State, and local officials and the interested public to determine whether additional signage or other means of public notification of higher spring river flows are needed.

(7) A Ute ladies'-tresses recovery team geomorphology working group, consisting of the National Park Service, Reclamation, and several independent researchers, is currently in place. As part of Reclamation's efforts to monitor and understand the effects of the proposed action on Ute ladies'-tresses this group will be expanded to include interested Federal and State agency geomorphologists, riparian ecologists, and botanists who choose to participate on a voluntary basis. This working group could assist in designing and implementing a monitoring program to gain additional knowledge about Ute ladies'-tresses. Reclamation will oversee this Ute ladies'-tresses working group and insure that the working group meets regularly to discuss and prioritize monitoring, assist with data interpretation, and prioritize any needed research. As part of the development of the annual operational plan (as discussed in section 2.5 of the EIS), this working group will also provide recommendations to the Flaming Gorge Technical Working Group.

(8) Reclamation would continue to participate in the Recovery Program efforts.

(9) Reclamation would support the Recovery Program, in coordination with the U.S. Fish and Wildlife Service and Western, in developing and conducting Recovery Program studies associated with flood plain inundation.

(10) Reclamation would establish the Technical Working Group consisting of biologists and hydrologists involved with endangered fish recovery issues. The Technical Working Group would meet at various times throughout the year to comment and provide input concerning endangered fish needs to Reclamation's operational plan.

Executive Summary
Operation of Flaming Gorge Dam
Final Environmental Impact Statement
Acronyms and Abbreviations

BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
cfs	cubic feet per second
CRSP	Colorado River Storage Project
EIS	final environmental impact statement
ESA	Endangered Species Act
2000 Flow and Temperature Recommendations	*Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam*
GWh	gigawatthour
kWh	kilowatthour
m^3/s	cubic meters per second
NEPA	National Environmental Policy Act
P.L.	Public Law
Reclamation	Bureau of Reclamation
Recovery Action Plan	*1993 Recovery Implementation Program Recovery Action Plan*
Recovery Program	Upper Colorado River Endangered Fish Recovery Program
RMP	resource management plan
RPA	Reasonable and Prudent Alternative
Secretary	Secretary of the Interior
U.S.C.	United States Code
USDA Forest Service	United States Department of Agriculture Forest Service
Western	Western Area Power Administration
§	Section
°C	degrees Celsius
°F	degrees Fahrenheit
%	percent

RECLAMATION

Managing Water in the West

Operation of Flaming Gorge Dam Final Environmental Impact Statement

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

September 2005

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Front cover artwork courtesy of
Arizona Game and Fish Department

Operation of Flaming Gorge Dam
Colorado River Storage Project
Final Environmental Impact Statement

Cooperating Agencies:	U.S. Department of the Interior Bureau of Reclamation (lead agency) Bureau of Indian Affairs Bureau of Land Management National Park Service U.S. Fish and Wildlife Service State of Utah, Department of Natural Resources United States Department of Agriculture, Forest Service U.S. Department of Energy Western Area Power Administration Utah Associated Municipal Power Systems

Abstract:

The Secretary of the Interior, acting through the Bureau of Reclamation, proposes to take action to assist in the recovery of four endangered fish in the Green River downstream from Flaming Gorge Dam, a Colorado River Storage Project facility in northeastern Utah, with a reservoir located in Utah and Wyoming. The purpose of the proposed action is to operate Flaming Gorge Dam to protect and assist in recovery of the populations and designated critical habitat of four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the Colorado River Storage Project, particularly those related to the development of water resources in accordance with the Colorado River Compact. This final environmental impact statement has been prepared pursuant to the National Environmental Policy Act to analyze the effects of operating Flaming Gorge Dam in accordance with a set of flow and temperature recommendations developed by the Upper Colorado River Endangered Fish Recovery Program.

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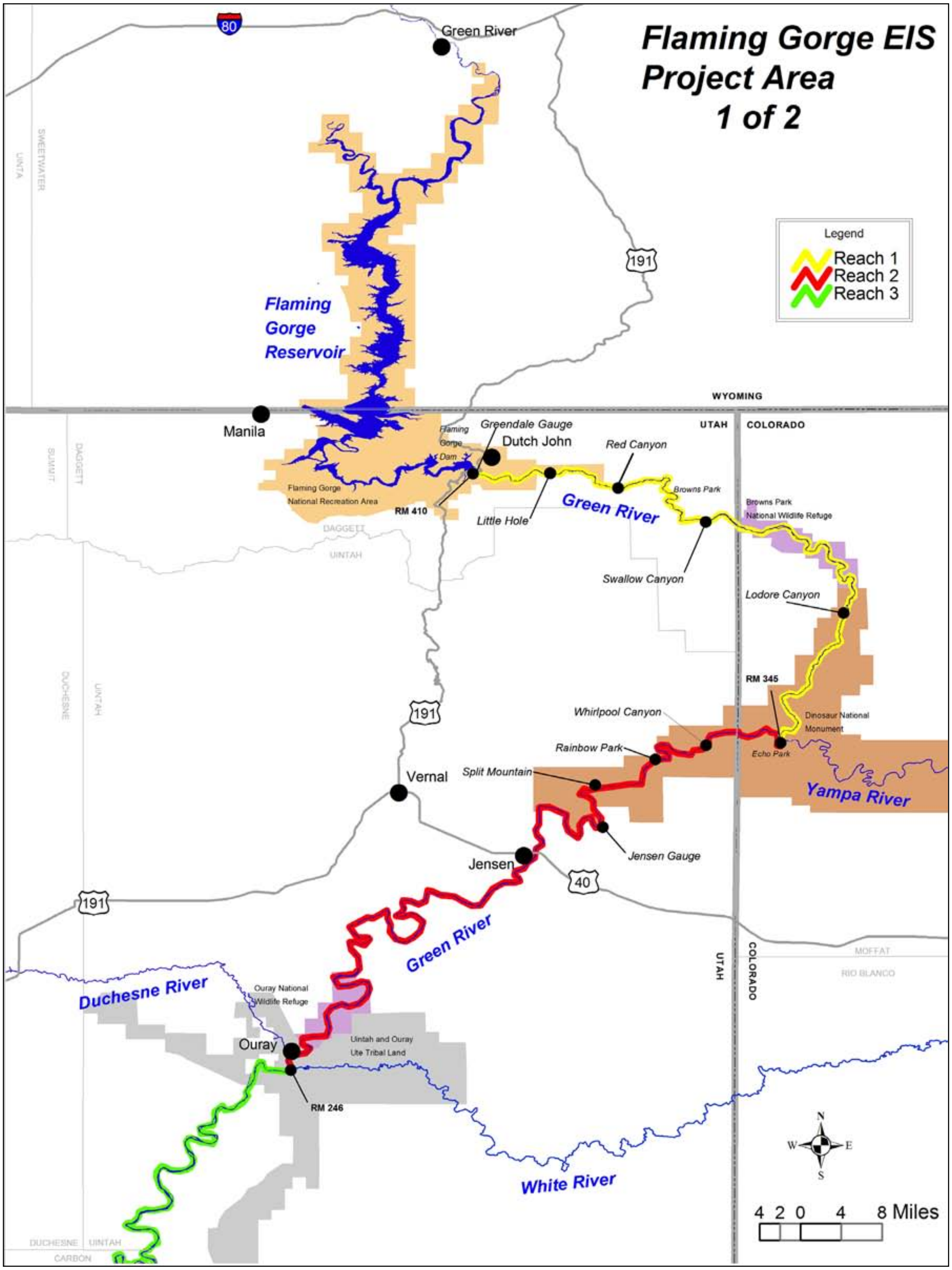

Flaming Gorge EIS
Project Area
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Reach 1
Reach 2
Reach 3
Green River
Flaming
Gorge
Reservoir
Manila
WYOMING
UTAH
COLORADO
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Echo Park
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Jensen
Green River
Duchesne River
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Ouray
Uintah and Ouray
Ute Tribal Land
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RIO BLANCO
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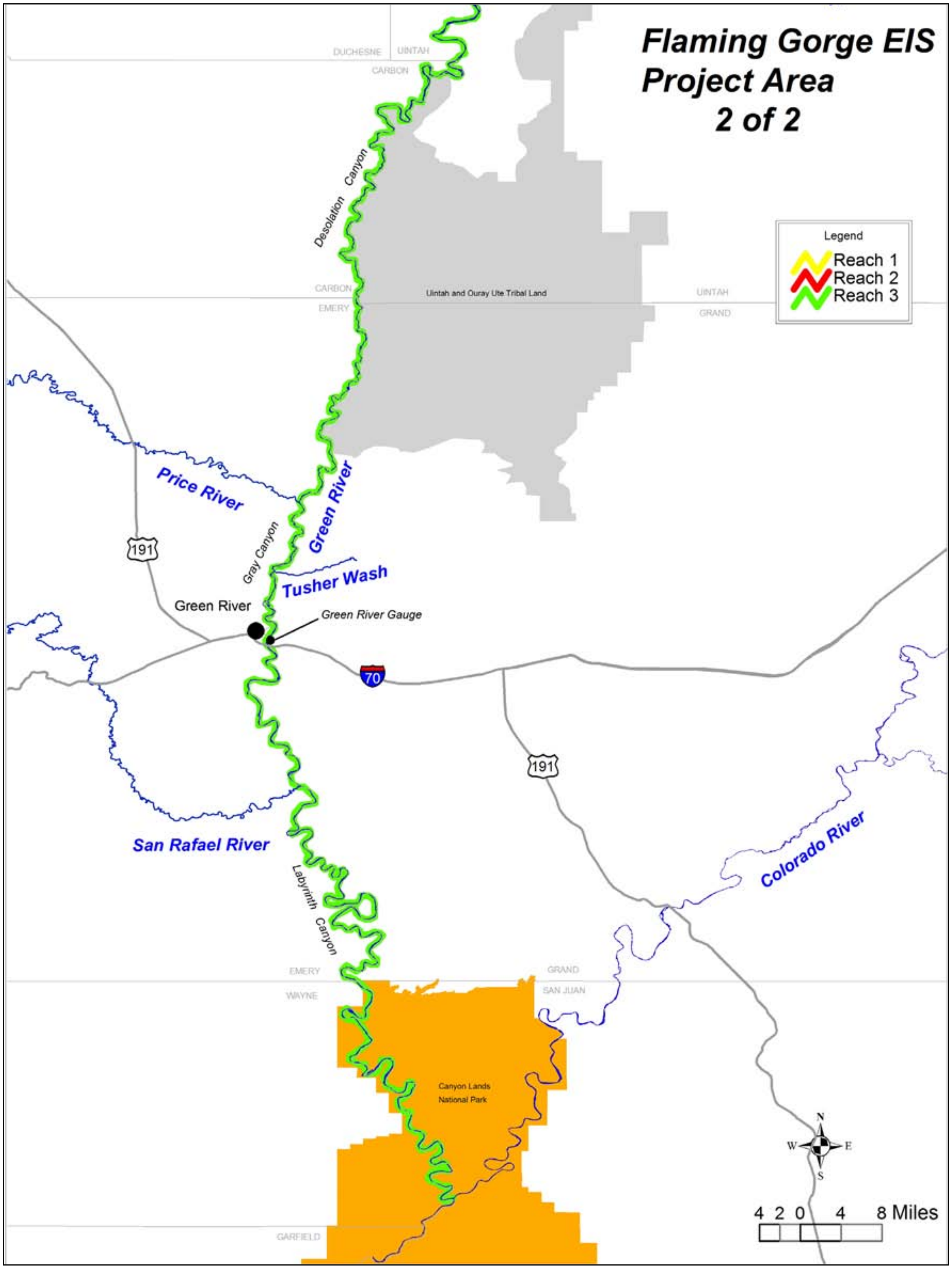
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DUCHESNE
UINTAH
CARBON
Desolation Canyon
CARBON
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UINTAH
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Green River
Green River Gauge
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Colorado River
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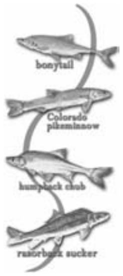

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FIGURES

FIGURES (CONTINUED)

1.0 Proposed Federal Action and Background

The Bureau of Reclamation proposes to take action to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes found in the Green and Colorado River Basins (proposed action). The four endangered fish species are Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), and bonytail (*Gila elegans*). Reclamation would implement the proposed action by modifying the operations of Flaming Gorge Dam, to the extent possible, to achieve the flows and temperatures recommended by participants of the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). Reclamation's goal is to implement the proposed action and, at the same time, maintain and continue all authorized purposes of the Colorado River Storage Project (CRSP).

The recommended flows and temperatures are intended to provide water releases of sufficient magnitude and, with the proper timing and duration, to assist in the recovery of the endangered fishes and their designated critical habitat. The flow and temperature recommendations for the Green River are described in the Recovery Program's September 2000 report, *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations).

1.1 Purpose of and Need for the Proposed Federal Action

The purpose of the proposed action is to operate Flaming Gorge Dam to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact. The proposed action is needed for the following reasons:

- The operation of Flaming Gorge Dam, under its original operating criteria, jeopardized the continued existence of the endangered fishes in the Green River.
- Reclamation is required to comply with the Endangered Species Act (ESA) for the operation of CRSP facilities, including Flaming Gorge Dam. Within the exercise of its discretionary authority, Reclamation must avoid jeopardizing the continued existence of listed species and destroying or adversely modifying designated critical habitat.
- The Reasonable and Prudent Alternative (RPA) to the 1992 Biological Opinion on the Operation of Flaming Gorge Dam required modification of Flaming Gorge releases to benefit the endangered fish, a 5-year study period to evaluate winter and spring flows, and reinitiation of discussions with the U.S. Fish and Wildlife Service following the study period to further refine the flow recommendations. With the results of these studies, as well as other relevant information, the Recovery Program developed and approved the 2000 Flow and Temperature Recommendations report for the Green River. These recommendations are an extension of the 1992 jeopardy Biological Opinion RPA. Reclamation committed to assist in meeting flow requirements through the refined operation of Flaming Gorge and other Federal reservoirs in the 1987 agreement that formed the Recovery Program.
- Flaming Gorge Dam and Reservoir is the primary water storage and delivery facility on the Green River, upstream of its confluence with the Colorado River. The storage capacity and ability to control water releases of Flaming Gorge Dam allow Reclamation flexibility in providing flow and temperature management to protect and assist in the recovery of endangered fish populations and their critical habitat within specific reaches of the river. Thus, the refined operation of Flaming Gorge Dam is a key element of the Recovery Program.
- The refined operation will offset the adverse effects of flow depletions from the Green River for certain Reclamation water projects in Utah, as defined by existing jeopardy Biological Opinions. Modifying the operation of Flaming Gorge Dam will also serve as the RPA, as defined by the ESA, to offset jeopardy to endangered fishes and their critical habitat that could result from the operation of numerous other existing or proposed water development projects in the Upper Colorado River Basin.

1.2 Lead and Cooperating Agencies

Reclamation is the lead agency in preparing this environmental impact statement (EIS). The eight cooperating agencies include the Bureau of Indian Affairs, Bureau of Land Management (BLM), National Park Service, State of Utah Department of Natural Resources, U.S. Fish and Wildlife Service, United States Department of Agriculture Forest Service (USDA Forest Service), Utah Associated Municipal Power Systems, and Western Area Power Administration (Western).

1.3 CONTENTS OF THIS ENVIRONMENTAL IMPACT STATEMENT

This EIS consists of five chapters:

Chapter 1 describes the purpose of and need for the proposed Federal action and provides background information, a brief history of Flaming Gorge Dam and Reservoir, a scoping summary, and applicable regulatory requirements.

Chapter 2 describes the process used to formulate alternatives, discusses the alternatives considered in detail, describes the alternatives that were considered but eliminated from detailed study, and provides a summary comparison of alternatives and impacts.

Chapter 3 describes the environment and resources that could be affected by the proposed action.

Chapter 4 describes and analyzes the environmental impacts of each alternative considered in detail. It also includes other considerations required by the National Environmental Policy Act (NEPA) including environmental justice, the relationship between short-term uses of the environment and long-term productivity, and the assessment of irreversible and irretrievable commitment of resources.

Chapter 5 includes consultation and coordination with other Federal and State agencies and Native American tribes and the EIS distribution list.

This document also contains a list of preparers, conversion tables, glossary, and bibliography. A separate volume of technical appendices, "Operation of Flaming Gorge Dam Final Environmental Impact Statement Technical Appendices," is available upon request. An executive summary, "Operation of Flaming Gorge Dam Final Environmental Impact Statement Executive Summary," is also available upon request. A separate volume of public comments on the draft EIS and Reclamation's response to those comments, "Operation of Flaming Gorge Dam Final Environmental Impact Statement Comments and Responses," is also available.

1.4 BACKGROUND

Flaming Gorge Dam, located on the Green River in northeastern Utah about 200 miles northeast of Salt Lake City, is an authorized storage unit of the CRSP. Flaming Gorge Dam was completed in 1962, and full operation of the dam and reservoir began in 1967. The powerplant, located at the base of the dam, began commercial operation in 1963 and was completed in 1964. Reclamation operates the dam and powerplant, and Western markets the power.

1.4.1 Brief History of Flaming Gorge Dam and Reservoir

1.4.1.1 Authorized Uses of Flaming Gorge Dam and Reservoir and Colorado River Development

Flaming Gorge Dam was authorized for construction by the CRSP Act of 1956 (Public Law [P.L.] 84-485). The underlying project purposes are defined by Section 1 of the Act (43 United States Code [U.S.C.] Section (§) 620):

> *In order to initiate the comprehensive development of the water resources of the Upper Colorado River Basin, for the purposes, among others, of regulating the flow of the Colorado River, storing water for beneficial consumptive use, making it possible for the States of the Upper Basin to utilize, consistently with the provisions of the Colorado River Compact, the apportionments made to and among them in the Colorado River Compact and the Upper Colorado River Basin Compact,*

> *respectively, providing for the reclamation of arid and semiarid land, for the control of floods, and for the generation of hydroelectric power, as an incident of the foregoing purposes, the Secretary of the Interior is authorized (1) to construct, operate, and maintain the following initial units of the Colorado River storage project, consisting of dams, reservoirs, powerplants, transmission facilities and appurtenant works [including] Flaming Gorge . . ..*

Section 7 of the CRSP Act of 1956 mandates the operation of CRSP powerplants to produce ". . .the greatest practicable amount of power and energy that can be sold at firm power and energy rates. . .." However, as described in this EIS in section 1.4.3, continued Upper Colorado River Basin development of water resources and implementation of the 2000 Flow and Temperature Recommendations may affect the practicable amount of power and energy generated. This EIS analyzes these effects in sections 4.4 and 4.16.1.

The Upper Colorado River Endangered Fish Recovery Program was developed in response to the request of Colorado, Wyoming, and Utah to facilitate the continued development of their compact apportionments in light of Endangered Species Act concerns. The 2000 Flow and Temperature Recommendations, which were developed by the Recovery Program, are specifically designed, in concert with other Recovery Program actions, to accomplish recovery. By implementing the 2000 Flow and Temperature Recommendations, Reclamation would be taking the steps necessary to facilitate recovery of the fish, which will make it possible for continued and further utilization of the States' compact apportionments. Thus, by "making it possible for the States of the Upper Basin to utilize…[their Compact] apportionments," the 2000 Flow and Temperature Recommendations, which are designed to facilitate further compact development through the recovery of listed species, are within the authorized purposes of CRSP Act. Moreover, that other authorized purposes of the unit may not be fully maximized for limited durations in certain year types does not invalidate the actions of the Secretary of the Interior (Secretary), as long as the overall goals of the project are being met.

In addition to this authority, the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs (including Flaming Gorge Reservoir) mandated by Section 602(a) of the 1968 Colorado River Basin Project Act (43 U.S.C. § 1501 et seq.) requires that the Annual Operating Plan for Colorado River reservoirs ". . . shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife, and other environmental factors."

1.4.1.2 Authorized Uses of Flaming Gorge Dam and Reservoir: Flaming Gorge National Recreation Area

The Flaming Gorge National Recreation Area was established by the Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540). According to that act, the purposes of the Flaming Gorge National Recreation Area are to provide (1) public outdoor recreation benefits; (2) conservation of scenic, scientific, historic, and other values contributing to enjoyment, and (3) such management, utilization, and disposal of natural resources that will promote or are compatible with and do not significantly impair the purposes for which the recreation area was established. The act added about 123,000 acres to Ashley National Forest and assigned management of the entire recreation area to the USDA Forest Service. The Flaming Gorge National Recreation Area contains 207,363 acres of land and water that are almost equally divided between Utah and Wyoming.

1.4.2 Operational Modifications Since the Beginning of Dam Operations

Construction of Flaming Gorge Dam and Powerplant began in 1956. Filling of the reservoir began in 1962 when the dam was completed. Full operation began in November 1967. Until 1984, Flaming Gorge Dam was operated to provide for a full reservoir while maximizing power generation, providing associated ancillary services, and avoiding the use of the river outlet works or the spillway. Flows were fluctuated as needed to meet system power demand, and consideration was given to known fish and wildlife needs.

The history of Flaming Gorge Dam operations can be divided into five phases. During the first phase, from 1962 to 1966, the reservoir was filling with water, and Green River flows downstream from the dam were reduced. The first full year of normal operations began in 1967. During the second phase, from 1967 to 1978, Flaming Gorge Dam was operated with few constraints, and water releases were made through the powerplant. The only constraint on releases during phase two began in 1974 when a 400-cubic-foot-per-second (cfs) minimum release was implemented to establish and maintain the tailwater trout fishery (1974 Interim Operating Criteria). This operating agreement between the Utah Division of Wildlife Resources and Reclamation stated:

> *A minimum flow of 400 cfs will be released from the reservoir at all times. However, for the foreseeable future and under normal conditions, a continuous flow of 800 cfs will be maintained as a minimum. To the extent the available water supply will permit and is compatible with multipurpose operations of all CRSP reservoirs, minimum flows in excess of 800 cfs will be maintained to enhance the use of the river for fishing, fish spawning, and boating.*

In 1978, the dam was retrofitted with a selective withdrawal structure to improve water temperatures for the tailwater trout fishery. During the third phase, from 1979 to 1984, operations were similar to those in the previous phase except for use of the selective withdrawal structure and the occurrence of spills in 1983 and 1984.

During the fourth phase, from 1985 to 1992, Reclamation began to constrain the operation of Flaming Gorge Dam to reduce negative impacts affecting endangered fishes in the Green River. Such constraints reduced operational flexibility and the ability to fluctuate flows to meet power system demands. In 1985, an interim flow agreement was established between Reclamation and the U.S. Fish and Wildlife Service to change Flaming Gorge Dam releases to protect critical nursery habitats for endangered fishes in the Green River downstream from Jensen, Utah. The recommended releases were based on observations made in 1985 that indicated "good" habitat conditions were available at lower flows. Reclamation also revised operational criteria at the dam to avoid spills. These changes were in place in the fourth phase, along with numerous research releases to support preparation of the Final Biological Opinion on the Operation of Flaming Gorge Dam issued on November 25, 1992. Significant financial impacts to hydropower generation, identified in section 4.16.2 of this EIS, occurred mainly as a result of flow changes implemented during this fourth phase.

In the fifth phase, from 1993 to present, Reclamation began making releases from Flaming Gorge Dam in an attempt to meet the flow and temperature recommendations given in the 1992 Biological Opinion. Flows recommended in the 1992 Biological Opinion were intended to restore a more natural hydrograph and protect nursery habitats of endangered fishes downstream from the Yampa River confluence. At the same time, Reclamation continued to meet the authorized purposes of Flaming Gorge Dam.

The Green River flows recommended in the 1992 Biological Opinion were based on the most current scientific data available at the time. The opinion included several actions Reclamation could take to avoid jeopardizing the recovery of endangered fishes in the Green River. One of these actions was to collect more information about the flow and temperature needs of the endangered fishes and, subsequently, to refine or modify the flow and temperature recommendations of the 1992 Biological Opinion. A 5-year research study began in 1992, and the resulting data and refinements were included in the 2000 Flow and Temperature Recommendations. The study included periodic test flows to evaluate the effects of summer flows on endangered fishes or to test specific hypotheses.

1.4.3 Compliance With the Endangered Species Act

To comply with the ESA, an evaluation of the effects of any discretionary Federal action must be conducted by the action agency in consultation with the U.S. Fish and Wildlife Service.

During the late 1970s and early 1980s, the U.S. Fish and Wildlife Service rendered Jeopardy Biological Opinions for the Upalco, Jensen, and Uinta Units of the Central Utah Project stating that all relied on the operation of Flaming Gorge Dam to provide flows for endangered fishes. More recent Biological Opinions for the Duchesne River Basin, the proposed Narrows Project, the ongoing Price-San Rafael Salinity Control Project, and other water development-related projects in the Colorado River Basin also rely on the operation of Flaming Gorge Dam to provide flows for endangered fishes.

On February 27, 1980, the U.S. Fish and Wildlife Service requested consultation under Section 7 of the ESA for projects currently under construction in the Upper Colorado River Basin and for the continued operation of all existing Reclamation projects in the basin (including the CRSP). Formal consultation on the operation of Flaming Gorge Dam began March 27, 1980. Issuing a Final Biological Opinion by the U.S. Fish and Wildlife Service for the operation of Flaming Gorge Dam was delayed until data collection and studies related to habitat requirements for the endangered fishes could be completed and used to recommend specific flows in the Green River downstream from the dam. Dam operations were initially evaluated for potential effects on endangered fishes from 1979 to 1984. Reclamation served as the lead agency for this consultation, with Western becoming a party to the consultation in 1991.

Additionally, on February 27, 1980, the U.S. Fish and Wildlife Service issued a Final Biological Opinion for the Strawberry Aqueduct and Collection System, a major feature of the Central Utah Project. The Biological Opinion determined that Strawberry Aqueduct and Collection System flow depletions from the Duchesne and Green Rivers would likely jeopardize the continued existence of the endangered Colorado pikeminnow and humpback chub. This Biological Opinion included a Reasonable and Prudent Alternative stating that Flaming Gorge Dam and Reservoir would compensate for those depletions and be operated for the benefit of the endangered fishes in conjunction with its other authorized purposes.

Both the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations were designed to account for the impacts of depletions mentioned above. The 2000 Flow and Temperature Recommendations as implemented under the Action Alternative would offset the impacts of water depletions on these other projects.

1.4.4 Upper Colorado River Endangered Fish Recovery Program

The Recovery Program was initiated in 1987 as a cooperative effort among the States of Utah, Colorado, and Wyoming;

environmental and water user organizations; Federal agencies including the National Park Service, Reclamation, U.S. Fish and Wildlife Service, and Western; and the Colorado River Energy Distributors Association. The goal of the Recovery Program is to protect and recover the endangered fish species of the Upper Colorado River Basin so they no longer need protection under the ESA, while the Upper Basin States continue to develop their 1922 Colorado River Compact entitlements.

Under the Recovery Program, five key elements are needed to recover the endangered fish species: (1) habitat management; (2) habitat development/ maintenance; (3) native fish stocking; (4) nonnative species and sport fish management; and (5) research, data management, and monitoring. The operation of Flaming Gorge Dam is essential to successful implementation of two of these five elements: habitat management and habitat development/maintenance. Operation of the dam is one of many management actions described in the 1993 Recovery Implementation Program Recovery Action Plan (Recovery Action Plan). The plan is periodically revised to accommodate programmatic Biological Opinions and annual updates as well as the designation of critical habitat for the endangered fishes. Implementation of all Recovery Action Plan recommendations is expected to achieve recovery of the endangered fishes.

Reclamation began informing the Recovery Program Management Committee of the EIS timeline in 1999. Beginning in 2001, the Recovery Program Management Committee requested and received regular updates on EIS progress through early 2005. Additionally, throughout 1999–2003 the staff of the Recovery Program Director's office met regularly with Reclamation authors to clarify flow recommendation issues during development of the EIS document, and Reclamation also interacted with the Recovery Program biology committee on EIS matters periodically throughout this period.

1.4.5 Final Biological Opinion on the Operation of Flaming Gorge Dam and the Reasonable and Prudent Alternative

The U.S. Fish and Wildlife Service issued a Final Biological Opinion on the Operation of Flaming Gorge Dam on November 25, 1992, stating that the current operation of Flaming Gorge Dam was likely to jeopardize the continued existence of the endangered fishes in the Green River. The opinion also described elements of an RPA that, in the opinion of the U.S. Fish and Wildlife Service, would offset jeopardy to the endangered fishes. The RPA required implementing the following five elements:

(1) Refining the operation of Flaming Gorge Dam so flow and temperature regimes of the Green River more closely resemble a natural hydrograph.

(2) Conducting a 5-year research program, including implementation of winter and spring research flows, beginning in 1992, to allow for potential refinement of flows for those seasons. The research program was to be based on the Flaming Gorge Flow Recommendations Investigation and called for annual meetings to refine seasonal flows consistent with research findings and water year forecasts. Except for specific research flows during the 5-year research program, year-round flows in the Green River were to resemble a natural hydrograph described under element 1 of the RPA.

(3) Determining the feasibility and effects of releasing warmer water during the late spring/summer and investigating the feasibility of retrofitting the river bypass tubes to include power generation, thereby facilitating increased spring releases.

(4) Legally protecting Green River flows from Flaming Gorge Dam to Lake Powell.

(5) Initiating discussions with the U.S. Fish and Wildlife Service, after conclusion of the 5-year research program, to examine further refinement of flows for the specified endangered Colorado River fishes.

1.4.6 2000 Flow and Temperature Recommendations

The research program called for in the 1992 Biological Opinion concluded in 1996. At that time, the Recovery Program funded a synthesis of research and development of flow and temperature recommendations for the Green River. The final synthesis report, which contained the 2000 Flow and Temperature Recommendations for endangered fishes in the Green River downstream from Flaming Gorge Dam, provided the basis for Reclamation's Action Alternative analyzed in this EIS and for additional Section 7 consultation by Reclamation and Western with the U.S. Fish and Wildlife Service.

1.4.7 New Biological Opinion on the Operation of Flaming Gorge Dam

Reclamation and Western have consulted with the Fish and Wildlife Service, as required by Section 7 of the ESA, on the proposed action analyzed in this EIS. The Final Biological Opinion was issued on September 6, 2005, and may be found in the Final Biological Opinion Technical Appendix of this EIS.

1.5 Operational Decisionmaking Process at Flamng Gorge Dam

The process of developing an operational plan for Flaming Gorge Dam takes into consideration all resources associated with Flaming Gorge Dam identified by the Flaming Gorge Working Group. The Flaming Gorge Working Group was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operation of Flaming Gorge Dam. Among others, these interests include power marketing, sport fisheries, endangered species, white water rafting, farming, land ownership, reservoir recreation, national park resources, land management, flood control, and wildlife refuge management.

The Flaming Gorge Working Group generally meets twice a year (April and August/September). These meetings are open to the public, and participants are encouraged to comment. Operational decisions are not made during the Flaming Gorge Working Group meetings; rather, these meetings are a forum for information exchange about past, current, and proposed operations at Flaming Gorge Dam. They also serve as a forum through which stakeholders can share information about specific resources of interest and the relationship between the operation of Flaming Gorge Dam and these resources. The Flaming Gorge Working Group provides input to Reclamation as well as educating various constituencies on operations at Flaming Gorge Dam.

Reclamation has sole responsibility for operations at Flaming Gorge, although the needs and expectations of stakeholders are considered in operational planning. Reclamation's priorities are first, dam safety, and then second, meeting project purposes in compliance with the ESA. When conflicts in operations arise, Reclamation's approach to conflict resolution and decisionmaking includes accepting input from all stakeholders and formulating a strategy that meets the most needs possible consistent with these established priorities.

Operational decisions for Flaming Gorge Dam are made through the Colorado River Annual Operating Plan process. A document, called the *24-Month Study*, is produced monthly and contains planned monthly releases from all CRSP reservoirs. In the 24-month study, reservoir inflows are revised to reflect forecasted inflow from the National Weather Service. These forecasted inflows are input into the 24-Month Planning Model. Planned releases from Flaming Gorge are adjusted monthly to reflect changing hydrology, to meet the requirements of the ESA, and to meet CRSP authorized purposes.

Reclamation continually coordinates release schedules with Western. Occasionally, Western will request that Reclamation consider modifying scheduled releases at Flaming Gorge Dam due to power market conditions. Reclamation considers all requests from Western for modified releases. Requests for modified operations by Western are usually met, although it is common for Reclamation and Western to negotiate a compromise solution that may alleviate pressure on other resources. The operation of the selective withdrawal structure, which affects release temperature, is coordinated among Reclamation, the U.S. Fish and Wildlife Service, and the Utah Division of Wildlife Resources.

Reclamation communicates with the U.S. Fish and Wildlife Service as release schedules are adjusted. Such communication generally takes place when proposals for modified releases are made by Western or when other requests are made for release modifications, including test flows for biological studies. Communication and coordination with the U.S. Fish and Wildlife Service also takes place each spring when peak releases, as required in the 1992 Biological Opinion, are set. Consultation between Reclamation and the U.S. Fish and Wildlife Service is necessary when releases outside of the RPA of the 1992 Biological Opinion are required.

The 1992 Biological Opinion constrains releases at Flaming Gorge Dam in the summer and fall so that the Green River near Jensen, Utah, (106 river miles below the dam) does not deviate by more than 12.5 percent (%) of the daily average flow for the day. This constraint reduces the magnitude of hour-to-hour fluctuations at Flaming Gorge Dam during the summer and fall. Historically since 1992, hour-to-hour fluctuations have generally been maintained at about 800 cfs per hour with a single peak per day. However, there are no formalized constraints that require this.

The 1992 Biological Opinion states that "the goal for winter releases is to provide low, stable flows near historic levels." While no formal ramping criteria has been established for the winter and spring, the guideline the past few years has been to use the plus or minus 12.5% constraint at Jensen, Utah, for the winter and spring seasons, as well as the summer and fall, to meet the stated requirement of the 1992 Biological Opinion to provide low stable flows in the winter.

Annually, the Utah Division of Wildlife Resources requests a steady 1,600-cfs release in the late afternoon and early evening hours on 2 consecutive days to conduct electro-fishing as part of its ongoing tailwater assessment. Requests for short-term modifications in releases have also come from the USDA Forest Service for search and rescue efforts and for removal of boats wedged in rocks. A variety of other requests are often received, and accommodated if they are reasonable, necessary, and do not interfere with dam safety, other authorized project purposes, or operations for ESA compliance.

1.6 Emergency Powerplant Operations

Normal dam and powerplant operations under the Action Alternative or any other alternative could be altered temporarily to respond to emergencies. These emergencies may be associated with dam safety, power system conditions, or personal safety of individuals or groups associated with recreation or other activities on the river. The North American

Electrical Reliability Council and the Western Electricity Coordinating Council have established guidelines and requirements for emergency operations of interconnected power systems that apply to Flaming Gorge Dam operations and may account for changes outside of those identified in descriptions of the alternatives. These changes in operations are intended to be of short duration as a result of emergencies at the dam or within the transmission network.

To reduce the impact to individual powerplants and transmission lines responding to system emergencies, Reserve Sharing Groups are organized among electric utilities to share resources. The CRSP resources are included in the Rocky Mountain Reserve Sharing Group and the Southwest Reserve Sharing Group under Western's membership. The sharing of resources reduces the amount of generation each CRSP powerplant would otherwise be obligated to provide as well as giving flexibility to respond to the emergency. The North American Electrical Reliability Council provides operating policies for system emergencies, of which several examples are given here.

1.6.1 Insufficient Generation Capacity

A control area is a geographical area comprised of an electric system or systems, interconnected together by transmission lines that is capable of controlling generation within the control area to maintain its interchange schedule with other control areas and that contributes to frequency regulation of the interconnection. When a control area has an operating capacity emergency, it must promptly balance its generation and interchange schedules to its load, without regard to financial cost, to avoid prolonged use of assistance provided by the interconnected power system. The emergency reserve inherent in frequency deviation is intended to be used only as a temporary source of emergency energy and must be promptly restored so the interconnected systems can withstand the next contingency. A control area unable to balance its generation and interchange schedules to its load must remove sufficient load to permit correction of its Area Control Error.

If a control area anticipates an operating capacity emergency, it must bring on all available generation, postpone equipment maintenance, schedule interchange purchases well in advance, and prepare to reduce load.

An example of insufficient generation capacity and the appropriate response could be as follows: if any coal-fired powerplant in Western's load control area was unexpectedly lost, the response would be an increase in CRSP generation or imports to compensate for the change in anticipated generation within the control area.

1.6.2 Transmission (Overload and Voltage Control)

If a transmission facility becomes overloaded or if voltage levels are outside of established limits and the condition cannot be relieved by normal means (such as adjusting generation or interconnection schedules), and a credible contingency under these conditions would adversely impact the interconnection, appropriate relief measures, including load shedding, are implemented promptly to return the transmission facility to within established limits. This action is taken by the system, control area, or pool causing the problem if it can be identified or by other systems or control areas, as appropriate, if identification cannot be readily determined.

An example of a response to an overloaded transmission system could be automatic relay tripping and taking a transmission line out of service or an increase in generation depending on the location of the overloaded transmission line. This action could cause Flaming Gorge Powerplant generation to be reduced or increased instantaneously to a predetermined level, based on the capacity or location of the line taken out of service.

1.6.3 Load Shedding

After taking all other steps, a system or control area, whose integrity is in jeopardy due to insufficient generation or transmission capacity, sheds customer load (i.e., disconnecting a load to an industrial facility or a section of a community) rather than risk an uncontrolled failure of interconnection components.

1.6.4 System Restoration

After a system collapse, restoration begins when it can proceed in an orderly and secure manner. Systems and control areas coordinate their restoration actions. Restoration priority is given to the station supply of powerplants and the transmission system. Even though the restoration should be expeditious, system operators avoid premature action to prevent a re-collapse of the system. Customer load is restored as generation and transmission equipment becomes available, while keeping load and generation in balance at normal frequency as the system is restored.

1.6.5 Emergency Information Exchange

A system control area or pool experiencing or anticipating an operating emergency communicates its current and future status to neighboring systems, control areas, or pools and throughout the interconnection. Systems able to provide emergency assistance make known their capabilities.

1.6.6 Special System or Control Area

Because the facilities of each system may be vital to the interconnection's secure operation, systems and control areas make every effort to remain connected. However, if a system or control area determines that it is endangered by remaining interconnected, it may take action as necessary to protect its system.

If a portion of the interconnection becomes separated from the remainder of the interconnection, abnormal frequency and voltage deviations may occur. To permit re-synchronizing, relief measures could be applied by those separated systems contributing to the frequency and voltage deviations.

An example of when the Flaming Gorge Powerplant might limit its response to the interconnected system would be during a search and rescue operation in the canyon where a need to control the releases exists.

Although emergency situations are infrequent, they do occur and require immediate, short-term changes in powerplant and dam operation. In general, changes resulting from emergencies at Flaming Gorge would result in decreases in flows while emergencies in the system away from the dam could result in either an increase or decrease in flows.

1.7 Public Scoping Process for This Environmental Impact Statement

The scoping process for the Operation of Flaming Gorge Dam EIS was initiated on June 6, 2000, to receive public comment to help determine the appropriate scope of the Flaming Gorge Dam EIS, consistent with requirements of NEPA. The formal scoping period ended on September 5, 2000. Scoping for this EIS was conducted for the following purposes:

- To identify relevant issues associated with the proposed action and its purpose and need.
- To help identify the geographic scope of the EIS—that is, how far upstream/downstream from the dam can impacts be meaningfully evaluated.
- To identify resources that may be affected by the proposed action.
- To identify the interested public or parties affected by the Action Alternative.
- To assist Reclamation in developing reasonable alternatives that are consistent with the purpose of and need for the proposed action.

A Notice of Intent to prepare a draft EIS and announcement of public scoping meetings was published in the *Federal Register* (FR) on June 6, 2000. A corresponding press release announcing that Reclamation was beginning the EIS process for Flaming Gorge Dam was issued the same date.

Public scoping meetings were held in July 2000 in Salt Lake City, Vernal, and Fort Duchesne, Utah; Grand Junction, Colorado; and Rock Springs, Wyoming. A total of 186 attendees registered at the five public scoping meetings, and verbal comments were received from 55 people.

In addition to the verbal comments provided at the five public scoping meetings, Reclamation received 175 form letters, 510 e-mail messages, signed petitions with a total of 1,476 signatures, and 40 letters and postcards from individuals and organizations. During the scoping process, the Forest Supervisor of the Ashley National Forest sent the Area Manager of Reclamation's Provo Area Office a position paper for the EIS (Forest Service Position Paper Technical Appendix). The comments from each oral presentation and each written statement were separated according to the particular issue or resource of concern and placed into appropriate categories. A total of 2,270 separate comments were derived from all of the comments received.

1.8 Scope of Analysis for This Environmental Impact Statement

The purpose of this EIS is to identify and consider the impacts of developing and implementing dam operations guidelines that result in protecting and assisting in the recovery of the populations and designated critical habitat of the four endangered fishes living in the Green River downstream from Flaming Gorge Dam. The scope of analysis for this EIS will focus on responding to the following question:

> If Reclamation operates Flaming Gorge Dam to achieve the 2000 Flow and Temperature Recommendations needed to avoid jeopardy and protect and assist in the recovery of the endangered fishes and their critical habitat in the Green River, consistent with CRSP purposes, then the effect(s) on other relevant resources/issues, both upstream and downstream from the dam, would be . . .

1.8.1 Geographic Scope of Analysis for This Environmental Impact Statement

The geographic area analyzed for possible impacts of the proposed action and alternatives includes Flaming Gorge Reservoir and the Green River downstream from Flaming Gorge Dam, to its confluence with the Colorado River. Because the proposed action depends exclusively on the operation of Flaming Gorge Dam, which is dependent on inflow into Flaming Gorge Reservoir, the Green River upstream of the reservoir is not affected. Please see the maps in the front of this document for a visual representation of the project area, including landmarks referenced throughout the EIS.

1.8.2 Public Issues and Concerns

Based upon scoping results, discussions with interested parties, and existing laws and regulations, Reclamation identified the following resources, issues, or concerns as potentially relevant to this EIS:

- Aquatic resources
- Biodiversity
- Cultural resources
- Disease vectors (mosquitoes)
- EIS/NEPA process (proposed action, purpose and need, scope, and alternatives)
- Environmental justice (potential impacts to low-income or minority populations)
- Facilities (dam and powerplant operation and maintenance and dam safety)
- Fish and wildlife (other than threatened and endangered species)
- Hydroelectric power generation and marketing
- Indian trust assets
- Invasive species
- Land use (agriculture, national parks)
- Reservoir limnology
- Riparian/wetlands
- River and reservoir fisheries
- River and reservoir recreation
- Socioeconomics (tourism-related jobs and income)
- Threatened and endangered species
- Water (conservation, drought, flood control, riverflows, water quality, water rights, water safety, water supply, water temperature, and water use)

Other potentially relevant resources, issues, or concerns may be identified during the process of completing this EIS and would be considered and analyzed as appropriate.

1.8.3 Resources and Significant Issues To Be Analyzed in Detail

The necessary framework to describe the affected environment and assess impacts was provided by several recent EISs, the studies resulting from the U.S. Fish and Wildlife Service's 1992 Biological Opinion, and other recent resource studies. Reclamation has used the best available data in preparing this EIS.

The EIS team consolidated and refined the issues of concern to the public and Federal, State, and tribal governments, identifying the resources and their significant issues to be analyzed in detail. The terms "resource issue" and "resource indicator" as used in this EIS are defined below:

Resource Issue: An effect or perceived effect, risk, or hazard on a physical, biological, social, or economic resource within the affected environment.

Resource Indicator: A quantification (measurement) of any environmental consequence arising from the implementation of 2000 Flow and Temperature Recommendations, which would indicate the presence of certain environmental conditions.

The following presentation summarizes the issues and resource indicators used to measure the impacts of the alternatives.

Issue 1

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the **fish**—their life cycles, habitat, and ability to spawn?

Indicators

Status and condition of the **aquatic food base**

Reproduction, recruitment, and growth of **native fish**

Reproduction, recruitment, and growth of **nonnative fish** (including trout)

Level of interactions between **native and nonnative** fish

Issue 2

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect cultural resources in the study area?

Indicators

Number of **sites** directly, indirectly, or potentially affected

Number of **Native American traditional cultural properties and resources** directly, indirectly, or potentially affected

Issue 3

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **paleontological resources** in the study area?

Indicators

Number of **paleontological resources** directly, indirectly, or potentially affected

Issue 4

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect disease **vectors** (particularly mosquitoes) in the study area?

Indicators

Area and frequency of **flooded bottomlands**

Issue 5

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **environmental justice** in the area?

Indicators

Proportion of affected minority populations and low-income populations

Issue 6

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **operation and maintenance** of the dam and powerplant and would there be any impacts to **dam safety**?

Indicators

Operational limitations, types, and frequency of **maintenance, costs, and hazards**

Issue 7

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **any Indian trust assets**?

Indicators

Leases or rights-of-use for lands, minerals, water rights, hunting and fishing rights, other natural resources, money, or claims

Issue 8

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **recreation** in the study area?

Indicators

River and reservoir **visitation**

River and reservoir **economic value**

River and reservoir **recreation safety**

Issue 9

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **vegetation** in the river corridor?

Indicators

Condition of vegetation and species composition of **wetlands**

Condition of vegetation and species composition of **riparian habitat**

Distribution and establishment of **invasive species**

Issue 10

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **wildlife (other than endangered species)** in the river corridor?

Indicators

Quality and composition of **woody and emergent marsh plants** for wildlife habitat

Abundance of **aquatic food base** for wintering waterfowl

Issue 11

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **land uses** in the area?

Indicators

Acres for **farming or ranching**

Mineral rights accessibility

Recreation uses

Issue 12

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the ability of Flaming Gorge Powerplant to supply **hydropower** at the lowest possible cost?

Indicators

Power operations flexibility

Power marketing resources, costs, and rates

Issue 13

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **sediment** resources throughout the study area?

Indicators

Contraction or expansion of **debris fans and rapids**

Riverbank erosion or aggradation

Sandbar development

Issue 14

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **threatened and endangered species** in the area?

Indicators

Reproduction, recruitment, and growth of the **Colorado pikeminnow, humpback chub, razorback sucker, and bonytail**

Quality, condition, and use of habitat for the **southwestern willow flycatcher**

Distribution and abundance of **Ute ladies'-tresses, bald eagle, yellow-billed cuckoo, and whooping crane**

Issue 15

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the **amount and**

quality of water in and available from Flaming Gorge Reservoir at specific times?

Indicators

Acre-feet of **streamflows**

Frequency of volume of **floodflow and other spills**

Acre-feet of **reservoir storage**

Chemical, physical, and biological characteristics of **water quality**

Issue 16

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **visual resources**?

Indicators

USDA Forest Service **visual resource** management goals

Issue 17

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect the **sport fishery** in the Green River?

Indicators

Reproduction, **recruitment**, **growth**, **body condition**, and **population size**

Preferred **temperatures** for trout species

Preferred **habitats** of adult (spawning and non-spawning) and young trout

Food resources

Issue 18

How would operating Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations affect **socioeconomics**?

Indicators

Regional economic activity (**output, employment, income**)

1.8.4 Issues Raised During Scoping Which Are Not Analyzed in Further Detail in This EIS

During the scoping process for this EIS, concerns were expressed regarding how the proposed action might affect water rights. A review of the hydrology modeling of both alternatives confirms that neither operational alternative would affect water rights within the context of the authorized purposes of Flaming Gorge Dam.

The United States of America segregated the undeveloped portion of Water Right No. 41-2963 (A30414) and assigned it to the Utah Board of Water Resources on March 12, 1996. This segregated Water Right No. 41-3479 (A30414b) is commonly referred to as the “Flaming Gorge Right” and is being reserved for future water development.

Both the segregation application that created Water Right No. 41-3479 and the assignment documents that gave it to the Department of Water Resources make Water Right No. 41-3479 subordinate to Water Right No. 41-2963. These documents clearly show Water Right No. 41-3479 is not entitled to storage in Flaming Gorge Reservoir and is entitled to divert water only as it is being released under the Flaming Gorge Dam operations.

1.9 RELATED AND ONGOING ACTIONS

This section describes laws and projects that affect the operation of Flaming Gorge Dam and may affect the potential impacts of the proposed action. Where applicable, these laws and projects are factored into the analysis of potential impacts under both alternatives, particularly the cumulative impacts analysis (section 4.16).

1.9.1 Regulatory Requirements

Federal statutes establish a number of responsibilities for the Secretary. These legislated responsibilities relate to the management of numerous agencies, projects, and lands, all or some relating to the operation of Flaming Gorge Dam. In some cases, the statutes specifically require the Secretary to mandate responsibility for management of reservoirs; while in others, the statutes allow the Secretary to grant discretionary authority.

1.9.1.1 The Law of the River

As a tributary of the Colorado River, the Green River is managed and operated according to a collection of over 50 compacts; Federal and State laws; court decisions and decrees; and contracts, treaties, and regulatory guidelines collectively known as the Law of the River. This collection of documents apportions the water among the seven Basin States and Mexico, and regulates and manages riverflows. Some of the statutes included within the Law of the River having a major impact on dam operations follow:

- ❖ Colorado River Compact of 1922
- ❖ Upper Colorado River Basin Compact of 1948
- ❖ Colorado River Storage Project Act of 1956
- ❖ Colorado River Basin Project Act of 1968

1.9.1.2 National Parks and Recreation Areas

The affected environment for this EIS includes portions of Flaming Gorge National Recreation Area, Dinosaur National Monument, and Canyonlands National Park. Enabling legislation for these units includes:

- ❖ Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540)
- ❖ Antiquities Act of 1906, 16 U.S.C. 431-433. The Dinosaur National Monument was originally designated by President Wilson in October 1915 and was enlarged by President Roosevelt in 1938.

Management authorities include:

- ❖ National Park Service Organic Act (16 U.S.C. 1-4, 22, 43)
- ❖ National Park Service General Authorities Act of 1970 (16 U.S.C. 1a-1)
- ❖ Redwood National Park Act of 1978 (P.L. 95-250, 92 Statute 163, as amended)

1.9.1.3 Environmental Compliance

Laws and Executive orders that were designed to restore and protect the natural environment of the United States relating to air, water, land, and fish and wildlife include the following:

- ❖ National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.)
- ❖ Endangered Species Act of 1973 (16 U.S.C. 1532 et seq.)
- ❖ Wilderness Act of 1964 (16 U.S.C. 1131 et seq.)
- ❖ Wild and Scenic Rivers Act of 1968 (16 U.S.C. 1271 et seq.)
- ❖ Clean Air Act (42 U.S.C. 7401 et seq.)

- ❖ Clean Water Act of 1972 (33 U.S.C. 1251 et seq.)
- ❖ Migratory Bird Treat Act of 1918 (16 U.S.C. 703 et seq.)
- ❖ Executive Order 11988, Floodplain Management, 1977
- ❖ Executive Order 13112, Invasive Species, 1999
- ❖ Executive Order 11990, Protection of Wetlands, 1977

1.9.1.4 Cultural Resource Laws

Laws designed to protect and preserve historic and cultural resources under Federal control include the following:

- ❖ National Historic Preservation Act (16 U.S.C. 470 et seq., 1966)
- ❖ Archaeological Resources Protection Act (16 U.S.C. 470aa et seq., 1974)

1.9.1.5 Native American Laws

Laws and policies relating to Native American consultation include the following:

- ❖ American Indian Religious Freedom Act (42 U.S.C. 1996, 1973)
- ❖ Enhancing the Intergovernmental Partnership, Executive Order 12875 of October 26, 1993 (58 FR 58093)
- ❖ Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. 3001)
- ❖ Consultation and Coordination with Indian Tribal Governments, Executive Order 13084 of May 14, 1998
- ❖ Protection of Indian Sacred Sites, Executive Order 13007 of May 24, 1996 (61 FR 26771)

1.9.2 Related Programs, Projects, and Activities

1.9.2.1 Recovery Program

As discussed in section 1.4.4, the Recovery Program's goal is to protect and recover the endangered fish of the Upper Colorado River Basin while allowing existing uses and future water development to continue in accord with the "Law of the River." The Recovery Program has a variety of programs and projects underway, concerning habitat acquisition or enhancement, levee removal, nonnative fish control, and native fish stocking, aimed at achieving that goal. The proposed action for which this EIS has been prepared—operating Flaming Gorge Dam as specified in the Recovery Program's 2000 Flow and Temperature Recommendations—would complement the other Recovery Program activities in moving toward endangered fish recovery.

1.9.2.2 Interim Surplus Guidelines and Colorado River Basin Project Act 602(a) Storage Requirement

Flaming Gorge is part of the Colorado Basin and is indirectly affected by decisions made under the December 2000 *Colorado River Interim Surplus Guidelines Final Environmental Impact Statement*. However, the effects are not measurable. In addition, Reclamation is currently preparing an environmental assessment on a proposed guideline to determine the amount of upper basin water required under Section 602(a) of the Colorado River Basin Project Act. This guideline could affect operations at Lake Powell but most likely would not influence operations at Flaming Gorge.

1.9.2.3 Relocation of Little Hole National Recreation Trail

The 7.2-mile segment of the Little Hole National Recreation Trail along the Green River between the Flaming Gorge Dam Spillway Recreation Complex (boat ramp launching and parking area) and Little Hole Recreation Complex (boat ramps, parking, and day use areas) will be relocated by the USDA Forest Service pending funding to prevent recurring trail damage and loss that has occurred from past high flows. Without relocation of the trail, further damage would be expected to occur under both the No Action and Action Alternatives.

This 7.2-mile trail segment provides access to the Green River for tens of thousands of annual visitors who participate in shore and boat fishing, scenic and recreational floating, hiking, and sightseeing activities. Several commercial operators also use the trail as part of their outfitting and guiding business. Annual trail use has ranged from 54,000 to 101,000 visitors over the past 11 years. Annual visitation numbers, types, and the economic value of uses along the trail are discussed and displayed in section 3.11 of this EIS.

The USDA Forest Service completed a field assessment and report in July 2001 of trail locations along the 7.2-mile trail segment. This assessment identified trail damage and repairs that have occurred from 1979 to the present due to releases from the dam, either in response to extremely wet hydrologic years or to support endangered fish research studies. The assessment also addressed alternative trail designs, locations, and costs that would prevent recurring trail damage and loss. Depending on alternative trail locations, the design and construction cost estimates ranged from $135,000 to $308,000. The USDA Forest Service will evaluate and analyze the alternative trail designs and locations as part of a separate NEPA process and document. In addition, the USDA Forest Service will evaluate and analyze the designs and plans for reconstruction of other ramps, picnic sites, and campsites affected during high releases along the Green River. Such facilities will also be relocated pending funding. The USDA Forest Service environmental document will tier to the EIS for the operation of Flaming Gorge Dam, as appropriate, relating to environmental, social, and economic resources and issues.

The USDA Forest Service, Reclamation, and other concerned Federal and State agencies will cooperate during the preparation of the referenced environmental document for the relocation of the trail and related facilities to assure that issues are addressed for the operation of the dam, riverflows, user safety, and protection of natural and physical resources. Reclamation will support the USDA Forest Service in obtaining funding through the USDA Forest Service budgeting process that will be needed to complete the USDA Forest Service environmental document and the relocation of the trail and related facilities.

1.9.2.4 Browns Park Highway Environmental Impact Statement

An EIS is currently being prepared for a Daggett County, Utah, proposal to realign and pave Browns Park Road from its junction with U.S. 191 in Utah to Colorado Route 318. The existing, unpaved 16.8-mile long segment of road crosses BLM, State, and private lands. Scoping meetings were held by the Federal Highway Administration, Utah Department of Transportation, and BLM in December 1999.

1.9.2.5 Cedar Springs Marina Environmental Impact Statement

The Ashley National Forest is currently preparing an EIS to upgrade the Cedar Springs Marina to include the full spectrum of facilities that are necessary to fully serve the public. A Notice of Intent was published in the *Federal Register* August 18, 2004.

1.9.2.6 Resource Management Plans and Wild and Scenic Rivers Eligibility Determination

The BLM Vernal Field Office is preparing to scope the draft resource management plan (RMP)/EIS for approximately 1.8 million acres in northeastern Utah. This plan, known as the Vernal Resource Management Plan, will combine the existing Diamond Mountain and Book Cliffs RMPs into a single plan. The final EIS is scheduled to be completed in September 2005.

The Ashley National Forest began revisions in March 2004 of its Land and Resource Management Plan, commonly referred to as Forest Plan. The process for revision of this plan, including NEPA compliance, is expected to take 4 to 5 years. The Ashley National Forest is also currently conducting an eligibility determination study pursuant to the Wild and Scenic Rivers Act of 1968. A final report is planned for August 2005.

1.9.2.7 Federal Reserve Water Rights

Canyonlands National Park and Dinosaur National Monument have incomplete Federal water rights to the Green River. However, the National Park Service is not actively working with the State of Utah to quantify those rights. Future plans for quantification are uncertain.

2.0 Description of Alternatives

2.1 Introduction

This chapter describes the two alternatives analyzed in detail in this environmental impact statement (EIS), the No Action Alternative and the Action Alternative. This chapter also explains the criteria for selecting alternatives and discusses alternatives that were considered but not analyzed in detail.

Based on descriptions of the relevant resources in **Chapter 3.0, Affected Environment**, and the predicted effects of the alternatives in **Chapter 4.0, Environmental Consequences**, this chapter also presents a summary comparison of the predicted environmental effects of both alternatives on the quality of the human environment in section 2.6.

Under the No Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended by the 1992 Biological Opinion on the Operation of Flaming Gorge Dam. Depending upon the hydrologic conditions of the upper Green River Basin, forecasted flows on the Yampa River would be supplemented by releases from Flaming Gorge Dam designed to achieve the peak flow, duration, and base flow (riverflows not associated with snowmelt runoff) recommendations described in the 1992 Biological Opinion.

Under the Action Alternative, Flaming Gorge Dam would be operated with a goal of achieving the flow and temperature regimes recommended in the September 2000 *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations) report, prepared by participants of the Upper Colorado River Endangered Fish Recovery Program

(Recovery Program). The 2000 Flow and Temperature Recommendations specifically describe the peak flows, durations, water temperatures, and base flow criteria necessary for the recovery of the endangered fishes. The Action Alternative is the operational strategy that is in accord with these flow and temperature criteria and the authorized purposes of the Flaming Gorge Unit of the Colorado River Storage Project (CRSP).

2.2 DEVELOPMENT OF ALTERNATIVES

2.2.1 Criteria Used to Select Alternatives

Potential alternatives to be analyzed in this EIS were studied to determine whether they could meet the purpose of and need for the proposed action. A number of scenarios for dam operation, originally thought to be viable alternatives, were determined to be more accurately described as possible subsets of the Action Alternative. Because of the inherent need for operational flexibility in dam operations, as acknowledged by and incorporated into the 2000 Flow and Temperature Recommendations, and because any potential impacts from discreet operational scenarios are already captured by analysis of the Action and No Action Alternatives, it was determined that analyzing subtle differences in dam operations as separate alternatives would not yield meaningful information for the public or the decisionmaker.

Alternatives that are included in this analysis are those which both:

- ❖ Meet flow and temperature recommendations as described in the 2000 Flow and Temperature Recommendations
- ❖ Maintain all authorized purposes of the Flaming Gorge Unit of the CRSP

2.2.2 Alternatives Considered but Eliminated From Detailed Study

In accordance with Section 1502.14 (a) of the Council on Environmental Quality regulations implementing the National Environmental Policy Act, this section discusses alternatives that were considered but eliminated from detailed study, and briefly explains the reasons for their elimination.

2.2.2.1 Modified Run of the River Alternative

During the scoping process, the National Park Service and others requested consideration of a Run of the River Alternative. Under such an alternative, dam releases would match the reservoir inflow (unregulated) to provide a more natural flow regime including more natural variations in the daily flows of the Green River below Flaming Gorge Dam. Further analysis of this alternative led to the establishment of a Modified Run of River Alternative, where dam releases equaled 87 percent (%) of the unregulated inflow to the reservoir. This provided reservoir operators the ability to store 13% of the spring inflow volume for release to meet project purposes and flow recommendations at other times of the year. The 87% level was chosen because it was the highest percentage that provided enough water storage to achieve the base flow ranges recommended in the 2000 Flow and Temperature Recommendations. Percentages higher than 87% could not achieve the recommended base flows of the 2000 Flow and Temperature Recommendations.

Preliminary analysis of the historic inflows into Flaming Gorge did show that it might be possible to operate Flaming Gorge using a "Modified Run of River" approach to achieve the 2000 Flow and Temperature Recommendations during the spring. However, it was learned through this study that the effect of water consumption above Flaming Gorge played a much more significant role than was originally thought. The Flaming Gorge Model did account for the inevitability that water consumption will increase in the future. The *Consumptive Uses and Losses Report*, published by Reclamation, estimates that current water consumption above Flaming Gorge Reservoir is about 450,000 acre-feet per year. This is about 25% of the mean annual unregulated inflow into Flaming Gorge Reservoir. In addition to the level of water consumed, irrigation diversions, which are not entirely consumed, occur most often during the months of May through August. While irrigation diversions are not usually completely consumed, there tends to be a lag period before the water returns to the river. Sometimes, this lag period can be as long as several months. Water consumption and diversions can significantly decrease the unregulated inflow peaks that occur during the spring. As a result, the "Modified Run of River" approach released less water than would have been released under natural conditions. For this reason, the "Modified Run of the River" could not achieve the spring flow objectives of the 2000 Flow and Temperature Recommendations.

Water consumption on the Green River has an ever increasing effect on the inflows (and unregulated inflows) to Flaming Gorge Reservoir. Consequently, water consumption will further complicate Reclamation's ability to achieve the 2000 Flow and Temperature Recommendations in the future. This modeling study indicated that, in the case of a "Modified Run of River" approach for operating Flaming Gorge Dam, the current level of water consumption in the Green River Basin already makes it too difficult to achieve the 2000 Flow and Temperature Recommendations without having significant negative impacts on the other resources associated with Flaming Gorge Reservoir. Based on these findings, the "Modified Run of River" approach was not considered a viable alternative that could be included for analysis in the Flaming Gorge Environmental Impact Statement.

2.2.2.2 Decommissioning and Removing Flaming Gorge Dam

During the scoping process, a request was made to consider decommissioning the dam as an alternative to allow endangered fish to recover. This alternative was not selected for detailed study in this EIS because it does not meet the purpose of and need for the proposed action. Specifically, decommissioning the dam would prevent continuing the authorized purposes of the dam under the CRSP and the Flaming Gorge National Recreation Area authorizing legislation, among others.

2.3 Description of the Alternatives Analyzed in This Environmental Impact Statement

2.3.1 No Action Alternative

Under the No Action Alternative, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the 1992 Biological Opinion. Flows recommended in the 1992 Biological Opinion were intended to mimic a more natural hydrograph than what occurred under previous dam operations and to protect nursery habitats of endangered fishes downstream from the Yampa River confluence.

Under normal operations, reservoir releases through Flaming Gorge Powerplant range from 800 to 4,600 cubic feet per second (cfs). These flows adhere to the interim operating criteria for Flaming Gorge Dam established by Reclamation in September 1974. Under these criteria, Reclamation agreed to provide (1) a minimum flow of 400 cfs at all times, (2) flows of 800 cfs under normal conditions and for the foreseeable future, and (3) flows exceeding 800 cfs when compatible with other CRSP reservoir operations.

Temperature requirements under the No Action Alternative, specified in the Reasonable and Prudent Alternative of the 1992 Biological Opinion (page 30), include the following:

> *Releases from Flaming Gorge beginning July 1 and continuing until November 1 should be of the warmest water available, approaching 59 degrees F (15 degrees C)[1] (highest lake levels). By releasing the warmest water available during this period, water temperatures in the upper Green River should not differ more than 9 degrees F (5 degrees C) in the Yampa River at Echo Park and should average near 72-77 degrees F (22-25 degrees C) in Gray Canyon from July 1 to August 15.*

2.3.2 Action Alternative

Under the Action Alternative, Flaming Gorge Dam would be operated with the goal of achieving the 2000 Flow and Temperature Recommendations while maintaining and continuing all authorized purposes of Flaming Gorge Dam and Reservoir. The 2000 Flow and Temperature Recommendations provide targets for each of the three sections or "reaches" of the Green River below Flaming Gorge Dam.

- ❖ Reach 1 begins at Flaming Gorge Dam and extends 65 river miles to the confluence of the Yampa River. In this reach, the Green River meanders about 10 river miles into northwestern Colorado and then flows southward for about 30 river miles. This reach is almost entirely regulated by releases from Flaming Gorge Dam.
- ❖ Reach 2 begins at the confluence of the Green and Yampa Rivers in Colorado and extends 99 river miles southwest to the White River confluence near Ouray, Uintah County, Utah. In this reach, tributary flows from the Yampa River combine with releases from Flaming Gorge Dam to provide a less regulated flow regime than in Reach 1.
- ❖ Reach 3 begins at the confluence of the Green and White Rivers and extends 246 river miles south to the Colorado River confluence in Canyonlands National Park at the boundary of Wayne and San Juan Counties in southeastern Utah. In this reach, the Green River is further influenced by tributary flows from the White, Duchesne, Price, and San Rafael Rivers.

Table 2-1 shows a summary of the recommended spring peak and summer-to-winter base flows from the 2000 Flow and Temperature Recommendations report for all three reaches of the Green River. Under the Action Alternative, Flaming Gorge Dam would be operated with the goal of achieving the 2000 Flow and Temperature Recommendations while maintaining and continuing all authorized purposes of Flaming Gorge Dam and Reservoir.

The 2000 Flow and Temperature Recommendations for each reach are not integrated in such a way that a particular release from Flaming Gorge Dam could equally achieve the recommendations for each reach simultaneously. The intent of the Action Alternative is first to meet the recommended objectives for Reach 2 and then, if necessary, make adjustments to releases so that the recommended objectives for Reach 1 could also be met. It is assumed that the flow objectives in Reach 3 are met whenever the flow objectives in Reach 2 are met.

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[1] Degrees Fahrenheit (°F); degrees Celsius (°C).

Table 2-1.—Recommended Magnitudes and Duration of Maximum Spring Peak and Summer-to-Winter Base Flows and Temperatures for Endangered Fishes in the Green River Downstream From Flaming Gorge Dam as Identified in the 2000 Flow and Temperature Recommendations

Location	Flow and Temperature Characteristics	Hydrologic Conditions and 2000 Flow and Temperature Recommendations[1]				
		Wet[2] (0–10% Exceedance)	Moderately Wet[3] (10–30% Exceedance)	Average[4] (30–70% Exceedance)	Moderately Dry[5] (70–90% Exceedance)	Dry[6] (90–100% Exceedance)
Reach 1 Flaming Gorge Dam to Yampa River	Maximum Spring Peak Flow	$8,600 cfs (244 cubic meters per second [m^3/s])	$4,600 cfs (130 m^3/s)	$4,600 cfs (130 m^3/s)	$4,600 cfs (130 m^3/s)	$4,600 cfs (130 m^3/s)
	Peak flow duration is dependent upon the amount of unregulated inflows into the Green River and the flows needed to achieve the recommended flows in Reaches 2 and 3.					
	Summer-to-Winter Base Flow	1,800–2,700 cfs (50–60 m^3/s)	1,500–2,600 cfs (42–72 m^3/s)	800–2,200 cfs (23–62 m^3/s)	800–1,300 cfs (23–37 m^3/s)	800–1,000 cfs (23–28 m^3/s)
Above Yampa River Confluence	Water Temperature Target	$ 64 degrees Fahrenheit (°F) (18 degrees Celsius [°C]) for 3-5 weeks from mid-August to March1	$ 64 °F (18 °C) for 3-5 weeks from mid-August to March 1	$ 64 °F (18 °C) for 3-5 weeks from mid-July to March 1	$ 64 °F (18 °C) for 3-5 weeks from June to March 1	$ 64 °F (18 °C) for 3-5 weeks from mid-June to March 1
Reach 2 Yampa River to White River	Maximum Spring Peak Flow	$26,400 cfs (748 m^3/s)	$20,300 cfs (575 m^3/s)	$18,600 cfs[7] (527 m^3/s) $8,300 cfs[8] (235 m^3/s)	$8,300 cfs (235 m^3/s)	$8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 22,700 cfs (643 m^3/s) should be maintained for 2 weeks or more, and flows$18,600 cfs (527 m^3/s) for 4 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance)
	Summer-to-Winter Base Flow	2,800–3,000 cfs (79–85 m^3/s)	2,400–2,800 cfs (69–79 m^3/s)	1,500–2,400 cfs (43–67 m^3/s)	1,100–1,500 cfs (31–43 m^3/s)	900–1,100 cfs (26–31 m^3/s)
Below Yampa River Confluence	Water Temperature Target	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.
Reach 3 White River to Colorado River	Maximum Spring Peak Flow	$39,000 cfs (1,104 m^3/s)	$24,000 cfs (680 m^3/s)	$22,000 cfs[9] (623 m^3/s)	$8,300 cfs (235 m^3/s)	$8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 24,000 cfs (680 m^3/s) should be maintained for 2 weeks or more, and flows 22,000 cfs (623 m^3/s) for 4 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance)
	Summer-to-Winter Base Flow	3,200–4,700 cfs (92–133 m^3/s)	2,700–4,700 cfs (76–133 m^3/s)	1,800–4,200 cfs (52–119 m^3/s)	1,500–3,400 cfs (42–95 m^3/s)	1,300-2,600 cfs (32–72 m^3/s)

[1] Recommended flows as measured at the United States Geological Survey gauge located near Greendale, Utah, for Reach 1; Jensen, Utah, for Reach 2; and Green River, Utah, for Reach 3.

[2] **Wet** (0% exceedance): A year in which the forecasted runoff volume is larger than almost all of the historic runoff volumes. This hydrologic condition has a 10% probability of occurrence.

[3] **Moderately Wet** (10–30% exceedance): A year in which the forecasted runoff volume is larger than most of the historic runoff volumes. This hydrologic condition has a 20% probability of occurrence.

[4] **Average** (30–70% exceedance): A year in which the forecasted runoff volume is comparable to the long-term historical average runoff volumes.

[5] **Moderately Dry** (70–90% exceedance): A year in which the forecasted runoff volume is less than almost all of the historic runoff volumes. This hydrologic condition has a 20% probability of occurrence.

[6] **Dry** (90–100% exceedance): A year in which the forecasted runoff volume is less than almost all of the historic runoff volumes. This hydrologic condition has a 10% probability of occurrence.

[7] Recommended flows $18,600 cfs (527 m^3/s) in 1 of 2 average years.

[8] Recommended flows $8,300 cfs (235 m^3/s) in other average years.

[9] Recommended flows $22,000 cfs (623 m^3/s) in 1 of 2 average years.

The 2000 Flow and Temperature Recommendations focus primarily on the flow regimes in Reaches 2 and 3, which include flows from the Yampa River. However, since these riverflow criteria are based solely on upper Green River hydrology, the 2000 Flow and Temperature Recommendations in Reaches 1 and 2 would most likely be achieved to varying degrees. For example, in years when the upper Green River Basin is wetter than the Yampa River Basin, meeting the 2000 Flow and Temperature Recommendations in Reaches 2 and 3 would most likely exceed the minimum target for the peak flow recommendations for Reach 1.

Conversely, if the Yampa River Basin is wetter than the upper Green River Basin, meeting the 2000 Flow and Temperature Recommendations for Reaches 2 and 3 could result in falling short of the peak flow target for Reach 1. Under this scenario, the Action Alternative might require Flaming Gorge Dam releases to be increased so that the 2000 Flow and Temperature Recommendations in Reach 1 could also be met. Flows in Reaches 2 and 3 would then exceed their respective minimum 2000 Flow and Temperature Recommendations. Since only one release pattern can be selected each year, depending upon how water is distributed between the upper Green River and Yampa River Basins, each reach would achieve or exceed its respective minimum 2000 Flow and Temperature Recommendations to varying degrees.

Each year, Reclamation would work closely with the U.S. Fish and Wildlife Service and Western Area Power Administration in developing a flow regime consistent with the 2000 Flow and Temperature Recommendations and CRSP purposes and would also consider input from the Flaming Gorge Working Group meetings. The framework for this decisionmaking process is described in section 2.5. The overall effectiveness of implementing the objectives of the 2000 Flow and Temperature Recommendations would be measured by the long-term frequency of achieving flow thresholds described in the 2000 Flow and Temperature Recommendations. Consideration would be given to hydrologic conditions, operational limitations, and past operational conditions. An administrative record of the operational decisionmaking would be maintained and available to the public. This record would include analysis of previous operations and the effectiveness of achieving desired targets on a year-by-year basis.

Water release temperatures at the dam would be regulated with the objective of achieving target temperatures for upper Lodore Canyon and the Yampa River and Green River confluence during the first 2 to 5 weeks of the base flow period and/or when Colorado pikeminnow larvae are present at this confluence.

2.4 REVIEW OF FLAMING GORGE MODEL DEVELOPED FOR THE FLAMING GORGE DAM EIS

As detailed in section 4.3.1.1, a river simulation model (Flaming Gorge Model) was developed for the Green River system to assess impacts of Flaming Gorge Dam operations in this EIS. The model was developed using the RiverWare simulation modeling software package. The Flaming Gorge Model evaluates two alternative operations: the No Action Alternative (operation of Flaming Gorge Dam as prescribed by the 1992 Biological Opinion; U.S. Fish and Wildlife Service, 1992) and the Action Alternative (operation of Flaming Gorge Dam consistent with the 2000 Flow and Temperature Recommendations). The model takes, as input, a set of natural flow volumes and estimates what release volumes and storage volumes would occur under the two operating regimes. The model then routes these release volumes through the

Green River to the U.S. Geological Survey (USGS) streamflow gauge on the Green River at Jensen, Utah, approximately 93 miles downstream from Flaming Gorge Dam.

For the Action Alternative, the Flaming Gorge Model predicts more frequent use of the bypass tubes and spillway at Flaming Gorge Dam when compared to the No Action Alternative. Under the Action Alternative, the Flaming Gorge Model predicts that the bypass tubes would be used in 50% of all years, and the spillway would be used in 29% of all years. In comparison, under the No Action Alternative, the bypass tubes would be used in 23% of all years, and the spillway would be used in 5% of all years.

A review of the Flaming Gorge Model was performed by three authors of the 2000 Flow and Temperature Recommendations to evaluate whether the degree of bypass and spill predicted by the Flaming Gorge Model would be necessary to meet the requirements of the 2000 Flow and Temperature Recommendations (see peer review report in the Hydrologic Modeling Technical Appendix). The review did not include an evaluation of the No Action Alternative. While the main focus of the model review was the frequency of bypass and spillway use, the reviewers also examined the model's behavior and evaluated how the model simulated the year-round operation of Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations.

2.4.1 Review Findings

In most situations, the reviewers found that the Flaming Gorge Model properly simulates the operation of Flaming Gorge Dam to meet the 2000 Flow and Temperature Recommendations in Reach 2, while minimizing the effects on authorized purposes of the dam.

The reviewers found that the Flaming Gorge Model performs well in dry, moderately dry, and average years. The review did show that the model appeared to bypass or spill more water than may be necessary in moderately wet and wet years, however.

A key issue with river simulation modeling is a lack of flexibility. Rules must be 'hard coded' into the operational decisionmaking of the model. While many model rules allow for decision trees, a model such as the Flaming Gorge Model cannot adjust to all situations or consider the balance of all available operating options. The inability to program extensive flexibility into the model's rules makes precise modeling of the effects of the 2000 Flow and Temperature Recommendations more difficult.

Reclamation acknowledges that the Flaming Gorge Model may overstate bypasses and, therefore, may overstate potential effects that result from bypassing water. Reclamation also notes that while the Flaming Gorge Model provides good information to assess potential effects of operating to meet the 2000 Flow and Temperature Recommendations, details and flexibility that cannot be captured by modeling will be factored into operational decisionmaking each year. Therefore, the following section provides further clarification on operations to implement both the No Action and Action Alternatives.

2.5 Operational Description

This section describes how Reclamation would implement the Action and No Action Alternatives while maintaining the authorized purposes and ensuring safe operations of Flaming Gorge Dam under normal operational conditions as explained in section 1.6. Operational plans could change due to malfunction of dam and powerplant equipment and during public emergencies.

2.5.1 Safe Operation of Flaming Gorge Dam

Safe operation of Flaming Gorge Dam is of paramount importance and applies to both the Action and the No Action Alternative. To safely and efficiently operate Flaming Gorge Dam, forecasted future inflows must be incorporated into the decisionmaking process. (See section 1.5 for a description of the operational decisionmaking process.)

These forecasted future inflows are provided by the National Weather Service through the River Forecast Center and are issued as monthly or seasonal (April through July) volumes of unregulated inflow that are anticipated to occur during the forecast period. When a forecast does not accurately predict the actual inflow that occurs, a forecast error is associated with the forecast. A forecast error is the volume difference between the forecasted inflow volume for the period and the actual inflow volume for the period. Forecast errors are attributable mostly to hydrologic variability and, to a much lesser degree, the forecasting procedure. For this reason, forecast errors will always be a factor associated with the operation of Flaming Gorge Reservoir.

Analysis of the historic forecast errors at Flaming Gorge was performed by the Colorado River Forecasting Service Technical Committee (CRFSTC) in April of 1987. This committee reported 5% exceedance forecast errors (table 2-2). Forecast errors of this magnitude occur in 1 out of every 20 years on average, and errors of greater magnitude occur less frequently. From the information provided by the CRFSTC, forecast errors at the 1% exceedance level (1 out of every 100 years) were computed. Exceedance levels indicate the frequency of the event in question. A 5% exceedance forecast error can be expected to occur about 5% of the time or about 1 out of every 20 years. A 1% exceedance error can be expected to occur about 1% of the time or about 1 year out of every 100 years.

Table 2-2.—CRFSTC Recommended Forecast Errors for Flaming Gorge Dam

Month	5% Exceedance Forecast Errors in 1 in 20 years (1,000 acre-feet)	1% Exceedance Forecast Errors in 1 in 100 years (1,000 acre-feet)
January	760	1,065
February	680	962
March	610	862
April	550	778
May	480	680
June	410	581
July	375	531

Safe operation of Flaming Gorge Reservoir limits the risk of uncontrolled spills to 1% when the greatest foreseeable forecast error occurs. In other words, the safe operation of Flaming Gorge Reservoir must assure that 99% of the foreseeable forecast errors can be successfully routed through the reservoir without uncontrolled spills occurring. To limit this risk, vacant storage space must be maintained in the reservoir at various times of the year to absorb the additional inflow volume if a forecast error occurs. For this reason, the reservoir elevation is intentionally drawn down during the fall and winter months.

The upper limit drawdown levels established as safe operating parameters for Flaming Gorge Reservoir were determined through routing studies of forecast error scenarios. These scenarios were based on the 1% exceedance forecast errors shown in table 2-2. The scenario that had the largest risk of an uncontrolled spill was routed through the reservoir beginning in May with various reservoir elevations and various inflow volumes that were based on historic records. The highest end of May elevations, where the 1% exceedance forecast error was successfully absorbed by the reservoir without an uncontrolled spill, was established as the upper limit drawdown levels for that forecast volume.

Upper limit drawdown levels for the safe operation of Flaming Gorge Reservoir under both the Action and No Action Alternatives are shown in table 2-3.

Table 2-3.—Upper Limit Drawdown Levels for Flaming Gorge Reservoir

Unregulated Inflow Forecast Percentage Exceedance Range	May 1 Upper Limit Drawdown Elevation Level
1 to 10	6023
10.1 to 30	6024
30.1 to 40	6025
40.1 to 59.9	6027

2.5.2 Reservoir Operations Process Under the No Action Alternative

2.5.2.1 Operations in May Through July (Spring Period)

Under the No Action Alternative, the hydrologic condition of the upper Green River Basin, including the April through July unregulated inflow forecast and the condition of the reservoir, would be used to establish the magnitude and duration of a spring peak release for the current year. The magnitude of the spring release would usually be from 4,000 cfs to powerplant capacity (about 4,600 cfs), unless hydrologic conditions indicated that bypasses (or spills) would be necessary for safe operations of the dam. In such case, these bypasses (or spills) would be timed to occur when the Yampa River peak flows and immediate post peak flows occur. The bypass tubes or spillway could potentially be used to make releases when dam or powerplant equipment is unavailable due to malfunction or maintenance.

Through consultation with the U.S. Fish and Wildlife Service and Western Area Power Administration (Western), Reclamation would establish a range of spring operational scenarios that would achieve the objectives of the Reasonable and Prudent Alternative of the 1992 Biological Opinion on the Operation of Flaming Gorge Dam. These objectives include ramp rates, magnitudes, durations, and timing of a spring peak release and are described in the 1992 Biological Opinion. The range of spring operational scenarios would provide flexibility in operations to adjust to changing hydrologic conditions and would be based on the probable minimum and probable maximum Water Supply Forecasts issued in April by the River Forecast Center. These forecasts bound the range of reasonable (80% probability) runoff volumes that would likely occur during the April through July time period. Timing of the spring peak release under the range of possible operational scenarios would occur with the peak flows and immediate post peak flows on the Yampa River.

When the hydrologic condition is determined to be dry, the spring peak duration would be 1 to 2 weeks. Most likely, the magnitude of the release during the spring peak in dry years would be limited to powerplant capacity and could be limited to 4,000 cfs to conserve reservoir storage. Peak releases would be timed with the peak flows and immediate post peak flows of the Yampa River. In dry years, the spring peak release would be completed no later than June 20.

When the hydrologic condition is determined to be average, the spring peak duration would be 2 to 5 weeks. The magnitude of the release during the spring peak most likely would be limited to powerplant capacity (about 4,600 cfs). The timing of the peak releases would be with the peak flows and immediate post peak flows of the Yampa River. The spring peak release in average years would be completed by July 10.

Hydrologic conditions determined to be wet would establish a spring peak duration of 5 weeks or greater. Peak releases in wet years could include bypass releases and possibly spillway releases, depending on the hydrologic condition of Flaming Gorge. The use of bypass tubes or the spillway would be based on avoiding uncontrolled spills through an analysis of potential forecast errors. The magnitude of peak releases in wet years would be at least powerplant capacity (about 4,600 cfs). The spring peak release in wet years would be completed by July 20.

2.5.2.2 Use of Bypass Tubes and Spillway at Flaming Gorge Dam

Under the No Action Alternative, the use of the bypass tubes or the spillway would occur only when hydrologically necessary to maintain safe operations of Flaming Gorge Dam, during emergency operations, or when the full release capacity of the powerplant is unavailable. For the No Action Alternative, under normal operations, the magnitude of peak releases for endangered fish would be limited to powerplant capacity (about 4,600 cfs). However, if Reclamation determines that bypass releases would be likely for hydrologic reasons, Reclamation would attempt to schedule these bypass releases to occur with the peak flows and immediate post peak flows of the Yampa River.

2.5.2.3 Summer and Fall Operations (Early Base Flow Period)

Under the No Action Alternative, after the spring peak release is completed, releases from Flaming Gorge Dam would be reduced so that flows of the Green River, measured at Jensen, Utah, would achieve a target flow ranging from 1,100 to 1,800 cfs. Daily average flows would be maintained as close to this target as possible until September 15. After September 15, releases from Flaming Gorge Dam could be increased so that the daily average flow measured at Jensen, Utah, would achieve a target ranging from 1,100 to 2,400 cfs.

During the early base flow period, fluctuating releases for power production would likely occur. These fluctuating releases would be limited so that the hourly flow of the Green River, measured at Jensen, Utah, would be maintained at ±12.5% of the daily average flow of the Green River (measured at Jensen, Utah).[2]

2.5.2.4 Winter Operations (Late Base Flow Period)

There are no specific flow recommendations provided by the 1992 Biological Opinion for the period from November to May. Beginning November 1, the 1992 Biological Opinion calls for releases to be low and stable near historic levels. Under the No Action Alternative, Flaming Gorge daily average releases from November through May potentially could range from 800 cfs to powerplant capacity (about 4,600 cfs). However, it is anticipated that in most years, releases during this period would range from 800 cfs to about 3,000 cfs. Releases from Flaming Gorge Dam during the late base flow period would be designed to reduce the reservoir elevation to maintain safe reservoir operations. A discussion of the safe operation of Flaming Gorge is located in section 2.5.1, "Safe Operation of Flaming Gorge Dam."

Under the No Action Alternative, releases would achieve an upper limit drawdown elevation on March 1 of 6027 feet above sea level. The upper limit drawdown elevations for May 1 under the No Action Alternative are the same as those for the Action Alternative. These elevations can be found in table 2-3 in section 2.5.1.

During the late base flow period, fluctuating releases for power production would likely occur. The Reasonable and Prudent Alternative of the 1992 Biological Opinion

[2] The daily average flow measured at Jensen, Utah, would be determined from the average of the instantaneous flow readings during a 24-hour period from midnight to midnight each day.

does not specifically limit fluctuating releases during the late base flow period. Under the No Action Alternative, however, fluctuating releases would be limited, similar to the early base flow period, as they have been historically. The hourly flow of the Green River measured at Jensen, Utah, would be maintained from ±12.5% of the daily average flow measured at Jensen, Utah.

2.5.3 Reservoir Operations Process Under the Action Alternative

In general, implementation of the 2000 Flow and Temperature Recommendations into the operational plans for Flaming Gorge Dam would occur through coordination as described on page 5-8 of the 2000 Flow and Temperature Recommendations. A Technical Working Group consisting of biologists and hydrologists involved with endangered fish recovery issues would be convened by Reclamation at various times throughout the year. Staff from Reclamation, U.S. Fish and Wildlife Service, and Western would be members of the Technical Working Group as well as other qualified individuals who choose to participate on a voluntary basis.

Reclamation would develop an initial operational plan with balanced consideration of all of the resources associated with Flaming Gorge Reservoir and the Green River. Reclamation would present this initial operational plan to the Technical Working Group for discussion and take into consideration the information described in table 2-5 (later in this chapter) and any new information that may be available to refine the plan to best meet the needs of the endangered fish. Reclamation could make refinements to the plan based on the Technical Working Group's recommendations and then present the new plan to the Flaming Gorge Working Group for additional discussion. Reclamation could further refine the plan based on information gathered at the Flaming Gorge Working Group Meeting. This process would ensure that the 2000 Flow and Temperature Recommendations and the authorized purposes of Flaming Gorge Dam are considered in a balanced and fair manner as each year's operational plan is developed.

Technical Working Group meetings would also provide an opportunity to discuss historic operations in terms of the accomplishments and shortcomings of meeting the 2000 Flow and Temperature Recommendations. Reclamation would maintain an administrative record of these meetings to document the planning process.

2.5.3.1 Operations in May Through July (Spring Period)

Under the Action Alternative, Reclamation would establish the hydrologic classification for the spring period (May through July) based on the forecasted unregulated inflow to Flaming Gorge Reservoir for the April through July period. This forecast is issued by the River Forecast Center beginning in early January and is updated twice a month until the end of July. During the spring period, Reclamation would classify the current hydrology of the Green River system into one of five hydrologic classifications described in the 2000 Flow and Temperature Recommendations (wet, moderately wet, average, moderately dry, and dry). Table 2-4 describes the percent exceedance ranges that would be used for each classification under the Action Alternative.

Table 2-4.—Percentage Exceedances and Hydrologic Classifications

Hydrologic Classification	Percentage Exceedance Range
Wet	<10
Moderately Wet	30 to 10.1
Average	70 to 30.1
Moderately Dry	90 to 70.1
Dry	>90

The hydrologic classification would be used to establish the range of flow magnitudes and durations that could potentially be targeted for the approaching spring release period. These targets would be incorporated into a spring operations plan. This plan would be prepared each year by Reclamation under consultation with the U.S. Fish and Wildlife Service and Western and in coordination with the Technical Working Group prior to the spring Flaming Gorge Working Group meeting. The factors listed in table 5.3 of the 2000 Flow and Temperature Recommendations (shown as table 2-5), along with the established hydrologic classification, would be considered in the development of the operations plan.

In most years, it is expected that the flow magnitudes and durations achieved in Reach 2 each spring would be consistent with the flow magnitudes and durations described in the 2000 Flow and Temperature Recommendations for the hydrologic classification established in May of each year. However, because the factors listed in table 2-5 are also considered, particularly runoff conditions in the Yampa River, there would be some years where the peak flows that occur in Reach 2 achieve the targets for either one or two classifications higher (wetter) or one classification lower (drier) than the actual classification established for the Green River. It is anticipated that in some years, when the hydrologic classification for the Green River is average, that the conditions of factors listed in table 2-5 could occur where it would be possible to achieve the targets established for either the moderately wet or wet classifications. Conversely, there would be some years classified as moderately wet when the conditions of these factors would be such that targets established for the wet or average classification would be met. There could also be years classified as wet where moderately wet targets would be achieved because of the conditions of these factors. It would be the responsibility of Reclamation to ensure that, over the long term, Flaming Gorge Dam and Powerplant are operated consistent with the 2000 Flow and Temperature Recommendations.

The operations plan would describe the current hydrologic classification of the Green River Basin and the hydrologic conditions in the Yampa River Basin, including the most probable runoff patterns for the two basins. The operations plan would also identify the most likely Reach 2 flow magnitudes and durations that would be targeted for the upcoming spring release. Because hydrologic conditions often change during the April through July runoff period, the operations plan would contain a range of operating strategies that could be implemented under varying hydrologic conditions. Flow and duration targets for these alternate operating strategies would be limited to those described for one classification lower or two classifications higher than the classification for the current year.

As stated in section 1.5, the spring operations plan would be presented to the Flaming Gorge Working Group each spring for discussion. Reclamation could modify the plan based on information gathered at the Flaming Gorge Working Group meeting.

In years classified as wet, bypass releases would usually be required to operate the dam safely and to meet the 2000 Flow and Temperature Recommendations. In some years classified as wet, spillway releases also would be necessary for safe operation of the dam. Releases above powerplant capacity in these wet years would be expected to be made for a period of about 4 to 9 weeks. The exact magnitude of the release and duration of the release would depend upon factors identified in table 2-5. Wet year, high releases would be expected to occur from mid-May to early July (and, in very wet years, through July). The bypass and spillway releases, required for safe operation of the dam in wet years, would be timed with the objective to meet Reach 2 wet or moderately wet year targets, depending upon the hydrologic conditions in the Yampa

Table 2-5.—Examples of Real-Time and Other Year-Specific Information To Be Considered in Determining Annual Patterns of Releases From Flaming Gorge Dam for Implementation of the 2000 Flow and Temperature Recommendations to Benefit Endangered Fishes in Downstream Reaches From the Green River

Onset of Spring Peak Flow	Magnitude of Spring Peak Flow	Duration of Spring Peak Flow	Onset of Summer-Winter Base Flow	Magnitude of Summer-Winter Base Flow
Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir	Forecasted and actual inflow to Flaming Gorge Reservoir
Water surface elevation of Flaming Gorge Reservoir	Forecasted and actual flow in the Yampa River and other large tributaries	Forecasted and actual flow in the Yampa River and other large tributaries	Forecasted and actual flow in the Yampa River	Forecasted and actual flow in the Yampa River
Forecasted and actual flows in the Yampa River	Desired areal extent of overbank flooding in Reaches 2 and 3	Desired duration of overbank flooding in Reaches 2 and 3	Initial appearance of drifting Colorado pikeminnow larvae in the Yampa River	Elevation of sandbars in nursery areas
Presence of adult razorback sucker congregations on spawning bars	Flow conditions and extent of overbank flooding in Reaches 2 and 3 in previous year	Desired base flow magnitude	Status of endangered fish populations	Status of endangered fish populations
Initial appearance of larval suckers in established reference sites in Reach 2 (e.g., Cliff Creek)	Existing habitat conditions	Presence of razorback sucker larvae in the Green River	Temperature of water released from the dam	Temperature of water released from the dam
Existing habitat conditions (e.g., condition of razorback sucker spawning sites in Reach 2)	Status of endangered fish populations	Existing habitat conditions	Temperature differences between the Green and Yampa Rivers at their confluence	Temperature differences between the Green and Yampa Rivers at their confluence
		Status of endangered fish populations		

Source: 2000 Flow and Temperature Recommendations, table 5.3.

River. The initiation of bypass and spillway releases would take place in mid- to late May coincident with the Yampa River peak. In extremely wet years, releases above powerplant capacity could be initiated in April or early May before the Yampa River peak.

In years classified as moderately wet, bypass releases usually (but not always) would be required for safe operation of the dam. Occasionally, some use of the spillway also might be required in moderately wet years for safe operation of the dam. The volume of the powerplant bypass in moderately wet years would be less than in wet years and would generally occur for a period of about 1 to 7 weeks. The timing of these releases would be from mid- to late May into June and sometimes extend into July. Releases from Flaming Gorge Reservoir in moderately wet years would be timed with the objective of meeting Reach 2 wet, moderately wet, or average year targets, depending upon the hydrologic conditions in the Yampa River Basin and the information contained in table 2-5.

In years classified as average, bypass releases likely would not be required for safe operation of the dam but periodically would be required to meet the objectives of the 2000 Flow and Temperature Recommendations. In most average years, spring peak releases would be limited to powerplant capacity (about 4,600 cfs) with peak releases taking place for about 1 to 8 weeks, usually in the mid-May to late June (but occasionally extending into July) time period. In about 1 out of every 3 average years, bypass releases from Flaming Gorge Dam would be required to achieve the Reach 2 flow recommendation peak and duration targets. In these years, the objective would be to achieve targeted flows in Reach 2 of 18,600 cfs for 2 weeks. To conserve water, bypass releases in these average years would be made only to the extent necessary to achieve this target. It can be expected that bypass releases, when required to meet the 2000 Flow and Temperature Recommendations in average years, would be implemented for a period of less than 2 weeks. In some years classified as average, the targets that would be achieved during the spring would be moderately wet or wet as a result of flows on the Yampa River that exceeded forecasted levels.

The objective in dry and moderately dry years would be to conserve reservoir storage while meeting the desired peak flow targets in Reach 2 as specified in the 2000 Flow and Temperature Recommendations. The bypass tubes and the spillway would not be used to meet flow targets in moderately dry and dry years but, on rare occasion, might be needed to supplement flows that cannot be released through the powerplant because of maintenance requirements. In dry years, a powerplant capacity release of 1 day to 1 week would occur during the spring, and this release would be timed with the peak of the Yampa River. In moderately dry years, a 1-week to 2-week powerplant capacity release would occur during the spring and would be timed with the peak and post peak of the Yampa River.

2.5.3.2 Use of Bypass Tubes and Spillway at Flaming Gorge Dam

The bypass tubes and the spillway at Flaming Gorge Dam have been utilized historically, as needed, for safe operation of the dam. In years with high inflow, bypass releases, and sometimes spillway releases, may be required under the Action Alternative to meet the 2000 Flow and Temperature Recommendations. Bypass and spillway releases, required for safe operation of the dam and to meet the 2000 Flow and Temperature Recommendations, would be scheduled coincident with Yampa River peak and post peak flow (the mid-May to mid-June time period) with the objective of meeting flow recommendation targets in Reach 2.

There would be some years (moderately wet years and average years) where use of the bypass would not be required for safe operation but would be needed to meet the 2000 Flow and Temperature Recommendations. As part of the annual planning process discussed above, Reclamation would consult with the U.S. Fish and Wildlife Service and Western and coordinate with the Technical Working Group and make a determination whether bypasses should be attempted to achieve the targeted Reach 2 magnitudes and durations.

Increased use of the spillway in comparison to past operations raises potential concerns for two reasons: (1) physical damage to the spillway, caused by cavitation, and (2) entrainment of potentially harmful nonnative fish into the Green River. Cavitation is a physical process that can occur when water flows across a surface at high velocity. This process has been shown to cause excessive erosion in concrete spillway structures at other Reclamation dams. In 1984, the spillway at Flaming Gorge was retrofitted with air slots, tested, and deemed successful in reducing cavitation. However, should damage to the spillway become excessive, repairs would be made, and use of the spillway would be limited to when hydrologically necessary. Smallmouth bass, present in Flaming Gorge Reservoir, could potentially have a detrimental effect on native fish in the Green River if they survived entrainment and established populations in the river or caused an increase in populations known to exist in Lodore Canyon. The potential entrainment of nonnative fish has been identified as a potential concern of the Action Alternative. The potential entrainment of nonnative fish would be carefully monitored by the Recovery Program.

2.5.3.3 Operations in August Through February (Base Flow Period)

Under the Action Alternative, during the base flow period, Reclamation would classify the current hydrology of the Green River system into one of the five hydrologic classifications described in the 2000 Flow and Temperature Recommendations (wet, moderately wet, average, moderately dry, and dry). For the month of August, the hydrologic classification would be based on the percentage exceedance of the volume of unregulated inflow into Flaming Gorge Reservoir during the spring period. For the months of September through February, the percentage exceedance would be based on the previous month's volume of unregulated inflow into Flaming Gorge Reservoir. If the unregulated inflow during the previous month is such that the percentage exceedance falls into a different classification than the classification assigned for the previous month, then the hydrologic classification for the current month could be shifted by one classification to reflect the change in hydrology. This shift would only be made when the reservoir condition indicates that the shift would be necessary to achieve the March 1 drawdown level of 6027 feet above sea level. Otherwise, the hydrologic classification for the current month would remain the same as for the previous month.

The range of acceptable base flows for Reach 2 would be selected from the 2000 Flow and Temperature Recommendations for the hydrologic classification set for the current month. Reclamation would make releases to achieve flows in Reach 2 that are within the acceptable range that also assure that the reservoir elevation on March 1 would be no higher than 6027 feet above sea level.

The 2000 Flow and Temperature Recommendations during the base flow period do allow for some flexibility, and the Action Alternative accommodates this flexibility. Under the Action Alternative, the flows occurring in Reach 2 during the base flow period would be allowed to vary from the targeted flow by ±40% during the summer to fall period (August through November) and by ±25% during the winter (December through February), as long as the day-to-day change is limited to 3% of the average daily flow and the variation is consistent with all other applicable 2000 Flow and Temperature Recommendations. Reclamation would utilize the allowed flexibility to the extent possible, to efficiently manage the authorized resources of Flaming Gorge Dam. Flaming Gorge Reservoir would be operated through the base flow period so that the water surface elevation would not be greater than 6027 feet above sea level on March 1.

During the base flow period, hourly release patterns from Flaming Gorge Dam would be patterned so that they produce no more than a 0.1-meter stage change each day at the Jensen gauge, except during emergency operations.

2.5.3.4 Operations in March and April (Transition Period)

From March 1 through the initiation of the spring peak release (typically, this occurs in mid- to late May), there are no specific flow requirements specified in the 2000 Flow and Temperature Recommendations. For the Action Alternative, releases during this transition period would be made to manage the reservoir elevation to an appropriate drawdown level based on the forecasted unregulated inflow into Flaming Gorge for the April through July period. Appropriate drawdown levels under normal operations during the transition period are those that would allow for safe operation of the dam through the spring. These upper limit drawdown levels are described earlier in table 2-3 in section 2.5.1.

Table 2-3 implies that upstream regulation above Flaming Gorge Reservoir remains relatively consistent with historic regulation.[3] In the event that less storage space would be available above Flaming Gorge Reservoir during the spring, these drawdown levels may have to be lower than those specified in table 2-3 for safe operation of Flaming Gorge Dam. In extreme wet years, the drawdown level for May 1 could potentially be lower than that specified to maintain safe operation of the dam.

Reclamation would determine the appropriate reservoir drawdown based on the percentage exceedance of the forecasted volume of unregulated inflow into Flaming Gorge Reservoir during the spring (April through July). The forecast is issued twice during March and twice during April. Under normal operations during the transition period, releases would be limited to a range from 800 cfs to powerplant capacity (4,600 cfs).

Releases during the transition period would be patterned so that they are consistent with the release patterns established during the preceding base flow period. The 2000 Flow and Temperature Recommendations do not address hourly fluctuation patterns during the transition period. During the transition period, Reclamation would maintain the fluctuation constraints as in the preceding base flow period to provide operational consistency as has been done historically.

[3] Historically (1988-2003), there generally has been about 200,000 acre-feet of vacant space at Fontenelle Reservoir (above Flaming Gorge) on May 1.

2.6 Summary Comparison of the Predicted Environmental Effects of All Alternatives

This section summarizes and compares the chapter 4 analyses of predicted environmental effects under both the Action and No Action Alternatives.

2.6.1 Hydrology

Tables 2-6, 2-7, and 2-8 present the key flow parameters and ranges described in both the 1992 Biological Opinion (No Action Alternative) and the 2000 Flow and Temperature Recommendations (Action Alternative) under dry, average, and wet hydrological conditions. The 2000 Flow and Temperature Recommendations report also provides recommended flow regimes for moderately wet and moderately dry hydrologic conditions; however, because the 1992 Biological Opinion does not address these conditions, they have been omitted from this comparative analysis.

The 1992 Biological Opinion does not specifically define the differences between wet, average, and dry hydrological conditions but rather, suggests that Reclamation and the U.S. Fish and Wildlife Service consult each year to make this determination. The 2000 Flow and Temperature Recommendations are more specific about how the hydrology of the upper Green River Basin is to be characterized.

The hydrologic conditions of the upper Green River Basin, as described in the 2000 Flow and Temperature Recommendations, are based on the forecasted or actual volume of unregulated inflow (adjusted for storage in upstream reservoirs) into Flaming Gorge Reservoir during the period from April through July. During the spring and early

Table 2-6.—Dry Hydrology Scenario (Runoff Volume Exceeded 90 to 100% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Release Peak Determination	***Release Peak Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. ▪ The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 1 week in dry years. ▪ Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River.	In dry years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: ▪ The combined flows of the Green and Yampa Rivers should provide a peak flow in Reach 2 that exceeds 8,300 cfs for at least 2 days. ▪ The minimum peak release from Flaming Gorge Dam should be 4,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for a dry year should be 350 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by June 20 in dry years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 900 cfs and 1,100 cfs during dry years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (18 °C) for the first 2 to 5 weeks during the base flow period (mid-June to March 1) for dry years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period.

Table 2-7.—Average Hydrology Scenario (Runoff Volume Exceeded 30 to 70% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Peak Flow Determination	***Peak Flow Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. ▪ The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 2 to 4 weeks in average years. ▪ Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River. Bypass releases, if necessary for hydrologic reasons, would be made before or during the Yampa River peak flow.	In average years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: ▪ The peak release should provide a peak flow in Reach 2 that exceeds 18,600 cfs in 1 out of 2 average years. ▪ In 1 out of 4 average years, the peak flow in Reach 2 should exceed 18,600 cfs for at least 2 weeks. ▪ In all average years, the peak flow in Reach 2 should exceed 8,300 cfs for at least 2 weeks. ▪ The minimum peak release from Flaming Gorge Dam should be 4,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for an average year should be 500 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by July 10 in average years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 1,500 cfs and 2,400 cfs during average years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (18 °C) for the first 2 to 5 weeks during the base flow period (mid-July to March 1) for average years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period.

Table 2-8.—Wet Hydrology Scenario (Runoff Volume Exceeded Less than 10% of the Time)

1992 Biological Opinion (No Action Alternative)	September 2000 Flow and Temperature Recommendations (Action Alternative)
Peak Flow Determination	***Peak Flow Determination***
The Biological Opinion calls for a peak release of 4,000 to 4,700 cfs for a duration of 1 to 6 weeks in all years. ▪ The intent of this peak release is to achieve a peak flow at Jensen, Utah, of 13,000 to 18,000 cfs for a period of 6 weeks in wet years. ▪ Timing of the peak release would begin during the period from May 15 to June 1 so that the peak release would coincide with the peak flow of the Yampa River. Bypass releases, if necessary for hydrologic reasons, would be made before or during the Yampa River peak flow.	In wet years, the 2000 Flow and Temperature Recommendations call for a peak release that should achieve the following: ▪ The peak release should provide a peak flow in Reach 2 that should exceed 26,400 cfs. ▪ Flows in Reach 2 should exceed 22,700 cfs for at least 2 weeks. ▪ Flows in Reach 2 should also exceed 18,600 cfs for at least 4 weeks. ▪ The minimum peak release from Flaming Gorge Dam should be 8,600 cfs. To target these requirements, the forecasted peak flow of the Yampa River would be supplemented by releases from Flaming Gorge Dam. The timing of the peak release should coincide with the peak and post-peak flows of the Yampa River.
Ramp Rate Determination	***Ramp Rate Determination***
The ascent rate would be limited to no more than 400 cfs per day. The decline rate would also be limited to 400 cfs per day.	The ascent rate is not specified in the 2000 Flow and Temperature Recommendations. The decline rate for a wet year should be 1,000 cfs per day or less.
Base Flow Determination	***Base Flow Determination***
Summer flows, after the spring peak release, would be between 1,100 and 1,800 cfs at Jensen, Utah, for all years and would be reached by July 20 in wet years. On September 15, if it is determined that the year was wetter than anticipated, the range of available target flows could be expanded to 1,100 to 2,400 cfs, if necessary.	The base flow target at Jensen, Utah, should be between 2,800 cfs and 3,000 cfs during wet years. Variability in flow around the established average base flow should be consistent with the variability that occurred in pre-dam flows. Accordingly, the average daily flow at Jensen, Utah, could fluctuate by 40% around the established average daily base flow target from August through November. From December through February, the average daily flow at Jensen, Utah, could fluctuate by 25% around the established average daily base flow target. Differences in average daily flows at Jensen, Utah, between consecutive days, and due strictly to reservoir operations, should not exceed 3%.
Hour-to-Hour Fluctuation Determination	***Hour-to-Hour Fluctuation Determination***
The flow at Jensen, Utah, would fluctuate no more than 12.5% of the daily average flow during the summer and fall period. Fluctuations during the winter period (November through February) would be moderated.	Flow variations resulting from hydropower generation at Flaming Gorge Dam should be limited to produce no more than a 0.1-meter (about 4 inches) stage change within a 24-hour period at the Jensen gauge.
Release Temperature Determination	***Release Temperature Determination***
Releases during the period from July 1 to November 1 would be regulated to achieve the warmest possible temperatures, approaching 59 °F (15 °C).	Release temperatures should be regulated with the objective to meet or exceed water temperatures in upper Lodore Canyon of 64 °F (8 °C) for the first 2 to 5 weeks during the base flow period (mid-August to March 1) for wet years. In addition to the above criteria, Green River temperatures at its confluence with the Yampa River should be no more than 9 °F (5 °C) colder than Yampa River temperatures during the summer base flow period (the 2000 Flow and Temperature Recommendations indicate that this may not be possible in wet years).

summer, operational decisions would be based on forecasted inflows. After August 1, operational decisions would be based on the measured inflows that occurred during the previous month as well as the previous April through July period.

For purposes of this analysis, and as defined by the 2000 Flow and Temperature Recommendations, dry conditions in the upper Green River Basin are identified as unregulated April-July inflow volumes that are exceeded in 9 out of every 10 years (90% exceedance value). The year 1977 was historically dry at which time the unregulated April through July inflow measured only 254,000 acre-feet. In contrast, wet conditions in the upper Green River Basin are identified as unregulated April through July inflow volumes that are exceeded in only 1 out of every 10 years (10% exceedance value). For example, 1986 was a historically wet year at which time the unregulated April through July inflow measured 2,224,000 acre-feet.

2.6.2 Water Quality, Water Temperature, and Sediment Transport

When the operation of Flaming Gorge Dam was changed to meet the requirements of the Reasonable and Prudent Alternative (RPA) of the 1992 Biological Opinion, the frequency of summer and fall reservoir drawdowns that produced algal blooms was reduced. This operational change improved the water quality of Flaming Gorge Reservoir. The analysis of the effects of the Action and No Action Alternatives shows that the frequency of reservoir drawdowns likely would not differ from drawdown conditions observed since 1992. Under either alternative, reservoir drawdowns during drought conditions would cause larger algal blooms. As an example, such a condition occurred in the fall of 2002.

For the Green River below Flaming Gorge Dam, the only water quality issue of concern with respect to the Action Alternative is water temperature. The No Action Alternative would result in future water temperatures based on the recommendations of the 1992 Biological Opinion. Under the Action Alternative, release temperatures and river temperatures in Reach 1 would be somewhat warmer to meet the temperature recommendation of 64 °F (18 °C) or greater in upper Lodore Canyon. Reaches 2 and 3, because of their distance from Flaming Gorge Dam, would likely have similar water temperatures under either of the alternatives.

Sediment transport is presented in the "Water Quality" section because it is an important function in the river system, with the potential to affect both riverine and riparian habitat. In comparison to the estimated average annual sediment load for Reach 1 under the No Action Alternative, sediment transport under the Action Alternative represents an increase of about 14%. Seasonally, during May, June, and July, sediment transport is expected to be about 56% greater under the Action Alternative relative to the No Action Alternative in Reach 1. In comparison to the estimated average annual sediment load for Reach 2 under the No Action Alternative, estimated annual sediment transport in Reach 2 under the Action Alternative represents an increase of about 7%. Sediment transport during May, June, and July under Action Alternatives conditions would average nearly 11% more than sediment transport under No Action Alternative conditions during the same season in Reach 2. Annual sediment loads in Reach 3 are expected to be about 8% greater under the Action Alternative flows relative to the No Action flows. Sediment transport in Reach 3 would average about 9% more during May, June, and July under the Action Alternative conditions related to the No Action conditions. (See table 2-9 for a summary of this information.)

Table 2-9.—Weight and Percent Increase in Sediment Load Under the Action Alternative, Above That for the No Action Alternative

		No Action Alternative	Action Alternative	
Reach Number	Time Period	Estimated Sediment Load (tons)	Sediment Load Increase (tons)	Increase (percent)
Reach 1	Average Annual	92,000	+13,000	+14
	May-June-July	45,000	+25,000	+56
Reach 2	Average Annual	1.2 million	+800,000	+ 7
	May-June-July	970,000	+110,000	+11
Reach 3	Average Annual	3.5 million	+280,000	+8
	May-June-July	3.3 million	+290,000	+9

2.6.3 Hydropower

Hydropower analysis focuses on the potential impacts of the alternatives on powerplant operations at Flaming Gorge Dam. This analysis used a computer model developed by Argonne National Laboratory in collaboration with Reclamation. The model uses an estimate of the quantity of energy injected into the power grid along with a forecasted hourly electricity spot price (market price) to determine the economic value for each alternative. The model determined the revenue generated as a result of operating Flaming Gorge Powerplant to achieve each alternative over the period from 2002 to 2026. The revenues for each alternative were then discounted by 5.5% per year so that they reflected their net present value. The total net present value of the revenue generated under each alternative was then compared to determine the economic impacts to power production under the proposed alternatives.

The results are summarized in table 2-10 and show that the net present value of economic benefits for the No Action Alternative simulation was $403.1 million while generating about 11,904 gigawatthours (GWh) of energy. The Action Alternative showed a net present value of about $423.1 million for the 25-year simulation, an increase of $20.0 million (5.0%) over the estimate for the No Action Alternative. The Action Alternative would generate about 11,374 GWh of energy, about 4.5% less, compared to the No Action Alternative generation. The Action Alternative generates less energy but is able to generate more of this energy during the seasons when market prices are higher, leading to a slightly greater net present value. The Action Alternative has greater benefits with fewer GWh due to the fluctuations in the market price of energy. The Action Alternative calls for more generation in the summer months when energy sells at higher prices than in the fall, when the No Action Alternative generates more power. Given recent volatility in historical prices, there is uncertainty associated with future prices. Because there is less total annual generation with the Action Alternative, use of an alternative price set that does not assume as large a relative seasonal price difference could result in a negative rather than a positive impact. In any case, the impact is considered to be insignificant when the total value of Flaming Gorge generation is considered.

In addition to the economic analysis, a financial analysis was performed as described

Table 2-10.—Table of Comparisons of the Alternatives for Hydropower

	No Action Alternative	Action Alternative	Comparison of Action to No Action
Net Present Value	$403.1 million	$423.1 million	$20 million (5.0%)
Generation in GWh	11,904.1	11,374.3	-529.8 (-4.5%)
Wholesale Electricity Price Composite	20.72 mills/kWh[1]	20.57 mills/kWh	-0.15 mills/kWh (-0.73%)

[1] Mills per kilowatthour.

in section 4.4.3. While an economic analysis shows the impacts on the national economy as a whole, the financial analysis describes the impacts to the customers who purchase wholesale electricity generated at Flaming Gorge Powerplant. The results of this analysis show that, compared to the No Action Alternative, the Action Alternative would not have a significant impact on the rate CRSP power users pay.

2.6.4 Agriculture

Under both the No Action and Action Alternatives, about 245 acres of cropland in the historic Green River flood plain could be expected to be flooded in nearly half of all years. On average, affected lands would be inundated 2 days longer under the Action Alternative, but since this incremental time would not do further crop damage compared with the No Action Alternative, there would be no differences in impacts between the two alternatives.

2.6.5 Land Use

There would be no impacts to land use around Flaming Gorge Reservoir under either alternative. In Reach 1 of the Green River, in wet years, the Action Alternative would have greater impacts to the use of campgrounds and other recreational facilities that have been built in the historic flood plain than would the No Action Alternative. In average hydrology years, the impacts to such facilities would be about the same under either alternative.

Under the No Action Alternative in Reach 2, the effects of the river on land use that have occurred over the past 10 years would continue. Under the Action Alternative, higher flows of longer duration would be expected to occur in wet years. This would result in inundation levels and durations in the historic flood plain that have not occurred in the recent past, and consequently, a temporary loss of land use in the flood plain on a more frequent basis. In Reach 3, there would not be a significant land use difference under either alternative.

2.6.6 Ecological Resources

Under the No Action Alternative, present conditions would be expected to continue for all flora and fauna around Flaming Gorge Reservoir and in the Green River.

Under the Action Alternative, both native and nonnative fish in Reach 1 would likely benefit from the 2000 Flow and Temperature Recommendations. There is the potential for both positive and negative effects to trout in the area immediately below Flaming Gorge Dam, though long-term negative effects are not expected. There is also a potential for negative impacts to trout in the Browns Park area if water temperatures in that area exceed 64 °F (18 °C).

Under the No Action Alternative, there would be continued proliferation of wetland plants and island marshes. Due to infrequent flooding, the flood plain forests of the old high water zone would continue to transition to desert. The old-growth cottonwoods would continue the trend of premature dieoff. There would be limited opportunity for establishment of cottonwoods and box elders. Under the Action Alternative, there may be erosion of wetland and riparian vegetation on islands and bars, followed by increased opportunity for cottonwood establishment. Larger floodflows may improve the health of mature cottonwoods.

Invasive species are present in all reaches and are expected to persist under the No Action Alternative. The Action Alternative could accelerate growth of some invasive species along the river. Tamarisk and giant whitetop are two such species that could increase in rate and acreage of invasion in higher flood plain settings under the Action Alternative.

In the short term, birds and animals along the Green River corridor could be negatively impacted by temporary loss of habitat due to increased flooding, but the potential impacts are not expected to be significant. In the long term, birds and animals are expected to benefit from enhancement of riparian vegetation and habitat.

2.6.6.1 Threatened and Endangered Fish

Under the No Action Alternative, existing conditions for the Colorado pikeminnow, humpback chub, and razorback sucker would be expected to continue. For both the No Action and Action Alternatives, conditions for the bonytail chub are assumed to be the same as for the other three endangered fish species. While these species would be expected to benefit from Recovery Program activities other than activities arising from implementation of the 2000 Flow and Temperature Recommendations, it is believed that continuation of No Action flow regimes would not provide enough benefit to support their recovery. Under the Action Alternative, river conditions are expected to benefit the endangered fish and their designated critical habitat.

2.6.6.2 Other Threatened and Endangered Species

Under the No Action Alternative, continued decline in the acreage and health of native riparian vegetation would have negative effects on the southwestern willow flycatcher. Under the Action Alternative, Ute ladies'-tresses could be lost in Reach 1. Suitable habitat may be lost or otherwise become unsuitable. Additional sites of potentially suitable habitat would likely develop at new locations under the Action Alternative. Long-term increases in cottonwood and native understory vegetation along the river corridor would benefit bald eagle and southwestern willow flycatcher. Other threatened and endangered species are not expected to be affected by either alternative.

2.6.6.3 Other Special Status Species

Under the No Action Alternative, continued decline in acreage and health of native riparian vegetation would have negative effects on yellow-billed cuckoo and other State sensitive songbirds. The Action Alternative may reverse degradation of riparian vegetation in Reach 2 and upper Reach 3.

2.6.7 Cultural Resources

Adjacent to the reservoir and along the Green River, there would be no effects from dam operations to cultural resources under either alternative.

2.6.8 Paleontological Resources

Adjacent to the reservoir and along the Green River, there would be no effects from dam operations to paleontological resources under either alternative.

2.6.9 Indian Trust Assets

The No Action Alternative would not affect Indian (American Indian) trust assets. The Action Alternative would not affect agriculture, oil and gas production, or other Indian trust assets if advance notice is provided on the timing of spring peak flows. There would be no significant difference between the Action and No Action Alternatives.

2.6.10 Safety and Public Health

There is public concern over the creation of mosquito habitat along the Green River due to the flow regimes under either alternative, which are intended to inundate flood plain depressions for the benefit of endangered fish. Under the No Action Alternative, the population of mosquitoes along the river would not increase. In Reach 1, the Action Alternative could result in an increase in the mosquito population along the river. In Reach 2, the Action Alternative also could result in an increase in mosquitoes, though not as large or as often as in Reach 1. As it has in the past, under either alternative, Reclamation would continue to coordinate peak flow releases with State and county officials to help minimize the mosquito population in the Jensen, Utah, area to the extent possible. Under either alternative, mosquito abatement control by the county would continue. In Reach 3, there would be no significant difference for mosquito populations between the Action and No Action Alternatives.

Public safety on Flaming Gorge Reservoir is expected to be unchanged under either alternative. Public safety along the Green River could be affected under the Action Alternative due to the potential for higher flows for longer durations. Existing safety procedures for dam operations would continue to be followed, along with notification to the public of scheduled high flows.

2.6.11 Air Quality

There are no significant impacts to air quality under either alternative.

2.6.12 Visual Resources

There are no significant effects on visual resources under either alternative.

2.6.13 Environmental Justice

No adverse impacts to minority or low-income populations have been identified under either alternative.

2.6.14 Recreation

On average, total water-based river and reservoir visitation within Flaming Gorge National Recreation Area for the Action Alternative is not expected to measurably change compared to the No Action Alternative (only +0.3% gain). Gains in economic value are expected to be higher (+9.5%) as a result of water levels moving closer to preferred conditions.

Under wet and dry conditions, each of which typically occur only 10% of the time, Action Alternative visitation and value on the river are expected to decline compared to the No Action Alternative but are more than offset by gains on the reservoir.

2.6.15 Socioeconomics/Regional Economics

The socioeconomic analysis evaluates the effect of changing expenditures on economic activity in the general vicinity of Flaming Gorge National Recreation Area. The economic impact region consists of the Daggett and Uintah Counties in Utah and Sweetwater County in Wyoming. Given the minor effect on local expenditures from changes in hydropower and agricultural production, the analysis focuses exclusively on recreation expenditures. The combined river and reservoir recreation expenditure impacts of the Action Alternative appear to be positive, but minor, under all hydrologic conditions.

2.7 PREFERRED ALTERNATIVE

As a result of the analyses presented in this EIS, Reclamation considers the Action Alternative to be the preferred alternative.

3.0 Affected Environment

This chapter provides a brief geographic description of the area in which the proposed action is to be undertaken. It then provides a description of the existing conditions for all resource areas that might be affected by the Action Alternative or the No Action Alternative. For a discussion of the potential consequences of each of the two alternatives, please see chapter 4.

3.1 INTRODUCTION

Flaming Gorge Dam is located in northeastern Utah, and Flaming Gorge Reservoir is located in northeastern Utah and southwestern Wyoming. The Wyoming portion of the reservoir is located in Sweetwater County and consists of high desert topography including low hills, shale badlands, and desert shrubbery. The Utah portion of the reservoir is located in Daggett County, in the Uinta Mountains, where the topography includes benches, canyons, and forest. Leaving the reservoir, the Green River flows east into Colorado, traversing the Uinta Mountains. In Colorado, the Green River turns south to its confluence with the Yampa River, turns west-southwest back into Utah, and then runs generally south to its confluence with the Colorado River. In Colorado and Utah, the Green River flows through the eastern part of the Uinta Basin, which extends south from the Uinta Mountains to the Tavaputs Plateau of the Book Cliffs. Please refer to the frontispiece map of the project area.

3.2 POTENTIALLY AFFECTED AREA

The geographic area that could be affected by the Proposed Action includes the Flaming Gorge Reservoir, which extends northward 91 miles from Flaming Gorge Dam, and the Green River downstream to the Colorado River confluence (see the frontispiece map). The Colorado River confluence is about 410 river miles south of Flaming Gorge Dam.

3.2.1 Description of Flaming Gorge Dam, Powerplant, and Reservoir

This section describes Flaming Gorge Dam, Powerplant, and Reservoir as they contribute to conditions in and along the Green River below the dam.

3.2.1.1 Flaming Gorge Dam and Reservoir

Flaming Gorge Dam is the principal feature of the Flaming Gorge Unit, one of four units of the Colorado River Storage Project (CRSP) that was authorized by an act of Congress on April 11, 1956. Completed in 1964, the dam and powerplant are operated and maintained by the Bureau of Reclamation. The reservoir began filling December 10, 1962, and filled for the first time August 1, 1974. Flaming Gorge Dam is a thin-arch concrete dam, which, from the streambed, stands 502 feet high and contains 987,000 cubic yards of concrete. The dam impounds waters of the Green River to form Flaming Gorge Reservoir, which has a total capacity of 3,788,900 acre-feet. At full elevation of 6040 feet, the L-shaped reservoir has a surface area of 42,020 acres and is 91 river miles long, with the first 32-mile-long portion roughly paralleling the Utah/Wyoming border and the remaining 59 miles extending northward into Wyoming. Flaming Gorge Dam has the capability of releasing 28,600 cubic feet per second (cfs) through the combined capacities of the powerplant, river outlet works, and spillway.

3.2.1.2 Flaming Gorge Dam River Outlet Works and Spillway

The river outlet works consist of two 72-inch-diameter steel pipes that extend through the dam and continue downstream to a valve structure located near the east abutment of the dam. The outlet works discharge directly into the Green River, bypassing the powerplant and turbines. The combined capacity of the two outlet pipes is 4,000 cfs. Normally, the outlet works are only used to release flows above the capacity of the powerplant, which is 4,600 cfs. However, on occasion, if the powerplant is out of service, water may be bypassed through the outlet works to maintain flows in the river. Since the intake for the outlet works is lower in the dam than either the penstocks (pipes that carry water from the reservoir to the turbines in the powerplant) or the spillway, outlet works water releases are typically colder than releases made through the other structures. Further information on water temperatures can be found in section 3.3.

The spillway is used to release water from Flaming Gorge Reservoir in amounts that exceed the combined release capacity of the river outlet works and the powerplant. The spillway is controlled manually by two 16¾- by 34-foot hydraulically operated fixed-wheel gates. The spillway can safely discharge up to 20,000 cfs. The reservoir level must be above 6006 feet before water can be released through the spillway. The spillway was used in 1983, 1984, and 1999 for flood control purposes. In 1997, the spillway was used instead of the outlet works when repair work was being done on the outlet works.

3.2.1.3 Flaming Gorge Powerplant

Flaming Gorge Powerplant, located at the base of Flaming Gorge Dam, first began producing hydroelectric power on

September 27, 1963. Water is conveyed to the powerplant by three 10-foot-diameter penstocks located near the center of the dam. The powerplant houses three generating units with a total capacity of about 152 megawatts (MW). On average, Flaming Gorge Powerplant generates 528,900 megawatt-hours of electrical energy per year, which is enough energy to serve about 150,000 homes. This is largely dependent on hydrologic conditions in the upper Green River Basin. The powerplant is capable of operating within the approximate range of 100 to 4,600 cfs. Under normal operating conditions, water is released through the penstocks and turbines where the energy from falling water is used to produce electricity. Water from the penstock cools the turbine bearings. When design temperatures are exceeded, turbine alarms trip, resulting in the affected generator going offline. This operating restriction has limited the ability to release warmer water downstream. Further detail is provided in section 3.3.4.1.

3.2.1.4 Flaming Gorge Dam Selective Withdrawal Structure

In 1978, Reclamation began releasing water through the selective withdrawal structure to provide warmer water for trout downstream. Prior to construction of the selective withdrawal structure, water releases were made through the penstocks. This mode of operation resulted in summertime water release temperatures ranging from 41-48 degrees Fahrenheit (°F) (5-9 degrees Celsius [°C]) which limited trout growth rates and the desired cold water sport fishery development. The selective withdrawal structure consists of a set of interlocking panels that can be manually raised to any height above the penstock intake to within 40 feet of the water surface. Around April 1 of each year, the upper gates are raised to an elevation about 40 feet below the surface of the reservoir. As inflows increase and debris approaches the intake structure, the gates are lowered to prevent the debris from entering the penstocks. As the debris dissipates, the gates are again raised to discharge warmer water into the river. Moving the gates up or down does not give an instantaneous change in the temperature. Temperature adjustment is an iterative process. Following gate movement, the discharge temperature is monitored; and if the temperature goal is not reached, another move is initiated.

3.3 Water Resources and Hydrology

This section describes the water resources in Flaming Gorge Reservoir and in the Green River downstream from Flaming Gorge Dam. It discusses basic hydrology and baseline conditions for water quality and water temperature.

3.3.1 Flaming Gorge Reservoir Hydrology

Reservoir elevations have fluctuated from a minimum of 5988 feet above sea level in January 1978 to a maximum elevation of 6044 feet above sea level in July 1983. Reservoir elevation fluctuations are the result of inflow volumes that are not matched by reservoir release volumes over a particular time period. Typically during the spring, inflow volumes exceed release volumes, resulting in increased reservoir elevations. The pattern is reversed during the fall and winter when release volumes exceed inflow volumes. Reservoirs are designed to operate this way so water can be stored when inflows are high and then released when water supplies are low and demand is high.

3.3.2 Flaming Gorge Reservoir Water Quality and Temperature

Water quality at Flaming Gorge Reservoir fluctuates with depth and location due to the interaction between underlying geologic formations, fluctuations in water volume, presence of organisms, and air. The shallow inflow area near Green River, Wyoming, receives sediments from erosion of the ancient Green River Lake deposits, as well as from the even older Mancos Sea deposits, which are also prevalent in the watershed. This sediment is laden with nutrients, particularly phosphorus, which drives large algal blooms in the northernmost 20 to 30 miles of the reservoir. However, where water depths increase, sediments, nutrients, and algae settle, forming new organic lake deposits. The water becomes nutrient depleted in the deeper portions of the reservoir closer to the dam. About 50 miles upstream of Flaming Gorge Dam, the water depth is greater than 200 feet and most of the sediment or algae have settled out. Nearly two-thirds of Flaming Gorge Reservoir has only minimal phytoplankton to support the food chain. Most of the reservoir is classified as nutrient and plankton deficient.

During the 1970s and 1980s, salinity and limnological studies of Flaming Gorge Reservoir revealed two important items (Bolke and Waddell, 1975; Miller, 1984). First, drawdown of the reservoir results in re-suspension of sediments deposited during filling. This sediment scouring releases high concentrations of phosphorus that drive large blooms of noxious and potentially toxin-producing blue-green algae into the northernmost 10 to 30 miles of the reservoir (Miller, 1984). These algal blooms decrease recreation activity and reduce dissolved oxygen, which affect the fishery resources during the August to October period. Second, reservoir drawdown results in salt leaching and increased salinity.

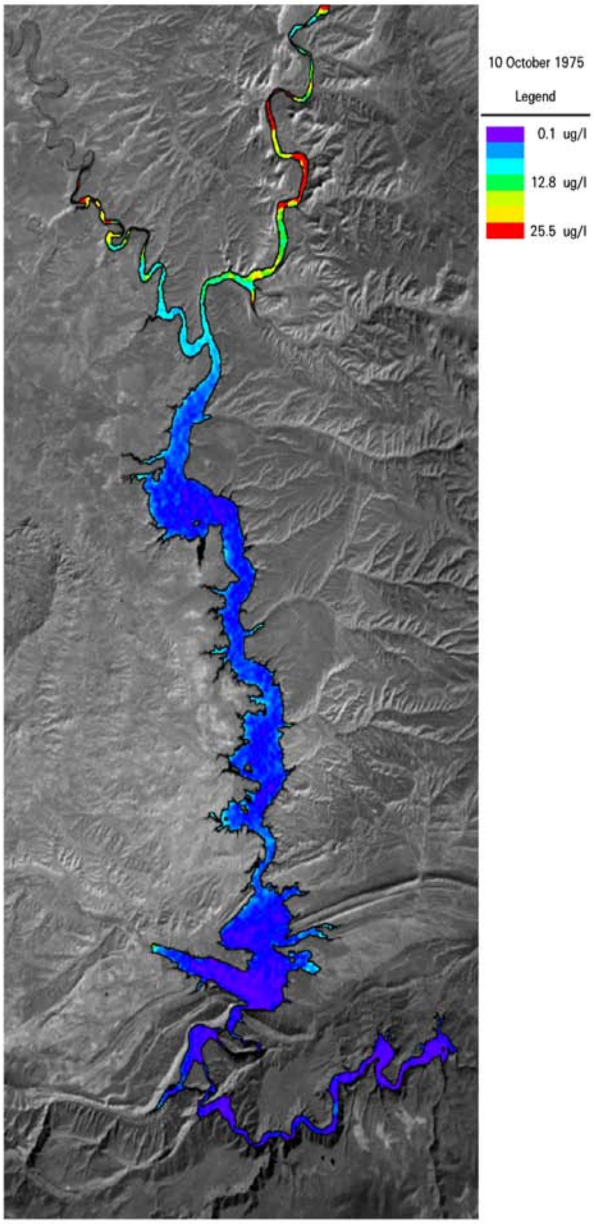
In 1978, the reservoir was drawn down to 5988 feet above mean sea level. The resulting algal blooms extended 20 to 30 miles further down the reservoir from their normal location near the Buckboard Marina and severely impacted fisheries and recreation in the Wyoming portion of the reservoir. The heaviest blue-green algal blooms occurred in October 1978, associated with the drawdown of about 50 feet.

Figures 3-1 and 3-2 are satellite images of Flaming Gorge Reservoir showing algae concentrations. The upper end of Flaming Gorge Reservoir, where the algal blooms are illustrated in red, would be classified as eutrophic (high nutrient) to hyper-eutrophic in the summer and fall. The area shown in red has chlorophyll a concentrations greater than 27 micrograms per Liter (µg/L) and can reach several hundred µg/L or hyper-eutrophic status at times in the red zones (greater than 10 being an indication of poor water quality and eutrophic conditions). The areas depicted in yellow would be classified as mesotrophic, which is generally considered a healthy environment for cold water fishery. Most of the reservoir shown in blue is oligotrophic (low nutrient) and often lacks sufficient algae to support a healthy food base.

In October 2002, the reservoir was drawn down to an elevation of 6011 feet, the lowest since 1982. This drought-induced drawdown produced a large algal bloom in the upper end of the reservoir (Miller, 2002).

The magnitude of algal blooms varies with reservoir elevation. The smaller the reservoir drawdown, the less sediment is re-suspended, and the less phosphorus is released from the sediment into the water. The combination of wet hydrology from 1983 to 1987, the test flows from 1987 to 1992, and the flow constraints implemented by the 1992 Biological Opinion resulted in decreased summer and fall reservoir drawdown. This resulted in improved water quality and decreased algal blooms.

Salinity in the reservoir can also be affected by reservoir elevations. During drawdown periods, bank storage (groundwater around the reservoir) flows back into the reservoir. Groundwater can potentially contain high levels of salt, depending on the sediment and rock formations surrounding the reservoir. It is estimated that the salt loading in Flaming Gorge Reservoir has decreased by a few



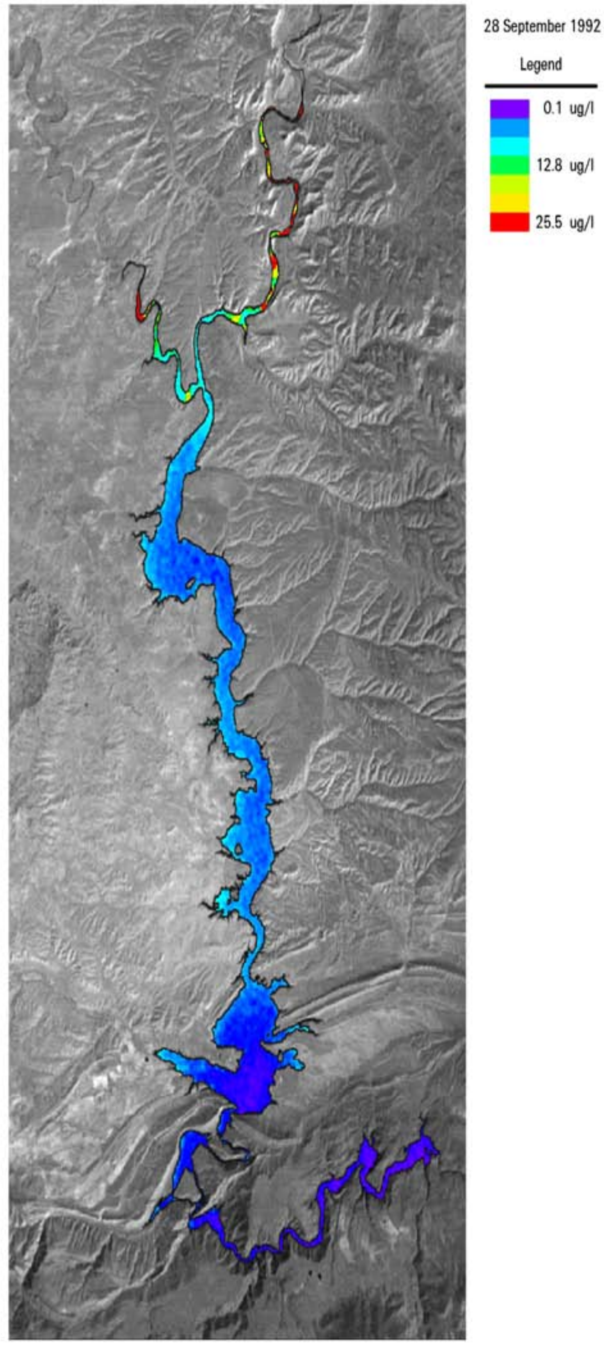


Figure 3-1 and 3-2.—Figures 3-1 and 3-2 (figure 3-2 is on the following page) depict the magnitude of algal blooms at Flaming Gorge in 1975 and in 1992 during years with minimal summer drawdown. However, in 1978 with extensive drawdown approaching nearly 60 feet, the algal blooms extended another 30 miles farther down reservoir. In 2002 with reservoir drawdown only 30 feet at elevation 6011, the algal blooms were very similar to those shown for 1978.

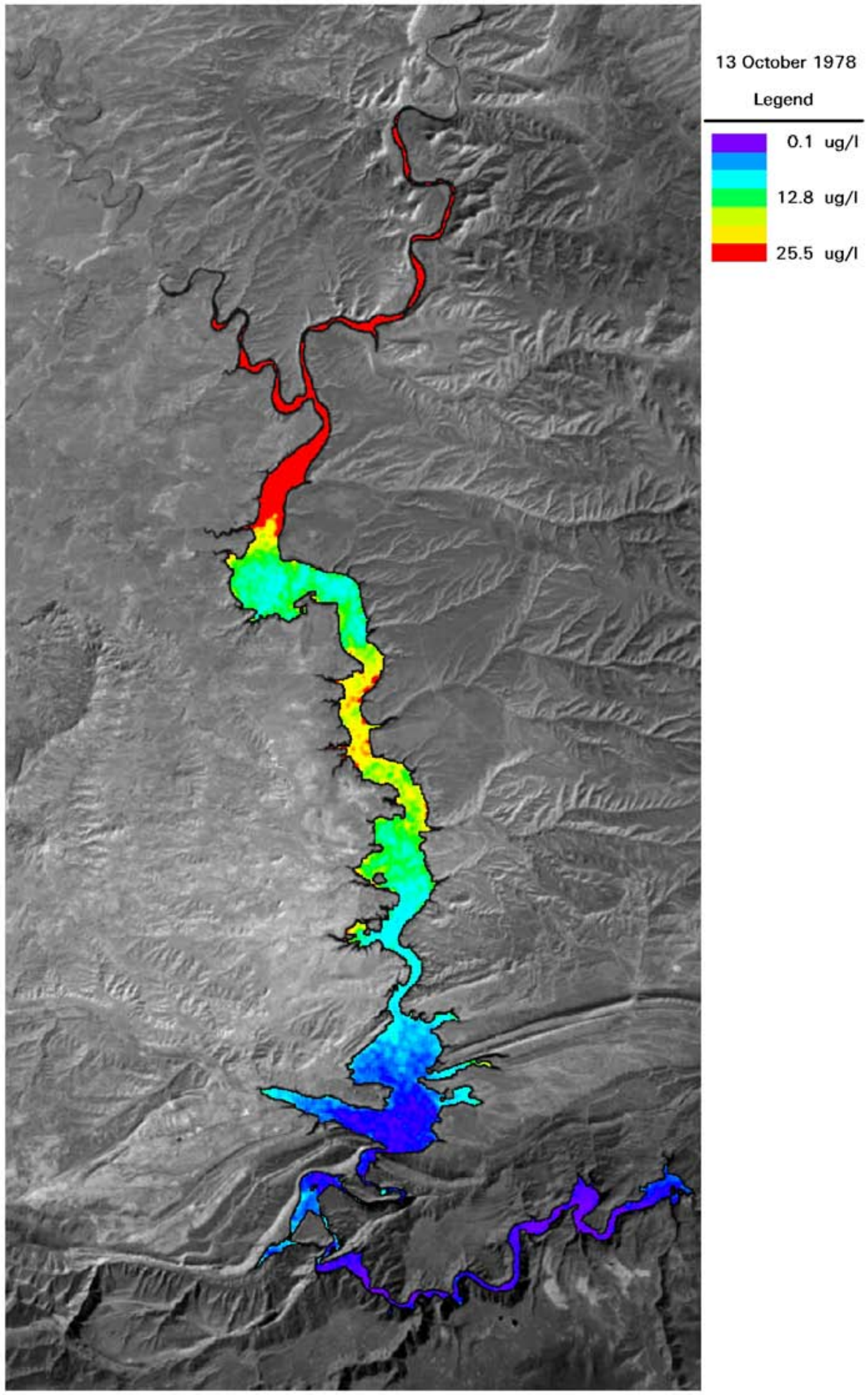


Figure 3-2.—The red and yellow depict areas with large enough blue-green algal blooms to impact both recreation and cold water fisheries. When the reservoir is drawn down, the algal blooms are much more extensive than when it is fuller. Figure 3-2 shows that the algal blooms extend nearly 20 miles farther down reservoir than they are in figure 3-1.

hundred thousand tons per year by reduced drawdown since 1983 (Miller, 2004).

3.3.3 Green River Hydrology

Most of the total annual streamflow in the Green River Basin is provided by the runoff of melting snow in the high mountains of the Uinta Range in northeastern Utah and the Wyoming and Wind River Ranges of west-central Wyoming. Prior to the construction of Flaming Gorge Dam, the hydrograph was dominated by spring peak flows from snowmelt runoff and low fall and winter base flows (Grams and Schmidt, 1999). The pre-dam spring flow typically peaked by early June and receded by mid-July. The pre-dam peak flows were typically 10,000 to 20,000 cfs, while base flows were typically 800 to 1,000 cfs (see figure 3-3).

The pattern of flows or hydrograph changed after the closure of Flaming Gorge Dam in 1962. Except for flood releases in 1983, 1984, 1986, 1997, and 1999, Green River spring peak flows were restricted to powerplant capacity at or below 4,600 cfs. Typical flows in the Green River below Flaming Gorge Dam between the mid-1960s and the early 1990s during the base flow period were 2,000 to 3,000 cfs.

From 1992 to present, Reclamation has operated Flaming Gorge Dam to meet the requirements of the Reasonable and Prudent Alternative (RPA), which included a powerplant capacity release of 1 to 6 weeks each spring followed by a period of low summer flows. The intent of these requirements was to establish flow and temperature regimes of the Green River that more closely resembled pre-dam conditions. While this change did not return the Green

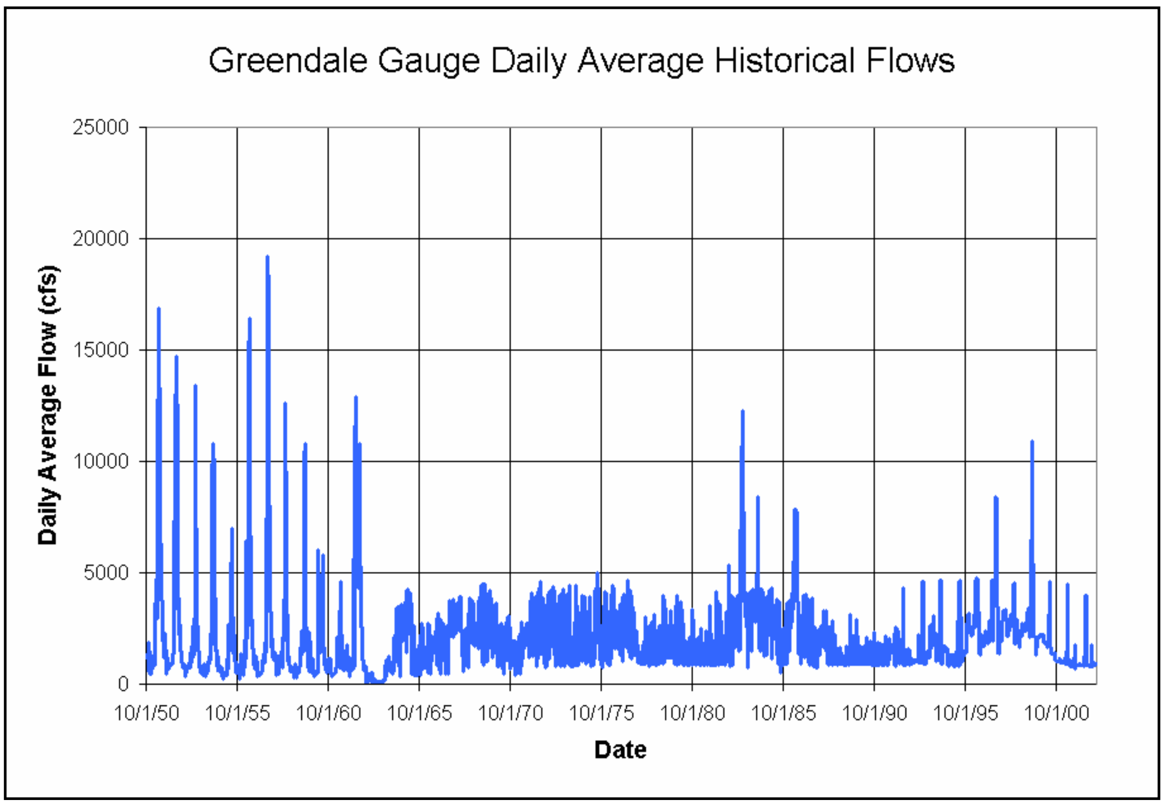


Figure 3-3.—Green River Historic Flows at Greendale, Utah, Located 0.25 Mile Downstream From Flaming Gorge Dam.

River to the flow pattern that occurred prior to closure of the dam, these changes in operation resulted in a more natural flow pattern. Peak flows, although smaller in magnitude than pre-dam peak flows, were released during the spring, and flows during the base flow period were reduced.

3.3.3.1 Reach 1

Flows in this reach are measured at the United States Geological Survey (USGS) gauge near Greendale, Utah, approximately 0.25 mile below the dam (figure 3-3). Except for usually minor flow contributions from tributary streams, flows in Reach 1 are completely regulated by Flaming Gorge Dam. While the average annual discharge (about 2,170 cfs[1]) has not been affected by Flaming Gorge Dam operations, the pattern of flows has changed. Powerplant operations prior to 1992 resulted in relatively uniform monthly release volumes with significant within-day fluctuations as compared to pre-dam conditions. Since 1992, monthly release volumes have shifted to a more natural pattern with high volumes during the spring and low volumes during the summer, fall, and winter. Within-day fluctuations have continued since 1992 but have been moderated somewhat by the requirements of the RPA of the 1992 Biological Opinion.

3.3.3.2 Reach 2

Flows in this reach are recorded at the USGS gauge near Jensen, Utah, about 29 miles downstream from the Yampa River confluence. The average annual flow of the Green River at the gauge near Jensen, Utah, is 4,370 cfs. Reach 2 exhibits a more seasonally variable flow, temperature, and sediment regime than Reach 1 because of inflow from the Yampa River. The average annual discharge of the Yampa River is about 2,150 cfs. During the spring, flows on the Green River in Reach 2 are usually dominated by the flows of the Yampa River, which can peak as high as 20,000 to 30,000 cfs in wet years or as high as 7,000 to 10,000 cfs in drier years. On average, the Yampa River peaks with a mean daily flow of 14,280 cfs. During the late summer, fall, and winter months, flows of the Yampa River do not contribute significant flows in Reach 2. In dry years, the flows of the Yampa River during these months can be as low as 100 to 200 cfs. In wet years, flows on the Yampa River during these months can reach 500 to 800 cfs. On average during the period from August through February, the flows of the Yampa River are 410 cfs. This is only 10 to 20 percent (%) of the average flow of the Green River in Reach 2 during these same months, due to releases from Flaming Gorge Dam.

3.3.3.3 Reach 3

Flows in Reach 3 of the Green River are measured at the USGS gauge located near Green River, Utah. This gauge is located about 196 river miles downstream from the USGS gauge on the Green River near Jensen, Utah, and 120 river miles upstream of the confluence of the Green River with the Colorado River. The average annual discharge of the Green River at Green River, Utah, is about 6,230 cfs. Flows in this reach are affected by tributary flows from the San Rafael, Price, White, and Duchesne Rivers. The flows on the Duchesne River have been depleted significantly through the development of the Central Utah Project (CUP) which diverts water out of the Duchesne River and transfers it to the Wasatch Front in the Great Basin. For this reason, the actual flows of the Duchesne River at the confluence with the Green River are substantially diminished from the flows that would naturally occur at this location.

[1] Average annual discharge values for gauges described in this portion of the environmental impact statement (EIS) are gauge data summary as reported by the USGS for the entire gauge history up to, and including, water year 2000 streamflow data.

Peak flows on the Price River occur in May and have averaged about 300 cfs historically. During the winter months, flows on the Price River have averaged about 60 cfs. Peak flows on the San Rafael River typically occur at the end of May and average about 600 cfs during the peak. San Rafael River flows during the winter months have averaged about 50 cfs historically. Peak flows on the Duchesne River have averaged about 2,000 cfs during the peak which usually occurs during the month of June; however, because of the CUP, future peak flows will likely be less than those that have occurred historically. During the winter months, the flows on the Duchesne River have averaged about 400 cfs. Peak flows of the White River have historically averaged about 2,000 cfs during the peak which most often occurs in late May. Winter flows on the White River have averaged about 400 cfs historically.

3.3.4 Green River Water Quality and Water Temperature

Prior to the construction of Flaming Gorge Dam, water quality in the Green River was characterized by sediment laden spring flows, but the snowmelt water was low in dissolved solids and salts. The later summer, fall, and winter flows were somewhat turbid with higher salinity. Water quality concerns that may be affected by the proposed action are limited to water temperature.

3.3.4.1 Reach 1

Daily water temperatures measured at the Greendale, Utah, USGS gauging station just below the present site of Flaming Gorge Dam during 1956-61 (table 3-1; see also Vanicek and Kramer, 1969) allow for estimating the summer and fall thermal regime in the Green River in Flaming Gorge Canyon prior to the emplacement of the dam. This is the period of the year for which temperatures are prescribed in the 1992 Biological Opinion and also the time during which the reservoir is stratified and temperatures can be most affected by the selective withdrawal structure. The pre-dam Green River in this reach experienced freezing temperatures from November through February. By April 1, average temperatures reached approximately 41 °F (5 °C) and, by June 1, typically exceeded 52 °F (11 °C). High temperatures of approximately 86 °F (30 °C) were reached during August. Cooling was rapid during September; and by the end of October, freezing temperatures could occur.

Table 3-1.—Pre-Dam Daily Water Temperature[1] Statistics in Degrees Celsius for the USGS Gauging Station at Greendale, Utah, Below Flaming Gorge Dam, During 1956-61

	Jun	Jul	Aug	Sept	Oct
Mean	16.7	20.3	20.2	14.8	8.0
Median	16.7	20.6	20.6	15.0	7.5
Minimum	11.1	13.3	14.4	6.7	0.0
Maximum	21.7	25.6	30.0	20.0	17.2
10^{th} Percentile	13.3	17.8	17.2	10.1	3.9
90^{th} Percentile	20.0	22.2	23.0	18.9	13.3

[1] Temperatures are in °C. Conversion from °C to °F = 9/5 x C + 32. 10% of all recorded temperatures lie below the 10^{th} Percentile value; 90% of all recorded temperatures lie below the 90^{th} Percentile value

Water temperatures in Reach 1 are controlled by the selective withdrawal structure on Flaming Gorge Dam, which typically is operated during May through September.

The potential of Flaming Gorge Dam to approximate the pre-dam water temperature regime using the selective withdrawal structure has been estimated using the CEQUAL-W2 two-dimensional reservoir model. Modeling was conducted for water years 1981-83, assuming 40 feet submergence for the selective withdrawal but using flow routing as it would occur under the Action Alternative. The years 1981-83 were chosen because they represent a wide range of inflow and reservoir elevations and, therefore, encompass a diverse set of reservoir and dam operations.

Potential release temperatures from Flaming Gorge Dam using the selective withdrawal structure are lower in early summer through

August than pre-dam water temperatures in the Green River, but they are higher during September and October (table 3-2). This lag, which is a reflection of the time necessary to stratify the reservoir and accrue heat in this large body of water, has the effect of adjusting dates at which critical temperatures are reached for warm water native fish. An average daily temperature of 61 °F (16 °C) in the pre-dam river was reached during June; but in the post-dam river with selective withdrawal releases, this average is not reached until July. Declining temperatures during fall months show the opposite relationship, with warmer temperatures persisting longer in selective withdrawal releases. Distinct differences in water temperatures are noticeable when comparing values during September and October under pre-dam (table 3-1) and post-dam selective withdrawal (table 3-2) operations. Thus, the potential exists to extend the growing season for native fish in early fall using the selective withdrawal, thereby compensating for the summer lag in warming.

Table 3-2.—Daily Statistics for Predicted Flaming Gorge Release Temperatures[1] in Degrees Celsius Based on Modeling Using CEQUAL-W2

	Jun	Jul	Aug	Sept	Oct
Mean	12.1	16.0	18.9	18.4	13.9
Median	11.7	16.9	19.9	18.4	14.1
Minimum	7.1	11.8	13.1	15.6	10.3
Maximum	16.4	19.7	20.9	20.4	15.6
10th Percentile	7.9	12.6	15.8	16.5	12.1
90th Percentile	15.8	18.8	20.6	20.1	15.4

[1] Temperatures are in °C. Conversion from °C to °F = 9/5 x C + 32.

The CEQUAL-W2 model considered only the maximum temperatures that could be released and did not take into account constraints that occur when releasing through hydroelectric turbines. Release waters are used to maintain bearing temperatures on turbines below critical values, and there are upper limits imposed on release temperatures by this dependency.

Design operating criteria for the turbine bearings at Flaming Gorge Dam have specifications for bearing oil temperatures not to exceed 140 °F (60 °C). Alarms are programmed to go off when turbine bearings exceed that temperature (*Designer's Operating Criteria*, *Flaming Gorge Dam, Powerplant and Switchyard*, Flaming Gorge Unit, Green Division, Colorado River Storage Project, November 1963). The relationship between release water temperatures and turbine bearing temperatures is affected by the volume of water released as well as the efficiency of exchange between bearing oil and release water. The uncertainty in this relationship has resulted in operation of the selective withdrawal to avoid tripping turbine alarms and subsequent downtime for generators. For these reasons, the target maximum release water temperature since the 1992 Biological Opinion has been 55 °F (13 °C) (Blanchard, 1999).

Actual Flaming Gorge release water temperatures for the months of June-October during the period 1993-2001 are best estimated by measurements at the Greendale USGS gauging station, approximately 0.25 mile below the dam (table 3-3). These data show that dam releases have reached 59 °F (15 °C) on only a few occasions during September in the period 1993-2001 and that the average values for the months of July-September have been very near the 55 °F (13 °C) limit imposed by the uncertainty in release temperatures that could cause alarms to be tripped and downtime for hydroelectric generators. It is also consistent with assumptions concerning release temperatures made by the *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations) in making temperature recommendations.

The 2000 Flow and Temperature Recommendations introduce a new target for Lodore Canyon of 64-68 °F (18-20 °C) or greater for 2 to 5 weeks in summer and fall, which has

Table 3-3.—Daily Statistics for Water Temperatures[1] in Degrees Celsius at the Greendale, Utah, USGS Gauging Station Below Flaming Gorge Dam During the Period 1993-2001

	Jun[2]	Jul	Aug	Sept	Oct
Mean	10.5	12.4	12.3	12.8	10.5
Median	10.4	12.6	12.4	12.7	10.8
Minimum	7.6	9.6	9.4	9.4	0.0
Maximum	14.5	14.0	14.3	17.0	14.4
10th Percentile	8.8	11.3	11.0	11.8	8.3
90th Percentile	12.8	13.3	13.4	14.2	12.3

[1] Temperatures are in °C. Conversion from °C to °F = 9/5 x C + 32.

[2] For a total of 31 days in 1997 and 1999, flows exceeded powerplant capacity with releases through the bypass tubes, which resulted in cooler downstream temperatures than were released through the selective withdrawal.

been incorporated into the Action Alternative for this EIS. Water temperatures measured at the Browns Park gauge located 38 miles below the dam provide the best retrospective data set for determining the extent to which the recommended temperatures were met during the period since the 1992 Biological Opinion. Neither daily mean or daily median temperatures in the months of June through October met this recommended target (table 3-4). Maximum recorded daily mean temperatures exceeded 64 °F (18 °C) in June, July, and August; but only in July was this temperature met or exceeded on more than 10% of the days.

Table 3-4.—Daily Statistics for Water Temperatures[1] in Degrees Celsius at the Browns Park, U.S. Fish and Wildlife Service Measuring Station During the Period 1993-2001. The Station Is Approximately 38 Miles Downriver From Flaming Gorge Dam.

	Jun	Jul	Aug	Sept	Oct
Mean	13.5	16.5	16.2	13.9	10.4
Median	13.4	16.8	16.2	14.0	10.7
Minimum	8.9	12.8	9.5	7.7	4.6
Maximum	19.8	20.4	19.5	16.7	14.6
10th Percentile	10.4	14.4	15.1	12.0	8.2
90th Percentile	17.6	18.2	17.2	15.7	12.3

[1] Temperatures are in °C. Conversion from °C to °F = 9/5 x C + 32.

3.3.4.2 Reach 2

The 1992 Biological Opinion targets water temperatures at the beginning of Reach 2 (confluence of the Green and Yampa Rivers) and recommends that summer temperatures in these two streams should not deviate by more than 9 °F (5 °C). The water temperature gauge established by the U.S. Fish and Wildlife Service in Echo Park on the Green River, above its confluence with the Yampa River, has only been operational since 1998; so the ability to measure attainment of this recommendation is limited to after 1998.

Maximum differences between the Green and Yampa Rivers exceeded 9 °F (5 °C) in each of the months of June through October during the period of record (table 3-5). The differences exceeded 9 °F (5 °C) by less than 2 °F (1 °C) in all months but July; however, in that month, the maximum difference was 13.3 °F (7.4 °C). July was the only month in which more than 10% of the recorded daily average temperatures exceeded the 9 °F (5 °C) targeted difference.

Table 3-5.—Differences in Daily Mean Temperatures[1] in Degrees Celsius Between the Green and Yampa Rivers as Measured at the Echo Park Gauging Stations Located in Both Rivers Above the Confluence. Negative Numbers Indicate Water Temperatures That Were Colder in the Green River Than in the Yampa River

	Jun	Jul	Aug	Sept	Oct
Mean	-2.2	-3.2	-3.7	-1.5	0.5
Median	-2.4	-2.9	-4.0	-1.9	0.5
Minimum[2]	1.1	0.2	-1.1	2.9	3.2
Maximum[3]	-5.2	-7.4	-5.5	-5.1	-5.8
10th Percentile	-0.4	-1.5	-2.1	-1.2	2.7
90th Percentile	-3.3	-6.4	-4.9	-3.6	-0.8

[1] Temperatures are in °C. Conversion from °C to °F = 9/5 x C + 32.

[2] Minimum differences represent the highest positive or least negative differences in water temperature between the Green and Yampa Rivers during the respective month.

[3] Maximum differences represent the highest negative differences in water temperature between the Green and Yampa Rivers during the respective month.

Release water from the reservoir will reach the ambient water temperature as it travels downstream (figure 3-4). The rate at which the water warms depends on the flow rate, the release water temperature, meteorological conditions, and the flow temperature of the tributaries. The relationship between release temperature and downstream temperature for a given location does not form a direct correlation. During late spring through summer, increasing reservoir release temperatures will result in warmer downstream temperatures.

Summer water temperatures in both the Yampa and the Green Rivers at their confluence are highly dependent upon streamflow and air temperature. The higher the flows, the lower the temperature, and vice versa. Temperatures in the Green and Yampa Rivers are similar until flows in the Yampa River begin to recede. The temperature at the confluence of the two rivers differs by less than 9 °F (5 °C) until the Yampa River flows decline to near those of the Green River. The Yampa River quickly reaches summer base flow conditions, while flows on the Green River are elevated due to the dam releases. While the Yampa River flow approaches historic conditions during snowmelt runoff, during summer base flow periods, much of its flow is diverted for irrigation. As a result, there are lower base flows and warmer temperatures in the Yampa River than occurred historically.

The temperature goal of less than 5 °C difference between the Green and Yampa Rivers will be met most of the time. The exception would be a high summer flow in the Green River coupled with a relatively low flow in the Yampa River. In June-July 1998, the maximum temperature difference between the Green and Yampa Rivers occurred when Green River summer base flows were greater than 2,000 cfs, while the Yampa River was contributing much less than that. During the extreme drought conditions of 2002, the Yampa River flow dropped to less than 10 cfs, while the Green River flowed at 800 cfs. Both rivers were very warm (70-82 °F [21-28 °C]); however, the temperature difference still did not exceed the 9 °F (5 °C) goal even on an hourly basis.

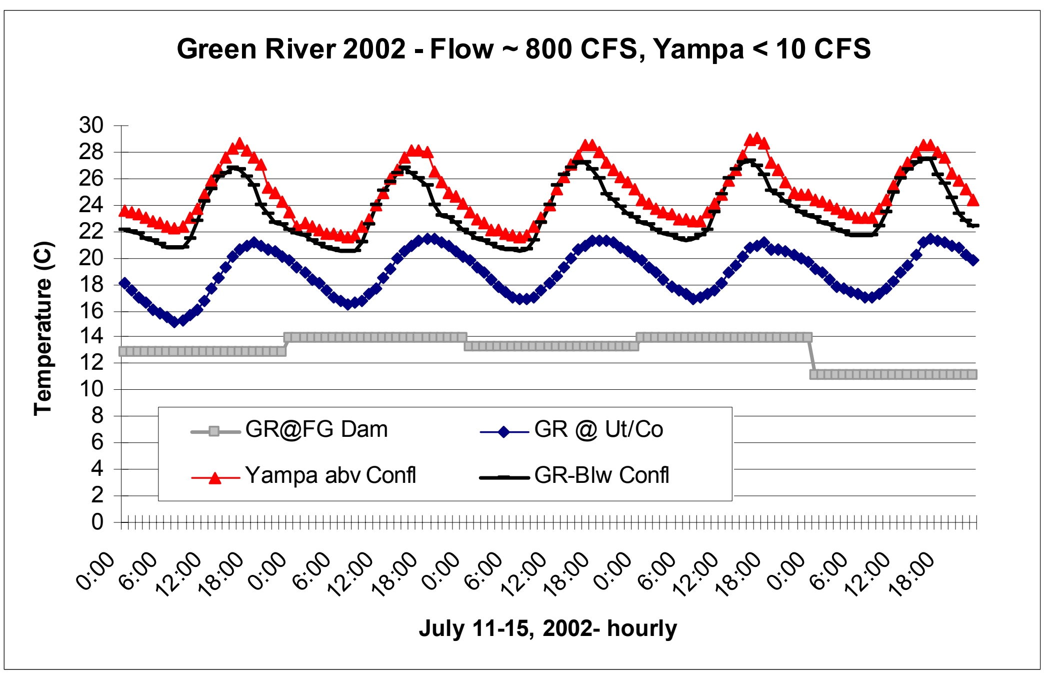


Figure 3-4.—2002 Hourly Temperature Variations From Flaming Gorge Dam to the Yampa River Confluence. Green River Flows at Approximately 800 cfs; Yampa Flows Near 10 cfs.

3.3.4.3 Reach 3

The 1992 Biological Opinion temperature requirement for the Green River at Gray Canyon calls for an average near 72-77 °F (22-25 °C) from July 1 to August 15. The extent to which this target was met is best estimated by measurements taken at the USGS gauging station at Green River, Utah, which is approximately 280 miles downriver from Flaming Gorge Dam. Records for June through October during 1993-2001 (table 3-6) show that fewer than 10% of the measurements during July and August were below 73 °F (23 °C). Inspection of these water temperatures and output of river modeling completed since the biological opinion was written (Carron, 2003) shows, however, that release temperatures from Flaming Gorge Dam have little influence on water temperatures in Reach 3 during summer months.

Table 3-6.—Daily Statistics for Water Temperatures[1] at Green River, Utah, USGS Gauging Station During the Period 1993-2001

	Jun	Jul	Aug	Sept	Oct
Mean	20.8	25.2	25.4	21.0	13.5
Median	20.5	25.0	25.0	21.0	13.3
Minimum	14.5	19.0	22.0	14.0	5.0
Maximum	28.0	30.0	30.0	26.0	20.0
10^{th} Percentile	18.0	23.0	24.0	17.0	10.0
90^{th} Percentile	25.0	28.0	27.0	24.0	18.0

[1] Temperatures are in °C. Conversion from °C to °F = 9/5 x C + 32.

3.3.5 Sediment Transport and Geomorphology

Prior to construction of Flaming Gorge Dam, the sediment transport regimes and characteristics of the Green River bed and bank varied greatly between canyon and fan-eddy-dominated reaches and meandering reaches (Grams and Schmidt, 2002). This variability still remains, although the decreased magnitude of peak flows due to construction of Flaming Gorge Dam has affected the quantity of sediment transported by a given flow due to alteration of the channel morphology and the availability of sediment within the channel.

Climate also influences sediment transport. Climate conditions can reduce a stream's ability to transport its supplied sediment load. Reduced upland vegetation cover due to drought reduces soil stability and increases erosion and subsequent siltation of streams. Drought followed by very wet years can also lead to increased upland erosion and stream siltation.

Recent research on the Green River has focused on the relationships between sediment transport and channel morphology over a range of flows in different geomorphic settings (Grams and Schmidt, 2002; Merritt and Cooper, 2000; Orchard and Schmidt, 2000; Allred and Schmidt, 1999; Grams and Schmidt, 1999; Martin et al., 1998; FLO Engineering, Inc., 1996). These studies include:

- Cobble and gravel deposits that are preferred spawning habitat of the endangered fishes have become less abundant and less frequently mobilized as they have aggraded with fine-grained sediment. Grams and Schmidt (2002) observed mid-channel sand deposits aggrading on deposits that, in the pre-dam era, were active gravel bars. These observations were limited to debris fan-eddy-dominated areas within Reach 1.
- Flow regulation reduced the dynamics of sediment deposition and erosion patterns. Each year, sediment deposits exposed during base flows are colonized by vegetation; and if subsequent floods do not scour these areas, a process of channel narrowing and increasing bank elevation can occur. At some point, this process becomes difficult to reverse because older, deeper-rooted vegetation is difficult to remove by all but the most extreme flood events. In Reach 1, Martin, et al. (1998) described the

re-distribution of sand in Lodore Canyon during 1995-97 when releases from Flaming Gorge Dam exceeded powerplant capacity. During a 6-day release when the flow of the Green River reached 8,600 cfs in this reach, significant erosion of eddy sandbars within this canyon reach was measured by these researchers. Merritt and Cooper (2000) described channel narrowing (11%) in Browns Park in Reach 1 during the decade immediately after closure of Flaming Gorge Dam followed by bank erosion and channel widening in Browns Park since 1977.

- Flood plains serve as important nursery habitat for growth and conditioning of endangered fish species in the Green River, particularly the razorback sucker. The frequency and extent of flood plain inundation varies considerably along the Green River and is largely a function of site-specific channel morphology (including the presence or absence of natural or human-made levees). In Reach 2, the greatest area of flood plain habitat suitable for satisfying the life-history requirements of endangered fishes is located in the Ouray National Wildlife Refuge. Under existing conditions, flood plain inundation begins to increase rapidly as flows exceed 18,600 cfs in this reach (FLO Engineering, Inc., 1996).

3.4 Hydropower Generation and Marketing

The three generating units have a total capacity of about 152 MW with a current generating capability of about 141 MW due to turbine limitations. The Flaming Gorge Powerplant has added more than 20,235 gigawatthours (GWh) of electricity into the power grid from November 1963 through the end of June 2002. While the Flaming Gorge Powerplant has generated an average of about 528.9 GWh of electricity annually, it has historically had a large amount of annual variability. Hydropower generation levels were as low as 251.6 GWh in 1990 and as high as 877.1 GWh in 1984. Generation is a result of water releases from the reservoir and is, among other things, dependent on the level of the water in the reservoir. A wet water year results in greater releases and greater power generation. Power generation is also affected by minimum streamflow levels, fluctuation restrictions, water delivery requirements, bypasses around the turbines, and water quality needs.

Power produced from the Flaming Gorge Powerplant is marketed by the Western Area Power Administration (Western) and is sold to municipalities, public utilities, and government agencies in Wyoming, Utah, Colorado, New Mexico, Arizona, and Nevada. Interconnecting transmission lines, both public and private, carry the power to major metropolitan areas and rural areas throughout the West. There are approximately 183 CRSP customers who purchase wholesale electricity from Western’s CRSP-Management Center office in Salt Lake City, Utah. Electrical power from the CRSP generally serves the rural areas and small towns of the Rocky Mountain States, Colorado Plateau, and Great Basin regions of the West. The CRSP marketing area includes parts of the States of Wyoming, Utah, Nevada, Arizona, New Mexico, Colorado, and Nebraska.

CRSP power customers are: (1) small and medium-sized towns that operate publicly owned electrical systems, (2) irrigation cooperatives and water conservation districts, (3) rural electrical associations or generation and transmission co-operatives who are wholesalers to these associations,
(4) municipal joint action agencies who are wholesalers to municipal electric utilities,
(5) Federal facilities such as U.S. Air Force bases, (6) universities and other State agencies, and (7) Indian tribes. Rural electric associations that buy power from CRSP serve

the rural areas of States. In Colorado and New Mexico, for example, CRSP customers serve almost all of the geographic area of the State outside of the major metropolitan areas.

Two Native American tribes receive CRSP electrical power (the Navajo Nation in Arizona and the Ute Mountain Ute Reservation in Utah), and effective October 1, 2004, 54 tribes have the opportunity of becoming CRSP firm electric service contractors.

Generally, the price these customers pay for their CRSP electrical power is less than the wholesale market price. However, these customers serve retail load in rural areas, where the cost to provide electrical service is high. Homes, farms, and other electrical connections are spread out, so that a significant transmission line and electrical generation investment has to be repaid by fewer retail customers. Generally, this is why private electrical suppliers chose not to extend their service to these areas and why the rural electric associations were set up to "electrify" the rural areas of the Nation. The retail prices charged by CRSP customers to end users are usually higher than adjacent urban areas. For example, the retail price for electricity charged by the CRSP customers who serve rural New Mexico is above $0.11 per kilowatthour (kWh) compared to about $0.07 per kWh in Albuquerque. Moreover, these rural areas and the tribal reservations are usually characterized by lower than average incomes and higher incidences of poverty. For example, the unemployment rate among the labor force on the Uintah and Ouray Ute Reservation in Utah was 28% in 1996. The per capita income on this same reservation in 1996 was $4,280, approximately one-fourth of the national average. The people that live in these areas are then less able to pay high electrical prices. Furthermore, higher electrical prices are one of the reasons that economic development is slower in rural areas of the American West.

These conditions do not accurately depict the situation for residences of the service territories of all CRSP customers. The CRSP municipal customers that are part of larger cities charge their end users less than that of surrounding towns. Usually, the retail price for towns like Bountiful and Murray, Utah, are lower than the price charged by the private electrical supplier in Salt Lake City.

Revenues earned from the sale of the power from Flaming Gorge Dam and other CRSP facilities are used to pay for construction, operation, and maintenance of the CRSP water storage units, among other repayment responsibilities associated with the CRSP and the participating projects. Western allocates long-term firm capacity and energy from the various Federal powerplants, including the Flaming Gorge facility, collectively referred to as the Salt Lake City Area Integrated Projects (SLCA/IP).

Western's power marketing responsibility, in most cases, begins at the switchyard of Federal hydroelectric power facilities and includes Federal transmission systems, while the hydroelectric plants are operated by Reclamation. Reclamation and Western work together on a daily basis in scheduling water releases. Western dispatches power generation at each facility to ensure compliance with minimum and maximum flow requirements and other constraints set by Reclamation in consultation with other Federal, State, and local entities.

Electric capacity and energy from SLCA/IP hydropower plants, along with power purchased by Western, is provided to Western's customers under contracts. Most power agreements are long-term firm contracts that specify the amounts of capacity and energy that Western agrees to offer for sale to its customers. These amounts constitute Western's commitment levels. Firm capacity and energy levels are guaranteed to the customer. If Western is unable to supply contracted amounts of firm capacity or energy from Reclamation hydroelectric resources, it must purchase the deficit from outside resources for delivery. Depending on the type of service offered, expense for this purchased power is either shared by all contractors and leads to a general increase in the overall rate or it is passed through to individual customers.

3.4.1 Hydropower Operations

Hydropower generation rises and falls instantaneously with the load (or demand)—a pattern called load following. The amount of load on the system is determined by how many electrical devices are using power. By comparison, coal- and nuclear-based resources are less efficient and have a relatively slow response time; consequently, they generally are not used for load following. At a hydropower facility, minimum and maximum water release levels determine the minimum and maximum power generation capability.

Ramping is the change in the water release from the reservoir to meet the electrical load. Both scheduled and unscheduled ramping are crucial in load following, ancillary services, emergency situations, and variations in real-time (what actually happens compared to what was scheduled) operations. North American Electric Reliability Council (NERC) and Western Electricity Coordinating Council operating criteria require Western and Reclamation to meet scheduled load changes by ramping the generators up or down beginning at 10 minutes before the hour and ending at 10 minutes after the hour.

As a control area operator, Western regulates the transmission system within a prescribed geographic area. Western is required to react to moment-by-moment changes in electrical demand within this area. Regulation means that "automatic generation control" will be used to adjust the power output of hydroelectric generators within a prescribed area in response to changes in the generation and transmission system to maintain the scheduled level of generation in accordance with prescribed NERC criteria.

Regulation depends on being able to ramp releases up or down quickly in response to system conditions. In addition, each utility is required to have sufficient generating capacity—in varying forms of readiness—to continue serving its customer load, even if the utility loses all or part of its own largest generating unit or largest capacity transmission line. This reserve capacity ensures electrical service reliability and an uninterrupted power supply. The Western Electricity Coordinating Council requires hydropower facilities to maintain 5-percent generation capacity in reserve; at Flaming Gorge, this would amount to about 7 MW (generated by a flow of about 260 cfs).

Generating capacity available that is in excess of the load on the system is called spinning reserve. "Spinning reserves" are used to quickly replace lost electrical generation resulting from a forced outage, such as the sudden loss of a major transmission line or generating unit. Additional generating units off line are also used to replace generation shortages, but they cannot replace lost generation capacity as quickly as spinning reserves.

3.5 AGRICULTURE

The highest agricultural use lands in the study area occur in Uintah County, south of Ouray and north of Green River. Uintah County, in the northeastern corner of Utah, covers about 4,477 square miles and has a total population of 25,926 people. Uintah County accounts for almost 5.5% of the total land area for the State of Utah (82,168 square miles) but only 1.1% of the total population (2000 Census of Population).

According to the 2000 Census of Population, urban dwellers (primarily in Vernal and Roosevelt) made up 45.9% of the county's population, with the remaining 54.1% of the total population being rural. The 1990 Census of Population showed that approximately 4% of the county's total population lived on farms within the county boundaries.

The number of farms in Utah has remained relatively stable from 1990 to 2000, at around 15,000 farms. Uintah County accounts for a little more than 5% of the total number of farms in the State.

3.5.1 Census of Agriculture Data

Census of Agriculture data for Uintah County, Utah, was available for 1997 and 1992. In 1997, there were 795 farms encompassing 2,268,090 acres of land, for an average farm size of 2,853 acres. The 1992 Census of Agriculture showed Uintah County as having 716 farms with an average farm size of 1,808 acres. The estimated, average market value of land and buildings for farmers in Uintah County rose from $206,510 in 1992 to $551,978 in 1997, a 167-percent gain in value.

In 1997, only about 39% of the farm residents in Uintah County listed farming as their principal occupation. The most common farm size in the county was between 10 and 49 acres. Total cropland in the county was 90,524 acres, of which 50% were in production. Idle croplands made up 5.5% of total cropland, and pastureland of all types totaled 2.1 million acres. Cropland in the county generally had a dual use, with about 76% of the total cropland acres being used for both grazing and the harvesting of a crop.

The 1997 agricultural census showed that 686 farms in Uintah County contained irrigated acreage. Total land for these 686 farms came to 2,225,467 acres of which 83,939 acres (3.8%) were irrigated. Irrigated cropland made up nearly 93% of the total harvested cropland in the county.

The primary crops produced in Uintah County included alfalfa and grass hay, barley, wheat, oats, corn grain, and corn silage. Wheat is primarily a dryland crop, with only 8% of wheat acres being irrigated. In contrast, acreage for hay and oat crops is about 95% under irrigation. Most of the barley acreage (74%) is irrigated with a small amount being dryland farmed.

3.5.2 Utah Agricultural Statistics

Information about the number of harvested acres of irrigated crops in Uintah County was obtained from the annual Utah Agricultural Statistics publication. This information source was also used for information about crop yields and price received. A 5-year average of the data was used to determine baseline crop acreage, yield, and price received.

Table 3-7 shows the irrigated crops produced in Uintah County from 1996 to 2000 and the number of acres of each harvested.

Hay is the most commonly produced crop in Uintah County, accounting for almost 87% of all the crops grown. More than 90% of all crop acres are accounted for if the corn silage acres are added to the hay acres. Alfalfa hay is clearly the dominant crop in the county with 71% of the total acreage for all the listed crops.

The next most commonly produced crop behind the hay crops (alfalfa and other hay) is corn silage, with an average of 2,100 acres. Barley more than doubled in acreage from 1996 to 1997 and has remained at that level. Corn grain showed a similar, smaller percentage increase in acreage over the same time. The number of acres planted in oats remained relatively constant over the 5-year timeframe.

Table 3-7.—Primary Crop Acreages for Uintah County, Utah, for 1996-2000

Crop	Acres Harvested 1996	1997	1998	1999	2000	5-Year Average
All Wheat	800	200	300	1,000	1,000	660
Corn Grain	700	1,000	1,400	1,000	1,100	1,040
Corn Silage	1,000	2,400	2,100	2,200	2,800	2,100
Oats	600	800	800	800	500	700
Barley	500	1,200	1,100	1,400	1,200	1,080
Other Hay	5,300	7,800	6,800	6,800	7,000	6,740
Alfalfa Hay	27,500	30,400	29,300	29,500	31,000	29,540
Total Number of Acres						41,860

Crop yields were also obtained for each of the above crops (table 3-8).

After obtaining the number of acres and yields for the crops grown in Uintah County, the price received for the crops was used to derive the total gross value of production. Prices received for the crops came from the Utah Agricultural Statistics and the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (table 3-9).

To derive the per acre gross income generated by the sale of a crop, the yield is multiplied by the price received. This product is then multiplied by the number of acres of that crop to calculate the total value of that crop to the county. Table 3-10 shows the per acre and total gross incomes for each of the crops listed in table 3-9.

3.6 Land Status and Use

Land within Flaming Gorge Reservoir is federally owned and consists primarily of Reclamation project lands acquired for the Flaming Gorge Unit of the CRSP. It is principally used for water storage. Land around Flaming Gorge Reservoir is federally owned public land, under the jurisdiction of the U.S. Department of Agriculture Forest Service (USDA Forest Service) and principally used for recreation.

Land ownership along the Green River downstream from Flaming Gorge Dam is a mixture of Federal, Indian trust, State, county, and private lands.

3.6.1 Flaming Gorge Dam and Reservoir

The reservoir lands and lands within the Flaming Gorge National Recreation Area (FGNRA) are under the jurisdiction of Reclamation and/or the USDA Forest Service. These federally owned lands have been withdrawn or acquired by fee or easement for the Flaming Gorge Unit of the CRSP. Their use is water storage, public outdoor recreation, and other purposes of the CRSP.

3.6.2 Green River Downstream From Flaming Gorge Dam

The lands along the Green River downstream from the dam have a variety of ownership and uses as outlined below. The river is divided into three reaches, as described in the following paragraphs.

Reach 1 begins just below the dam in the FGNRA, runs through Browns Park National Wildlife Refuge, and ends in the Dinosaur National Monument after traveling a distance of approximately 70 miles. The first 14 miles

Table 3-8.—Crop Yields for Uintah County, Utah, 1996-2000

Crop	Yield Unit	Crop Yield 1996	1997	1998	1999	2000	5-Year Average
All Wheat	Bushel	46	50	70	39	53	51.6
Corn Grain	Bushel	111	152	139	140	140	136.4
Corn Silage	Ton	23	21	19	20	17	20
Oats	Bushel	57	68	75	70	69	67.8
Barley	Bushel	98	92	88	74	64	83.2
Other Hay	Ton	3.6	4.1	4.2	4.1	3.4	3.9
Alfalfa Hay	Ton	3.8	4.5	4.5	4.5	3.7	4.2

Table 3-9.—Prices Received by Crop (1996-2000)
($)

Crop	Price Received 1996	1997	1998	1999	2000	5-Year Average
All Wheat	4.45	3.29	2.95	2.60	3.00	3.26
Corn Grain	3.80	3.05	2.45	2.36	2.50	2.83
Corn Silage	28.00	28.00	26.00	25.00	27.00	26.80
Oats	2.10	1.97	1.45	1.50	1.60	1.72
Barley	2.93	2.29	1.86	1.89	1.85	2.16
Other Hay	72.00	84.00	76.00	71.50	77.50	76.20
Alfalfa Hay	72.50	85.00	77.00	73.00	78.50	77.20

Table 3-10.—Average Annual Gross Income for the Crops Grown in Uintah County (1996-2000)

Crop	Acres	Yield	Price ($)	Gross Income Per Acre ($)	Total Value ($)
All Wheat	660	51.6	3.26	168.11	110,954.45
Corn Grain	1,040	136.4	2.83	386.28	401,736.19
Corn Silage	2,100	20	26.80	536.00	1,125,600.00
Oats	700	67.8	1.72	116.89	81,821.04
Barley	1,080	83.2	2.16	180.04	194,448.38
Alfalfa Hay	29,540	4.2	77.20	324.24	9,578,049.60
Other Hay	6,740	3.9	76.20	297.18	2,002,993.20
				Total Value	13,495,602.86

of this reach, located in the FGNRA, contains steep, wooded terrain and, therefore, is used mainly for limited recreational pursuits. Next, the river runs through Browns Park for approximately 16 miles. This land is more open with gentle slopes to the river and contains sage and scrub brush vegetation. The use here is mainly recreation consisting of camping, boating, and rafting. There are many unpaved access roads leading to camping spots and river access points for raft launching.

The river then enters Browns Park National Wildlife Refuge and meanders through many low wetland areas in the refuge for approximately 20 miles. Browns Park National Wildlife Refuge is managed by the U.S. Fish and Wildlife Service, and the land is used for wildlife mitigation. At this point, the river enters the Dinosaur National Monument managed by the National Park Service. This last 20 miles of Reach 1 consists mainly of a steep, rugged rock canyon called Lodore Canyon. Because of the rugged terrain, the area is a popular recreation site used for river rafting and camping.

Reach 2 begins at the confluence of the Green River and the Yampa River, in the middle of Dinosaur National Monument. After leaving the monument, the Green River flows through private lands, State of Utah lands, Federal lands managed by the Bureau of Land Management (BLM), Ouray National Wildlife Refuge, and Ute Indian tribal lands.

Within Dinosaur National Monument, the river flows through two steep, rock canyons (Whirlpool Canyon and Split Mountain Canyon) and one area with a wider river bottom and low lying meadows (Island Park and Rainbow Park). After leaving Dinosaur National Monument, the river runs through privately owned lands containing some areas of rolling hills and some low lying areas. Farms border the river corridor, mainly with pasture lands and range lands. Some development is beginning to appear in the historic flood plain areas, since the construction of Flaming Gorge Dam provides some flood control to these areas. Most of this development consists of agricultural sprinkler systems and basic farm and storage structures, although some development includes residential houses.

Next, the river flows past Stewart Lake Wildlife Refuge, managed by the State of Utah Division of Wildlife Resources, and private lands. In this area, some residential homes have been constructed in the historic flood plain or near the banks of the Green River. The river then runs through a stretch of Federal lands (managed by BLM), State of Utah lands, and private lands. These lands, in the vicinity of Horseshoe Bend, are used for public lands, agricultural development, and oil and gas development.

The last portion of Reach 2 brings the river through the following land ownerships: Ouray National Wildlife Refuge (managed by the U.S. Fish and Wildlife Service), Federal lands in trust for the Ute Indian Tribe, private lands, and BLM lands. These lands are used for wildlife mitigation, oil and gas exploration, and development and residential purposes.

There are four highway bridges crossing the Green River in Reach 2. The first bridge is on State Highway 149 and crosses the river approximately 6 miles southeast of the Dinosaur National Monument. The second bridge crosses the river on U.S. Highway 40 at Jensen, Utah. The third bridge is on State Highway 45 and crosses the Green River approximately 7 miles south of Naples, Utah. The fourth bridge crosses the river on State Highway 88 just south of Ouray, Utah.

Reach 3 begins at the confluence of the Green River and the White River. Land ownership includes some Ute Indian tribal lands; Federal, State, and county lands; and private lands. Land uses include agriculture, recreation, and oil and gas mining. Contained within this reach are the Canyonlands National Park and the Hill Creek Extension of the Uintah and Ouray Indian Reservation.

The land within Reach 3 is classified as "high desert," with elevations ranging from 3700 feet to 7200 feet above sea level. Much of the land immediately adjacent to the Green River is composed of vast sedimentary rock deposits which, over the years, have been deeply incised, creating deep canyons (particularly Desolation Canyon and Labyrinth Canyon). These rock deposits and deep canyons limit the use of the lands adjacent to the river and also limit the points of access to the river, therefore limiting the use of the river.

The areas immediately south of Ouray and north of Green River have the highest agricultural use within Reach 3. Predominant crops include corn, alfalfa, watermelon, and grain. Land use along the Green River is primarily determined by topography. Agricultural areas have a minimal slope and often abut dense riparian habitat along the river. A vast amount of Indian trust land, which is generally higher in elevation, is also used for oil and gas exploration. In these areas, there appears to be a general lack of vegetation and an abundance of collection/ distribution pipeline infrastructures running on the land surface, along with many dirt access roads.

3.7 ECOLOGICAL RESOURCES

This section describes the affected environment for plants and animals in and around the reservoir and the river. It includes information on threatened and endangered species and other special status species.

3.7.1 Flaming Gorge Dam and Reservoir

3.7.1.1 Aquatic Animals

The Flaming Gorge Reservoir fish community consists of the following nonnative species: lake trout (*Salvelinus namaycush),* brown trout (*Salmo trutta),* rainbow trout (*Oncorhynchus mykiss)*, cutthroat trout (*Oncorhynchus clarki),* kokanee salmon (*Oncorhynchus nerka),* white sucker (*Catostomus commersoni),* smallmouth bass (*Micropterus dolomieui),* channel catfish (*Ictalurus punctatus),* common carp (*Cyprinus carpio),*Utah chub (*Gila atraria*), redside shiner (*Richardsonius balteatus),* and the Bear Lake sculpin (*Cottus extensus).* It is also home to small numbers of the following native species: flannelmouth sucker (*Catostomus latipinnis),* mountain whitefish (*Prosopium williamsoni),* and the mottled sculpin (*Cottus bairdi).*

Since the reservoir was filled, rainbow trout have been annually stocked in Flaming Gorge Reservoir and provide the bulk of the harvest, as well as being the most sought-after species by anglers. Kokanee salmon and smallmouth bass were stocked during the mid 1960s and have since developed naturally reproducing fisheries. After rainbow trout, kokanee are typically second in harvest and popularity with anglers. Other sport fish occasionally stocked in the reservoir include brown trout and channel catfish.

Lake trout, which drifted into Flaming Gorge from the upper Green River drainage, have also become established as a wild population. Lake trout are managed as a trophy fishery in Flaming Gorge. Regulations are designed to keep lake trout numbers in balance with populations of kokanee salmon and Utah chubs, their primary prey.

Kokanee salmon concentrate in different locations in the reservoir every year, but consistent concentration areas include Cedar Springs, Jarvies Canyon, Hideout, Red Cliffs, Horseshoe Canyon, Pipeline, Wildhorse, Squaw Hollow, Lowe Canyon, and Big Bend. Flaming Gorge Reservoir provides important shoreline spawning habitat for kokanee salmon, and most recruitment of these fish comes from shoreline spawning; however, Kokanee can spawn at water depths up to 60 feet (Gipson and Hubert, 1993). Shoreline spawning habitat areas are located on the east shore of the reservoir, which has steep slopes (greater than 20 degrees), and abundant substrate of small (less than 4 inches) shale particles extending from the water's edge to depths of more than 60 feet (University of Wyoming, 1991). Kokanee are an important sport fish in the reservoir. As the fall spawning season approaches, mature kokanee concentrate or "stage" adjacent to these spawning areas.

Smallmouth bass are found in rocky shoreline habitat throughout Flaming Gorge Reservoir. A dense population dominated by smaller fish exists from the dam north to Linwood Bay. From the Antelope Flats area north, fewer but larger bass are found. Smallmouths in Flaming Gorge Reservoir feed almost exclusively on crayfish. They spawn from late May through early July and during this period mature fish move into shallow water 2 to 20 feet in depth (Sigler and Sigler, 1996). Smallmouth bass were introduced into Flaming Gorge Reservoir to promote growth of rainbow trout by reducing the Utah chub population (Tuescher and Luecke, 1996).

3.7.1.2 Aquatic Food Base

Prior to construction of the dam, the aquatic food base was comprised mostly of coarse organic material carried into the river from the drainage basin. That material is now deposited in Flaming Gorge Reservoir. Presently, benthic algae, phytoplankton, and zooplankton are at the base of the reservoir's food web. The reservoir traps nutrients like phosphorus and nitrogen as it traps incoming suspended sediments.

3.7.1.3 Vegetation

Shoreline vegetation along Flaming Gorge Reservoir consists mainly of pinion and juniper woodlands and sagebrush communities. Fluctuating water levels, steep gradient slopes, and loss of soil through erosion combine to severely limit vegetation establishment along the shoreline. Riparian and wetland vegetation associated with the reservoir is limited to mouths of tributaries and infrequent locations along the shoreline where lower gradient slope and fine soils that retain subsurface water connections are present. Most wetland vegetation is in the rush and sedge families, with occasional presence of native and nonnative grasses, willows (*Salix* sp.), cottonwoods (*Populus* sp.), and tamarisk (*Tamarix ramosissima*).

3.7.1.4 Terrestrial and Avian Animals

Several species of game mammals, including mule deer, elk, moose, pronghorn, and bighorn sheep, occur along the Green River corridor above and below Flaming Gorge Dam. All of these species use riparian habitats as foraging and watering areas but are not restricted to riparian areas at any time of the year. Mule deer, elk, and pronghorn range widely throughout this portion of Utah and Colorado but move toward the river in the fall and use the river valley, especially Browns Park, as wintering range. Mule deer occur along the river throughout the year and are the most abundant game mammal in the area. Moose numbers are low in the region but appear to be increasing (BLM, 1990). Within the area, moose habitat occurs in Browns Park (Schnurr, 1992).

3.7.2 Green River Downstream From Flaming Gorge Dam

3.7.2.1 Aquatic Animals Overview

Historically, the Green River in the area of Flaming Gorge was an unregulated, turbid, temperate stream that exhibited wide fluctuations in flow (2000 Flow and Temperature Recommendations). Water temperature ranged from near freezing to greater than 70 °F (21 °C) annually. The river supported 12 native fish species, including 4 that are now endangered: Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. Several native species, including mountain whitefish

(*Prosopium williamsoni)*, mountain sucker (*Catostomus platyrhynchus),* mottled sculpin (*Cottus bairdi)*, and Colorado River cutthroat trout (*Oncorhynchus clarki pleuritcus)*, were likely only part-time residents in the Flaming Gorge area, preferring cooler water temperatures that were found farther upstream. The river warming that occurred naturally would have completely precluded their presence by the time the Green River reached its confluence with the Yampa River. From that confluence downstream, the remaining eight warm water species (the four endangered species plus the flannelmouth sucker (*Catostomus latipinnis)*, bluehead sucker (*Catostomus discobolus)*, roundtail chub (*Gila robusta)*, and speckled dace (*Rhinichthys osculus)* comprised the entire fish community. These species were historically found throughout the Green River and the lower reaches of its tributaries: the Yampa, White, Duchesne, Price, and San Rafael Rivers.

Earliest impacts to the Green River system came in two forms: alterations of the physical environment (channelization, diking, and pollution) and the introduction of nonnative species. The first major diversion structure placed in the main channel of the Green River was at Tusher Wash, near the town of Green River, Utah, in 1906 (Cavalli, 2000). Even considering similar diversion structures and larger storage projects on Green River tributaries, Tusher Wash Dam remained the only significant barrier to warm water fish movement and the most significant form of river regulation on the Green River until the construction of Flaming Gorge Dam.

By the early 1900s, nonnative fish populations—in particular, channel catfish (*Ictalurus punctatus*)—had become established in the main stem Colorado River. Since that time, either intentionally or otherwise, a total of 25 nonnative species representing 9 families has been introduced into the Green River and its tributaries. Nonnative fish now dominate the fish community of the entire Colorado River system and are believed to contribute to reductions in the distribution and abundance of native species through competition and predation (Carlson and Muth, 1989).

Completion of Flaming Gorge Dam in 1962 had profound effects on downstream conditions. Historic operations greatly altered the seasonal and daily flow and temperature patterns. These changes rendered sections of the Green River immediately downstream from the dam largely unsuitable for native fish. It also shifted the aquatic invertebrate community from one dominated by a diverse assemblage of warm water species (Holden and Crist, 1981) to species tolerant of cold, clear water (Vinson, 1998).

In 1962, a project to eradicate "coarse" fishes from the Flaming Gorge Reservoir basin and its tributaries was conducted to clear the way for the proposed trout sport fishery. The coarse fish referred to were the native Colorado River species. Effects of the project went beyond the intended scope (Miller, 1963; Dexter, 1965; Pearson et al., 1968) when detoxification of the fish toxicant (rotenone) failed and native fish were inadvertently killed downstream through Dinosaur National Monument (Holden, 1991). Followup reports conducted by the Wyoming Game and Fish Commission (Binns et al., 1964) indicated that razorback sucker and native chubs were collected near the dam site, but native fish populations were affected as much as 80 miles downstream.

Rainbow trout were first introduced to the Green River tailwater in 1963, and brown trout were introduced in 1965. The stocked fish survived, but growth rates were low due to cold dam releases (39 to 47 ºF [4 to 8 ºC]). Penstocks were modified in 1978 to raise release temperatures by withdrawal of water from higher reservoir depths (Holden and Crist, 1981), and growth rates of trout improved (Modde et al., 1991). Native fish also benefited from the warmer river. Within 6 months of the penstock modifications, Holden and Crist (1981) documented re-colonization and reproduction of both warm water native and nonnative fish in the Green River upstream of its confluence with the Yampa River. Adult Colorado pikeminnow and razorback sucker were observed, but no signs of successful reproduction were found.

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program), established in 1987, promoted the early research that led to the flow and temperature recommendations identified in the 1992 Biological Opinion. In addition to identifying the flow needs of the endangered fish, the Recovery Program has directed effort at developing habitat, reducing nonnative species, reducing the impacts of sport fish and sport fishing, raising and stocking endangered species, and gaining public support for all these activities through an information and education program.

The Green River provides excellent habitat for the river otter. The State of Utah considers river otter a species of special concern due to declining populations and limited distribution. Reintroduction of river otter to the Green River drainage began in 1989 and 1990 with the release of 23 otters at sites below the dam (Utah Division of Wildlife Resources, 1992). Seventeen otters were released in Island and Rainbow Parks in Dinosaur National Monument in 1991 (Cranney and Day, 1993). Since then, otters have moved into the Flaming Gorge Reservoir and reaches of the river near Ouray, Utah. Fish (especially carp) make up most of this species' diet. Abandoned beaver dens, clusters of boulders, or rock crevices near the water's edge are used as shelters.

Beaver den mainly in the banks of the Green River and in wetlands created for waterfowl. These areas exist below the dam. Beaver are abundant in these areas and can affect woody plant species composition and coverage by their feeding habits. They can also negatively affect the operation of waterfowl management areas by their damming activities. Muskrat exist in abundance within the Green River below the dam.

Many species of waterbirds use the Green River below Flaming Gorge Dam. The Green River and waterfowl management areas adjacent to the river in Browns Park provide habitat for migration, breeding, nesting, and foraging activities of these birds.

3.7.2.2 Native Fish Species Overview

3.7.2.2.1 Colorado Pikeminnow – The Colorado pikeminnow was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967, and subsequently received protection under the Endangered Species Act of 1973. Critical habitat was designated on March 21, 1994, and includes the entire Green River downstream from Reach 1. Threats to the species include streamflow regulation, habitat modification, competition with and predation by nonnative fish species, and pesticides and pollutants (U.S. Fish and Wildlife Service, 2002b).

This large, predatory fish is widely distributed throughout the Upper Colorado River Basin, and recent estimates of abundance indicate the population in the Green River subbasin is on the rise (McAda, 2002). Adult habitat includes deep, low velocity runs, pools, eddies, and seasonally flooded lowland habitats. Pikeminnow display fidelity to natal spawning areas, of which there are few in the Green River subbasin; one is located on the lower Yampa River, and one is located on the Green River in Gray Canyon. Pikeminnow migrate to those spawning areas during the spring, coinciding with the descending limb of the hydrograph as river temperatures warm in excess of 62 ºF (18 ºC). Spawning occurs after spring runoff at water temperatures typically between 64 and 73 ºF (18 and 23 ºC); however, there are accounts of spawning at cooler temperatures (61 ºF [16 ºC]) (Bestgen et al., 1998).

Although never visually observed due to high turbidity, researchers using radiotelemetry have determined that pikeminnow spawn over cobble-bottomed riffles (Tyus, 1990). These cobble bars are formed and maintained by various aspects of the spring peak and post-peak flows (Harvey et al., 1993). Eggs are adhesive and require a clean cobble surface for attachment (Hamman, 1981). Embryos incubate for 4-7 days, depending on river temperature; and larvae hatch and remain in the spawning substrates for an additional 6-7 days (Bestgen et al., 1998). Larvae then emerge from the substrate and are carried downstream to low velocity nursery habitats. Larvae produced in the lower Yampa River spawning bar are thought to mostly colonize backwaters between Jensen, Utah, and the Ouray National Wildlife Refuge. Larvae produced in Gray Canyon drift into habitats in Reach 3.

3.7.2.2.2 Humpback Chub – The humpback chub was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967, and received protection as endangered under the Endangered Species Act of 1973. Critical habitat was designated on March 21, 1994, and included stretches of the Yampa, Colorado, and Green Rivers in the Upper Colorado River Basin. The canyon-bound reaches of the Green River between its confluence with the Yampa and Colorado Rivers (Reaches 2 and 3) were designated. Threats to the species include streamflow regulation, habitat modification, predation by nonnative fish species, parasitism, hybridization with other native chubs, and pesticides and pollutants (U.S. Fish and Wildlife Service, 2002c). This species is highly adapted to life in canyon environments. Adult habitat includes deep pools and shoreline eddies in the warmer portions of the main channel. Specific physical spawning requirements are less understood for this species than other native Colorado River fishes. Humpback chub do not display spawning migrations and appear to complete their life cycle within the confines of relatively short stretches of canyon bound river. Drift of humpback chub larvae is less extensive than for Colorado pikeminnow. Spawning coincides with the spring runoff and typically occurs very soon after the peak when main channel temperatures warm in excess of 62 ºF (17 ºC) (Chart and Lentsch, 1999; Tyus and Karp, 1989; Valdez and Clemmer, 1982). The majority of spawning occurs when temperatures range from 61 to 72 ºF (16 to 22 ºC) (U.S. Fish and Wildlife Service, 2002c). Young occupy warm, low velocity shoreline habitats but appear less specific in their nursery habitat selection than pikeminnow (Chart and Lentsch, 1999).

3.7.2.2.3 Razorback Sucker – The razorback sucker was federally listed as endangered on October 23, 1991, with critical habitat designated March 21, 1994. The entire Green River from its confluence with the Yampa River downstream to its confluence with the Colorado River (Reaches 2 and 3) was included in this designation. There is no critical habitat in Reach 1. Threats to the species include streamflow regulation, habitat modification, predation by nonnative fish species, and pesticides and pollutants (U.S. Fish and Wildlife Service, 2002d). It is found in warm water reaches of the Green River and the lower portions of its major tributaries. It occurs primarily in the low gradient reaches between the confluences of the Yampa and Duchesne Rivers in Reach 2. Adult habitat includes runs, pools, eddies, and seasonally flooded lowlands. Spawning occurs in April through June, as the river rises to its spring peak (McAda and Wydoski, 1980; Tyus, 1987; Modde and Wick, 1997; Muth et al., 1998). In recent years, spawning has occurred when average daily flows ranged between 2,754 and 22,000 cfs and temperatures ranged between 46 ºF (8 ºC) and 67 ºF (19 ºC). Razorback suckers spawn over coarse cobbles, and their eggs hatch in 6.5-12.5 days, dependent on water temperatures. Larval razorbacks are then transported downstream into off-channel nursery environments (tributary mouths, backwaters, and inundated flood plains) where quiet, warm water is found (Mueller, 1995; Paulin et al., 1989).

Declines in the abundance and distribution of razorback suckers in the Upper Colorado River Basin have been noted for decades (Wiltzius, 1978). Although there continues to be evidence of successful reproduction, the Green River population of wild razorback suckers continues to decline due to lack of sufficient recruitment and may soon be extirpated (Bestgen et al., 2002). Stocking efforts, which have been experimental in nature to date (Burdick, 2002), are scheduled to increase in the near future in an attempt to increase abundance.

3.7.2.2.4 Bonytail – The bonytail was listed as endangered under a final rule published on April 23, 1980. Critical habitat was designated on March 21, 1994, and includes Reaches 2 and 3 of the Green River. Threats to the species include streamflow regulation, habitat modification, predation by nonnative fish species, hybridization, and pesticides and pollutants (U.S. Fish and Wildlife Service, 2002a).

The bonytail was historically common to abundant in warm water reaches of larger rivers from Mexico to Wyoming, but it is now the rarest of the Colorado River endangered fishes. Life history requirements of the bonytail are poorly understood; it is considered adapted to main stem rivers where it has been observed in pools and eddies. As do other closely related fish species, bonytail probably spawn in the spring in rivers over rocky substrates. It has also been hypothesized that flooded bottomlands may provide important areas for growth and conditioning, particularly for the early life stages (U.S. Fish and Wildlife Service, 2002a).

3.7.2.2.5 Other Native Fish Species of Concern – Flannelmouth suckers are widespread in warm water reaches of larger river channels. Adults typically occupy pools and deeper runs, eddies, and shorelines and spawn in the spring prior to peak flows. Young flannelmouth suckers occupy low velocity shorelines or other seasonally flooded low velocity habitats.

Bluehead suckers are also widespread. They occur in a wider range of water temperatures, including cooler habitats than those occupied by flannelmouth sucker. The bluehead sucker is more of a fast water fish, occupying riffles or shallow runs over rocky substrates. It spawns in the spring at slightly warmer temperatures than flannelmouth suckers. Young bluehead suckers also occupy low velocity shorelines or seasonally flooded areas.

Roundtail chubs are less abundant in the Green River main stem than the native suckers but are more abundant in the smaller tributaries and in the upper reaches of the Green, White, and Colorado Rivers. Roundtail chubs are also commonly collected in the Yampa River, including its lower, canyon-bound portions (Haines and Modde, 2002). Adult habitat includes riffles, runs, pools, eddies, backwaters, and areas that provide a diversity of flows. Roundtail chubs spawn during the spring peak, typically on the descending limb as temperatures range between 62 and 70 °F (21 °C) (Chart and Lentsch, 1999). Young roundtail chubs occupy low velocity shoreline habitats.

McAda and Ryel (1999) report that in the Colorado River, larvae and young-of-the-year (YOY) of these native fishes were more abundant in years with high peak runoff than in years with low peak runoff. These three main channel dwelling species and their young likely provided the bulk of the Colorado pikeminnow diet prior to the establishment of nonnative species (Osmundson, 1999).

3.7.2.3 Reach 1

3.7.2.3.1 Aquatic Food Base – The main aquatic food base in the Green River downstream from Flaming Gorge Dam is the filamentous green alga *(Cladophora* sp.*)* and attached periphyton communities (Johnson et al., 1987) and a freshwater amphipod (*Hyallela* sp.*)* (U.S. Department of Energy, 1996). *Cladophora* serves as an indicator of productivity in the upper portion of the Green River. Algae and periphytic diatoms provide food for chironomids and amphipods, dominant invertebrates in the trout diet (Johnson et al., 1987; Modde et al., 1991). Macroinvertebrates are most abundant above the Yampa River confluence (Holden and Crist, 1981). In the tailwater and in canyons between the dam and Browns Park, large, stable substrates and clear, cold water support abundant growths of *Cladophora* and other attached algae (Holden and Crist, 1981; Gosse, 1982; Modde et al., 1991).

Low-gradient reaches within Browns Park lack *Cladophora* except where occasional rapids and riffles provide suitable hard substrates. Macroinvertebrates in these low-gradient reaches include chironomids, oligochaetes, mayfly larvae and biting midges, and sandflies (Annear, 1980; Holden and Crist, 1981; Grabowski and Hiebert, 1989). Productivity generally declines further downstream from the dam. This is likely due to increased turbidity and declining availability of nutrients like phosphorus and nitrogen.

In general, daily fluctuating flows in the river are detrimental to the food base of both native and nonnative fish and have a negative effect on algal production and abundance of aquatic invertebrates due to repeated drying and wetting of the shoreline zone. Production of *Cladophora* is lower within the fluctuating zone, and areas dewatered for greater than 12 hours do not sustain a *Cladophora*-based community.

Greater drift of macroinvertebrates occurs during fluctuating flows rather than during steady flows. Large floods can wash a great quantity of macroinvertebrates downstream. This could temporarily reduce the food base in the reaches of the river directly below the dam following a flood (Vinson, 1998).

The New Zealand mud snail (*Potamopyrgus antipodarum*) is a nonnative species that is rapidly spreading throughout the Western United States. This small snail has become extremely abundant in some ecosystems, reaching densities of 100,000 per square meter and comprising 95% of the invertebrate biomass. Trout eat the snails but may derive very limited nutritional value from them. The New Zealand mud snail has been recently detected in several river systems in Utah and was first found in the Green River below Flaming Gorge Dam in September 2001. Since that time, their distribution and abundances have increased, and this snail is currently found from the dam downstream to the State line. Their preferred habitat appears to be beds of rooted aquatic vegetation, particularly sego pondweed (*Potamogeton pectinatus*) (Vinson, 2004). Ultimate distributions, densities, and this invasive species' effect on the existing aquatic community remains uncertain.

3.7.2.3.2 Threatened and Endangered Fish –

3.7.2.3.2.1 Colorado Pikeminnow – Colorado pikeminnow historically occurred throughout Reach 1 and likely reproduced in or near Flaming Gorge Canyon (2000 Flow and Temperature Recommendations). Low velocity habitats found in Browns Park may have provided nursery habitat for larvae and other life stages. Juvenile and adult pikeminnow (greater than 400 millimeters total length) are currently found in Lodore Canyon during spring, summer, and fall. Ongoing telemetry efforts indicate that adult pikeminnow may also be spending the winter in Reach 1 (Kitcheyan, 2003). Pikeminnow abundance has increased since 1980 (Bestgen and Crist, 2000), and they are distributed as far upstream as Browns Park. Growth rates of pikeminnow in Lodore Canyon are high, presumably due to the abundance of forage (Bestgen and Crist, 2000). Although many of the native species currently found in Reach 1 successfully reproduce there (a positive response to penstock modifications and associated river warming), Colorado pikeminnow do not. Provided that suitable spawning habitat exists in Reach 1, further warming of the river would likely be necessary for pikeminnow to successfully reproduce.

3.7.2.3.2.2 Humpback Chub – The best available information suggests that prior to the construction of Flaming Gorge Dam, the upstream distribution of humpback chub in the Green River reached Flaming Gorge Canyon (Vanicek, 1967; Holden, 1991). Due to the fish eradication program of the 1960s, this species was eliminated from Reach 1. Primarily due to a combination of sub-optimal thermal regimes and this species' sedentary nature, humpback chub have not re-colonized Reach 1.

3.7.2.3.2.3 Razorback Sucker – Prior to construction of Flaming Gorge Dam, razorback suckers were found as far upstream as Green River, Wyoming (Jordan, 1891; Evermann and Rutter, 1895; Simon, 1946). This species was more common in the lower Green River and apparently rare upstream of the Yampa River confluence even before construction of Flaming Gorge Dam (Simon, 1946). Razorback suckers disappeared from the Green River upstream of the Yampa River confluence for a period following dam construction (Vanicek et al., 1970). Since penstock modification, razorback sucker adults have been collected in Reach 1 on several occasions, however always in very low numbers. Those collections have been confined in recent years to the lower portion of Lodore Canyon.

3.7.2.3.2.4 Bonytail – The last evidence of natural bonytail reproduction in the Upper Colorado River Basin was documented in the Green River of Dinosaur National Monument near Echo Park (the transition between Reaches 1 and 2 (Vanicek and Kramer, 1969). Since that time, collections of bonytail have been very rare throughout the Upper Colorado River Basin. Bonytail have not been collected during the three most recent fishery surveys conducted in the lower portions of Reach 1 (as summarized by Bestgen and Crist, 2000). Hatchery-produced bonytail have been stocked on an experimental basis (Chart and Cranney, 1993; Bedame and Hudson, 2003); and the Recovery Program intends to increase efforts in the near future. Since 2000, the State of Colorado has released 18,000 bonytail (approximately 4 inches in length) at Browns Park and 5,000 bonytail near the downstream terminus of Reach 1. Additional stocking is planned for the future. Future sampling efforts will be directed at determining the success of those releases.

3.7.2.3.3 Native Fish Species, Nonlisted – There are three common native species found in Reach 1 main channel habitats: the flannelmouth sucker, bluehead sucker, and roundtail chub. All three species were present in pre-dam and in all post-dam fisheries collections. Examination of two comparable data sets from the mid-1970s (Holden and Crist, 1981) and the mid-1990s (Bestgen and Crist, 2000) indicates that the distribution and relative abundance of flannelmouth and bluehead suckers in Lodore Canyon has changed very little, with the greatest abundances of both species found in the upper canyon. Although roundtail chub were not abundant in either study, Bestgen and Crist hypothesized that the population is declining. Possible explanations for such a decline included poor recruitment due to cooler than optimal water temperatures and a high abundance of brown trout and other predatory fish.

Although successful reproduction of these species seemed to be reduced in Reach 1 during that period of time between closure of the dam and penstock modification, Bestgen and Crist (2000) report that all three species currently reproduce there.

Perhaps of greatest concern regarding the native flannelmouth suckers in Reach 1 is the increasing incidence of their hybridization with nonnative white suckers. The white sucker is more suited to cool water temperatures, and its distribution declines in a downstream direction from the dam through Lodore Canyon. Hybridization is a chronic threat to the continued existence of the native sucker populations and appears to be increasing in several Upper Colorado River Basin locations (Bezzerides and Bestgen, 2002).

3.7.2.3.4 Nonnative Fish –

3.7.2.3.4.1 Cold Water Nonnatives (Trout) – The first known nonnative trout introduced to the Green River tailwater were 18,900 catchable-sized rainbow trout stocked in 1963, and brown trout were first stocked in 1965. Initial plants of Yellowstone and Snake River cutthroat trout occurred in 1967 and 1971, respectively, and brook trout were first stocked in the tailwater in 1970.

The Utah Division of Wildlife Resources currently manages the tailwater below the Flaming Gorge Dam with a combination of stocking and special regulations. Rainbow and cutthroat trout are stocked annually in the river between the dam and Little Hole, and some natural reproduction of these species occurs in this reach (Modde et al., 1991). Brown trout have not been stocked into the Green River for several years, and current populations are sustained through natural reproduction. Trout below the dam are in good physical condition.

The current management practice is to stock hatchery-reared rainbow trout about 7 inches long with the goal of having those fish reach 12 inches by end of year. Trout less than 12 inches at the end of a growing season are more likely to die during the winter than larger trout (Modde et al., 1991). Increased growth rate during the warmer period of the year increases the proportion of the trout population that survives the winter. Excessive activity during the winter can result in mortality if it causes energy reserves of individual trout to fall below critical levels. Since flow fluctuations force increased movements of trout, the potential for winter mortality increases with increasing fluctuations in flow.

Rainbow and brown trout are the co-dominant fish species from the dam to the State line. The trout fishery has been divided into three sections: the *A* section extends from the dam to Little Hole (7 miles), the *B* section from Little Hole to Taylor Flat (9.5 miles), and the *C* section from Taylor Flat to the Colorado/Utah State line (12.5 miles). The overwhelming majority of fishing occurs in the *A* section. Brown trout are present throughout Reach 1 and accounted for as much as 27% of the fish collected with electrofishing in portions of Lodore Canyon (Bestgen and Crist, 2000).

The portion of Reach 1 between Flaming Gorge Dam and Taylor Flat (16 river miles) provides the best habitat for trout in the Green River, and spawning occurs there for all species. The greatest density of redds (nests) occurs immediately below the dam and between Little Hole and Red Creek (Modde et al., 1991). Brown trout redds have been identified only downstream from Little Hole. Eddies are preferred by adult rainbow and cutthroat trout, although a variety of other habitats are used, and use changes seasonally and with changing flows. YOY trout typically inhabit shallow (less than 16 inches deep), near shore (within 2 meters of the shoreline) areas with low water velocity (less than 1 foot per second). The amount of habitat available for adult rainbow trout is strongly influenced by flow and, on the basis of field measurements, is maximized in the tailwaters at flows between 800 and 1,200 cfs (Modde et al., 1991). Research has demonstrated that the Green River tailwater contains limited juvenile habitat, particularly during high discharges (Johnson et al., 1987).

Whirling disease is the common name of the disorder caused by the parasite *Myxobolus cerebralis* that has been implicated in severe declines of some wild populations of rainbow trout in the Western United States during the 1990s. This disease has its most devastating effects on early life stages of trout. Whirling disease has not been detected in the Green River tailrace trout fishery but has recently been reported from the New Fork River, a tributary to the Green River downstream from Flaming Gorge Dam (State of Utah, Division of Wildlife Resources, letter, dated January 27, 2004). Whirling disease will likely show up in the tailrace fishery at some point in the future; but based on the State of Utah's management strategy (stocking 7-inch trout), its impact may not be as significant as in a wild trout fishery.

Fluctuating flows can result in low trout recruitment by several mechanisms. Potential spawning substrates can be reduced, eggs can be desiccated, fry can be stranded, and YOY trout can be forced from the narrow band of suitable shoreline habitat. This causes either direct mortality or increased energy expenditures and vulnerability to predation. Internal Utah Division of Wildlife Resources (UDWR) memos from November 1969 first documented the stranding and associated fish mortality due to rapid down-ramps at the dam (Brayton and Armstead, 1997). Incidents of stranding have typically occurred during emergency situations and not exclusively during spawning events. A September 1974 Interim Operating Criteria formalized the minimum flow ". . . for the foreseeable future and under normal conditions, a continuous flow of 800 cfs will be maintained as a minimum."

Trout fry are dependent on zooplankton as food. Adults feed on macroinvertebrates, decaying organic material, and fish. Brown trout tend to be more piscivorous than rainbow trout and can be significant predators on native species where they co-occur (Valdez and Hugentobler, 1993). A large portion of the diet of trout below the dam is composed of *Cladophora*, amphipods, and the other invertebrates supported by *Cladophora*. Within Reach 1, algae production is supported at all depths, because the high degree of water clarity allows sunlight to penetrate to the bottom in all areas.

Optimum temperature for growth of both rainbow and brown trout ranges from 50-61 °F (10-16 °C) (Hokanson et al., 1977; Stevenson, 1987; Brannon, 1999). When temperatures reach 68-72 ºF (20-22 °C), growth can become limited; at 77-79 ºF (25-26 °C), temperature can become lethal (Molony, 2001).

3.7.2.3.4.2 Warm Water Nonnatives (Large-Bodied: Common Carp, Channel Catfish, and Smallmouth Bass) – Common carp prefer sheltered areas with an abundance of aquatic vegetation in warm water lakes, reservoirs, and rivers. The adults are opportunistic feeders that are able to utilize any available food source (Sigler, 1958). Carp typically spawn in flooded vegetation during the months of May and June in temperate climates. Carp are tolerant of a wide range of temperatures, but production is highly correlated with the number of days greater than 68 ºF (20 °C) (Backiel and Stegman, 1968).

Adult carp are common throughout Reach 1. Although found in very low numbers near the dam, their numbers increase in a downstream direction. They comprised approximately 12% of the entire electrofishing catch in both the upper and lower portions of Lodore Canyon during 1994-1996 (Bestgen and Crist, 2000). A summary of fish collections in Reach 1 prior to closure of the dam (Gaufin et al., 1960) and during three post-dam surveys (Banks, 1964; Smith, 1966; Vanicek et al., 1970; Holden and Crist, 1981) indicates carp consistently reproduce in Reach 1.

Channel catfish prefer warmer water with a diversity of water velocities, depths, and structural features that provide cover and feeding areas. Channel catfish spawn in late spring and early summer (generally late May through mid-July) when temperatures reach about 70 ºF (21 °C) (Pflieger, 1975). The optimal temperature range for adult channel catfish growth is 79-84 ºF (26-29 °C) (Chen, 1976), and growth is poor at temperatures less than 70 ºF (21 °C) (Andrews and Stickney, 1972).

Distribution of channel catfish in rivers has generally been shown to depend on both size of fish and the season. Smaller-sized catfish in the San Juan River tend to prefer lower velocities and sand or silt substrates, which are found in the lower portions of that river (Gido and Propst, 1999). Channel catfish are predacious and have been implicated in the decline of native fishes throughout the Upper Colorado River Basin. Colorado pikeminnow are known to prey on channel catfish; however, this interaction can turn negative if the prey (catfish) becomes lodged in the throat of the predator (pikeminnow) (McAda, 1983). Researchers at a 1995 nonnative fish control workshop in Boulder, Colorado, identified channel catfish as the greatest nonnative fish threat to the endangered fish community.

In Reach 1, catfish have been found sporadically in electrofishing samples from throughout much of Lodore Canyon, with the greatest abundances reported in the lower portions of the canyon. Bestgen and Crist (2000) surmised that river warming associated with the lower and more stable base flows called for in the 1992 Biological Opinion could have resulted in their increased abundance in recent years. Channel catfish are not known to successfully reproduce in Reach 1. Therefore, this relatively recent increase in abundance in lower Lodore Canyon is likely because of immigration from Reach 2 or the Yampa River.

Smallmouth bass occur in Lodore Canyon and become more abundant further downstream. These fish are not native to the Green River and pose a threat to endangered fish species. They prey on native species, especially young. They also compete with native fish for food and cover. Smallmouth bass inhabit streams and rivers with gradients ranging from 4-25 feet per mile (Funk and Pflieger, 1975). The gradient through Lodore Canyon averages 15.3 feet per mile.

3.7.2.3.4.3 Warm Water Nonnatives (Small-Bodied Minnows: Red Shiner, Fathead Minnow, Sand Shiner, and Redside Shiner) – This group of minnows can attain an adult size of 1 inch in their first year and attain maximum sizes of only 2 to 3 inches throughout the course of their 2- to 3-year life span. They are all capable of spawning numerous times in a single spawning season, and each species has the potential to become extremely abundant. The redside shiner (*Richardsonius balteatus)* prefers cool water and is found in a variety of habitats. Red shiner (*Cyprinella lutrensis)*, fathead minnow (*Pimephales promelas)*, and sand shiner (*Notropis stramineus)* all prefer warmer water and low velocity habitats and are tolerant of high turbidities. They are commonly found in those habitats used by the young of native fish species.

Researchers studying the interactions of these nonnative minnows and young Colorado pikeminnow in controlled environments found negative impacts to pikeminnow from competition (Byers et al., 1994) and predation (Bestgen et al., 1997). Nesler (2002) hypothesized that, from a potential impact perspective, the relative abundance of these three species could pose more of a threat to native fish than nonnative game fish (largemouth bass [*Micropterus salmoides]*, green sunfish [*Lepomis cyanellus*], and catfishes) in the Colorado River in Colorado.

Analyzing 15 years of fall YOY fish sampling on the Colorado River, McAda and Ryel (1999) showed that catch rates of native species were negatively correlated with catch rates of red shiner, fathead minnow, and sand shiner and positively correlated with the catch of young Colorado pikeminnow. They also found that the relative abundance of these nonnative minnows was lower in years with high spring peak flows than it was in years with low spring peak flows (McAda and Ryel, 1999).

In the upper, canyon-bound stretches of Reach 1, which provide the premier trout habitat, this entire group of fish is poorly represented. Redside shiners and fathead minnows are very abundant in the Browns Park area, where shifting sandbars provide sheltered low velocity habitats during the low flow periods (Bestgen and Crist, 2000). Redside shiners become less abundant through upper and middle reaches of Lodore Canyon where suitable low velocity habitats are scarce and river temperatures are warm. Further downstream in Reach 2, summer water temperatures greatly reduce redside shiner abundance.

Displaying a greater preference for warmer water, red shiner and sand shiner were virtually absent from seine collection in the Browns Park area and in the upper and middle stretches of Lodore Canyon (Bestgen and Crist, 2000). However, in the lower reaches of Lodore Canyon (the lower boundary of Reach 1), the combination of warmer water and suitable habitats accounts for their increased abundance. Fathead minnow, red shiner, and sand shiner abundances increase downstream and dominate the fish community in low velocity habitats in Reaches 2 and 3.

Successful reproduction has been documented for all four species of nonnative minnows in Reach 1. However, based on the distribution of adults, red shiner and sand shiner reproduction is highest in the very lowest portions of the reach.

3.7.2.4 Reach 2

3.7.2.4.1 Aquatic Food Base – Gourley and Crowl (2002) described Green River productivity (food base) in Reach 2 over a 3-year period. Riverine productivity, as it directly relates to fish, was dominated by macroinvertebrates with the primary groups being Diptera (true flies, primarily midges) and Odonata (dragonflies). In addition to the dipterans, Ephemeroptera (mayflies), Trichoptera (caddisflies) and Plecoptera (stoneflies) became more abundant during the high flow periods. Zooplankton densities were always low in the main channel with the greatest densities found in backwaters (Grabowski and Hiebert, 1989).

On the flood plain, macroinvertebrates also became abundant seasonally (at times more abundant than in the main channel), and densities of zooplankton were much higher than those found in the main channel. Crowl et al. (2002) stressed the importance of maintaining the connection between the river and its flood plain in terms of overall food web structure and complexity. They stated that increased availability of both macroinvertebrates and zooplankton has repeatedly been shown to benefit fish growth by offering fish (particularly young fish) a variety of food types as their feeding preferences change.

3.7.2.4.2 Threatened and Endangered Fish – In Reach 2, except for Whirlpool and Split Mountain Canyons (the upper portion of the reach), fish sampling has been quite intensive in the more accessible low gradient, alluvial areas that account for approximately 82% of the 98.7 river miles in this reach. The Interagency Standardized Monitoring Program, which was initiated in 1986, was responsible for collections of juvenile and adult Colorado pikeminnow throughout this reach each spring and sampled all species in backwaters each fall from the mouth of Split Mountain Canyon (river mile 220) downstream through the remainder of Reach 2. The Flaming Gorge studies, which served as the basis for the 2000 Flow and Temperature Recommendations, sampled various aspects of the fish community throughout the Green River and are summarized in the 2000 Flow and Temperature Recommendations.

In more recent years, an intensive effort has been conducted to characterize the fish communities in both the inundated flood plain and the main channel. Birchell et al. (2002) focused their efforts in the Uinta Basin portion of Reach 2, sampling 12 flood plain sites and 42 contiguous river miles. The results of these long-term and intensive sampling efforts provide the basis for the following description of the affected environment.

3.7.2.4.2.1 Colorado Pikeminnow – Late juvenile and adult Colorado pikeminnow are more abundant in Reach 2 than the other two reaches of the Green River. Pikeminnow spawning has not been documented in Reach 2. Resident adults migrate either to the Yampa River spawning area about 16 miles above the Green River confluence or downstream into Reach 3 to the spawning area in Gray Canyon. Prior to spawning migrations, Colorado pikeminnow adults stage in the flooded habitats available in Reach 2.

The low gradient stretches of Reaches 2 and 3 provide nursery area for larval pikeminnow drifting downstream off the Yampa River spawning bars. As Green River flows decline from their spring peak, sandbars become exposed in the main channel. Low velocity pools or backwaters form around these sandbars and can persist throughout the base flow period if flows remain stable. These backwaters, abundant in the lower half of Reach 2, provide habitats for the young pikeminnow through their first year of life (Tyus and Haines, 1991). The summer densities of young pikeminnow have varied greatly from year to year (e.g., 0.25 fish per 100 cubic meters [m^3] sampled habitat in 1996 to as many as 177 fish per 100 m^3 in 1992). Trammell et al., (1999) intensively sampled these habitats in Reach 2 as part of the Recovery Program's Flaming Gorge Studies to better describe pikeminnow habitat and how flows create and maintain them (2000 Flow and Temperature Recommendations). This information factored heavily into both the peak and base flow components of the 2000 Flow and Temperature Recommendations.

3.7.2.4.2.2 Humpback Chub – Due to its affinity for the more isolated canyon bound reaches of river, it is not surprising that records of humpback chub in Reach 2 are sparse. A few humpback chubs have been reported from Whirlpool Canyon (Holden and Stalnaker, 1975; Karp and Tyus, 1990) and Split Mountain Canyons (Vanicek, 1967). However, other than some very occasional and opportunistic sampling, those canyons have not been sampled since the 1980s. The populations are not expected to be large, but their status remains relatively unknown.

3.7.2.4.2.3 Razorback Sucker – The population of razorbacks in Reach 2 has persisted longer than any other in the Upper Colorado River Basin. Unfortunately, this population is also in decline, and recent abundance estimates suggest the number of wild adults may have dwindled from 524 individuals reported 6 years earlier (Modde et al., 1996) to 100 (Bestgen et al., 2002). Concentrations of razorback sucker in spawning condition were located at two sites within or very near Reach 2: the mouth of the Yampa River (just upstream of the Green River confluence) and in the Green River adjacent to Escalante Ranch (river mile 302-313) (Tyus and Karp, 1990). Fish in spawning condition captured at those areas were found in runs of cobble, gravel, and sand substrates in water averaging 0.63 meter deep. More than 99% of the razorback sucker larvae collected in the middle Green River during spring and summer 1992-1996 (Muth et al., 1998) were from areas within or downstream from the Escalante Ranch. Bestgen et al. (2002) and Muth et al. (1998) provide a thorough description of flows and temperatures that coincide with razorback sucker spawning.

The occurrence of razorback sucker in the middle Green River coincides with the greatest expanse of flood plain habitat in the Upper Colorado River Basin. Historically, inundated flood plain habitats provided nursery areas for recently hatched larval razorback suckers. Tyus and Karp (1990) associated low recruitment with reductions in the availability of this habitat type since 1962 (dam construction), and Modde et al. (1996) linked increases of razorback sucker recruitment back to the high water years of 1983, 1984, and 1986. Flood plain habitats were shown to support much higher densities of zooplankton (larval razorback sucker food) than main channel habitats (Birchell et al., 2002). Modde and Irving (1998) demonstrated that most razorback sucker adults in the middle Green River moved into the flooded bottomlands soon after spawning. In Reach 2, the amount of flood plain inundation increases rapidly as flows exceed

18,600 cfs (2000 Flow and Temperature Recommendations). The timing of flood plain inundation may be of equal or greater importance than the amount and duration of the inundation and should be a factor of dam operations (Bestgen et al., 2002). Captures of larvae in Reach 2, 1997-1999, coincided only with the latter part of spring peak flows when flows were declining.

Flood plain habitats support large numbers of nonnative fish. In a recent study of these habitats in Reach 2, nonnatives comprised 99% of the total catch, which was attributed to the productivity found there (Birchell et al., 2002). Black bullhead, fathead minnow, and green sunfish dominated the flood plain nonnative fish community, which was attributed to their ability to use these habitats for reproduction. Negative interactions were expected between the nonnatives and native species (young razorback sucker in this case) in flood plain habitats, but researchers did not detect increases in riverine populations of nonnatives when the flood plain habitats drained naturally. It should be noted that populations of nonnatives in the main channel were very high prior to flood plain draining (Birchell et al., 2002). Efforts to increase the availability of flood plain habitats to benefit razorback sucker will have to account for the potential benefit to nonnatives as well.

3.7.2.4.2.4 Bonytail – In addition to the recent releases of hatchery-reared bonytail by the State of Colorado in Reach 1, there have been two experimental stockings in Reach 2. In a study to determine survival and habitat selection of hatchery reared adult bonytail, the State of Utah Division of Wildlife Resources radio-tagged and released 86 individuals in Island and Rainbow Parks in Dinosaur National Monument during 1988-1989 (Chart and Cranney, 1993). During the summer of 2002, the U.S. Fish and Wildlife Service and Utah Division of Wildlife Resources experimentally stocked several hundred thousand larval bonytail in an artificially flooded wetland along the Green River to determine survival rates in the face of nonnative competition and predation. Preliminary results indicate that some bonytail grew to 60 millimeters total length by July (Modde and Christopherson, 2003).

The Recovery Program intends to stock 5,330 hatchery-produced bonytail (greater than or equal to 200 millimeters total length) for 6 consecutive years to establish a target adult population of 4,400 adult bonytail in the middle Green River (Nesler et al., 2003). These targets are the first step in meeting criteria identified in the Bonytail Recovery Goals (U.S. Fish and Wildlife Service, 2002a).

3.7.2.4.3 Native Fish, Nonlisted – In addition to the four endangered species present in Reach 2, three other large-bodied native species are found there: the flannelmouth sucker, bluehead sucker, and roundtail chub. Flannelmouth sucker was the most abundant native fish collected in the main channel and in flood plain habitats during 1996-1999 (Birchell et al., 2002). Bluehead sucker was numerically the next most abundant species but was significantly less abundant than flannelmouth sucker and not significantly more abundant than the endangered Colorado pikeminnow. Roundtail chubs were very scarce in electrofishing samples.

Flannelmouth suckers were found to use the inundated flood plain; however, they vacated all flood plain habitats as the river dropped and the connection was lost. Although some native fish larvae were collected in flood plain habitats, the main channel appears to provide most of the nursery area for young native fish. On the Colorado River, McAda and Ryel (1999) looked at similar collection information and determined that larvae and YOY of native fishes were more abundant in years with high peak runoff than in years of low peaks. A greater understanding of the relationship between native species' reproductive success and flow and habitat in the Green River is needed.

3.7.2.4.4 Nonnative Fish –

3.7.2.4.4.1 Coldwater Nonnatives – Trout are virtually nonexistent in the main channel fish collections in Reach 2 and Reach 3. There is a very localized population of brown, rainbow, and cutthroat trout at the mouth of Jones Hole Creek, a 4-mile-long spring-fed tributary stream. Trout are abundant throughout Jones Hole Creek from Jones Hole National Fish Hatchery, located near the stream source, downstream from the Green River. The trout found in the Green River proper are an extension of the stream population taking advantage of the cool, clear tributary flows at the confluence.

Northern pike (*Esox lucius)* is classified as a coolwater species and has been collected primarily in the alluvial reaches of Reach 2 for many years. This species is similar in size and body shape to the Colorado pikeminnow and, like the pikeminnow, switches to an almost exclusive fish diet early in life. Northern pike in the Green River system apparently come from dispersal of a breeding population in the Yampa River in Colorado. Juvenile and adult pike have been found in increasing numbers throughout Reach 2 for many years. This predacious nonnative species prefers low flow areas in the spring (inundated flood plain or the mouths of tributaries/dry washes) and is known to spawn in these areas in the upper Yampa River. The Recovery Program has funded, and plans to continue to fund, specific efforts to control this species in the Yampa River in Colorado and in the Green River through the Uintah Basin of Utah.

3.7.2.4.4.2 Warm Water Nonnatives (Large-Bodied: Common Carp, Channel Catfish, and Smallmouth Bass) – In a 4-year study of the main channel and flood plain habitats throughout a 40-mile stretch of Reach 2, researchers used a variety of techniques to characterize the fish community (Birchell et al., 2002). Of 172,007 fish collected from main channel habitats, 169,473 (98.5%) were nonnative. Carp was typically the most abundant large-bodied fish collected in the main channel. Channel catfish were less abundant than large-bodied native fish (predominately native suckers), but they were collected in all areas every year.

In the flood plain habitats, in excess of a million fish were collected, with nonnative species accounting for over 99% of the total catch in most areas. Carp were collected in the flood plain but were often outnumbered by black bullhead and green sunfish. After 3 weeks of flood plain inundation, carp were found to reproduce in many of the habitats. Channel catfish did not appear to use the flood plain habitats to any great extent.

The relationship between these two abundant nonnative species and flows is not well understood. Carp will utilize flooded areas and will spawn there if the habitats persist for 3 weeks or longer. Channel catfish reproduction in canyon bound reaches may be negatively affected by high flow years, but the majority of the channel type through Reach 2 is broad and meandering.

Smallmouth bass occur throughout Reach 2. They are considered detrimental to native fish species.

3.7.2.4.4.3 Warm Water Nonnatives (Small-Bodied Minnows: Red Shiner, Fathead Minnow, Sand Shiner, and Redside Shiner) – In a 6-year study to characterize the use of low velocity habitats by young Colorado pikeminnow, Day et al. (1999) found the nonnative red shiner to be the most commonly collected species (occurring in 91% of the 945 samples). Red shiner was by far the most abundant species occupying these areas, which are the same habitats that young Colorado pikeminnow prefer during their first year of life. The second most abundant species was fathead minnow, occurring in 70% of the sites sampled, followed by sand shiner, which increased in abundance during the last 3 years of study. The nonnative species greatly outnumbered native fish in these important habitats every year. These data are consistent with less intensive, but more long-term, sampling conducted under the Interagency Standardized Monitoring Program since 1986.

During spring runoff, these small nonnative species proliferate in inundated flood plain habitats. Of the three, fathead minnow took the greatest advantage of flooded areas, often comprising greater than 50% of the total catch (often ranging from tens to hundreds of thousands) in a given habitat throughout the year. Within 3 weeks of connection to the main channel (i.e., nonnative invasion) nonnative minnows would begin to reproduce. As the riverflows receded, many of their larvae were flushed out to the main channel.

Although negative correlations between nonnative minnow densities and magnitude and duration of the spring runoff have been documented in some areas throughout the upper basin (McAda and Ryel, 1999), the relationship is confused in Reach 2, due primarily to the abundance of the flood plain habitat. Nevertheless, researchers in all areas observed that these nonnative minnows recovered quickly from any setback, whether from adverse environmental conditions or nonnative control efforts.

3.7.2.5 Reach 3

3.7.2.5.1 Aquatic Food Base – Specific investigations to describe primary (algae) and secondary productivity (aquatic insects) are lacking in Reach 3. The energy pathways described for the flood plain habitats in Reach 2 apply to similar habitats found in the very upper portions of Reach 3. The large, out-of-bank habitats that flood at flows above 18,600 cfs near Ouray, Utah, are generally lacking in the middle and lower portions of Reach 3. In Reach 3, as the river rises during the spring, it floods the mouths of tributaries and otherwise dry washes, which offer similar habitat and production as the flood plain on a much smaller scale. During the base flow period, main channel backwater habitats are presumed to be where most of the primary and secondary productivity occurs through the low gradient stretches of Reach 3—similar to the situation in Reach 2. Productivity increases in main channel areas where gradient and substrate size increase, which, in part, explains increased densities of fish in these areas. Cobble runs and riffles are found throughout the Desolation and Gray Canyon sections of Reach 3. In the lower 100 miles of the Green River, cobble bars are relatively scarce, found only at the mouths of side canyons.

3.7.2.5.2 Endangered Fish –

3.7.2.5.2.1 Colorado Pikeminnow – All life stages of Colorado pikeminnow are found in Reach 3. One of two Colorado pikeminnow spawning bars in the Green River subbasin is found in Gray Canyon in Reach 3. The other spawning location is on the Yampa River. Spawning was first documented on the Green River in the late 1980s (Tyus, 1990) near Three Fords Rapid in Gray Canyon. Since then, groups of fish in spawning condition have been collected as far as 5 miles upstream and downstream from that specific location (Chart and Lentsch, 2000), but spawning still seems centered on the Three Fords site. Harvey and Mussetter (1994) report that the spawning bars in Reach 3 are constructed at high flows, but the actual spawning habitat is created and cleansed following the peak flow when discharge ranges between 2,800 and 8,020 cfs. Adult pikeminnow have migrated as far as 180 miles, from both upstream and downstream in the Green River, and from the White River to spawn at this site in Reach 3 (summarized in Irving and Modde, 2000).

The lowermost 120 miles of the Green River typically support the greatest abundances of YOY pikeminnow found in the Green or Colorado subbasins (McAda and Rydel, 1999). Catch rates of YOY pikeminnow were greater than other reaches in 12 of the 14 years sampled, 1986-1999. Catch rates were greatest in 1988, when 5.6 YOY pikeminnow were collected per 10 square meters of sampled backwater habitat and lowest in 1997 when the catch rate dropped to 0.097. Reach 3 provides nursery habitat (backwaters) for larvae produced at the Gray Canyon spawning bar as well as those produced upstream at the Yampa River spawning bar. Backwater habitats in Reach 3 are formed by similar geomorphic processes, as described in Reach 2 (Rakowski and Schmidt, 1999) but are generally less abundant than in Reach 2. YOY pikeminnow also occupy low velocity habitats in Desolation and Gray Canyons. Three separate research efforts studying YOY pikeminnow backwater use in Reaches 2 and 3 found selection for larger, deeper, scour channel backwater habitats when they were available (Day et al., 1999; Day et al., 2000; Trammell et al., 1999). This information factored heavily in the development of the 2000 Flow and Temperature Recommendations.

Juvenile pikeminnow (ages 2-5; 100-350 millimeters) are also found in greater abundances in the lower portions of Reach 3 than farther upstream. Standardized monitoring (shoreline electrofishing) from 1986-2000 revealed that roughly 60% of the pikeminnow collected in Reach 3 were less than 400 millimeters in length, whereas only 10% collected in Reach 2 were that small (interpreted from graphs in McAda, 2002). Researchers have speculated that pikeminnow disperse upstream of the lower reaches of the Green and Colorado River (Osmundson et al., 1997) as they mature, which would account for this skewed size distribution (Tyus, 1991; McAda, 2002). Juvenile pikeminnow are collected in backwaters but are also found along quiet shoreline areas and other main channel habitats.

3.7.2.5.2.2 Humpback Chub – Reach 3 supports the greatest concentration of humpback chub in the Green River subbasin. The Desolation/Gray population was discovered by researchers in the late 1960s (Holden and Stalnaker, 1975). Monitoring to determine the distribution and relative abundance of this population of humpback chub, which also includes roundtail chubs and apparent hybrids of the two species, began in the 1980s. More recently, the Recovery Program has initiated a mark/recapture study to determine population size and how that relates to criteria outlined in the Humpback Chub Recovery Goals (U.S. Fish and Wildlife Service, 2002c). Those efforts have been hampered by low flows, and these data are preliminary at this time.

The humpback chub population in Desolation and Gray Canyons occupies 55 miles of river located roughly 210 river miles below Flaming Gorge Dam. Catch rates, which describe the number of fish collected in a net positioned in a quiet portion of the river for 1 hour, vary greatly from site to site within the canyon and have varied from year to year. Juvenile and adult chubs are most readily collected from main channel eddy and pool habitats. The Utah Division of Wildlife Resources reports an average humpback chub catch rate of 0.13 from 1993-2000 (i.e., it takes between 7 and 8 hours of netting to catch one humpback chub [derived from data provided in Utah Division of Wildlife Resources Recovery Program Project 22-C, *2000 Annual Report*]). For comparison, average catch rates in Westwater Canyon on the Colorado River for the same period of time averaged 0.33 (i.e., one might assume that humpback chub in Westwater Canyon are roughly 2.5 times as abundant as in Desolation and Gray Canyons). Conversely, catch rates in the lower Yampa River Canyon and in Cataract Canyon on the Colorado River are much lower than those reported for Desolation Canyon.

YOY chubs (both humpback and roundtail) were collected during two separate studies designed to better understand chub reproduction and recruitment in Desolation and Gray Canyons (Day et al. (2000) sampled backwaters during 1994-1996; Chart and Lentsch (2000) sampled a variety of habitats during 1992-1996). Day et al., (2000) found chubs in large and deep backwaters in Desolation Canyon. They also reported that increased turbidity was a characteristic of backwaters used by chubs. Although YOY were collected each year, survival through their first winter was not always documented. Competition and predation by abundant nonnative fishes (channel catfish in the main channel and nonnative minnows in the backwaters) may negatively impact survival of young chubs in Desolation and Gray Canyons (Chart and Lentsch, 2000). During the period of 1992-1996, YOY produced in 1993 (a high water year) were best represented in sampling as age 1+ fish the following year. During the same timeframe, survival of young channel catfish was low.

3.7.2.5.2.3 Razorback Sucker – As was mentioned in section 3.7.2.4.2.3, the abundance of wild razorback suckers throughout the Green River system is in decline. A total of 118 wild adult razorback suckers were collected during an intensive sampling effort throughout the Green River, 1996-1999. The overwhelming majority of those were collected in Reach 2 between the confluence of the White River and Split Mountain Canyon (Bestgen et al., 2002). Razorback sucker adults have been collected from Reach 3, but in very low numbers. Since 1980, only 19 wild adult razorbacks have been collected from Reach 3, including Desolation Canyon downstream to the confluence with the Colorado River (Chart et al., 1999). The last wild razorback collected in this area was captured in 1997 near the mouth of the San Rafael River, 97 miles upstream of the confluence with the Colorado River and 313 miles below Flaming Gorge Dam.

Although adult razorback suckers have been extremely rare in the lower river, larvae were present in samples every year from 1994-1999. The majority of those captures came from an area near the mouth of the San Rafael River. The presence of larvae at this location in multiple years and the relatively large size of larvae found there suggest that the San Rafael River may be an important rearing area for razorback suckers (Bestgen et al., 2002). During many years, larvae were present in Reach 3 prior to their appearance in Reach 2; this left researchers reasonably certain that those larvae captured in Reach 3 were produced there (Muth et al., 1998).

As mentioned in the Reach 2 discussion, based on the timing of razorback sucker spawning, inundated flood plain habitats likely provided important warm, food-rich areas for larvae. Equally important as the magnitude and duration of the flows is the timing of the flows. In Reach 3, larval razorback collections (spawning time) coincide with peak or pre-peak spring flows that allow the larvae to fully utilize the inundated habitats. However, low velocity habitats at any time of the year are also havens for nonnative fish. In Reach 3, the predominant nonnative predators/competitors are channel catfish and nonnative minnows. The Recovery Program has experimented with mechanical control of these species in Reach 3 with limited or no apparent success to date (Bedame, 2002; Meismer and Trammell, 2002).

3.7.2.5.2.4 Bonytail – The only wild bonytail collected in Reach 3 was reported by Tyus et al. (1987) from U.S. Fish and Wildlife Service collections in Gray Canyon, 1982-1985. The Recovery Program and the State of Utah began stocking bonytail in the lower Green River near the town of Green River, Utah, in 1999 (Bedame and Hudson, 2003). The Recovery Program's Integrated Stocking Plan (Nesler et al., 2003) calls for stocking levels to achieve Recovery Goal criteria. As stipulated in the Bonytail Recovery Goal (U.S. Fish and Wildlife Service, 2002a), populations of 4,400 adult bonytail are required in the middle Green and Colorado Rivers. A redundant population (a third population of 4,400 adults) is required in Reach 3 as insurance against a catastrophic event in one of the other recovery areas. To achieve the target and maintain it for several years, the Recovery Program intends to stock 5,330 bonytails (greater than or equal to 200 millimeters total length) for 6 years.

3.7.2.5.3 Native Fish, Nonlisted – Flannelmouth sucker, bluehead sucker, roundtail chub, and speckled dace are found throughout Reach 3. The greatest amount of native fish community data is from Desolation and Gray Canyons; data were collected while monitoring the population of humpback chub (summarized in Chart and Lentsch, 2000). Fish community information from main channel habitats downstream from Desolation and Gray Canyons is more spotty, collected by various researchers (Cavalli, 2000; Chart et al., 1999; Valdez, 1990). These studies serve as the basis for the description of the main channel fish community (native and nonnative) in Reach 3.

In Desolation and Gray Canyons (1989-1996), flannelmouth and bluehead sucker comprised approximately 20-30% of the large-bodied fishes collected in main channel habitats. Flannelmouth sucker were typically more abundant than blueheads. Bluehead sucker prefer swift flowing habitats with large substrates, which are abundant in these canyons, but they also prefer cooler temperatures and are typically more abundant in the upper reaches of the river. Collections of juvenile sized suckers (ages 1-3) varied greatly from year to year and were either low or lacking throughout the study period. However, a group of age 1 native suckers (spawned the previous year) were relatively abundant in 1994; 1993 was one of the higher flow years studied (peak flow of 25,400 cfs, recorded on May 31).

Roundtail chub were collected throughout Desolation and Gray Canyons. The relationships discussed between flow and humpback chub reproductive success apply to this species as well.

Downstream from Desolation and Gray Canyons, the river gradient drops, cobble bars become less abundant, and substrate shifts to sand as the river flows to the confluence with the Colorado River. Through this stretch, numbers of large-bodied fish in the main channel generally decline, presumably due to the reduction in productivity associated with sand substrates and high turbidity. Flannelmouth sucker is still the most commonly collected native fish in the main channel and is similar in abundance to nonnative carp and catfish. Bluehead sucker become rare in this portion of Reach 3, and roundtail chub are virtually nonexistent.

Native species comprise as much as 70% of the catch in deeper habitats of the San Rafael and Price Rivers, tributaries to the Green River in Reach 3 (Tyus and Saunders, 2001). Based on the species composition and habitat availability found in these smaller river systems, it is assumed that a significant amount of native fish reproduction occurs there. That production may, in turn, contribute to populations in the Green River main channel; however, specific data on reproductive success in these tributaries are not available to substantiate this link. In their status review of flannelmouth sucker, bluehead sucker, and roundtail chub, Bezzerides and Bestgen (2002) report that these species currently occupy only 45%, 50%, and 45% of their historical range in the Colorado River Basin, respectively. Much of that loss of range has occurred in tributaries to the Green, San Juan, and Colorado Rivers.

3.7.2.5.4 Nonnative Fish –

3.7.2.5.4.1 Cold Water Nonnatives – Trout are not found in any portion of the Green River in Reach 3 because summer temperatures are too warm. Northern pike and walleye have been collected in relatively low numbers compared to other locations in the subbasin. However, preliminary data collected in the past few years suggests that walleye are increasing in Reach 3 (Hudson, 2003). Northern pike and walleye are more commonly found in northern climes, native to rivers and lakes in Canada, though they are also found as far south as the northern portions of Alabama and Georgia. Both species spawn earlier in the spring than any of the native Colorado River species. Main channel summer maximum temperatures in Reach 2 and 3 likely become stressful for these species, but not likely lethal. The Recovery Program is currently funding efforts to control these species in upstream reaches (in Reach 2, the Duchesne River, and in the Yampa River), the likely sources of these predacious nonnative species.

3.7.2.5.4.2 Warm Water Nonnatives (Large-Bodied: Carp, Channel Catfish, and Smallmouth Bass) – Carp, channel catfish, and smallmouth bass are found throughout Reach 3. In Desolation and Gray Canyons, channel catfish were the most commonly collected species while netting and electrofishing main channel habitats, 1989-1996 (Chart and Lentsch, 2000). Channel catfish were nearly twice as abundant as native chubs. Whereas data suggests that native fish reproduction in Desolation and Gray Canyons was positively correlated with spring flow, there was some indication that channel catfish reproduction was negatively impacted during the higher flow years. Carp were also abundant during that study, with similar catch rates as native chubs. YOY and juvenile carp were not collected in large enough numbers to determine relationships with flow. Channel catfish have experienced summer die-offs in Desolation and Gray Canyons during extremely low flow years. The most recent such event occurred when Green River flows dropped below 1,000 cfs during the summer of 2002 (Hudson, message posted to Recovery Program listserver, 2002). Catfish die offs appear to be linked with the occurrence of summer storms, which result in a large pulse of sediment into an extremely warm river.

In the lower 50 miles of Reach 3, Valdez (1990) found carp and catfish the dominant species in main channel habitat sampled with electrofishing (1987 and 1988) and with nets in 1988.

The Recovery Program is currently funding efforts to remove channel catfish and smallmouth bass in Desolation and Gray Canyons. The purpose of those efforts is to reduce the perceived negative impacts this predacious nonnative species is having on humpback chubs.

3.7.2.5.4.3 Warm Water Nonnatives (Small-Bodied: Red Shiners, Sand Shiners, and Fathead Minnows) – Three nonnative species–red shiner, sand shiner, and fathead minnow–dominate the fish community in low velocity habitats throughout Reach 3. Day et al. (2000) reported negative correlations between red shiner and fathead minnow catch per unit effort in Desolation and Gray Canyons. In other words, although these species remained relatively abundant from year to year, their numbers were reduced in the higher flow years. Similarly, Trammel and Chart (1999) reported that backwater habitat availability and nonnative shiner and minnow densities in Reach 3 were lower in years with moderate to high spring peaks.

In portions of Reach 3 (Desolation and Gray Canyons, for example) densities of native fish, including chubs and pikeminnow, were also negatively correlated with the same aspects of the spring hydrograph that reduced nonnative species (Day et al., 2000). Flow manipulation alone may not be sufficient to control these nonnative species (McAda and Kaeding, 1989).

The Recovery Program has funded studies to determine the feasibility of mechanically controlling nonnative minnows in the lower Green and Colorado Rivers. Unfortunately, results of those studies did not show a measurable, lasting reduction in the densities of those species. At a recent workshop of the Recovery Program, participants were unable to identify alternative approaches to potentially improve the success of reducing these species through mechanical control (Upper Colorado River Endangered Fish Recovery Program, 2002).

3.7.2.6 Vegetation

Vegetation found along the Green River and affected by riverflows is classified as riparian and wetland vegetation. Wetlands are areas that are saturated or inundated by surface or subsurface water for at least a few weeks of the year and that support vegetation adapted to this saturated condition. Riverine wetlands occur along rivers or moving bodies of water and generally receive seasonal pulses of floodwaters that contribute to the saturated condition. The riparian zone is a transition zone between water and upland and is composed of plant species that are usually more robust than their upland counterparts and/or are composed of different species than those of adjacent areas.

Because much of the Western United States is arid, riparian zones provide the moisture and nutrients to support a greater variety of vegetation than upland areas that, in turn, support a greater diversity of wildlife. In addition to providing habitat for 75-80% of Utah's wildlife, riparian zones are important for their role in water quality improvement, flood control, recreation, and ground water recharge and discharge.

The riparian zone of the Green River changes character as the river alternately meanders through bedrock confined canyons and broad valleys. Narrow canyon reaches such as Red Canyon, Lodore, Whirlpool, and lower Labyrinth Canyon provide only limited opportunities for plant growth; yet plant communities are complex due to the diverse environmental gradients between surface types (pools, eddies, gravel bars). The wider alluvial, unconfined reaches of Browns Park, Island Park, and Ouray historically were composed of expansive and highly productive riparian plant communities. Intermediate to the above reach types are the confined alluvial reaches such as Echo Park, Grays, Desolation, and Stillwater Canyons. These areas, while still confined within a limited width of valley floor, historically also allowed for development of complex riparian zones.

The floodflows of the pre-dam period played a major role in defining species composition and location. These historic floods scoured away existing vegetation and deposited fine sediment. These actions provided the proper conditions for seedling establishment of woody riparian vegetation, namely Fremont cottonwood (*Populus deltoides* subsp. *wislizenii)* and coyote willow (*Salix exigua*). A range of vegetation responses has occurred since closure of Flaming Gorge Dam. These responses vary depending on river reach, sediment, and flow contributions from tributaries, moisture content of substrate, elevation above river, and responses during extreme drought and wet years.

Fremont cottonwood is the dominant tree species along the wide alluvial sections of the Green River, while box elder (*Acer negundo*) is the dominant tree of the canyon reaches. Both species are flood dependent. Successful establishment of cottonwood communities depends on spring peak flows and associated overbank flooding timed to correspond with seed dispersal. Under current flow regimes, the floodflows necessary to scour away existing vegetation and deposit fine loamy sediment needed for new seedbeds rarely occur.

Under post-dam conditions, stage change is small, and many newly established cottonwood seedlings, restricted to the river margin, have little prospect of long-term survival. Their location makes them susceptible to both prolonged inundation and scour from high flows and ice. If seedlings do establish at the few protected sites, they face competition from both woody and herbaceous nonnative plants that have now invaded the Green River corridor. Invasive plants, such as tamarisk (*Tamarix ramosissima, T. chinenis,* or hybrid of the two), giant whitetop, or perennial pepperweed (*Cardaria draba*), and sweet clover (*Melilotus* sp.) colonize the same opens sites necessary for cottonwood seed germination and seedling survival. Competition for water appears to be a key factor related to cottonwood survival. When water is scarce, cottonwood seedlings suffer greater stress than neighboring tamarisk and other invasive species (Cooper et al., 1999).

The presence of tamarisk is important to note due to its contributions to channel narrowing and stabilization, soil salinity, and displacement of native riparian vegetation with accompanying reduction in biodiversity. This invasive shrub flowers and produces seeds throughout summer and into fall. Tamarisk can rapidly colonize bare, moist soils and, once established, can tolerate a range of environmental conditions.

Tamarisk invasion along the lower Green River was underway by the 1920s. Prior to dam closure, tamarisk establishment occurred in a relatively wide range of locations and elevations within the flood plain. River regulation has reduced the range of elevations suitable for establishment but has increased the availability of suitable habitat (Larson, 2004). River regulation has provided optimum establishment opportunities, especially when peak flows occur later in the summer, benefiting tamarisk over cottonwood seed germination. In canyon reaches, post-dam tamarisk establishment is prevalent on gravel bars and debris fans (Larson, 2004; Birken, 2004; Cooper et al., 2003). Under river regulation, large floods generally occur too infrequently to prevent tamarisk seedlings from reaching the age where they become highly resistant to removal by floodflows.

Russian olive (*Elaeagnus angustifolia*) is another invasive plant of concern along alluvial reaches of the Green River. Relative to willow and cottonwood, it is drought and shade tolerant at both the seedling and adult stages. Russian olive does not depend on spring flooding and disturbed soils for establishment. Due to these characteristics, it can become the dominant climax community and prevent establishment of native vegetation, especially cottonwoods (Shafroth et al., 1995).

A description of the riparian communities of the three reaches and related environments follows.

3.7.2.6.1 Reach 1 – Reach 1 is most dependent on flows from Flaming Gorge for its riparian and wetland vegetation makeup. Many species found in Reach 1 were not present pre-Flaming Gorge Dam and are not present today on similar reaches of the nearby Yampa River (Cooper, 1999). After dam closure, the riparian zone was no longer subject to high spring floodflows and low summer/fall base flows. The new, more stable flow regime led to a shift in plant community composition and location.

The zone closest to the river's edge is now composed of marsh type plants—those that can tolerate long periods of root saturation. This post-dam flood plain (Grams and Schmidt, 2002) is inundated on an almost annual basis, sometimes in 8-week stretches, by the powerplant releases of 4,600 cfs. Canyon reaches and the upper portion of Browns Park have an almost continuous narrow band of wetland plants that have established along the river's edge. Plants in the sedge and rush families dominate this zone, particularly spike rush (*Eleocharis palustris*), with coyote willow (*Salix exigua*), cattail (*Typha latifloia* and *T. angustifolia*), bulrush (*Scirpus* sp.), common reed (*Phragmites australis*), and tamarisk also present.

In the wide alluvial valley of lower Browns Park, low elevation islands are vegetated by coyote willow, spike rush, bulrush, and other marsh species. Islands are one of the few areas in this reach where expansion of wetland and riparian vegetation is occurring (Merritt and Cooper, 2000). Most of this expansion is in a downstream direction; there has been little vertical accretion of sediment. Thus, island soils are saturated by shallow ground water for most of the year, providing favorable conditions for marsh plants but precluding riparian forest species such as cottonwood.

At elevations just above this post-dam flood plain is a zone that is only rarely flooded under post-dam conditions. Inundation of this intermediate bench surface (Grams and Schmidt, 2002) generally begins above flows of 4,600 cfs. Several surface types are associated with this zone, and each surface type tends to have a distinct plant community. Tamarisk, coyote willow, and the giant whitetop are found on debris fans, islands, and cobble bars. The nonnative grass, redtop (*Agrostis stolonifera*), characterizes eddy and pool bars.

In Lodore Canyon, tamarisk invasion is especially prevalent on many debris fans. Under river regulation, decreased flood magnitudes and the formation of inset flood plains has limited tamarisk's establishment to a narrow elevation zone. This zone tends to be densely covered with tamarisk. Larson (2004) found that the majority of tamarisk in both Lodore Canyon and Yampa Canyon are located on deposits inundated less frequently than the 2-year flood (the intermediate bench surface in Lodore). Larson also found that tamarisk do not appear to establish at most base flow elevations due to the ability of even small floodflows to remove them.

Without the power of large spring flows to remove or prevent establishment of most vegetation in the active flood zone, island and mainland cobble bars are filling in with vegetation, and side channels are connecting islands to mainland. The threatened Ute ladies'-tresses orchid falls within the intermediate bench zone and the lower post-dam flood plain and is found on vegetated cobble bars in Red and Lodore Canyons and Browns Park (see section 4.7.8.2 for a full discussion of effects).

Lower Browns Park is composed of high, straight riverbanks with the post-dam flood plain inserted below these banks. Appropriate elevations and locations for cottonwood establishment are now occupied by the nonnative plants whitetop, tamarisk, sweet clover, and Canada thistle (*Cirsium arvense*), and the native scouring rush (*Equisetum* sp.) and occasional coyote willow. These areas do not receive the scouring effect of large floodflows; thus, there is little opportunity for cottonwood establishment.

The old high water terrace, a pre-dam feature found at higher elevations, is an area that, in Reach 1, does not receive floodflows in the current post-dam setting. Conifers and box elder are common in the canyon reaches with Fremont cottonwood common on the meandering wider valley reaches. Common understory species of both canyon and wider valley reaches are mostly composed of upland and desert shrub type plants: sagebrush, rabbitbrush (*Chrysothamnus nauseosa),* greasewood (*Sarcobatus vermiculatus*), desert grasses, and aster. This desert plant community is atypical of unregulated rivers of the arid and semiarid West.

In lower Browns Park, the old high water zone sits high above nearly vertical banks that line both sides of the river and prevent overbank flooding even during the infrequent post-dam high flood years. Older stands of Fremont cottonwood forests are prevalent, having become established during floodflows of the pre-dam era. Comparative studies along the Yampa River indicate that these Browns Park cottonwood forests are in various stages of premature decay. With the loss of the historical floodflows, the cottonwoods have lost their fine root system, leaving main taproots as the only means of supplying water (Williams, 2000).

There is very little successful cottonwood regeneration occurring in lower Browns Park due to a lack of unvegetated sites that provide the proper moisture, yet protection from ice and scouring high flows. The existing cottonwood community is not replacing itself and, instead, is being replaced by the nonnative tamarisk or native desert species. There has been little cottonwood establishment in Reach 1 since 1962.

3.7.2.6.2 Reach 2 – The Yampa River tempers the effects of river regulation on the riparian zone of Reach 2. As in Reach 1, there is the presence of a distinct post-dam flood plain with corresponding wetland plants. The addition of unregulated flows from the Yampa River creates greater stage changes, thereby limiting true wet meadow communities that proliferate under more stable flows.

In Whirlpool and Split Mountain Canyons, plant communities with more similarities to the Yampa River Canyon than Lodore Canyon of Reach 1 dominate the herbaceous riparian vegetation. Herbaceous communities characterized by prairie cordgrass (*Spartina pectinata)* and the sedge *(Carex emory)* are typical of the Yampa Canyon and Green River canyons of Reach 2 but are absent in Reach 1. In Lodore Canyon, the most characteristic community is dominated by redtop grass, yet this community is absent in the canyons of Reach 2. Inundation of the post-dam flood plain surfaces of Reach 2 begins at about 16,000 cfs, which is the post-dam 2-year flood.

The intermediate bench, which is only occasionally flooded in the post-dam era, is generally inundated by flows greater than 21,000 cfs. In the alluvial valley of Island Park, soil deposition is occurring in abandoned channels and oxbows, providing opportunities for cottonwood establishment. During the wetter years of 1984-1986, successful cottonwood establishment was prevalent. Old (100-year plus) cottonwoods are sparse and are located on a high terrace that sits 13-15.5 feet above base flow stage. Like Browns Park, the understory vegetation of this terrace is composed of desert shrub species (i.e., big sagebrush (*A. tridentata*) greasewood, rabbitbrush, and desert grasses). Islands range from unvegetated to densely vegetated with coyote willow and young tamarisk.

Further downriver in the wide alluvial valley of the Ouray area, the intermediate bench is heavily vegetated with tamarisk, Russian olive, and three-leaf sumac (*Rhus aromatica*) with an understory of herbaceous vegetation dominated by grasses and poverty weed (*Iva axillaris*). Side channels with silt-clay substrates that occasionally receive floodflows are currently providing seedling beds for tamarisk and Russian olive.

In the Ouray area of Reach 2, there are occasional bands of young cottonwoods that likely established with the 1983-86 floods. Other than populations within Dinosaur National Monument, this is the only age group of cottonwoods that appears to have established in Reach 2 since closure of Flaming Gorge Dam. Tamarisk established throughout the upper Green River well before river regulation (Allred and Schmidt, 1999; Birken, 2004). Following dam closure, this invasive species took quick advantage of the additional establishment opportunities that came about with the lack of scouring floodflows. This change allowed vegetation to expand further down the riverbanks, contributing to accretion and channel narrowing.

3.7.2.6.3 Reach 3 – The upper portion of Reach 3 is a continuation of the wide alluvial flood plain forests as described for Reach 2.

Throughout Reach 3, at least two distinct topographic surfaces now exist in the area of bank accretion. An intermediate elevation surface is densely vegetated with tamarisk and Russian olive, and one low elevation surface that includes one to two natural levees is densely covered with willows (Allred and Schmidt, 1999; Cooper, 1999).

In Gray Canyon, large-scale cottonwood establishment currently occurs on gravel bars. This establishment surface is a different landform than that historically occupied by cottonwood (Cooper, 1999). Cooper found that, since dam closure, cottonwoods established only in 1983 on higher Gray Canyon flood plain surfaces. The high flow years of 1984-1986 likely provided the needed moisture to insure seedling survival at these higher surfaces.

Throughout Labyrinth and Stillwater Canyons, there are ancient lakes behind the levees in all bottoms. These lakes have laminated clay soils and are surrounded by tamarisk and cottonwood but used to function as reservoirs and perhaps marshes in the years of big flows, likely prior to the 1930s (Cooper, 2002). The active flood plain is dominated by a dense thicket of sandbar willow and young tamarisk on the banks.

Thick bands of 40+ year-old tamarisk proliferate just above the active flood plain; and, in the old high water zone, stands of greasewood, three-leaf sumac, desert olive (*Forestiera* sp.), and herbaceous vegetation dominate. High terraces with 100- to 300-year-old cottonwoods are present throughout**.**

3.7.2.7 Terrestrial and Avian Animals

3.7.2.7.1 Reach 1 – Thick growth and the variety of plant species in the riparian zone provide a structural diversity that makes the Green River corridor some of the most important wildlife habitat in the region. Wider and more extensive riparian zones provide habitat for a larger and more diverse wildlife and avian community. Wetland and riparian habitats along the river serve as an oasis in a desert region where rainfall averages only about 7 inches a year. Drier habitat around the wetlands adds to the diversity of species living in the area.

Riparian vegetation supplies food and cover for insects emerging from the river, as well as its own resident invertebrate populations and their terrestrial predators (e.g., predacious insects, amphibians, reptiles, birds, and mammals). These resources, in turn, provide food for numerous fish, mammals, birds, reptiles, amphibians, and invertebrates. Terrestrial and aquatic invertebrate assemblages play a major role in both aquatic and terrestrial food webs in the system.

Many species use riparian woody plants directly as nest sites or cover. Other wildlife species (e.g., beaver [*Castor canadenis*]) use these plants as food. Waterfowl nest in emergent marsh plants and other suitable sites.

Increase in riparian habitat since construction of the dam has led to increases in both population size and species diversity within the river corridor. This new zone of vegetation provides important habitat for many native terrestrial wildlife species, including numerous species of mammals (including bats), birds, amphibians, reptiles, and terrestrial invertebrates.

Ant populations have increased after dam closure due to the reduced frequency of high bank scouring flows that removed colonies of ants from the scour zone. Willow communities support more species of insects compared to tamarisk communities.

Many passerine and/or migratory birds are dependent on this riparian vegetation for general and nesting cover and foraging areas. For insectivorous birds, riparian vegetation provides cover and food. Some species that do not nest in the riparian zone use the zone as feeding areas. At high flows during nesting season, some ground nesting birds may lose their young to inundation.

Riparian patch size is important to several bird species (e.g., southwestern willow flycatcher), and they will not use a patch that is too small. Actions that decrease riparian patch size would, therefore, affect use of these areas by these birds.

Numerous species of nongame vertebrate wildlife use riparian habitats along the Green River below Flaming Gorge Dam (Bogan et al., 1983). The greatest species diversity occurs in the riparian habitats of broad valleys such as Browns, Echo, Island, and Rainbow Parks. Wildlife is less diverse in canyon areas (e.g., Lodore, Split Mountain) because of limited riparian habitat.

Several bat species exist within the area. They are attracted to the river corridor by the insects associated with the river and riparian vegetation. Bats and birds are also important prey for raptors. The formerly endangered peregrine falcon (*Falco peregrinus*) feeds on bats, swallows and other passerine birds, and ducks within the canyons. Prey is plentiful due to the abundance of insects along the river that attract prey species for the falcon. The peregrine falcon occurs along the Green River below Flaming Gorge Dam and is most common in major canyons where potential nest and perch sites exist on cliff faces. The species nests within Dinosaur National Monument (Eason, 1992) along both the Green and Yampa Rivers. Numbers of nests have increased within the past two decades. Only 2 active nest sites were known within the monument in 1976, but 8 nesting pairs fledged a total of 13 young in 1992. There are currently 12 active eyries within Dinosaur National Monument. Each eyrie has fledged an average of one and two young per year. Although peregrines usually occur in the area only during the breeding season (March-October), some birds could occur during the winter (U.S. Fish and Wildlife Service, 1977).

Ringtail (*Bassariscus astutus*) are found in the river corridor. Human activity may increase their numbers due to the ringtail's scavenging habits in human refuse.

Several species of game mammals, including mule deer (*Odocoileus hemionus*), elk (*Cervus elaphus*), moose (*Alces alces*), pronghorn (*Antilocapra Americana*), and bighorn sheep (*Ovis Canadensis*), occur along the Green River corridor above and below Flaming Gorge Dam (BLM, 1990; Schnurr, 1992). All of these species use riparian habitats as foraging and watering areas but are not restricted to riparian areas at any time of the year. Mule deer, elk, and pronghorn range widely throughout this portion of Utah and Colorado but move toward the river in the fall and use the river valley, especially Browns Park, as wintering range. Mule deer occur along the river throughout the year and are the most abundant game mammal in the area. Moose numbers are low in the region but appear to be increasing (BLM, 1990). Within the area, moose habitat occurs in Browns Park.

The Green River and associated wetlands provide important breeding, migration, and wintering habitat for numerous waterfowl species (Aldrich, 1992). Before the river was confined by dikes and the dam, annual spring floods inundated bottomland areas in Browns Park and other broad flood plain areas along the river. These flooded bottomlands provided important foraging and breeding areas for migrating and resident water birds. Browns Park National Wildlife Refuge and Browns Park Wildlife Management Area, situated along the river corridor in Browns Park, are managed to mitigate the effects of dam-induced reductions in spring flooding on these important waterfowl habitats. Within these management areas, bottomlands are artificially flooded each year by pumping river water into diked marshlands to create suitable waterfowl habitat. Other slack water areas are attractive to waterbirds and provide habitat for them.

Waterfowl species that commonly breed along the Green River corridor include Canada goose (*Branta Canadensis*), mallard (*Anas platyrhynchos*), common merganser (*Mergus merganser*), gadwall (*Anus strepera*), green-winged teal (*Anus crecca*), and redhead (*Anthya Americana*). In addition to these species, American widgeon (*Anus Americana*), common goldeneye (*Bucephala clangula*), and American coot (*Fulica americana*) are common during migration or winter. Waterfowl use large eddies and riparian communities associated with them as nesting and brood habitat. They use ice-free areas of the river during the winter.

Canada geese are particularly susceptible to changes in flow on the Green River (Holden, 1992; Aldrich, 1992). Islands and sandbars with low vegetation (e.g., grasses and forbs) are important nesting habitat for this species, and Browns Park is the most important nesting area for Canada geese in the area (Schnurr, 1992). Most nesting occurs from March 15 to May 15.

Great blue heron (*Ardea herodias*), spotted sandpiper (*Actitis macularia*), and killdeer (*Charadrius vociferous*) forage along shoreline and riparian habitats during the breeding season (Bogan et al., 1983). The great blue heron uses large trees (e.g., cottonwood) as nesting and roosting sites along the river. Killdeer and spotted sandpiper nest on the ground above the water line.

Many species of amphibians and reptiles inhabit the river corridor. Most of these animals use both upland and riparian sites. The river is a source of abundant invertebrate food for these species. Cliff faces above the river provide escape and resting habitat for reptiles. The zone of fluctuating water level is an important foraging area for reptiles and amphibians. Dense stands of tamarisk do not usually provide suitable habitat for these animals (Jakle and Gatz, 1985). The leopard frog (*Rana pipiens*) depends on backwater and flooded bottom land habitat.

3.7.2.7.2 Reach 2 – This reach is home to herds of pronghorn, mule deer, elk, bighorn sheep, and wild horses. Mule deer are relatively common and widespread within this reach.

Bighorn sheep are common in riparian areas along the Green River within Lodore, Whirlpool, and Split Mountain Canyons. These animals are the result of reintroductions that began in 1952 after a die-off of the natural population.

Numerous species of nongame vertebrate wildlife use riparian habitats along the Green River below the Yampa River confluence. The greatest species diversity occurs in the riparian habitats of broad valleys, such as Echo, Island, and Rainbow Parks and Ouray National Wildlife Refuge. Wildlife is less diverse in canyon areas (e.g., Split Mountain) because of the lack of habitat diversity.

The Green River corridor within this reach provides habitat for a vast number of migrating waterfowl, shorebirds, and wading birds from spring through fall. Over 200 species of birds can be found within this reach. Hawks, Canada geese, falcons, and many species of songbirds are commonly seen. Bald eagles (*Haliaeetus leucocephalus*) winter along the Green River.

Other birds commonly using this area include the pied-billed grebe (*Podilymbus podiceps*), eared grebe (*Podiceps nigricollis*), western grebe (*Aechmophorus occidentalis*), Clark's grebes *(Aechmorphorus clarkia*), double-crested cormorant (*Phalacrocorax auritus*), great blue heron, snowy egret (*Egretta thula*), black-crowned night-heron (*Nycticorax nycticorax*), white-faced ibis (*Plegadis chihi*), American bittern (*Botaurus lentiginosus*), mallard, gadwall, northern pintail (*Anus acuta*), redhead, common merganser, ruddy duck (*Oxyura jamaicensis*), American widgeon, Virginia rail (*Rallus limicola*), black-necked stilt (*Himantopus mexicanus*), American avocet (*Recurvirostra Americana*), Wilson's phalarope (*Phalaropus tricolor*), Forster's tern (*Sterna forsteri*), black tern (*Chlidonias niger*), greater yellowlegs (*Tringa melanoleuca*), lesser yellowlegs (*Tringa flavipes*), willet (*Catoptrophorus semipalmatus*), killdeer, and all three species of teal. During migration, these species of birds and many others visit the Ouray National Wildlife Refuge and other wetlands, along with occasional flocks of sandhill cranes (*Grus canadensis*).

Marshlands yield abundant food, water, and shelter for migrating waterfowl. Cattails and bulrush provide nesting habitat for redhead and ruddy ducks. Most ducks, however, do not locate nests in such wet places, preferring drier sites. These include the mallard, pintail, gadwall, and cinnamon teal (*Anus cyanoptera*). Waterfowl offspring prefer concentrated, nutritious food.

Macroinvertebrates fulfill this need, and marsh waters can provide these small food parcels.

Cottonwoods grow in stands along the Green River. Although of marginal value to waterfowl, cottonwoods provide cover, food, and nesting sites for a wide variety of animals. Mule deer, raccoons (*Procyon lotor*), porcupines (*Erethizon dorsatum*), Lewis's woodpeckers (*Melanerpes lewis*), red-tailed hawks (*Buteo jamaicenis*), great horned owls (*Bubo virginianus*), yellow-rumped warblers (*Dendroica coronata*), and other wildlife frequent the cottonwood groves. Great blue herons and double-crested cormorants nest in rookeries high up in cottonwoods along the river. A blue heron rookery exists near Old Charley Wash. Cottonwoods give the area a lot of its wildlife diversity.

Many areas have salty or alkali soils; only vegetation tolerant of saline soils will flourish in these areas. Greasewood (*Sacrobatus vermiculatus*), tamarisk (*Tamarix* sp.), and saltgrass (*Distichlis spicata*) dominate the plant life. Although this habitat is not ideal for waterfowl due to its poor nesting cover, ducks such as cinnamon teal commonly nest in saltgrass if it is near water. These areas are important to mule deer as winter cover.

3.7.2.7.3 Reach 3 – The majority of terrestrial and avian animals that exist within riparian zones of the upper reaches of the affected area also exist within riparian zones of Reach 3. However, riparian habitat is much more limited in this reach than upstream reaches. Most of Reach 3 has a limited area of flood plain.

Species occupying the shrublands, grasslands, and riparian habitats near the river include the northern harrier (*Circus cyaneus*), burrowing owl (*Athene cunicularia*), ring-necked pheasant (*Phasianus colchicus*), Say's phoebe (*Sayornis saya*), western kingbird *(Tyrannus verticalis*) eastern kingbirds (*Tyrannus tyrannus*), horned lark (*Eremophila alpestris*), loggerhead shrike (*Lanius ludovicianus*), sage thrasher (*Oreoscoptes montanus*) (uncommon), vesper sparrow (*Pooecetes gramineus*), lark sparrow (*Chondestes grammacus*), and sage sparrow *(Amphispiza belli*), lazuli bunting (*Passerina amoena*), mourning dove (*Zenaida macroura*), yellow-billed cuckoo (*Coccyzus americanus*), Lewis's woodpecker (*Melanerpes lewis*), downy woodpecker (*Picoides pubescens*), hairy woodpecker (*Picoides villosus*), northern flicker (*Colaptes auratus*), black-capped chickadee (*Poecile atricapillus*), house wren (*Troglodytes aedon*), warbling vireo (*Vireo gilvus*), yellow warbler (*Dendroica petechia*), yellow-breasted chat (*Iicteria virens*), spotted towhee (*Pipilo maculatus*), northern oriole (*Icterus galbula*), marsh wren (*Cistothorus palustris*). Yellow-headed blackbird (*Xanthocephalus xanthocephalis*) breed in and around wetlands; and a few Lewis's woodpeckers nest in riverside cottonwoods. From spring through fall, Lewis's woodpecker can be found in cottonwood forests.

The river is used by beaver, northern river otter (*Lutra Canadensis*), and muskrats (*Ondatra zibethicus*). Adjacent stands of cottonwoods, willows, squawbrush (*Rhus trilobata*), and tamarisk (*Tamarix sp.*) provide cover for cottontails (*Sylvilagus auduboni*), raccoons, mule deer, bobcats (*Felis rufus*), and porcupines. Raptors, including bald and golden eagles (*Aquila chrysaetos*), great-horned owls, and several species of hawks, also use this habitat. Peregrine falcons and osprey (*Pandion haliaetus*) find refuge along the river.

Greasewood, rabbitbrush (*Chrysothamnus sp.*), and cacti compete for the limited water of the higher, drier sites. Prairie dogs (*Cynomys sp.*), jackrabbits (*Lepus sp.*), and coyotes (*Canis latrans*) are typical upland residents. Other upland species include burrowing owl (*Athene cunicularia*), short-eared owl (*Asio flammeus*), American kestrel (*Falco sparverius*), loggerhead shrike, sage thrasher, Brewer's sparrow (*Spizella breweri*), sage sparrow, Ord's kangaroo rat (*Dipodomys ordii*), black and white-tailed jackrabbit, desert cottontail (*Sylvilagus audubonii*), white-tailed antelope squirrel (*Ammospermophilus leucurus*), mule deer, and pronghorn. Many species of reptiles live in these uplands.

The river and its associated habitats provide food and cover for nesting ducks including mallards, pintails, and teal, as well as Canada geese. The area provides food for migrating waterfowl like sandhill cranes (*Grus Canadensis*) and whooping cranes (*Grus Americana*). Deer, raccoon, ring-necked pheasant, garter snake (*Thamnophis sirtalis*), Woodhouse's toad (*Bufo woodhousei*), boreal chorus frog (*Pseudacris triseriata*), and northern leopard frog (*Rana pipiens*) also benefit from the food and cover provided by these riparian habitats.

Wildlife depends on riparian zones within Desolation Canyon for habitat and water. These species include bighorn sheep, mule deer, elk, mountain lion (*Felis concolor*), black bear (*Ursus americanus*), golden eagle, prairie falcon (*Falco mexicanus*), Cooper's hawk (*Accipiter cooperii*), goshawk (*Accipiter gentiles*), American kestrel, red-tail hawk, Canada geese, bald eagle, and peregrine falcon.

3.7.3 Other Threatened and Endangered Species

3.7.3.1 Southwestern Willow Flycatcher

The southwestern willow flycatcher (*Empidonax traillii extimus*) was federally listed as an endangered species in 1995 (U.S. Fish and Wildlife Service, 1995). A final recovery plan was published in March 2003 (U.S. Fish and Wildlife Service, 2003). The U.S. Fish and Wildlife Service has designated an "administrative boundary" between subspecies of willow flycatchers until genetic and/or vocal analysis can offer a clearer distinction between the subspecies. The current administrative designation considers all resident willow flycatchers within the Colorado Plateau physiographic region south of the Uintah Basin to be southwestern willow flycatchers. Therefore, for this EIS, only Reach 3 is considered to be southwestern willow flycatcher habitat. There is no critical habitat designation within the Green River Basin.

The southwestern willow flycatcher is a small neotropical migrant bird that depends on riparian vegetation for much of its life cycle. Once common along rivers of the Southwest, rough estimates are that there are now 1,200 to 1,300 pairs left in the United States. Population declines are attributed to loss and fragmentation of riparian habitat, encroachment of exotic plants, and parasitism by brown-headed cowbirds. In Utah and Colorado, the southwestern willow flycatcher historically nested in dense willow habitat that tended to have a scattered overstory of cottonwoods. Following widespread invasion of nonnative shrubs, the southwestern willow flycatcher now also nests in tamarisk and Russian olive. Preferred nesting habitat also seems to be associated with standing water, exposed sandbars, or nearby fluvial marshes.

Using the U.S. Fish and Wildlife Service approved protocol (Sogge et al., 1997a), surveys were conducted in Reach 3 in 1999 and 2000 (Johnson et al., 1999; Howe and Hanberg, 2000; Howe, 2000). A total of eight birds were identified as southwestern willow flycatchers. The majority of suitable habitat between Ouray and Green River, Utah, occurs on islands and sandbars (Howe and Hanberg, 2000). Mainland patches of large tamarisk, often mixed with willow, characterize southwestern willow flycatcher habitat along the lower Green River. The habitat component of standing water or fluvial marshes is limited.

There is little information about the history of southwestern willow flycatcher along the Green River. Explanations as to the absence of birds are speculative. Causes are most likely due to unsuitable habitat components (i.e., geographic, temperature, predators, food resources, adjacent land uses, and lack of standing water) and effects of historic extirpation and slow colonization (Johnson et al., 1999). In addition, 2 years of surveys do not necessarily mean that birds have been extirpated from the lower Green River. Sogge et al. (1997b) have documented several instances where flycatchers disappeared from former breeding locations along the Colorado River only to return 3 to 5 years later. Suitable habitat may currently be unoccupied because the flycatcher is now so rare that there are not enough individuals to disperse into all available habitats. If so, effective management of suitable but unoccupied riparian habitats is important as these birds recover under Endangered Species Act recovery activities.

Survey results indicate that the Green River is used as a migratory stopover for northern subspecies of willow flycatchers moving farther north to breed and for possible intergrades between the subspecies. Migration is a period of extreme energy demand, and most songbirds must stop periodically during migration to replenish depleted fat stores. Based on the numbers recorded during surveys, the Green River appears to provide important stopover habitat for the willow flycatcher subspecies as well as other neotropical migrants.

3.7.3.2 Ute Ladies'-Tresses

The Ute ladies'-tresses (*Spiranthes diluvialis*) was federally listed as a threatened species on January 17, 1992 (U.S. Fish and Wildlife Service, 1992a). Critical habitat has not been designated for this species. The current range of Ute ladies'-tresses includes Colorado, Idaho, Montana, Nebraska, Utah, Washington, and Wyoming, with a historical occurrence in Nevada. Along the Green River, Ute ladies'-tresses are currently found only in Reaches 1 and 2.

The Ute ladies'-tresses is a perennial orchid which typically occurs on sandy or loamy alluvial soils mixed with gravels. Typical habitat is in mesic to very wet meadows along streams and abandoned stream meanders, riparian edges, gravel bars, and near springs, seeps, and lakeshores at elevations ranging from 4265 to 6561 feet (U.S. Fish and Wildlife Service, 1992a; UDWR, 2002; Nevada Natural Heritage Program, 2001; NatureServe, 2001). Threats to populations of Ute ladies'-tresses include modification of riparian habitats by urbanization, stream channelization (for agriculture and development) and other hydrologic changes, conversion to agriculture and development, heavy summer livestock grazing, and hay mowing. Most populations are small and vulnerable to extirpation by habitat changes or local catastrophic events (U.S. Fish and Wildlife Service, 1992a). Several historic populations in Utah and Colorado appear to have been extirpated.

Populations of Ute ladies'-tresses often are located in riparian habitats on active flood plains in unconfined river reaches below confined reaches (Ward and Naumann, 1998). Along major rivers, these habitats may be somewhat transitory, subject to erosion and deposition. Ute ladies'-tresses are often found in early mid-succession stage habitats, and adverse changes to habitat in some areas may be the result of succession resulting in tall and dense vegetation. Periodic inundation may help maintain open habitat characteristics. Although tolerant of periodic inundation, frequent scouring or deposition can eliminate Ute ladies'-tresses or preclude their establishment (Ward and Naumann, 1998).

3.7.3.2.1 Reach 1 – A large number of Ute ladies'-tresses occurs within Reach 1. The occurrence of Ute ladies'-tresses along the Green River is influenced by river channel geometry, hydrology, and depositional and erosional patterns. Surveys conducted from 1998 to 2002 located 10 sites in Red Canyon, 25 sites in Browns Park, and 81 sites in Lodore Canyon (Grams et al., 2002; Ward and Naumann, 1998). The numbers of individuals found at these locations were generally low, ranging from 1 to 50; however, several sites in Lodore Canyon contained hundreds of flowering plants.

Within Reach 1, Ute ladies'-tresses predominantly occur on features that post-date Flaming Gorge Dam: post-dam flood plains and intermediate benches (Ward and Naumann, 1998; Grams et al., 2002). The post-dam flood plains are typically flat surfaces and are inundated annually by flows of 4,600 cfs; the intermediate benches are inundated by 10,900 cfs and average 6.2 feet above the 800-cfs base flow. In Lodore Canyon, many otherwise suitable areas are invaded with tamarisk and support few or no Ute ladies'-tresses.

3.7.3.2.2 Reach 2 – Within Reach 2, riverflows are strongly influenced by the Yampa River, and suitable habitat for Ute ladies'-tresses is less common (Ward and Naumann, 1998).

In Island Park and Rainbow Park, Ute ladies'-tresses typically occur on post-dam flood plains and intermediate benches, which are inundated more frequently than in Reach 1. In this reach, the post-dam flood plains are inundated at about 16,100 cfs (the post-dam 2-year flood). The intermediate benches are likely inundated by flows exceeding 20,000 cfs (and typically above the 17,100-cfs stage). Most occurrences of Ute ladies'-tresses are found on areas approximately 3 feet above the 3,300-cfs elevation. In this reach, nine populations of Ute ladies'-tresses have been found in Island Park-Rainbow Park, five below Split Mountain (Ward and Naumann, 1998). One population in Island Park occurs on a higher terrace, averaging 14 feet above base flow, which shows no evidence of inundation.

3.7.3.3 Bald Eagle

About 50 bald eagles (*Haliaectus leucocephalus*) winter along the Green River below Flaming Gorge Dam each year (Howe, 1992; Huffman, 1992). Eagles perch in large trees, especially cottonwoods, near open, ice-free water and forage for fish and occasionally waterfowl. Concentrations of eagles occur in broad, open areas of the valley with cottonwood groves, such as Browns Park and Island Park (Huffman, 1992).

Although nesting by the bald eagle has not been observed in the vicinity of Flaming Gorge Dam or the Green River, it is possible given documented nesting activity elsewhere in Utah and Colorado (Kjos, 1992) and the availability of suitable large cottonwood trees in Browns, Island, and Rainbow Parks.

The bald eagle winters along the Green River below the dam and also around the reservoir. They feed on the abundant trout population, especially during spawning activities of winter-spawning trout. Osprey also are found in the same areas and exploit the same prey base. Riparian areas with large cottonwood trees are used for roosting and perching. There are no known bald eagle nests in the area.

3.7.3.4 Black-Footed Ferret

Black-footed ferret (*Mustela migripes*) exist in release sites in eastern Utah near the Colorado border, located near prairie dog towns in the project area. These release sites are in Coyote Basin in Uintah County southeast of Jensen, Utah. This species is very rare.

3.7.3.5 Canada Lynx

Canada lynx (*Lynx canadensis*) may exist within the project area in coniferous forests. The Uinta Mountains likely form the species' southernmost range, though recent reports have given evidence of their existence in the Manti LaSal National Forest further south. The species is considered rare in Utah.

3.7.3.6 Mexican Spotted Owl

Mexican spotted owls (*Strix occidentalis Lucida*) are found within the Green River corridor. They were listed as a threatened species in 1993. This bird nests in caves in steep-walled, usually narrow, moist canyons. Most nesting sites occur in southern Utah, but sites have been found as far north as Dinosaur National Monument (Huffman, 1992). These owls prey on a variety of animals including mice, vole, bats, birds, and beetles, but their primary prey is woodrat. The primary threat to these birds has been habitat loss due to timber harvest practices. These owls prefer diverse, multiple layered forests. They will use uniform forests, grasslands, and shrublands also. The Mexican spotted owl is a potential year-round resident in wooded canyons along the Green River in all reaches below Flaming Gorge Dam. They are found as far north as Dinosaur National Monument.

3.7.4 Other Special Status Species

3.7.4.1 Yellow-Billed Cuckoo

In July 2001, the U.S. Fish and Wildlife Service announced the designation of the western population of the yellow-billed cuckoo (*Coccyzus americanus*) as a candidate species for listing as federally endangered. The yellow-billed cuckoo is currently listed on several State wildlife lists as sensitive or threatened, including Utah (as sensitive). Biologists have generally recognized western and eastern subspecies. The eastern and western populations are considered to be discrete based on physical (geographical area), morphological, behavioral, and genetic characteristics (U.S. Fish and Wildlife Service, 2001).

Yellow-billed cuckoo were historically uncommon to rare in Utah and likely uncommon in western Colorado (Bailey and Niedrach, 1965 in U.S. Fish and Wildlife Service, 2001; Kingery, 1998 in U.S. Fish and Wildlife Service, 2001). While still relatively common east of the Rockies, cuckoos of the West have faced significant population declines due to loss or degradation of 80-95% of their habitat, increased use of pesticides (thereby reducing food sources), and low colonization rates (U.S. Fish and Wildlife Service, 2001; Hughes, 1999). Habitat degradation and loss have been attributed to the result of conversion to agriculture, grazing, dams and riverflow management, bank protection, and competition from exotic plants. Additional impacts identified on the Green River include recreation and oil and gas drilling (Howe and Hanberg, 2000).

3.7.4.1.1 Reach 1 – Current conditions in Reach 1 provide little to no suitable habitat for yellow-billed cuckoo. Instead of the dense understory of riparian vegetation that characterize cuckoo habitat, the cottonwood gallery forests of Browns Park have an understory of low desert shrubs. There is little cottonwood regeneration occurring, and the cottonwood forests are being replaced by desert shrubs. There have been no recorded sightings of yellow-billed cuckoo in Reach 1.

3.7.4.1.2 Reach 2 – The Ouray area of Reach 2 contains large patches of suitable habitat—mature cottonwood forest with dense understory. Yellow-billed cuckoo breeding was confirmed in 1992. From 1999 through 2001, additional birds were detected at four sites in the Ouray area. Breeding was not confirmed but was probable due to the presence of birds and territories during late-season surveys. Ute Indian tribal lands along Reach 2 have not been surveyed.

3.7.4.1.3 Reach 3 – Suitable habitat in Reach 3 is characterized by large blocks of vegetation having an extensive overstory of cottonwood and old-growth tamarisk with a dense understory of tamarisk and willow. Eighteen sites with potential cuckoo habitat have been identified in sections of Reach 3 from the upper end of Desolation Canyon to the lower end of Gray Canyon (Howe and Hanberg, 2000). Additional suitable habitat has been identified along the lower Green River in Canyonlands National Park (Johnson et al., 1999). Recent surveys for Reach 3 have recorded a single sighting at Mineral Bottom.

3.7.4.2 Whooping Crane

Whooping cranes (*Grus americanus*) migrate through the region of Flaming Gorge Dam and the Green River Basin in the spring and fall. These cranes belong to a population established at Gray's Lake National Wildlife Refuge in southeastern Idaho. These birds are part of a recovery program for this species (Armbruster, 1990). Efforts to establish the Gray's Lake population began in 1975. The current population consists of cranes that have not yet nested but migrate annually with sandhill cranes to wintering grounds in and around the Bosque del Apache National Wildlife Refuge (Armbruster, 1990).

Habitats used by whooping cranes during migration include agricultural fields, wetlands, and small reservoirs (Rose, 1992). Whooping cranes have been observed in the vicinity of the Green River near Jensen, Utah. Wetlands along the river could be used occasionally by migrating individuals.

3.8 CULTURAL RESOURCES

Historic properties are the subset of cultural resources including sites, districts, buildings, structures, or objects that are at least 50 years of age and are included in, or eligible for inclusion in, the *National Register of Historic Places* (NRHP). Historic properties also include properties of traditional religious and cultural importance to tribes and other communities that meet one or more of the NRHP criteria for evaluation (see Code of Federal Regulations [CFR] 60). Cultural resources also include sacred sites as defined under Executive Order 13007.

3.8.1 Definition of Affected Environment

The affected environment for cultural resources corresponds to the area of potential effect (APE), defined in 36 CFR 800.16(d) as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist." For purposes of this EIS, the APE for cultural resources includes Flaming Gorge Reservoir and the Green River flood plain downstream from Flaming Gorge Dam to the town of Green River, Utah. Though Reach 3 extends to the confluence of the Green and Colorado Rivers, Reclamation believes that the best available data (see section 4.3.2.7) about implementing flow recommendations results in such negligible changes in hydrology below the town of Green River, Utah, that this is a reasonable termination point for the determination of APE for cultural resources.

Effects to cultural resources were defined following 36 CFR 800.16(i) as any alteration to the characteristics of a historic property qualifying it for inclusion in or eligibility for the NRHP. Direct, indirect, or cumulative effects were defined using a combination of the Council of Environmental Quality regulations at 40 CFR 1508.8 and the criteria of adverse effect at 36 CFR 800.5. Direct effects are reasonably foreseeable changes in the integrity of properties believed to be caused by the proposed action and that are likely to occur at the same time and place; indirect effects were defined as those reasonable foreseeable effects caused by the undertaking that may occur later in time, be further removed in distance or be cumulative.

Reclamation reviewed existing information on historic properties and other resources within the APE in compliance with 36 CFR 800.4(a). To identify cultural resources that might be present within the APE of the proposed action, Reclamation reviewed information on file at the State Historic Preservation Offices (SHPO) of Wyoming, Colorado, and Utah, as well as information synthesized by Spangler (1995). Information regarding the locations of individual cultural resource sites is restricted in order to preserve and protect these nonrenewable resources.

Consultation regarding cultural resources has been conducted with the Northern Ute Tribe; the Southern Ute Tribe; the Ute Mountain Ute Tribe; the Northwest Band of Shoshone; the Wind River Shoshone of Fort Washakie; the Hopi Tribe; the Paiute Indian Tribe of Utah; the Pueblo of Nambe; the Pueblo of Zia; the Kaibab Paiute Tribe; the Pueblo of Laguna; and the Pueblo of Zuni.

Information was also sought from Federal land managing agencies surrounding Flaming Gorge Reservoir and lands bordering the Green River downstream from Flaming Gorge Dam to the confluence of the Green and Colorado Rivers. This section describes the cultural resources located within the Flaming Gorge Reservoir APE and within the APE downstream along Reaches 1, 2, and 3 of the Green River.

3.8.1.1 Flaming Gorge Reservoir

Historic properties near Flaming Gorge Reservoir that could be affected by the proposed action are defined by location either below or above the 6040-foot-high water level elevation of the reservoir. Sites located below this level could be directly affected, and those located above could be indirectly and cumulatively affected. For a list of cultural resource sites located in and around the reservoir, see tables 3-11 and 3-12.

3.8.1.2 Green River

The downstream APE for cultural resources includes all of Reaches 1 and 2. The APE for the proposed action on Reach 3 extends from the confluence of the Green and White Rivers to the confluence of the Green and Colorado Rivers. However, since the hydrological model showed negligible differences in stage elevations between the No Action and the Action Alternatives, the APE for cultural resources was not extended further downstream than the town of Green River, Utah.

In all three reaches, the lateral extent of the APE considered for cultural resources is the flood plain of the Green River that could be inundated or wetted by the maximum proposed releases from Flaming Gorge Dam under the No Action and Action Alternatives. The indirect and cumulative effect on downstream resources is defined by the highest historic release from the dam of 12,300 cfs.

3.8.1.2.1 Reach 1 – Potentially affected cultural resources situated below Flaming Gorge Dam in Reach 1 on the Green River were determined based on a 10,000-cfs water flow in the river. See frontispiece map for the location of Reaches 1, 2, and 3. Historic properties that could be inundated at the 10,000-cfs water level were considered to be within the APE. Those located above the 10,000-cfs water level but below the highest historic release from the dam (12,300 cfs, March 16, 1983) (Elbrock, 2004) are also considered to be within the APE because they could be indirectly and perhaps cumulatively affected. Table 3-13 lists all previously documented cultural resource sites in Reaches 1 and 2 that could be affected by the proposed action. There are 33 located in Utah, and 16 are in Colorado. Thirty-two of the sites are prehistoric, eleven are historic, five are unknown, and one is multicomponent (both prehistoric and historic). Of the 49 sites, 24 are either listed on or eligible for the NRHP.

3.8.1.2.2 Reach 2 – The APE for cultural resources in Reach 2 was also determined using hydrologic modeling information and historic flood flow information. At the beginning of Reach 2, the Yampa River adds a large volume of water to the Green River. Thus, cultural resource sites located in the flood plain, in areas that would be inundated by a flow of 25,000 cfs, could be directly affected by the proposed action. Sites at an elevation that could be inundated by flows greater than 25,000 cfs could be indirectly affected (see table 3-13).

3.8.1.2.3 Reach 3 – Reach 3 begins at river mile 165 downstream from Flaming Gorge Dam at the confluence of the Green and White Rivers and ends at river mile 411 with the confluence of the Green and Colorado Rivers.

Table 3-14 lists cultural resource sites in the Reach 3 APE. There are 24 sites—18 are prehistoric, 4 are historic, 1 is multicomponent, and 1 is unknown. Of the 24 cultural resource sites, 12 are either listed in or eligible for the NRHP. All of Reach 3 is located in Utah.

Table 3-11.—Cultural Resources Inundated by Flaming Gorge Reservoir by Prior Mitigation, Cultural Resource Site Type, Age, and NRHP Eligibility

Site No.	Prior Mitigation	Age	Cultural Resource Site Type	NRHP Eligibility
42DA026	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW009	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW010	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW011	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW012	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW013	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW014	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW015	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW016	No	Prehistoric	Lithic scatter with feature	Not eligible
48SW017	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW018	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW022	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW028	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW029	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW030	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW036	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW040	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW041	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW042	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW048	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW049	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW051	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW053	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW054	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW055	No	Prehistoric	Lithic scatter with feature	Not eligible
48SW056	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW057	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW058	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW068	Yes	Prehistoric	Lithic scatter with feature	Not eligible
48SW027	No	Prehistoric	Hearth	Not eligible
42DA002	Yes	Prehistoric	Lithic scatter	Not eligible
42DA008	Yes	Prehistoric	Lithic scatter	Not eligible
42DA009	Yes	Prehistoric	Lithic scatter	Not eligible
42DA018	Yes	Prehistoric	Lithic scatter	Not eligible
42DA019	Yes	Prehistoric	Lithic scatter	Not eligible
42DA023	Yes	Prehistoric	Lithic scatter	Not eligible

Table 3-11.—Cultural Resources Inundated by Flaming Gorge Reservoir by Prior Mitigation, Cultural Resource Site Type, Age, and NRHP Eligibility (Continued)

Site No.	Prior Mitigation	Age	Cultural Resource Site Type	NRHP Eligibility
42DA025	Yes	Prehistoric	Lithic scatter	Not eligible
42DA027	Yes	Prehistoric	Lithic scatter	Not eligible
42DA028	Yes	Prehistoric	Lithic scatter	Not eligible
42DA029	Yes	Prehistoric	Lithic scatter	Not eligible
48SW003	Yes	Prehistoric	Lithic scatter	Not eligible
48SW021	Yes	Prehistoric	Lithic scatter	Not eligible
48SW023	Yes	Prehistoric	Lithic scatter	Not eligible
48SW024	Yes	Prehistoric	Lithic scatter	Not eligible
48SW025	Yes	Prehistoric	Lithic scatter	Not eligible
48SW026	Yes	Prehistoric	Lithic scatter	Not eligible
48SW034	Yes	Prehistoric	Lithic scatter	Not eligible
48SW035	Yes	Prehistoric	Lithic scatter	Not eligible
48SW037	Yes	Prehistoric	Lithic scatter	Not eligible
48SW038	Yes	Prehistoric	Lithic scatter	Not eligible
48SW039	Yes	Prehistoric	Lithic scatter	Not eligible
48SW4242	No	Prehistoric	Lithic scatter	Not eligible
48SW4244	No	Prehistoric	Lithic scatter	Not eligible
48SW4245	No	Prehistoric	Lithic scatter	Not eligible
48SW008	Yes	Prehistoric	Lithic scatter	Not eligible
42DA001	No	Prehistoric	Rock shelter	Not eligible
42DA003	No	Prehistoric	Rock shelter	Not eligible
42DA020	Yes	Prehistoric	Rockshelter	Not eligible
48SW047	Yes	Prehistoric	Rockshelter	Not eligible
48SW045	Yes	Prehistoric	Rockshelter with rock art	Not eligible
42DA010	Yes	Prehistoric	Rockshelter with structures	Not eligible
48SW046	Yes	Prehistoric	Rockshelter with structures	Not eligible
42DA468	No	Prehistoric	Storage cist	Not eligible
48SW050	No	Prehistoric	Stratified, multicomponent	Not eligible
48SW059	No	Prehistoric	Stratified, multicomponent	Not eligible
42DA363	No	Historic	Town site	Not eligible
48SW060	No	Prehistoric	Lithic scatter with feature	Not eligible

Table 3-12.—Cultural Resources Immediately Above the Flaming Gorge Reservoir Pool by Prior Mitigation, Cultural Resource Site Type, Age, and NRHP Eligibility

Site No.	Prior Mitigation	Age	Cultural Resource Site Type	NRHP Eligibility
42DA011	Yes	Prehistoric	Lithic and ceramic scatter	Eligible
42DA012	Yes	Prehistoric	Lithic scatter	Eligible
42DA015	Yes	Prehistoric	Lithic scatter with feature	Not eligible
42DA016	Yes	Prehistoric	Lithic scatter with feature	Eligible
42DA017	Yes	Prehistoric	Lithic scatter with feature	Unevaluated
42DA497	No	Prehistoric	Lithic scatter	Unevaluated
48SW00033	Yes	Prehistoric	Lithic scatter	Not eligible
48SW00080	Yes	Prehistoric	Lithic scatter	Eligible
48SW00361	No	Prehistoric	Quarry	Not eligible
48SW04243	No	Prehistoric	Lithic scatter	Not eligible
48SW09382	No	Prehistoric	Habitation with features	Not eligible
48SW10430	No	Prehistoric	Lithic scatter with feature	Eligible
48SW13230	No	Historic	Burial	Not eligible

Table 3-13.—Cultural Resources Within the Reaches 1 and 2 Areas of Potential Effects by Direct or Indirect Impacts, Age, Cultural Resource Site Type, and NRHP Eligibility

Site No.	Effect	Age	Cultural Resource Site Type	NRHP Eligibility
42DA030	Indirect	Prehistoric	Rockshelter	Eligible
42DA040	Indirect	Prehistoric	Campsite	Eligible
42DA196	Direct	Prehistoric	Lithic scatter	Eligible
42DA203	Direct	Prehistoric	Campsite	Eligible/Tested
42DA204	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA225	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA332	Indirect	Multicomponent	Lithic scatter, corral	Not eligible
42DA337	Indirect	Prehistoric	Habitation	Eligible
42DA338	Indirect	Historic	Canal	Not eligible
42DA339	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA341	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA342	Indirect	Historic	Dugout	Eligible/Tested
42DA377	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA394	Direct	Historic	Canal	Eligible
42DA485	Indirect	Prehistoric	Campsite	Eligible

Table 3-13.—Cultural Resources Within the Reaches 1 and 2 Areas of Potential Effects by Direct or Indirect Impacts, Age, Cultural Resource Site Type, and NRHP Eligibility (Continued)

Site No.	Effect	Age	Cultural Resource Site Type	NRHP Eligibility
42DA561	Indirect	Unknown	Unknown	Unknown
42DA562	Indirect	Prehistoric	Lithic scatter	Eligible
42DA564	Direct	Prehistoric	Campsite	Eligible/Tested
42DA661	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA668	Indirect	Prehistoric	Rockshelter	Eligible
42DA750	Indirect	Prehistoric	Lithic scatter	Not eligible
42DA751	Indirect	Prehistoric	Lithic scatter	Not eligible
42UN0054	Direct	Prehistoric	Rockshelter	Tested
42UN0065	Indirect	Prehistoric	Lithic scatter	Not eligible
42UN0136	Direct	Unknown	Unknown	Unevaluated
42UN0256	Indirect	Unknown	Unknown	Unevaluated
42UN0265	Indirect	Prehistoric	Campsite	Eligible
42UN0267	Indirect	Prehistoric	Rock art	Eligible
42UN0271	Indirect	Prehistoric	Rockshelter	Eligible
42UN1563	Indirect	Historic	Bridge	Not eligible
42UN1600	Indirect	Historic	Structure	Not eligible
42UN1746	Indirect	Prehistoric	Campsite	Eligible
42UN260	Direct	Unknown	Unknown	Unevaluated
5MF0067	Indirect	Prehistoric	Structure	Eligible
5MF0605	Direct	Historic	Structure	Listed/Tested
5MF0840	Direct	Prehistoric	Structure	Eligible/Tested
5MF1230	Indirect	Prehistoric	Campsite	Not Eligible
5MF1233	Direct	Historic	Trash scatter	Eligible
5MF1234	Direct	Historic	Building	Eligible/Tested
5MF1238	Indirect	Prehistoric	Lithic scatter	Not eligible
5MF2357	Indirect	Historic	Inscription, cabin	Listed
5MF2388	Indirect	Historic	Cabin	Not eligible
5MF2399	Direct	Historic	Structure	Not eligible
5MF2498	Direct	Unknown	Unknown	Not eligible
5MF2964	Direct	Prehistoric	Rock art	Eligible
5MF2966	Direct	Prehistoric	Rock art	Eligible
5MF2968	Direct	Prehistoric	Rock art	Eligible
5MF3668	Direct	Prehistoric	Lithic scatter	Not eligible/Tested
5MF3669	Indirect	Prehistoric	Lithic scatter	Not eligible

Table 3-14.—Cultural Resources Within the Reach 3 Area of Potential Effects by Direct or Indirect Impacts, Age, Cultural Resource Site Type, and NRHP Eligibility

Site No	Effect	Age	Cultural Resource Site Type	NRHP Eligibility
42Cb220	Indirect	Prehistoric	Rock art	Listed
42Cb228	Indirect	Prehistoric	Lithic scatter with groundstone	Eligible
42Cb235	Indirect	Prehistoric	Rock Art	Eligible
42Cb236	Indirect	Prehistoric	Rock Art	Eligible
42Em0655	Indirect	Prehistoric	Lithic and ceramic scatter	Eligible
42Em0723	Indirect	Prehistoric	Rock art	Eligible
42Em1071	Indirect	Prehistoric	Lithic scatter	Eligible
42Gr0618	Direct	Prehistoric	Lithic scatter	Not eligible
42Gr0655	Direct	Prehistoric	Lithic scatter	Not eligible
42Gr0815	Direct	Multicomponent	Rock art, sheep camp	Eligible
42Gr2552	Indirect	Historic	Building	Not eligible
42Gr2553	Indirect	Historic	Rock alignment	Not eligible
42Gr2558	Indirect	Prehistoric	Lithic scatter	Not eligible
42Gr2559	Indirect	Prehistoric	Lithic scatter	Not eligible
42Gr2560	Indirect	Historic	Building	Not eligible
42Un0137	Indirect	Prehistoric	Lithic quarry	Not eligible
42Un0230	Direct	Unknown	No form, no card	Unevaluated
42Un0349	Indirect	Prehistoric	Rock art	Eligible
42Un0432	Indirect	Prehistoric	Lithic scatter with groundstone	Eligible
42Un0446	Indirect	Historic	Campsite (Powell)	Eligible
42Un0729	Indirect	Prehistoric	Lithic scatter with groundstone	Not eligible
42Un0869	Indirect	Prehistoric	Rock art	Not eligible
42Un0870	Indirect	Prehistoric	Lithic scatter	Not eligible
42Un0967	Direct	Prehistoric	Rock art	Eligible

It should be noted here that all of Desolation Canyon in Reach 3 was designated a National Historic Landmark in 1969. Desolation Canyon was selected based on its exceptional historic value, including the John Wesley Powell expedition which passed through the canyon in 1869.

3.9 PALEONTOLOGICAL RESOURCES

Paleontologists from the Utah Geological Survey assessed the geological formations and the known paleontological resources in the vicinity of Flaming Gorge Reservoir and the Green River downstream from Flaming Gorge Dam that lie within the project area for the Proposed Action (DeBlieux et al., 2002). They concluded that the most sensitive formations for paleontological resources are the Morrison, Cedar Mountain, Uinta, and Duchesne River Formations. Information about the locations of individual paleontological resources is restricted to help preserve and protect these nonrenewable resources.

The current assessment of paleontological resources was taken from DeBlieux et al. (2002). The report assessed the likelihood that paleontological resources would be found in the geologic formations along the shores of Flaming Gorge Reservoir and along the course of the Green River to the confluence of the White River within the State of Utah. The majority of rock units exposed along the shores of the reservoir and the Green River are fossil-bearing. Several geological formations contain significant fossil resources and are ranked in the *very sensitive* and *extremely sensitive* categories for paleontological resources as defined by the State paleontologist of Utah. These include the Morrison, Cedar Mountain, Uinta, and Duchesne River Formations. Several other formations have the potential to contain significant fossil resources based on the occurrence of significant fossils in these formations in other regions, and these formations are placed in the *significant sites known* category. Formations placed in this category are the Park City/Phosphoia, Moenkope, Chinle, Stump, Mowry, Mancos, Wasatch, and Green River and the Mesa Verde Group.

A 2003 pedestrian inventory of 50 miles of shoreline along Flaming Gorge Reservoir in Wyoming concluded that neither paleontological nor cultural resource sites were located between the high and low water marks in that area (Todd, 2003).

Reservoir margins are important sites for erosion and fossil exposure for several reasons. First, wave action along the shore exposes rocks even where they were previously covered by alluvial soils and vegetation. Second, fluctuating water levels expose the shore to a variety of energy and environmental conditions. Finally, reservoir shores are readily accessible to visitors, which can result in the loss of fossils and, much like cultural resources, may be disturbed, destroyed, or stolen, either by unintentional mistreatment or by intentional vandalism and theft.

The report (DeBleuix et al., 2002) involved a literature search and a search of the Utah Paleontological Database. This information was used to construct paleontological sensitivity maps, which are included in the report. A field survey of the most sensitive formation was conducted, using a boat to access potential fossil-bearing strata along the shores of Flaming Gorge Reservoir, and resulted in the discovery of several fossil sites, including a significant vertebrate track site.

Most geologic deposits along the Green River corridor in Reaches 1, 2, and 3 consist of unconsolidated river-deposited sands and gravels that are of low paleontological sensitivity. In regard to fossil sites along the Green River in Dinosaur National Monument, the Utah Geological Survey contacted the Chief of Research and Resource Management at Dinosaur National Monument (written communication, 2002) who stated that as far as park personnel are aware, no significant fossil sites are located along the river corridor within the project area.

3.10 INDIAN TRUST ASSETS

Indian trust assets are legal interests in property held in trust by the United States for Indian tribes or individuals. Examples of trust assets are lands, minerals, hunting and fishing rights, and water rights. The United States has an Indian trust responsibility to protect and maintain rights reserved by or granted to Indian tribes or Indian individuals by treaties, statutes, and Executive orders which are sometimes further interpreted through court decisions and regulations. This trust responsibility requires Reclamation to take all actions reasonably necessary to protect trust assets.

The Uintah and Ouray Reservation was established by the Executive orders of October 3, 1861, and January 5, 1882, and by Acts of Congress approved May 27, 1902, and June 19, 1902. The reservation, reaching from the Utah/Colorado border west to the Wasatch Mountain Range, consists of approximately 4.5 million acres with lands in Carbon, Duchesne, Grand, Uintah, and Utah Counties, Utah. The Northern Ute Indian Tribe of the Uintah and Ouray Reservation, with approximately 3,200 enrolled members, consists of three Ute bands: the Uintah, Uncompahgre, and Whiteriver. Tribal headquarters are located at Fort Duchesne. According to the U.S. Census, the total five-county population of the reservation was 19,182 in 2000 compared to a 1990 population of 17,224. A portion of Reach 2 of the Green River passes through the reservation in Uintah County near Ouray, Utah. Reach 3 continues through reservation lands in Uintah County and adjacent to reservation lands in Grand County. Indian trust assets of concern for this action include the rights to fish, hunt, and gather. The resources that provide for these rights to be exercised include fish, wildlife, and vegetation. In addition, land and mineral rights are important trust assets for the Ute Indian Tribe. The ability to exercise these rights (i.e., agricultural production and the development, operation, and maintenance of oil and gas wells) is of special concern for this action.

3.11 RECREATION

This section describes the geographic impact area and current conditions for recreation. The geographic impact area describes where the majority of impacts are expected to occur as well as the rationale for defining the impact area. The current conditions section presents current information on riverflows and reservoir water levels, recreation visitation, and recreation economic value.

3.11.1 Geographic Impact Area

Flaming Gorge Reservoir and the Green River for approximately 12 miles downstream from the dam comprise the Flaming Gorge National Recreation Area which is managed by the Ashley National Forest, USDA Forest Service (see map at the front of this document). After exiting the Flaming Gorge National Recreation Area, the Green River flows across BLM and State of Utah lands for approximately 18 miles before entering the U.S. Fish and Wildlife Service-managed Browns Park National Wildlife Refuge along the Utah and Colorado border, 30 miles downstream from the dam. Immediately downstream from the refuge, approximately 47 miles downstream from the dam, lies Dinosaur National Monument managed by the National Park Service. The upper portion of Dinosaur Nation Monument, upstream of the confluence with the Yampa River, reflects the end of Reach 1 of the study area.

This recreation visitation and value analysis addresses impacts to both Flaming Gorge Reservoir and the Green River downstream from Flaming Gorge Dam. The analysis focuses upon the effects on recreation visitation and economic value within Reach 1 and, specifically, within the Flaming Gorge National Recreation Area, where the majority of the potentially impacted water-based recreation occurs. Relatively little of the river-oriented recreation activity within the region initiates within the 35-mile stretch of the river between the Flaming Gorge National Recreation Area and Dinosaur National Monument.

In Dinosaur National Monument, water-based recreation is dominated by rafting activities. Rafting within the monument is managed via a permit system that covers both the Green and Yampa Rivers. If flow conditions deteriorated on the Green River to the point of adversely impacting rafting activity, the possibility exists of shifting activity to the Yampa River. While the National Park Service constrains the total number of permits for both commercial and private rafting parties across both rivers to 600 a year and the number of launches from either river to 4 per day, there still exists the potential for rafting substitution between the rivers. In addition, the majority of commercial and private rafting trips are scheduled well ahead of time. Commercial rafting operations are popular, and early reservations are often required since space on these trips tends to fill up quickly. Private rafting permits are limited to one per person annually and must be obtained via a lottery system months prior to the actual trip date. Given the degree of planning and financial commitment required for these rafting trips, a fairly strong incentive exists to take trips even when flow conditions are less than ideal. To substantiate this discussion, attempts were made to model the impact of average monthly flows on rafting visitation within Dinosaur National Monument (see the Recreation Visitation and Valuation Analysis Technical Appendix for more information on the models). Separate models were estimated for commercial and private rafting activity. These models either resulted in insignificant flow variables (commercial model) or significant flow variables with relatively minor impacts on rafting activity (private model). As a result, the assumption was made that rafting activity within Dinosaur National Monument would not vary substantially with the fluctuations in Green River flows associated with the EIS alternatives. Finally, changes in water-based recreation activity within Reaches 2 and 3, based on the EIS alternatives, were also assumed to be relatively minor either due to low levels of recreation use or the overriding effect of the combined flows from the numerous tributaries (e.g., Yampa, Duchesne, and White Rivers, etc.) as compared to dam releases. Given all of the above, the decision was made to focus the recreation visitation and value analysis on water-based effects primarily within the Flaming Gorge National Recreation Area.

The Green River portion of the Flaming Gorge National Recreation Area is located entirely within Daggett County, Utah, in the northeast corner of the State. The southernmost portions of the reservoir are also within Daggett County. This part of the reservoir is relatively narrow since the water is constricted via a series of canyons. The reservoir widens as one travels northward out of the canyons and toward the Utah/Wyoming border. The Wyoming portion of the reservoir, located entirely within Sweetwater County, is relatively wide and extends northward for many miles before narrowing at the confluence of the Green and Blacks Fork Rivers.

Potentially affected recreation facilities within the Flaming Gorge National Recreation Area along both the Green River and Flaming Gorge Reservoir include the following:

Green River:

(1) Boat ramps at the spillway below Flaming Gorge Dam and at the Little Hole recreation complex.

(2) Little Hole National Recreation Trail (from the spillway of Flaming Gorge Dam to the Little Hole recreation complex, 7 miles downstream).

(3) Fishing pier at the Little Hole recreation complex.

(4) Eighteen riverside campgrounds (seven are on BLM lands, outside Flaming Gorge National Recreation Area).

Flaming Gorge Reservoir:

(1) Eleven boat ramps (four associated with marinas).

(2) Three marinas.

(3) Three boat-based campgrounds.

(4) Four swimming beaches.

(5) Cut Through-Horseshoe Canyon Bypass (not evaluated within the recreation analysis since it has only minor impacts on recreation use).

While the Green River recreation analysis emphasizes impacts within the upper portion of Reach 1, primarily within Flaming Gorge National Recreation Area, consideration is also given to recreation facilities downstream, all the way to the confluence with the Colorado River. After passing out of Reach 1 within Dinosaur National Monument, the Green River flows across private lands, State of Utah lands, Federal lands (BLM, U.S. Fish and Wildlife Service including Ouray National Wildlife Refuge), and Ute Indian tribal lands within Reach 2. Very few recreational facilities are found in this reach. Reach 3 of the Green River starts at the confluence with the White River and ends at the Colorado River. This long stretch of river includes Ute Indian tribal lands (including Desolation Canyon), State of Utah lands (including Green River State Park), Federal lands (BLM, National Park Service including Canyonlands National Park), and private lands. Numerous recreational facilities are located within Reach 3. The following represents a list of recreational facilities found along the Green River downstream from Flaming Gorge National Recreation Area within Reaches 1, 2, and 3.

Green River – Reach 1 (downstream from Flaming Gorge National Recreation Area):

BLM:

(1) Three boat ramps (Indian Crossing, Bridge Hollow, and Swallow Canyon—a fourth ramp at the pipeline crossing below Jarvies Ranch, is being phased out).

(2) Twenty campgrounds, of which only one (at Bridge Hollow) may be impacted. Six of these are administered by the USDA Forest Service for BLM.

State of Utah:

(3) One boat ramp (Bridge Port Camp).

(4) Five campgrounds (Gorge Creek, Little Davenport, Bridge Port, Elm Grove, and Burned Tree).

U.S. Fish and Wildlife Service (Browns Park National Wildlife Refuge):

(5) Two boat ramps (Swinging Bridge, Crook).

(6) Two campgrounds (Swinging Bridge, Crook).

(7) Fishing Pier.

National Park Service (Dinosaur National Monument):

(8) Three boat ramps (Lodore, Deerlodge, and Split Mountain).

Note: Facilities located downstream from the Yampa River are technically Reach 2 (e.g., Split Mountain):

(9) Five riverside campgrounds (Lodore, Deerlodge, Echo Park, Split Mountain, and Green River).

(10) One riverside picnic area (Split Mountain).

Green River – Reach 2 (Yampa River to White River:

U.S. Fish and Wildlife Service (Ouray National Wildlife Refuge):

(1) One boat launch site.

Green River – Reach 3 (White River to Colorado River):

BLM:

(1) Five boat ramps/launch sites (Sand Wash, Swasey's Beach ramp, Nefertiti, Butler Rapid, and Mineral Bottom).

(2) One riverside campground (Swasey's Beach).

State of Utah (Green River State Park:)

(3) One boat ramp.

(4) One campground.

Private:

(5) One boat launch site (Ruby Ranch).

National Park Service (Canyonlands National Park):

(6) Eight campsites

3.11.2 Current Conditions

This section describes current conditions within the geographic impact area in terms of Green River flows and Flaming Gorge Reservoir water levels, recreation visitation, and the economic value of recreation. This information should provide some perspective when considering the recreation impacts presented under the environmental consequences section. In addition, the current condition information was used in the analysis process, providing a basis or starting point of the two applied analyses—the facility availability approach for reservoir visitation and the linear interpolation approach for river visitation, river valuation, and reservoir valuation analyses.

Recreation visitation is measured in terms of the number of recreation visits for each recreation activity. A recreation visit reflects a round trip excursion from a recreator's primary residence for the main purpose of recreation. Recreation economic value reflects the sum of individual recreator benefits aggregated across users of a site. Recreator benefits or values per visit are represented by consumer surplus that is measured by estimating recreator willingness-to-pay in excess of per visit costs.

Recreation activities studied were water based, implying they require the use of water for participation. Water-influenced activities, such as picnicking and sightseeing, which do not require water access, but typically benefit from the presence of water, were insignificant compared to the water-based activities at both the Green River and Flaming Gorge Reservoir. Activities studied on the Green River include scenic floating, guide boat fishing, private boat fishing, shoreline fishing/trail use, and boat-based camping. Activities studied on Flaming Gorge Reservoir include power boating and waterskiing, boat fishing, boat-based camping, swimming, and waterplay. These water-based activities represent virtually all of the visitation on the river and nearly 80% of the visitation at the reservoir.

3.11.2.1 Current Hydrology

This section presents information on current Green River and Flaming Gorge Reservoir hydrology in terms of average monthly riverflows and end-of-month reservoir water levels. In this analysis, all riverflows are measured in cfs, and all reservoir water levels are measured in feet above mean sea level (msl). Given that much of the information used to develop the recreation analyses were obtained from a survey conducted across the summer of 2001, and the analyses used current conditions information from the survey as a starting point in the estimation process, it was necessary to link current hydrological conditions to the survey period. The survey was conducted from May to September 2001 and asked recreators about their activity over the prior 12 months. Therefore, depending on when a recreator was contacted, riverflows or reservoir water levels from as early as June 2000 to as late as September 2001 could be relevant. In other words, current hydrology is based on riverflows and reservoir water levels during the June 2000 to September 2001 period reflected by the recreation survey.

Actual conditions allow for the assessment of impacts based on the hydrology modeling for this EIS (see section 4.3). To calculate current average monthly riverflows or reservoir water levels, the percent of the survey sample contacted each month was used as a weight (May: 11.3%, June: 20.5%, July: 29.2%, August: 15.4%, and September: 23.6%). Table 3-15 presents actual flows and water levels by month. Riverflows are included only for the months from March to October since visitation data were only available for those months.

3.11.2.2 Current Annual Recreation Visitation

Recreation visitation has been gathered by USDA Forest Service contractors from March to October on an annual basis since the early 1990s on the Green River portion of the Flaming Gorge National Recreation Area. Visitation counts on the reservoir have been less frequent, with the most recent annual estimates made in fiscal year 1997 (October 1996 to September 1997).

Table 3-15.—Current Hydrology (June 2000 Through September 2001 Survey Period)

Month	Green River Flows (cfs)	Flaming Gorge Reservoir Water Levels (feet above msl)
January	NA[1]	6020.3
February	NA[1]	6020.4
March	1,036	6020.7
April	1,145	6021.5
May	2,478	6021.8
June	1,215	6021.3
July	1,007	6021.3
August	1,122	6020.9
September	1,118	6020.6
October	1,024	6020.4
November	NA[1]	6020.6
December	NA[1]	6020.4

[1] Not applicable due to lack of visitation data.

Current visitation was calculated on a monthly basis based on USDA Forest Service data. As with the hydrology data, to allow for use in the interpolations, current visitation estimates also needed to be consistent with the time period of the recreation survey (May 2000 to September 2001). While the reservoir visitation data was for a different time period compared to the survey data, fortunately, the availability of recreation facilities along the reservoir were identical for both the October 1996-September 1997 and June 2000-September 2001 periods, implying the fiscal year 1997 visitation data could be considered representative of visitation for the survey period. USDA Forest Service monthly visitation data by recreation activity for both the river and reservoir were weighted, using the monthly sampling percentage approach described above, to come up with the estimates of current monthly visitation by activity. Table 3-16 presents estimates of current water-based recreation on the river and reservoir by month and activity.

Reviewing the Green River visitation data in table 3-16 indicates that shoreline fishing, scenic floating, and private boat fishing are the top three recreation activities on the Green River portion of Flaming Gorge National Recreation Area. Combined, these activities account for slightly over 85% of the river visitation. The top three high use months are June, July, and August, with over 60% of the total annual river visitation. As noted below, river visitation accounts for less than 14% of the combined total visitation for the river and reservoir.

Reviewing the Flaming Gorge Reservoir visitation data in table 3-16 indicates that power boating/waterskiing (62.8%) and boat fishing (31.7%) are the dominant activities accounting for nearly 95% of the total water-based reservoir visitation. From a monthly perspective, the months of May through August reflect nearly 75% of water-based visitation. Although not presented in the

Table 3-16.—Current Green River and Flaming Gorge Reservoir Visitation by Month and Activity

Recreation Activity	Months												Total	% by Activity and Site	% of Total by Activity
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec			
I. Current Green River Visitation:															
Scenic Floating	N/A	N/A	42	217	99	5,527	11,063	7,749	62	9	N/A	N/A	24,768	26.8	3.7
Guide Boat Fishing	N/A	N/A	280	1,560	2,018	2,099	1,781	1,814	1,530	318	N/A	N/A	11,400	12.3	1.7
Private Boat Fishing	N/A	N/A	1,265	3,214	3,549	1,767	1,520	1,457	4,827	932	N/A	N/A	18,531	20.0	2.8
Shoreline Fishing	N/A	N/A	1,774	5,892	4,942	5,976	7,708	5,462	2,935	793	N/A	N/A	35,482	38.4	5.3
Boat Camping	N/A	N/A	0	0	0	668	655	600	352	6	N/A	N/A	2,281	2.5	.3
River Total:	N/A	N/A	3,361	10,883	10,608	16,037	22,727	17,082	9,707	2,058	N/A	N/A	92,461	100	13.9
Percent by Month:	N/A	N/A	3.6	11.8	11.5	17.3	24.6	18.5	10.5	2.2	N/A	N/A	100		
II. Current Flaming Gorge Reservoir Visitation:															
Power Boating	583	0	2,694	21,532	57,792	77,943	84,871	49,273	28,250	25,426	6,638	4,276	359,278	62.8	54.1
Boat Fishing	293	0	1,358	10,870	29,170	39,343	42,838	24,870	14,260	12,834	3,352	2,160	181,348	31.7	27.3
Boat Camping	75	0	677	1,761	1,388	1,863	1,386	1,174	536	674	483	357	10,374	1.8	1.6
Swimming	35	0	159	1,277	3,424	4,618	5,028	2,919	1,675	1,508	393	255	21,291	3.7	3.2
Reservoir Total:	986	0	4,888	35,440	91,774	123,767	134,123	78,236	44,721	40,442	10,866	7,048	572,291	100	86.1
Percent by Month:	.2	0	.9	6.2	16.0	21.6	23.4	13.7	7.8	7.1	1.9	1.2	100		
III. Combined Total:	986	0	8,249	46,323	102,382	139,804	156,850	95,318	54,428	42,500	10,866	7,048	664,752		100
Percent by Month:	.2	0	1.2	7.0	15.4	21.0	23.6	14.3	8.2	6.4	1.6	1.1	100		

table, the most used reservoir sites from a water-based activity perspective are Lucerne Valley (52.8%), Buckboard Crossing (15.8%), and Cedar Springs (15.8%). These three sites combine for nearly 85% of the reservoir's total water-based activity.

The combined total of nearly 665,000 water-based activity visits annually is dominated by visitation to the reservoir, reflecting over 86% of the total visitation. May through August are the heaviest use months, with severe drops in visitation prior to April and after October.

3.11.2.3 Current Annual Recreation Economic Value

The current annual total value estimates by activity were developed by simply multiplying the current value estimates per visit by activity, as obtained from the recreation survey, by the estimates of total current visitation by activity, as obtained from USDA Forest Service data. All value per visit estimates were developed using a conservative, frequently applied approach of assuming survey nonrespondents had a value of zero. Table 3-17 presents the estimates of Green River and Flaming Gorge Reservoir total current value by recreation activity.

It is interesting to note the differences when comparing the percent of total visits by activity to the percent of total value by activity. The percent of total value by activity takes into account both the visitation and value per visit components. On the river, while shore fishing/trail use reflects 38.4% of river visitation, it represents only 17.4% of the river value due to the relatively low value per visit. Conversely, guide boat fishing reflects only 12.3% of river visitation, but 43.5% of the river value due to the high value per visit. The differences between the reservoir visitation and valuation percentages are less dramatic compared to those of the river. The largest differentials are for power boating/waterskiing and swimming/waterplay.

When combining Green River and Flaming Gorge Reservoir values, the river represents about 25% of the total recreation value compared to only 14% of the total visitation. This is due to the higher values per visit for river activities. The reservoir obviously still dominates, representing nearly 75% of the combined total value.

3.12 SOCIOECONOMICS AND REGIONAL ECONOMICS

This section includes a brief discussion of the geographic impact area followed by information on current conditions within the area.

3.12.1 Geographic Impact Area

As described in the recreation section (section 3.11), the recreation analysis focuses on effects at Flaming Gorge Reservoir and along the Green River primarily within the FGNRA. Access to the northern portions of the reservoir would likely involve economic activity in the Wyoming towns of Green River and Rock Springs. Conversely, access to the southern reaches of the reservoir and the Green River may involve economic activity in communities further south. Since Daggett County has only small communities, the decision was made to include Uintah County, Utah, within the impact region due to the influence of the town of Vernal. As a result, the socioeconomics geographic impact area for both the reservoir and river recreation analyses includes all three counties: Daggett and Uintah Counties in Utah and Sweetwater County in Wyoming (see the frontispiece map).

Table 3-17.—Current Green River and Flaming Gorge Reservoir Annual Value Estimates by Activity

Recreation Activity	Original Value per Visit (Survey)	No. of Responses	Full Sample	Revised Current Value per Visit	Current Number of Total Visits	% of Total Visits	Current Total Value ($1,000s)	% by Activity and Site	% of Total by Activity
I. Current Green River Valuation:									
Scenic Floating	$ 80.05	38	65	$ 46.80	24,768	3.7	$ 1,159.2	24.2	6.2
Guide Boat Fishing	$ 296.19	21	34	$ 182.94	11,400	1.7	$ 2,085.5	43.5	11.1
Private Boat Fishing	$ 85.00	37	84	$ 37.44	18,531	2.8	$ 693.8	14.5	3.7
Shoreline Fishing/ Trail Use	$ 33.55	105	150	$ 23.49	35,482	5.3	$ 833.5	17.4	4.4
Camping	$ 24.55	8	59	$ 10.78	2,281	0.3	$ 24.6	0.5	0.1
Total:					92,461	13.9	$ 4,796.5	100	25.5
II. Current Flaming Gorge Reservoir Valuation:									
Power Boating/ Waterskiing	$ 50.60	62	122	$ 25.71	359,278	54.1	$ 9,237.0	66.1	49.2
Boat Fishing	$ 57.30	55	125	$ 25.21	181,348	27.3	$ 4,571.8	32.7	24.4
Boat Camping	$ 30.10	46	106	$ 13.06	10,374	1.6	$ 135.5	1.0	0.7
Swimming/ Waterplay	$ 35.00	4	97	$ 1.44	21,291	3.2	$ 30.7	0.2	0.2
Total:					572,291	86.1	$ 13,975.0	100	74.5
III. Combined Total:					664,752	100.0	$ 18,771.5		100.0

3.12.2 Current Conditions

The latest available data for the IMpact analysis for PLANning (IMPLAN) regional input-output model used in the analysis reflects regional economic activity for calendar year 1999. (For information on the IMPLAN model, see section 4.12.1.1, “Regional Economics Modeling Methodology.”) Table 3-18 presents “current” base year 1999 conditions from the IMPLAN three-county model for total industry output, employment, and labor income. The table is broken down by major aggregated industry as well as the eight most directly impacted recreation-oriented economic sectors identified in the analysis. The eight directly impacted sectors are shown separately, but under their associated major industry (e.g., “air transportation” is presented under transportation; each directly impacted sector is preceded by a dash). To estimate totals for the primary industries listed in the table, add the separately presented sectors to the major industry estimates (e.g., adding “air transportation” with “other transportation” estimates total transportation).

Reviewing table 3-18, the most important industries vary depending on the measure. From an output perspective, the top five industries include mining (33.8%), transportation (12.0%), services (9.7%), construction (8.4%), and manufacturing (8.1%). From an employment perspective, the top five industries include services (20.9%), retail trade (17.6%), government (17.3%), mining (10.8%), and manufacturing (8.3%). The top five industries from the perspective of labor income include mining (22.1%), government (16.1%), transportation (14.8%), services (13.1%), and construction (8.7%).

The eight most affected sectors, from a recreation expenditure perspective, combined to provide 5.4% of total industry output, 16.6% of employment, and 7.3% of labor income. These directly impacted sectors are fairly significant contributors to regional employment but relatively insignificant in terms of output and income. Food stores, automobile dealers and service stations, eating and drinking establishments, miscellaneous retail stores, and hotels and lodging places, in particular, combine for 16.1% of total regional employment.

3.13 PUBLIC SAFETY AND PUBLIC HEALTH

This section elaborates further on the affected environment in relation to safety and public health. The existing environment for recreation is described in section 3.11, and potential safety consequences as they relate to recreation activities are described in sections 4.11.2 and 4.11.4. This section describes elements of public safety that are not directly related to recreation, including risks associated with high riverflows and disease vectors.

3.13.1 Public Safety Considerations for the Reservoir and the River Immediately Below the Dam

Public safety at Flaming Gorge Reservoir relates to the area between the high water elevation and the elevation of the reservoir at a given point in time. Hazards on the reservoir can occur at all elevations, but generally increase as the reservoir goes down. Distances from roads and parking lots to the reservoir increase at lower reservoir elevations. Access to the reservoir at lower elevations is not developed and may be steep, uneven, and covered with rocks and debris.

When flows exceed the powerplant capacity of 4,600 cfs, there could be some additional danger to the public in the area immediately below the dam. However, public access is restricted in this area. The area between the spillway boat ramp and the dam is controlled

Table 3-18.—Current Conditions
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(Data Year: 1999)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output		Employment		Labor Income	
		Millions of Dollars ($M)	% of Total	No. of Jobs	% of Total	Millions of Dollars ($M)	% of Total
Agriculture, Forestry, Fishing	1-27	50.8	1.3	1,340	3.5	15.9	1.2
Mining	28-47, 57	1,349.7	33.8	4,146	10.8	283.9	22.1
Construction	48-56	335.5	8.4	3,210	8.3	111.3	8.7
Manufacturing	58-432	322.1	8.1	1,728	4.5	85.4	6.7
Other Transportation	433-436 438-440	471.8	11.8	2,899	7.5	187.4	14.6
- Air Transportation:	437	6.4	0.2	74	0.1	2.7	0.2
Communications	441-442	45.7	1.1	194	0.5	11.1	0.9
Utilities	443-446	285.2	7.1	625	1.6	45.4	3.5
Wholesale Trade	447	89.3	2.2	1,074	2.8	36.9	2.9
Other Retail Trade	448-449 452-453	52.9	1.3	1,579	4.1	25.8	2.0
- Food Stores:	450	32.2	0.8	882	2.3	18.9	1.5
- Automotive Dealers and Service Stations:	451	55.4	1.4	1,076	2.8	25.3	2.0
- Eating and Drinking:	454	66.5	1.7	2,292	6.0	22.6	1.8
- Miscellaneous Retail:	455	17.1	0.4	921	2.4	8.4	0.7
Finance, Insurance, and Real Estate (FIRE)	456-462	206.2	5.2	1,769	4.6	27.2	2.1
Other Services	464-476 478-487 489-509	345.7	8.7	6,891	17.9	152.1	11.9
- Hotels and Lodging Places:	463	36.1	0.9	1,004	2.6	14.4	1.1
- Automobile Rental and Leasing:	477	.4	0.0	13	0.0	0.1	0.0
- Amusement and Recreation Services:	488	3.2	0.1	149	0.4	1.4	0.1
Federal, State, and Local Government	510-515 519-523	261.7	6.6	6,659	17.3	207.1	16.1
TOTAL:		3,993.7	100	38,523	100	1,283.3	100
MOST AFFECTED SECTORS:		217.3	5.4	6,410	16.6	93.8	7.3

during high use periods, which contributes to public safety. Signage along the river access road indicates that the river may fluctuate at any time up to 4 feet in elevation.

3.13.2 Public Safety Considerations for the Green River

Riverflows in Reach 1 up to 4,600 cfs do not pose any safety problems relative to structures (buildings, bridges, and roads) over or near the river. Prior to 1992, releases of 4,600 cfs for power generation occurred more often than they have since 1992. Problems can arise at the bridges that cross the Green River; high flows can inundate bridge approaches. If these areas are inundated for more than a few days, then questions of structural stability can arise. The river in Reach 1 has exceeded 8,000 cfs two times in the past 10 years and four times since the dam was constructed. The Greendale gauge was installed 12 years prior to dam construction. During that time Reach 1 exceeded 8,000 cfs in 9 of the 12 years.

Reach 2 of the Green River is greatly influenced by the essentially unregulated flows of the Yampa River. In Reach 2, the river has exceeded 18,000 cfs 5 times in the past 10 years and 10 times in the past 20 years. The effects of dam operations are even further attenuated in Reach 3. In general, higher flows in the Green River can be said to increase hazards to the public.

3.13.3 Public Health: Disease Vectors

Common vectors, such as mosquitoes, deer mice, bats, and ticks, can transmit serious diseases to people. Mosquitoes can transmit malaria, West Nile virus, and encephalitis; deer mice can transmit hanta virus; bats and other mammals can transmit rabies; and ticks can transmit Lyme disease.

During the EIS scoping sessions, individuals expressed concerns that the proposed changes to the operation of Flaming Gorge Dam may produce conditions that benefit mosquitoes and exacerbate the potential problems with the encephalitis virus. In the Jensen, Utah, area, the Saint Louis virus and the Western Equine Encephalitis virus are potential threats of the disease; and perhaps the West Nile virus may be a problem. West Nile virus was discovered in the Uintah Basin in 2003. Similar levels of concern for the nonaquatic vectors were not expressed at the scoping meetings, and it is not anticipated that the operational changes would cause similar impacts on nonaquatic vectors. Therefore, this EIS will only assess the mosquito vector. There are many species of mosquitoes living along the Green River. Two common mosquito species in the Jensen, Utah, area are the *Aedes* and the *Culex* species, which are major mosquito nuisances in the area (Romney, 2002). A common mosquito, *Culex tarsalis,* is considered to be one of the principal vectors of the Western Equine Encephalitis virus (American Mosquito Control Association, Inc., 1990). The floods that result from the operation changes may impact other aquatic vectors such as other biting insects.

Meteorological conditions such as temperature and humidity are important factors in determining the longevity of mosquitoes (American Mosquito Control Association, Inc., 1990). High temperatures and low humidity can shorten the life span of mosquitoes. Under the right conditions, mosquitoes can live many months. However, many mosquitoes do not live past 2 weeks. The number of mosquitoes present at a location is generally dependent on the amount of habitat available. A good breeding site is one where standing water is present for about 2 weeks and protected from the elements such as wind. Vegetation and shallow depressions along rivers provide good habitat for mosquitoes, especially after a rain or flood. The female mosquito requires a blood meal for egg development, and the blood meal can be taken from a variety of sources including birds, cattle, horses, and people. Diseases can be transferred at the same time the blood meal is taken. In order to transmit the encephalitis virus to people, the mosquito must make two successful feedings. One feeding must be from the infected source and the second feeding will infect the new host. A potential mosquito vector is one that lives more than 10 days and takes two or more blood meals (American Mosquito Control Association, Inc., 1990).

Procedures exist to control mosquitoes in the larval, pupal, or adult life stages. Federal, State, and local regulations govern the use of insecticides and have limited the number of chemical controls in and near waters. Applications of insecticides must comply with the labeling requirements for that product. The Uintah County Mosquito Abatement District applies *Bacillus thuringiensis* (BT) by aircraft to control mosquitoes at the larval stage. BT must be applied before the mosquito develops into the pupal stage. BT produces a toxin that kills the mosquito.

BT is a naturally occurring soil bacterium, and anyone coming in contact with soils may encounter the microorganism. BT is registered for use to control mosquito larval in waters. Current information on the toxicity and exposure data of BT indicates that the use of pesticide products containing BT should not be harmful to endangered mammals, birds, fish, and plants (U.S. Environmental Protection Agency [EPA], 1998). The use of pesticide products with BT should not pose a threat to human health (EPA, 1998). BT does show some toxicity to honey bees and water fleas (*Daphnia)* (EPA, 1998).

Irving and Burdick (1995) conducted an inventory, largely based on aerial photography, of potential flooded bottomland habitats in the Green River. They determined that approximately 1,591, 8,648, and 8,154 acres of potential mosquito habitat were present in Reaches 1, 2, and 3, respectively. In Reach 3, about 2,718 acres were present in the portion of the reach between the White River confluence and Pariette Draw, and about 1,878 acres were present in Canyonlands. They did not determine the relationship of flood plain inundation to flow.

Bell et al. (1998) used aerial photography to determine the relationship between flow and flood plain inundation in Reach 2 from Split Mountain Canyon to the White River and the upper portion of Reach 3 from White River to Pariette Draw. In Reach 2 at 19,988; 22,037; and 24,897 cfs, approximately 5,189; 8,648; and 12,108 acres, respectively, would be flooded. In the upper portion of Reach 3, Bell et al. (1998) indicated that at flows of 22,001; 24,014; and 32,490 cfs, about 655; 1,050; and 1,895 acres, respectively, would be flooded.

The Uintah County Mosquito Abatement District provides mosquito control treatment for about 50 river miles of Green River between the Dinosaur National Park boundary and Ouray, Utah (Romney, 2002). Reach 2 covers most of this area. Generally, the higher the flows in the river, the more adjacent lands will be flooded, and more mosquito habitat is created. Mosquito habitat would be sustained as long as the river is running high. The Uintah County Mosquito Abatement District has provided an estimate of the number of aggregate acres they may have to treat based on the flows in the river at the Jensen Station. Since BT has a relatively short active period, repeat treatments of the same area are usually required. The Uintah County Mosquito Abatement District indicated that within the 50-mile (80.4-kilometer) affected area, they consider treating 10,000 acres when flows reach 10,000 cfs. When flows reach 15,000; 18,000; and 26,000 cfs, treatment is considered on about 15,000; 30,000; and 40,000 acres, respectively (Romney, 2002). The acre numbers, provided by the Uintah County Mosquito Abatement District, include multiple treatments of the same area.

Since 1964, the Centers for Disease Control and Prevention reported that there have been 639 confirmed cases of Western Equine Encephalitis and 4,478 reported cases of St. Louis Encephalitis in the United States. In 1978, an outbreak of Western Equine

Encephalitis affected 68 horses in the Jensen, Utah, area (Romney, 2002). Birds are known carriers of the encephalitis virus, and monitoring chicken populations would provide important information. Since 1983, the local abatement districts employ chicken plots to monitor the incidence of the encephalitis virus in the area. The plots indicated that the Jensen, Utah, area is considered to be one of the principal areas where the virus could become established (Romney, 2002). The virus would be difficult to eliminate from the area since the encephalitis virus could be imported by migrating bird populations.

As of November 19, 2003, the Centers for Disease Control and Prevention reported 8,470 mild and severe human disease cases of West Nile virus nationwide (Centers for Disease Control and Prevention, 2003). In 2003, the virus has been reported throughout much of the United States, including the States of Utah, Colorado, and Wyoming.

3.14 AIR QUALITY

The Flaming Gorge region generally has good air quality that is affected both by weather and industry, which includes electric utility generation. Changes in pollution discharges can have an impact, but these changes are also dependent on the ability of the environment to disperse and absorb the pollutants. Electric generation by fossil-fired powerplants provides significant levels of some pollutants; any change in the production of such powerplants due to the Action Alternative can affect the air quality of the region.

This region is semi-arid, with wide variations in climate due to varying topography. It is affected by warm air masses moving from the Pacific Ocean eastward and Canadian air masses that occasionally settle over the region. Wind flows generally occur from west to east but often are modified by local topographic features. Topography also affects the speed of wind flows, with western exposed mountain slopes having high wind speeds but protected valleys experiencing relatively low wind speeds. High pressure weather systems with light wind conditions occur often. High winds occur during the winter and spring seasons.

Temperatures can vary widely through this region, depending on elevation and season of the year. Annual precipitation averages 12 inches a year, with generally higher levels in the mountain areas. Precipitation from Pacific storms occurs more often between October and April. Summer storms from the Gulf of Mexico occur between July and September. Evaporation rates are high throughout the river basins due to high temperatures, low humidity, clear skies, and moderate winds. Atmospheric dispersion of pollutants improves with increases in wind speed and precipitation.

While the air quality is generally good in this region, pockets of nonattainment of Clean Air Act standards do exist in Utah. These occur around the Salt Lake County area and other industrial portions of Utah for pollutants such as sulfur dioxide, carbon monoxide, ozone, and total suspended particulates/small particulate matter. Also, an industrial region east of the reservoir in Wyoming has nonattainment pockets for total suspended particulates/small particulate matter. From 1981 to 1990, the electric utility industry generated from 23% to 51% of the sulfur dioxide levels in the Southwestern part of the United States and from 34% to 56% of the nitrogen oxides. The electric utility industry also generated up to 39% of the total carbon dioxide levels for the six-State region in the Southwestern United States during the same timeframe. Substantial changes in output by the electric utility industry could have significant effect on the air quality around the Flaming Gorge region and the Southwestern United States area if weather patterns do not disperse these pollutants.

3.15 VISUAL RESOURCES

Flaming Gorge Reservoir is situated on the eastern slope of the scenic Uinta Mountains in northeastern Utah. The concrete arch dam was constructed during the mid-1960s. The heart of the Flaming Gorge National Recreation Area is a 91-mile long reservoir, created by Flaming Gorge Dam. There are over 300 miles of shoreline. An estimated 3,000 acres of shoreline are involved.

The Green River flows out of the dam, down through the lower reaches of Red Canyon, and into Browns Park. The stretch of river covers approximately 20 miles. An estimated 100 acres of riverbank are involved.

The landscape consists of a high plateau, about 8000 feet in elevation, covered by ponderosa pine, pinion pine, and Utah juniper, and is dissected by the Red Canyon. The Green River flows through the deep Red Canyon beginning at Flaming Gorge, near Sheep Creek Flats, and exits at Browns Park, a broad open valley near the Utah-Colorado State line. Rock formations are prominent, and soils are reddish in color. The Uinta Mountains form a high, scenic backdrop to the west.

The Wyoming portion consists of a different land type, prominent grayish ledges and bluffs, where the Green River corridor is not as deeply defined. Vegetative patterns are of a sage nature. Soils consist of shale or clay type material. Open spaces are prominent.

3.15.1 Scenic Integrity

Visual qualities are perceived by those who normally recreate or spend time in a particular area, who, in this case, would be the casual forest visitor. Much of their recreational experience relates to their concern for scenic quality and the condition of the view shed.

Scenic values and qualities within the FGNRA and along the Green River corridor are high. With a background of the Uinta Mountains and distant vistas, this is the premier scenic showcase for northeastern Utah and southwestern Wyoming.

The Recreation Opportunity Spectrum calls for this area to be managed for a Roaded-Natural or Roaded-Modified setting. The Recreation Opportunity Spectrum for the area around Flaming Gorge Dam is close to an "Urban" setting.

The Scenic Integrity Level for the southern end of the FGNRA, including Cedar Springs, the dam, Dutch John, Antelope Flats, and Little Hole, is considered high to moderate. Scenic Integrity Levels for the Wyoming portion and Green River corridor, below Little Hole, would be considered as high to moderate. The desired scenic condition for the entire FGNRA and Green River corridor would be natural appearing and cultural.

BLM-administered lands from Little Hole to the Colorado State line are being managed as Class II areas. The objective of Class II is that management actions may cause alternations to the natural settings, but they shouldn't attract the attention of the casual observer.

3.15.2 Constituent Information

Visitors to the FGNRA come from Utah, Wyoming, Colorado, and all over the United States. Most international visitors are from England, Germany, France, and Japan. They expect to view outstanding scenery, visit the dam, and catch trophy fish. The majority of recreation use occurs during the summer months, between Memorial Day and Labor Day, or approximately 100 days.

Recreational opportunities include driving for pleasure, viewing scenery, fishing, boating, floating, waterskiing, swimming, scuba diving, hunting, mountain biking, and hiking. Winter activities include cross-country skiing, snowmobiling, and ice fishing on the reservoir and stream fishing on the river. Facilities include visitor centers, boat ramps, campgrounds, trails, commercial lodges, service stations, and marinas.

3.15.3 Landscape Visibility

Most areas within the FGNRA are seen by the public from one point or another. People in boats scrutinize all parts of the reservoir and shoreline from the water level. Other forest visitors and fishermen view the reservoir from above and points around the FGNRA, such as Red Canyon Visitor Center, Flaming Gorge Dam and Visitor Center, campgrounds, marinas and dispersed areas.

People floating the Green River and hiking the trails have the perspective of Red Canyon at the water level. Only a few vista points along the river are available from roadways. These include views from Flaming Gorge Dam, spillway, boat ramp, Little Hole area, and at Browns Park.

3.16 ENVIRONMENTAL JUSTICE

Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," dated February 11, 1994, requires agencies to identify and address disproportionately high and adverse human health or environmental effects of their actions on minorities and low-income populations and communities as well as the equity of the distribution of the benefits and risks of their decisions.

Table 3-19 presents population data by race and Hispanic origin for the States of Utah and Wyoming, the Uintah and Ouray Reservation, and the counties which may potentially be affected by changes in the flows of the Green River. Moffat County, Colorado, and San Juan and Wayne Counties, Utah, were not included since the lands adjacent to the Green River within those counties are publicly owned and no one lives on them. Carbon County, Utah, was not included because the lands adjacent to the Green River in this county are part of, and are included in, the data for the Uintah and Ouray Reservation. The study area is predominately white. In 1990, the white population in the area ranged from 83.3% to 98.0%. The range of percentages for 2000 changed slightly, from 81.2% to 95.6%. The American Indian and Alaskan Native population is the largest minority group in the study area, with the highest percentage of total population ranging from 15.4% in 1990 to 14.5% in 2000 on the Uintah and Ouray Reservation. The Hispanic population is a minority ethnic group which can be of any race. Sweetwater County, Wyoming, had the greatest percentage of Hispanic population—8.9% in 1990 and 9.4% in 2000.

The percentages of all people in poverty for the States of Utah and Wyoming, the Uintah and Ouray Reservation, and the study area counties are shown in table 3-20. The reservation and all of the counties, except Emery and Grand Counties, showed a decrease in the percentage of people in poverty from 1989 to 1999. All of the study area is considered to be nonmetropolitan. When compared to the percentage of people in poverty for the nonmetropolitan areas in 1999, the reservation and Grand and Uintah Counties had greater percentages of people in poverty.

Table 3-19.—Population by Race and Hispanic Origin

Area	Year	Total Population	Race							Ethnicity
			White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some Other Races	Two or More Races	Hispanic or Latino (of Any Race)
State of Utah	1990	1,722,850	1,615,845	11,576	24,283	25,696	7,675	37,775	(NA)	84,597
	% Total Population	100.0	93.8	0.7	1.4	1.5	0.4	2.2	(NA)	4.9
	2000	2,233,169	1,992,975	17,657	29,684	37,108	15,145	93,405	47,195	201,559
	% Total Population	100.0	89.2	0.8	1.3	1.7	0.7	4.2	2.1	9.0
Uintah and Ouray Reservation	1990	17,224	14,355	12	2,650	34	19	154	(NA)	459
	% Total Population	100.0	83.3	0.1	15.4	0.2	0.1	0.9	(NA)	2.7
	2000	19,182	15,585	25	2,780	33	19	278	462	673
	% Total Population	100.0	81.2	0.1	14.5	0.2	0.1	1.5	2.4	3.5
Dagget County	1990	600	674	–	9	5	–	2	(NA)	15
	% Total Population	100.0	97.7	–	1.3	0.7	–	0.3	(NA)	2.2
	2000	921	871	6	7	1	–	22	14	47
	% Total Population	100.0	94.5	0.7	0.8	0.7	–	2.4	1.5	5.1
Emery County	1990	10,332	10,127	4	44	30	6	121	(NA)	219
	% Total Population	100.0	98.0	–	0.4	0.3	0.1	1.2	(NA)	2.1
	2000	10,860	10,386	20	71	34	11	203	135	568
	% Total Population	100.0	95.6	0.2	0.7	0.3	0.1	1.9	1.2	5.2

Table 3-19.—Population by Race and Hispanic Origin (Continued)

Area	Year	Total Population	Race							Ethnicity
			White	Black or African American	American Indian and Alaska Native	Asian	Native Hawaiian and Other Pacific Islander	Some Other Races	Two or More Races	Hispanic or Latino (of Any Race)
Grand County	1990	6,620	6,341	7	203	19	5	45	(NA)	291
	% Total Population	100.0	95.8	–	3.1	0.3	–	0.7	(NA)	4.4
	2000	8,485	7,861	21	327	19	4	141	112	471
	% Total Population	100.0	92.6	0.2	3.9	0.2	–	1.7	1.3	5.6
Uintah County	1990	22,211	19,537	9	2,335	61	21	248	(NA)	691
	% Total Population	100.0	88.0	–	10.5	0.3	0.1	1.1	(NA)	3.1
	2000	25,224	22,130	29	2,365	56	20	264	360	894
	% Total Population	100.0	87.7	0.1	9.4	0.2	0.1	1.0	1.4	3.5
State of Wyoming	1990	453,588	427,061	3,606	9,479	2,638	168	10,636	(NA)	25,751
	% Total Population	100.0	94.2	0.8	2.1	0.6	–	2.3	(NA)	5.7
	2000	493,782	454,670	3,772	11,133	2,771	302	12,301	8,883	31,669
	% Total Population	100.0	92.1	0.8	2.3	0.6	0.1	2.5	1.8	6.4
Sweetwater County	1990	38,823	36,564	289	305	247	7	1,411	(NA)	3,470
	% Total Population	100.0	94.2	0.7	0.8	0.6	–	3.6	(NA)	8.9
	2000	37,613	34,461	275	380	240	16	1,349	892	3,545
	% Total Population	100.0	91.6	0.7	1.0	0.6	–	3.6	2.4	9.4

[1] "–" represent zero or rounds to zero.

[2] Because individuals could only report one race in the 1990 census and could report more than one race in the 2000 census, data on race for 1990 and 2000 are not directly comparable.

Source: U.S. Census Bureau, Census 1990 and 2000.

Table 3-20.—Poverty[1]

Area	1989 Percent	1999 Percent
Utah – State	11.4	9.4
Utah – Metro Areas	10.8	8.8
Utah – Nonmetro Areas	15.4	13.5
Uintah and Ouray Reservation	22.9	20.2
Daggett County	14.8	5.5
Emery County	10.5	11.5
Grand County	14.6	14.8
Uintah County	18.7	14.5
Wyoming – State	11.9	11.4
Wyoming – Metro Areas	11.0	10.3
Wyoming – Nonmetro Areas	12.2	11.9
Sweetwater County	8.0	7.8

[1] All people in poverty.
Source: U.S. Census Bureau, 1990 and 2000 Census Population.

4.0 Environmental Consequences

4.1 INTRODUCTION

This chapter presents the potential impacts of the two alternatives analyzed in detail in this environmental impact statement (EIS). It is organized by resource, giving the effects for each alternative. For some resource analyses, the discussions are organized by alternative. For other resources, a side-by-side comparative analysis yielded a clearer understanding of the potential consequences of each alternative. Where appropriate, there is an explanation of the assumptions and methodology used to assess impacts. This chapter also discusses uncertainties regarding potential impacts, as well as environmental commitments that apply to both alternatives.

4.2 FLAMING GORGE FACILITIES

4.2.1 Spillway

4.2.1.1 No Action Alternative

The spillway is used to release water from Flaming Gorge Reservoir in amounts that exceed the combined release capacity of the river outlet works and the powerplant, that is, releases greater than 8,600 cubic feet per second (cfs). Historically, this has occurred only four times, as noted in section 3.2.1.2. Under the No Action Alternative, future use of the spillway can be expected for about 15 days per year in 5 percent (%) of all years.

4.2.1.2 Action Alternative

Under the Action Alternative, the frequency of spillway use could increase to about 15 days per year in 7% of all years. Spillway use of 1 to 10 days is expected in nearly 17% of all years. With increased spillway use, there is greater opportunity for degradation of concrete in the spillway tunnel. Should damage to the spillway become excessive, repairs would be made or use of the spillway would be limited to when hydrologically necessary. While difficult to quantify, operation and maintenance costs would increase. Following each period of spillway use, it may be necessary to inspect the spillway using high-angle rope work techniques. It is estimated that one spillway inspection would cost up to $12,000. Any needed concrete repair would require cutting out existing sections and replacing these sections with new concrete; working conditions would be difficult given the steep incline of the spillway tunnels. Actual increases in operation and maintenance costs associated with the Action Alternative are unknown and would depend on the frequency of spills and the extent of concrete damage. It is estimated that concrete repair would be needed sooner under the Action Alternative than under the No Action Alternative. A minimal repair would cost about $30,000 and could increase substantially depending on the amount of concrete being repaired. It is also possible that nitrogen saturation within the tailwater area could occur during the spillway use (discussed later in section 4.7.2.4.1.2).

4.2.2 Selective Withdrawal Structure

4.2.2.1 No Action Alternative

Under the No Action Alternative, use of the selective withdrawal structure would be similar to its use over the past 11 years; therefore, no impacts to operation and maintenance of the facilities themselves are expected.

4.2.2.2 Action Alternative

To meet desired temperatures for varying flow magnitudes under the Action Alternative, it will be necessary to gain experience on equipment capabilities to release warmer water and the effects of such releases on downstream fish populations. Equipment operating limitations will need to be considered. Over the next several years, the selective withdrawal structure will be adjusted more frequently to attempt to meet desired temperatures. These added adjustments will result in an increase in operation costs. However, it is believed that, as experience is gained, the frequency of selective withdrawal structure adjustments may lessen with an associated decrease in operation costs.

4.3 WATER RESOURCES

This section addresses the potential impacts of both alternatives on water levels in the reservoir and in the river, water quality (including temperature) in the reservoir and in the river, and sediment transport, a function of riverflows that, in turn, relates to biological and other resource considerations.

4.3.1 Hydrology, Flaming Gorge Reservoir

This section addresses impacts to water resources within the affected environment at Flaming Gorge Reservoir. Only direct impacts to reservoir elevation are considered in this section. Impacts to other resources as a result of changes in reservoir elevation are reported in their respective sections.

Each alternative was simulated with a computer model of the reservoir and Green River system over a 39-year period (2002-2040) to determine a range of reservoir elevations and associated reservoir contents that could likely occur in the future.

Reservoir elevations that occurred in the model, under each alternative simulation, were analyzed to characterize the differences between the alternatives.

4.3.1.1 Evaluation Methodology

A computer model (the Flaming Gorge Model [Clayton and Gilmore, 2002]) was developed for the Green River that included all relevant river features (reservoirs, river reaches, confluences, diversions, etc.) from Fontenelle Reservoir, upstream of Flaming Gorge Reservoir, to the confluence of the Green and Colorado Rivers. For this modeling project, emphasis was placed on the details of river features directly below Flaming Gorge Reservoir and on the Yampa River. This provided the Flaming Gorge Model the ability to reliably predict the impacts to flows in the Green River in Reaches 1 and 2 as a result of operating Flaming Gorge Dam under the Action and No Action Alternatives.

Less emphasis was placed on modeling the lower tributaries of the Green River (i.e., Duchesne, White, Price, and San Rafael Rivers). This was because detailed and reliable information regarding how these rivers systems are diverted and depleted was not available at the time the Flaming Gorge Model was constructed. Given this lack of reliable information on the tributary river systems, and the fact that:

- ❖ Modeling assumptions do not always predict what actually occurs with absolute certainty.
- ❖ Compounding effects of errors caused when modeling assumptions are imposed in series.
- ❖ Impacts to flows from Flaming Gorge Dam diminish with distance from the dam.

It was decided that the Flaming Gorge Model would not be used to analyze the differing flow regimes in Reach 3 that resulted from operating Flaming Gorge Dam under the Action and No Action Alternatives.

The Flaming Gorge Model was used to study the long-range effects of operating Flaming Gorge Dam to achieve specific riverflow objectives defined in the Action and No Action Alternatives for the Flaming Gorge EIS. The flow objectives of the Action Alternative are those that would achieve the *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations) while maintaining the other authorized purposes of the Flaming Gorge Unit within the constraints of the model environment. The flow objectives of the No Action Alternative are those that would achieve the Reasonable and Prudent Alternative of the 1992 Biological Opinion, while also maintaining the authorized purposes of Flaming Gorge Dam within the constraints of the model environment.

A simulation was run for both the Action and No Action model to generate a set of results for comparison of the alternatives. Monthly reservoir elevation data were obtained from these model simulations. Additional information on the hydrology modeling for this EIS may be found in section 4.3.2.1 and the Hydrologic Modeling Technical Appendix.

4.3.1.2 Reservoir Average Monthly Elevations

Figure 4-1 shows the average monthly reservoir elevations that would be expected under the Action and No Action Alternatives for each month of the year. Reservoir elevations are typically at their lowest level in early spring when the Action and No Action Alternatives attempt to achieve a drawdown target. During late summer, reservoir elevations are typically at their highest level of the year as a result of storing a portion of the spring runoff.

Reservoir elevations during the months of August, September, and October typically are lower under the Action Alternative than under

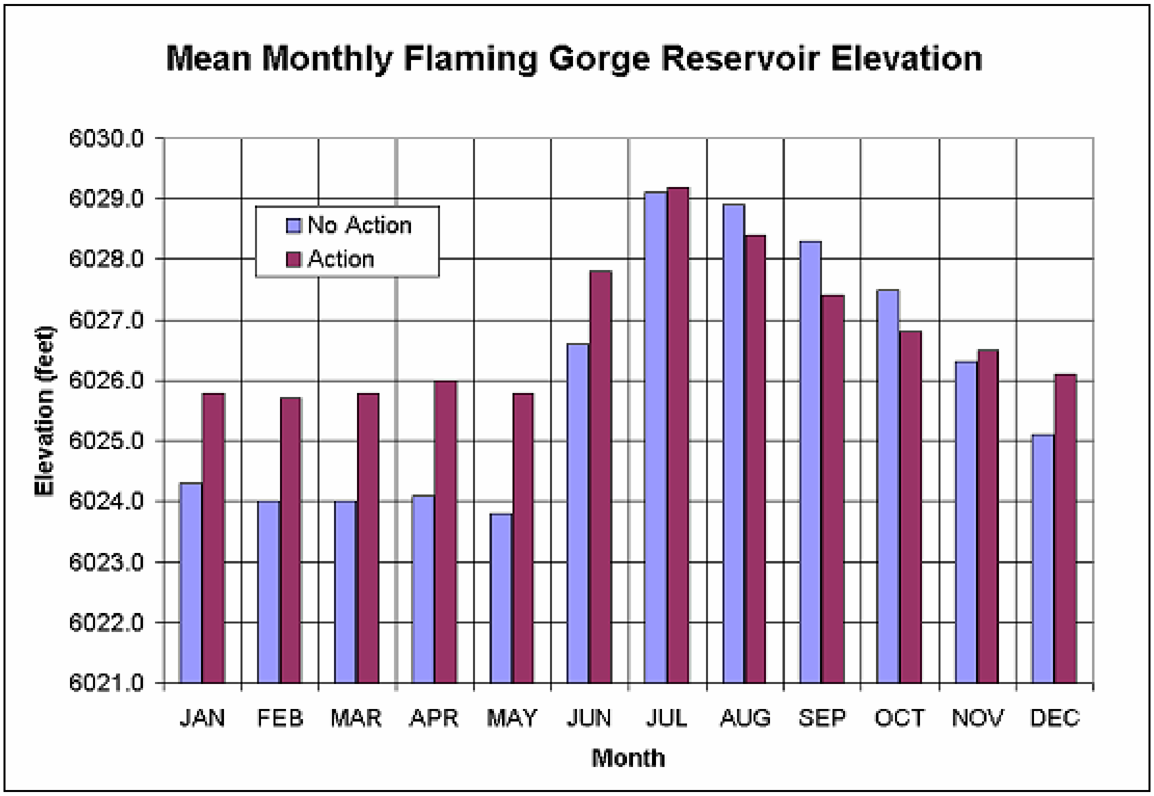


Figure 4-1.—Average End-of-Month Flaming Gorge Reservoir Elevations.

the No Action Alternative. Reservoir elevations under the Action Alternative typically are higher during all other months.

Spring peak releases under the Action Alternative are typically larger than those of the No Action Alternative. As a result, the reservoir does not store as much of the spring runoff as does the reservoir operated under the No Action Alternative. Also, under the No Action Alternative, releases after the spring peak are controlled so that flows in Reach 2 are maintained between 1,100 and 1,800 cfs until September 15. Typically, flows on the Yampa River are elevated during this time, and releases from Flaming Gorge Dam must be minimized to achieve this flow objective. The No Action Alternative typically causes the reservoir to fill to higher levels than the Action Alternative as a result of trying to achieve this flow objective.

4.3.1.3 Frequency of Reservoir Elevation

The Green River model results provided, among other things, a set of potential end-of-month reservoir elevations that could occur under the Action and No Action Alternatives during the period of analysis (2002-2040). Each set was subdivided by month and ranked from highest to lowest to determine the probability of occurrence associated with various reservoir elevations for each month of the year. Figures 4-2 and 4-3 show the distribution of reservoir elevations for the months of February and June as determined from the model results. These months are shown because reservoir elevations are typically near their lowest level of the year by the end of February and approach their highest level by the end of June.

In February, a reservoir elevation lower than 6025 feet can be expected to occur about 18% of the time under the Action Alternative

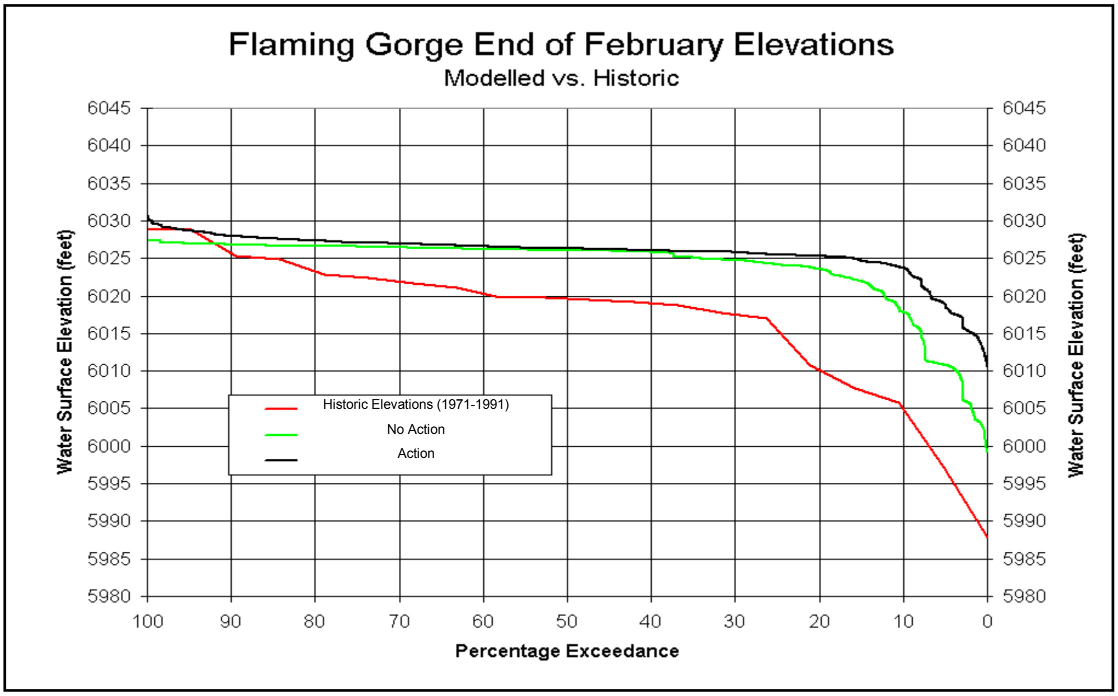


Figure 4-2.—February Reservoir Elevation Distribution Plot.

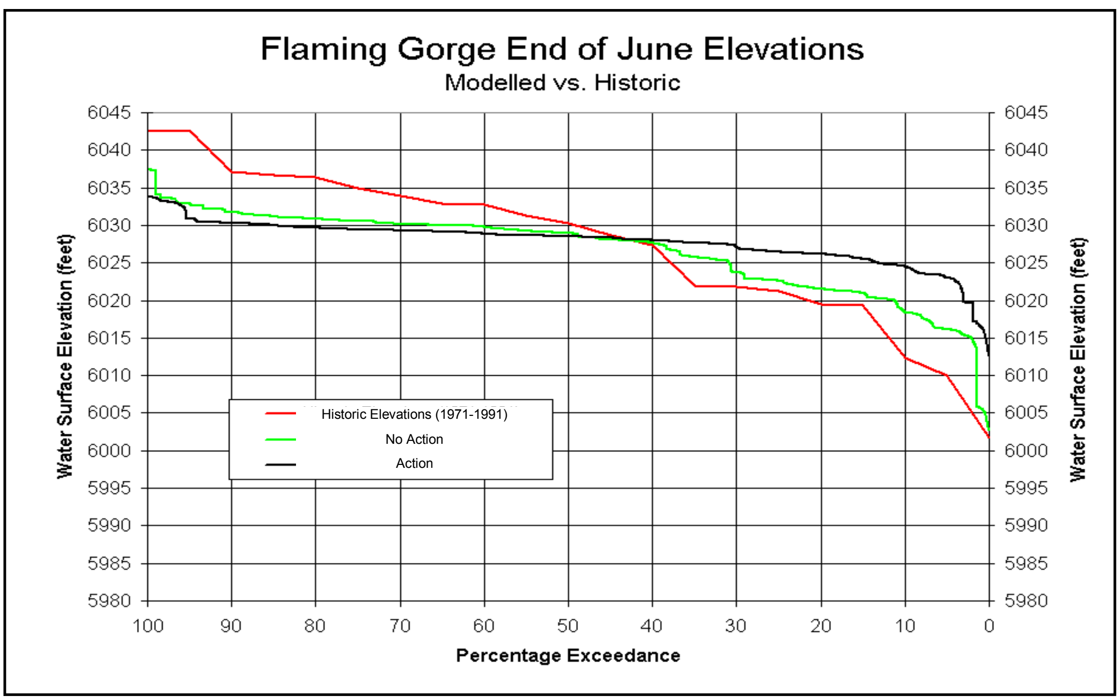


Figure 4-3.—June Reservoir Elevation Distribution Plot.

conditions and can be expected to occur about 33% of the time under the No Action Alternative conditions. Thus, reservoir elevation greater than 6025 feet would occur 82% of the time under Action Alternative operations and 67% of the time under No Action Alternative conditions during February. Similar expected frequency of occurrence estimates can be calculated for the range of elevations shown in figure 4-2 for February conditions.

In June, a reservoir elevation lower than 6025 feet can be expected to occur about 11% of the time under the Action Alternative conditions and can be expected to occur about 31% of the time under the No Action Alternative conditions. Thus, reservoir elevation greater than 6025 feet will occur 89% of the time under Action Alternative operations and 69% of the time under No Action Alternative conditions during June. Similar expected frequency of occurrence estimates can be calculated for the range of elevations shown in figure 4-3 for June conditions.

4.3.2 Hydrology, Green River

This section addresses impacts to water resources within the affected environment downstream from Flaming Gorge Dam. Only direct impacts to riverflows are considered in this section. Impacts to other resources that result from operating Flaming Gorge Dam under the Action and No Action Alternatives are reported in their respective sections.

The affected environment for hydrology on the Green River is divided into three reaches of the Green River below Flaming Gorge Dam. These reaches are described in the 2000 Flow and Temperature Recommendations and previously in this document. Flows in Reach 1 are almost entirely controlled by releases from Flaming Gorge Dam. Flows in Reach 2 can be dominated by tributary flows in the Yampa River or by releases from Flaming Gorge Dam, depending on the time of year. During the spring, flows in Reach 2 are mostly dominated by tributary flows from the Yampa River. But during the summer, fall, and winter, flows in Reach 2 are mostly affected by releases from Flaming Gorge Dam. Flows in Reach 3 are affected by tributary flows from the San Rafael, Price, Duchesne, White, and Yampa Rivers. The effect of releases from Flaming Gorge Dam on flows in Reach 3 is significantly diminished from the effect these releases have on flows in Reaches 1 and 2.

4.3.2.1 Evaluation Methodology for the Hydrologic Modeling

In terms of hydrology, the Action and No Action Alternatives were simulated using a computer model of the Green River system, referred to as the Flaming Gorge Model. For more detailed information regarding the Flaming Gorge Model, see the Hydrologic Modeling Technical Appendix. The Flaming Gorge Model provided, among other things, estimates of the flows that would likely occur in Reaches 1 and 2 from operating Flaming Gorge Dam under the Action and No Action Alternatives. The estimated flows are those that would likely occur over the next 39 years, beginning in January of 2002.

The logic and decisionmaking processes for achieving the flow objectives of each alternative were incorporated into a section of the Flaming Gorge Model called the ruleset. A unique ruleset was developed for the Action and No Action Alternatives. The most important function of the ruleset was to calculate the volume of water to be released from Flaming Gorge Dam so that the flow objectives of the alternative would likely be achieved while also maintaining the other authorized purposes of Flaming Gorge Reservoir (i.e., power production, recreation, water storage, etc.). Each ruleset monitored the available hydrologic information, including forecasted reservoir inflows and estimated future flow conditions on the Yampa River, and calculated how much water to release from Flaming Gorge Dam in order to meet the specific flow objectives in Reaches 1 and 2.

The modeled rulesets for each alternative operate Flaming Gorge Dam to control the reservoir elevation for safe operation of the dam, maximize reservoir storage, and minimize bypass releases while also attempting to meet the flow objectives of each alternative during the spring peak release as well as during the base flow period. Inflow forecasting under real world conditions has a significant level of uncertainty associated with it. Much of the time, the forecasted inflows to Flaming Gorge do not accurately predict what actually occurs. The model was designed to simulate these real world conditions by applying random errors to the forecasted inflows into Flaming Gorge and also the predicted flows of the Yampa River. For the forecasted inflows, these random errors were statistically similar to the forecast errors that have occurred historically. For the predicted flows of the Yampa River, the random errors that were introduced were those thought to create a reasonable level of uncertainty about predicting future daily flows of the Yampa River based on observed flows at the headwater gauges in the Yampa River Basin. These random errors provided a more realistic environment for simulating how Flaming Gorge would be operated under the two alternatives. The underlying modeling assumption associated with the introduction of these errors is that the actual forecasting and prediction accuracy will not improve or deteriorate in the future.

It is important to note that the Flaming Gorge Model and rulesets had limited sources of information from which to make decisions. For example, the model did not have the ability to monitor the changes in weather that usually precede changes in hydrology. In reality, a reservoir operator is able to monitor these changes in weather. In most cases, the information available in real time is much better than what the Flaming Gorge Model had for making similar operational decisions. In cases where the model had to work with less information than would be available in reality, modeling assumptions were made in order to find a workable solution that would mimic (as best as possible) what a real time reservoir operator would do. For this reason, the results of the Flaming Gorge Model represent an approximation of how Flaming Gorge would be operated under the Action and No Action Alternatives and not an exact representation of how Flaming Gorge would be operated under these alternatives.

Also, model simulation of the Action Alternative did not reflect the full level of flexibility allowed under the 2000 Flow and Temperature Recommendations. Authors of the 2000 Flow and Temperature Recommendations recognized that natural historic flows of the Green River varied during the base flow period as a result of shifting climatic patterns. Under the 2000 Flow and Temperature Recommendations, a target flow is established during the base flow period (August through February) for Reaches 1 and 2 based on the current hydrologic classification of the Green River Basin. The authors realized that historic flows in Reaches 2 and 3 did gradually migrate above and below the average flow for the base flow period. To give the 2000 Flow and Temperature Recommendations the flexibility to achieve this natural variation, the flow recommendations allow the flows in Reach 2 to vary about the established target flow by ±40% during the summer-fall period (August-November) and ±25% during the winter period (December-February) as long as the daily average flow in Reach 2 does not change by more than 3% per day and the temperature objectives of the 2000 Flow and Temperature Recommendations continue to be achieved.

Analysis of Reach 3 potential future flows resulting from operation of Flaming Gorge Dam under the Action and No Action Alternatives is also presented in this section of the EIS. The predicted future flows in Reach 3 were estimated by adding the predicted flows in Reach 2 (computed by the Flaming Gorge Model) to an estimated inflow that corresponded to the historic input from all Reach 2 and 3 tributaries. This estimate included historic losses that would have occurred along the channel of Reach 3, including evaporation, infiltration, and depletions. It was not possible to separate out each tributary inflow because the historic record for the tributary gauges was not as extensive as for the gauges on the Green River. An estimate of the historic tributary inflow was established by subtracting the historic flows of the Green River located at Greendale, Utah, from the historic flow of the Green River located near Green River, Utah, accounting for an approximate lag period of 5 days. Given the available historic gauge records, the Reach 3 flows presented in this section are the best possible estimates of what the flows in Reach 3 would be if Flaming Gorge Dam were operated under the Action and No Action Alternative.

In order to better describe the differences between the two alternatives as they apply to the environmental consequences for other resources, the following sections provide a comparative discussion rather than isolating the model results for each of the two alternatives.

4.3.2.2 Reach 1 – Average Monthly Flows

Figure 4-4 shows the average monthly flows that would likely occur under the Action and No Action Alternatives for each month of the year. On average, the lowest flows of the year in Reach 1 for the No Action Alternative occur in July. This is because the 1992 Biological Opinion requires that flows in Reach 2, measured at the Jensen gauge, be limited to a range of 1,100-1,800 cfs between the end of the spring peak release and September 15. Often, the Yampa River flows in July, and sometimes in early August, are elevated above normal base flow levels because of melting high elevation snow. To achieve the No Action Alternative required flow range in Reach 2, releases from Flaming Gorge Dam, during July and August, are often limited to the minimum required release of 800 cfs. Restrictions under the No Action Alternative are relaxed after September 15 to allow flows in Reach 2 to be as high as 2,400 cfs. Then in November, the No Action Alternative lifts these flow restrictions, and releases from Flaming Gorge Dam are set to the appropriate level so that a drawdown target can be achieved by March. Reach 1 flows, under the No Action Alternative from November to February, are noticeably higher than the Reach 1 flows that occur during the months of July through October.

The 2000 Flow and Temperature Recommendations, on the other hand, do not focus on restricting flows during the months of July through October. Under the Action Alternative, flows during the base flow period are determined the same way each month, resulting in similar flow levels throughout the entire base flow period. Average flows under the Action Alternative appear to have a more natural pattern with high flows during the spring followed by low stable flows during the summer, fall, and winter months.

4.3.2.3 Reach 1 – Spring Peak Flows

The distributions of peak flows in Reach 1 for the Action and No Action Alternatives are shown in figure 4-5. Reach 1 peak flows are limited to powerplant capacity (approximately 4,600 cfs) under the No Action Alternative during normal operations. Only in very wet years, when releasing 4,600 cfs does not release a great enough volume to safely control the reservoir elevation, does the No Action Alternative allow a release rate above 4,600 cfs. The Action Alternative, on the other hand, attempts to achieve target flows in Reach 2 as the main priority for the spring release. Under the Action Alternative, the flows of the

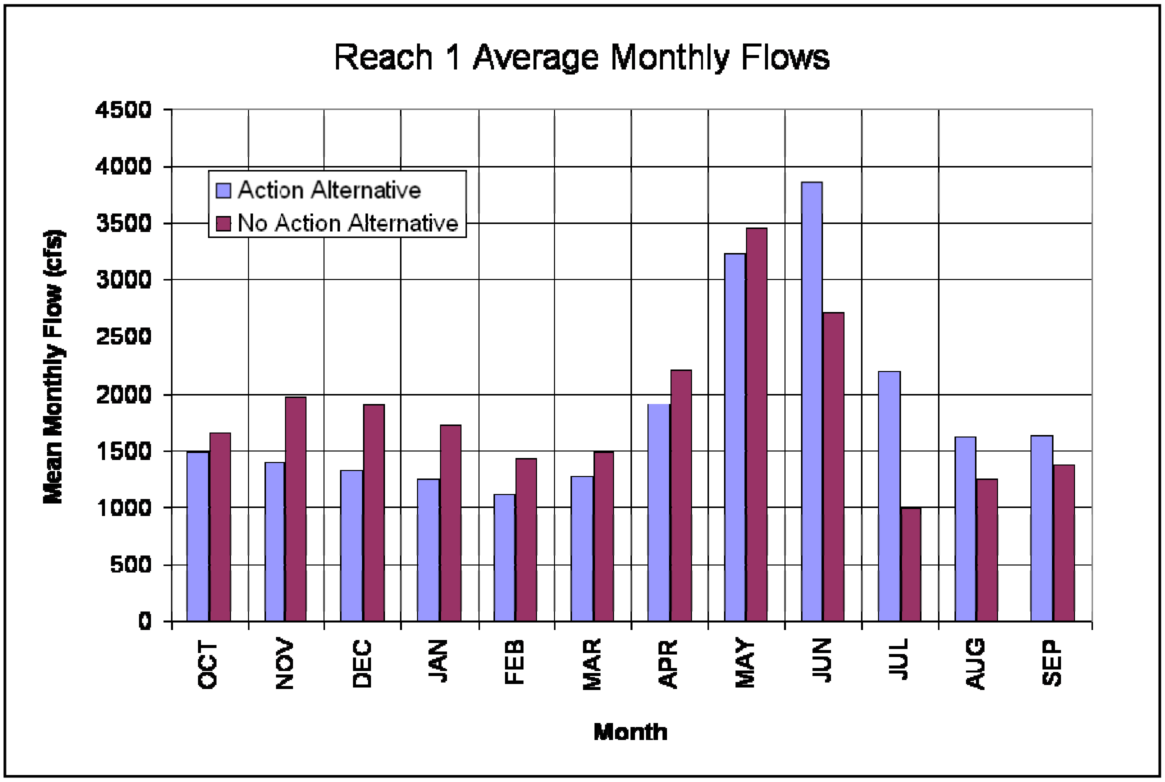


Figure 4-4.—Reach 1 Average Monthly Flows.

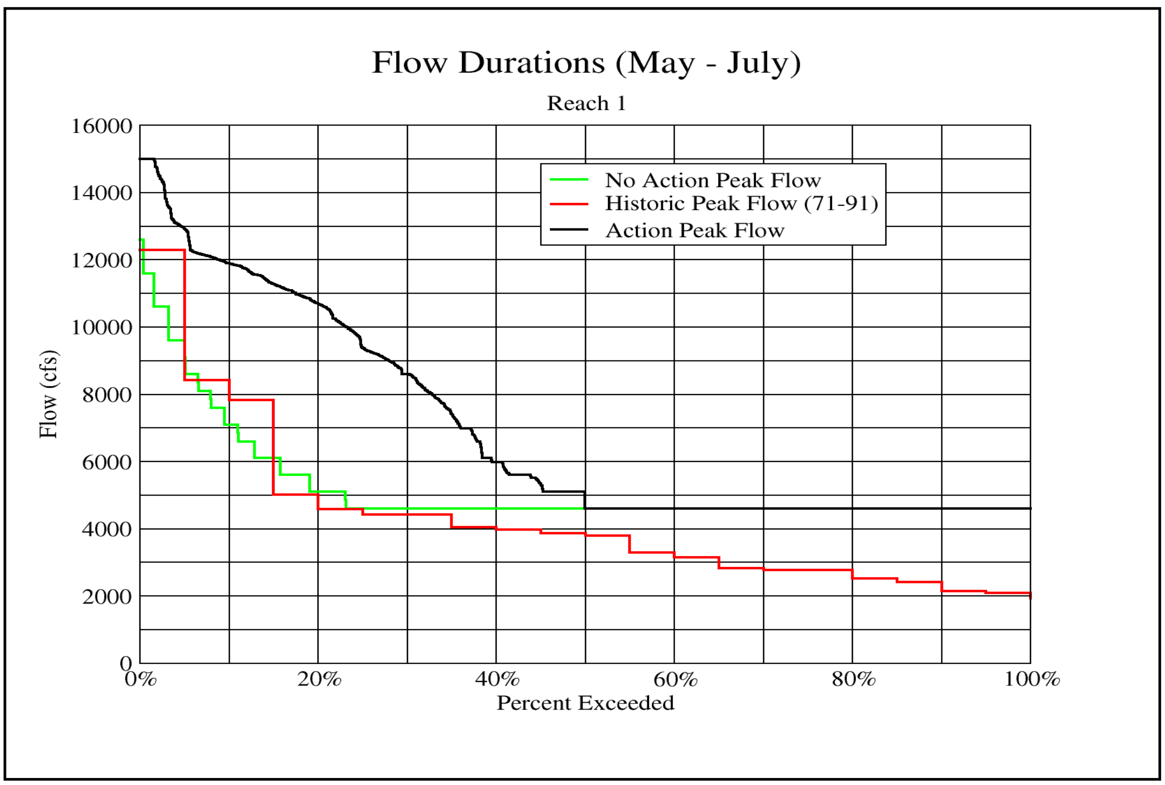


Figure 4-5.—Reach 1, 1-Day Peak Flow Distribution.

Yampa River are monitored closely during the spring, and releases are adjusted to achieve target flows in Reach 2. In most cases, the Action Alternative peak flows in Reach 1 are greater in magnitude than those under the No Action Alternative for similar hydrologic conditions.

Under the Action Alternative, the Flaming Gorge Model predicts that Reach 1 peak flows would likely exceed the capacity of the powerplant (approximately 4,600 cfs) in about 50% of all years. Under the No Action Alternative, the Flaming Gorge Model predicts that Reach 1 peak flows would likely exceed the powerplant capacity in about 23% of all years. In terms of spillway use, the Flaming Gorge Model predicts that spillway releases will occur about 29% of the time under the Action Alternative and about 5% of the time under the No Action Alternative. For the hydrologic modeling, the Action Alternative peak releases were limited to 15,000 cfs, which occurred about 1% of the time. The Flaming Gorge Model under the No Action Alternative limited peak releases to 12,600 cfs. In about 1% of all years, peak releases under the No Action Alternative achieved 12,600 cfs. Releases could exceed these thresholds on rare occasions when warranted by extreme hydrologic conditions.

The 2000 Flow and Temperature Recommendations call for peak flows in Reach 1 of 8,600 cfs or higher in at least 10% of all years and 4,600 cfs in all years. Table 4-1 shows how often the Flaming Gorge Model achieved target flows for Reach 1 under the No Action and Action Alternatives. Reservoir operations under the Action Alternative achieve the flow objectives for Reach 2 as the first priority. This explains why the peak flow targets in Reach 1 are exceeded by much more than the 10% required by the 2000 Flow and Temperature Recommendations.

4.3.2.4 Reach 2 – Average Monthly Flows

Figure 4-6 shows the monthly average flows in Reach 2 for all months of the year. The average monthly flows do not show a significant difference under the two alternatives. The average monthly flows in Reach 2 during the summer months of June and July would likely be about 1,100 cfs higher under the Action Alternative. Conversely, during the fall and winter months, flows in Reach 2 would likely be about 200-600 cfs higher under the No Action Alternative.

The pattern of flows throughout the year that was established in Reach 1 is also noticeable in Reach 2. Flows in Reach 2 during the summer months appear to be less under the No Action Alternative (as compared to the Action Alternative) and more during the fall and winter months. While these differences appear to be less significant in Reach 2, the overall pattern is similar to what occurs in Reach 1 and is a result of how releases are determined by the Action and No Action Alternatives during the summer and early fall months. While the restrictions of the No Action Alternative maintain lower flows

Table 4-1.—Reach 1 Flow Objective Comparison of Action and No Action Alternatives

Spring Peak Flow Recommendations	Target (%)	Action Ruleset (%)	No Action Ruleset (%)
Peak >= 8,600 cfs for at least 1 day	10	30.2	6.5
Peak >= 4,600 cfs for at least 1 day	100	100	100

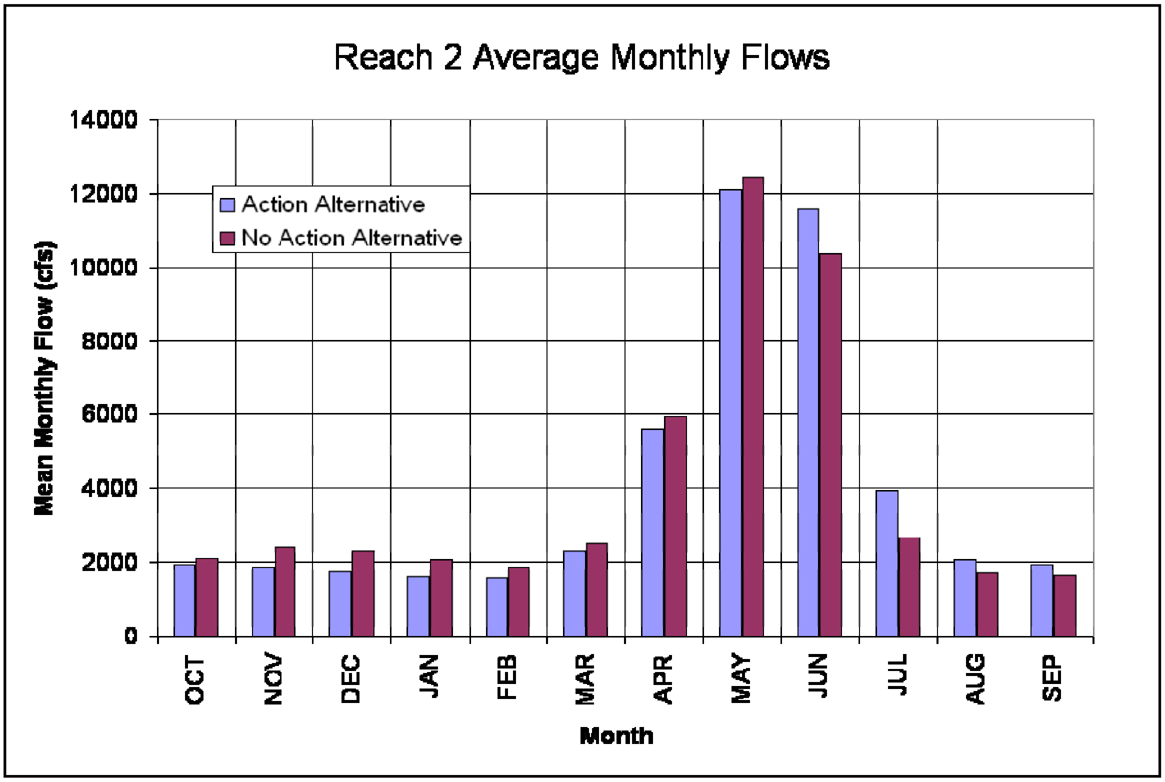


Figure 4-6.—Reach 2 Average Monthly Flows.

during these months, releases in the late fall and winter months are much higher to control reservoir storage. The Action Alternative takes a much more consistent approach to setting releases during the entire base flow period resulting in Reach 2 flow levels that change only moderately during the base flow period.

4.3.2.5 Reach 2 – Spring Peak Flows

Figure 4-7 shows the distribution of peak flows that would occur in Reach 2 under the Action and No Action Alternatives. Peak flows would be similar, despite the fact that the releases from Flaming Gorge are determined in very different ways under the Action and No Action Alternatives. In about 13% of all years, when conditions are wet, the peak flows in Reach 2 under the Action and No Action Alternatives would show a noticeable difference. The 2000 Flow and Temperature Recommendations call for peak flows in Reach 2 to exceed 26,400 cfs in at least 10% of all years. In order to achieve this, the Action Alternative monitors conditions in the Yampa River Basin. When the Yampa River is likely to flow at high levels, releases from Flaming Gorge Dam under the Action Alternative are made to achieve this target flow. In about 87% of all years, the distribution of peak flows in Reach 2 would be very similar under the two alternatives.

The 2000 Flow and Temperature Recommendations also specify several flow duration targets for Reach 2. These targets are to be achieved to various levels of frequency. Table 4-2 shows the spring flow and duration targets specified in the 2000 Flow and Temperature Recommendations and the frequencies that these targets should be achieved. The simulation of the Action Alternative of the Flaming Gorge Model predicts that the frequencies that each of

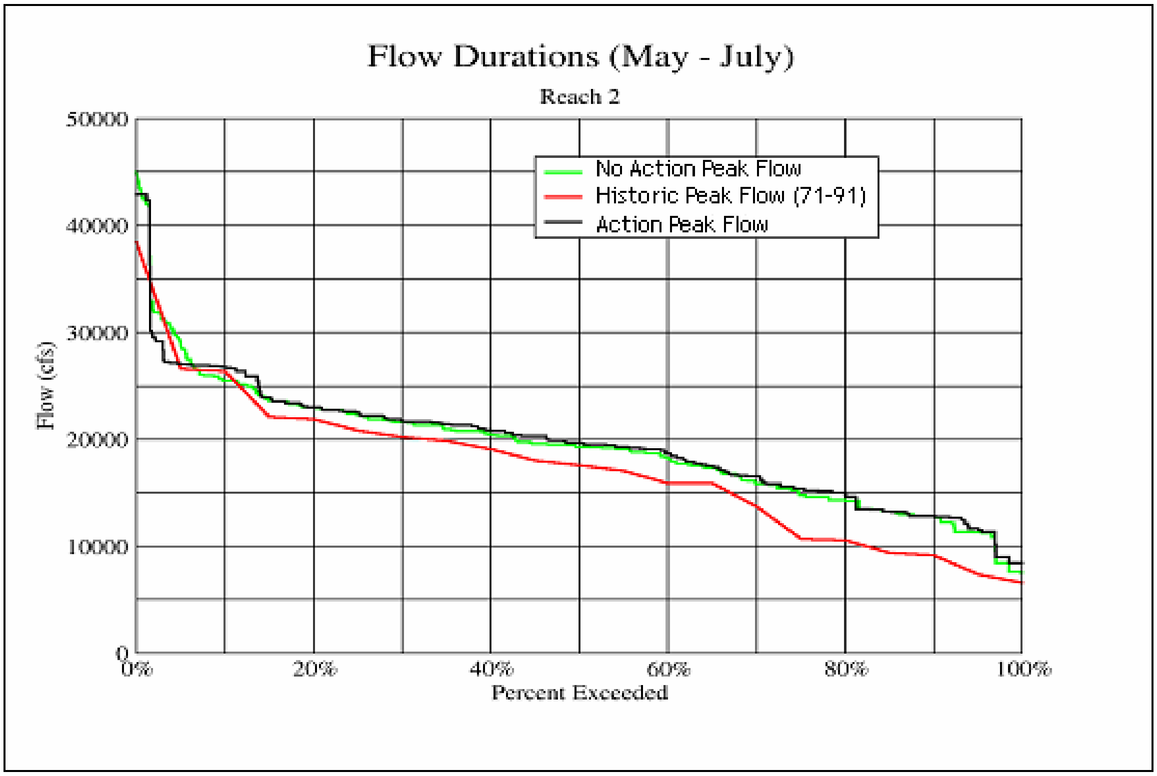


Figure 4-7.—Reach 2, 1-Day Average Peak Flow Distribution.

Table 4-2.—Reach 2 Flow Objective Comparison of Action and No Action Alternatives

Spring Peak Flow Recommendations	Target Frequency (%)	Action Ruleset (%)	No Action Ruleset (%)
Peak >= 26,400 cfs For at least 1 day	10	11.3	7.1
Peak >= 22,700 cfs For at least 2 weeks	10	10.7	4.6
Peak >= 18,600 cfs For at least 4 weeks	10	11.1	6.0
Peak >= 20,300 cfs For at least 1 day	30	46.3	42.3
Peak >= 18,600 cfs For at least 2 weeks	40	41.1	15.6
Peak >= 18,600 cfs For at least 1 day	50	60.3	59.1
Peak >= 8,300 cfs For at least 1 day	100	100	98.5
Peak >= 8,300 cfs For at least 1 week	90	96.8	96.9
Peak >= 8,300 cfs For at least 2 days except in extreme dry years	98	99.6	98.4

these targets will be achieved at the level prescribed by the 2000 Flow and Temperature Recommendations. The frequencies in which the No Action Alternative also achieves these targets are also shown.

4.3.2.6 Reach 3 – Average Monthly Flows

Figure 4-8 shows the monthly average flows in Reach 3 for all months of the year. The average monthly flows do not show a significant difference under the two alternatives. The impacts of the Action and No Action Alternatives are diminished significantly in Reach 3 as a result of tributary flows that contribute to the flow of the Green River.

As with the other reaches, flows under the No Action Alternative change during the base flow period at the end of September. During the months of July, August, and September, after the spring peak release, the No Action Alternative limits flows in Reach 2 to 1,800 cfs. In October, the No Action Alternative limits the flows in Reach 2 to 2,400 cfs. Beginning in November, releases from Flaming Gorge are not limited by the No Action Alternative and are controlled to optimize reservoir operations so that a drawdown target is achieved by the end of February. The effect of these No Action restrictions does translate into all three reaches of the Green River, causing flows in the summer months to be much lower than the flows of the Action Alternative. During the winter months when the No Action Alternative restrictions are not in effect, flows tend to be much higher under the No Action Alternative than the flows of the Action Alternative.

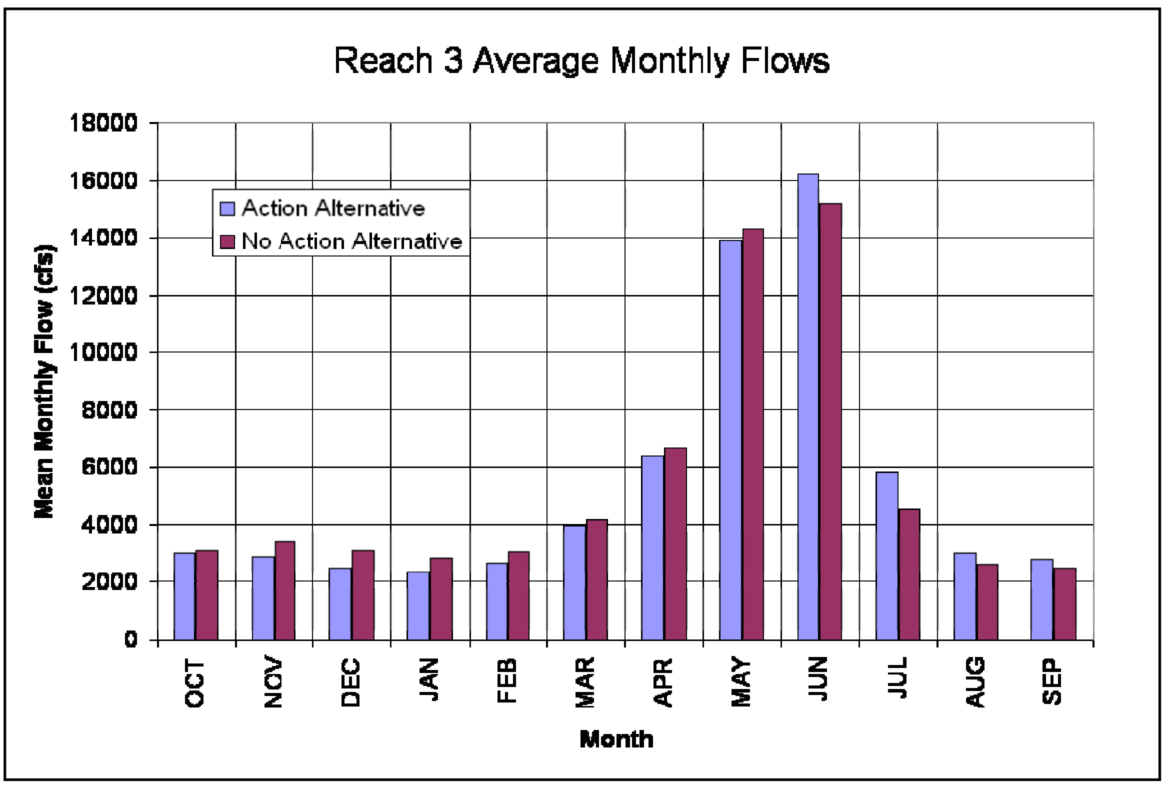


Figure 4-8.—Reach 3 Average Monthly Flows.

4.3.2.7 Reach 3 – Spring Peak Flows

Figure 4-9 shows the distribution of the estimated peak flows that would occur in Reach 3 under the Action and No Action Alternatives. Reach 3 peak flows would be quite similar under the Action and No Action Alternatives. The average single day peak flows in Reach 3 are basically the same under the two alternatives. Differences occur between the Action and No Action Alternatives in Reach 3 in the duration of peak flows. Under the Action Alternative, Reach 3 peak flow magnitudes are maintained longer than under the No Action Alternative. The amendment to the Hydrologic Modeling Report (in the Hydrologic Modeling Technical Appendix) describes in more detail the differences between the two alternatives with respect to peak flows that would occur in Reach 3.

The 2000 Flow and Temperature Recommendations specify several flow duration targets for Reach 3 in addition to the targets established for Reaches 1 and 2. These Reach 3 targets are important for the recovery of the endangered fishes in Reach 3; however, the authors of the 2000 Flow and Temperature Recommendations did recognize the limitation of operating Flaming Gorge Dam to achieve these targets. The Flaming Gorge Model did not focus on achieving any of these targets and, rather, focused on achieving the targets established for Reach 2. But as a result of achieving Reach 2 targets, all but one of the Reach 3 targets was achieved in the model results by operating Flaming Gorge Dam under the Action Alternative. Only the 1-day peak flow target of 39,000 cfs fell short of the recommended frequency. Table 4-3 shows

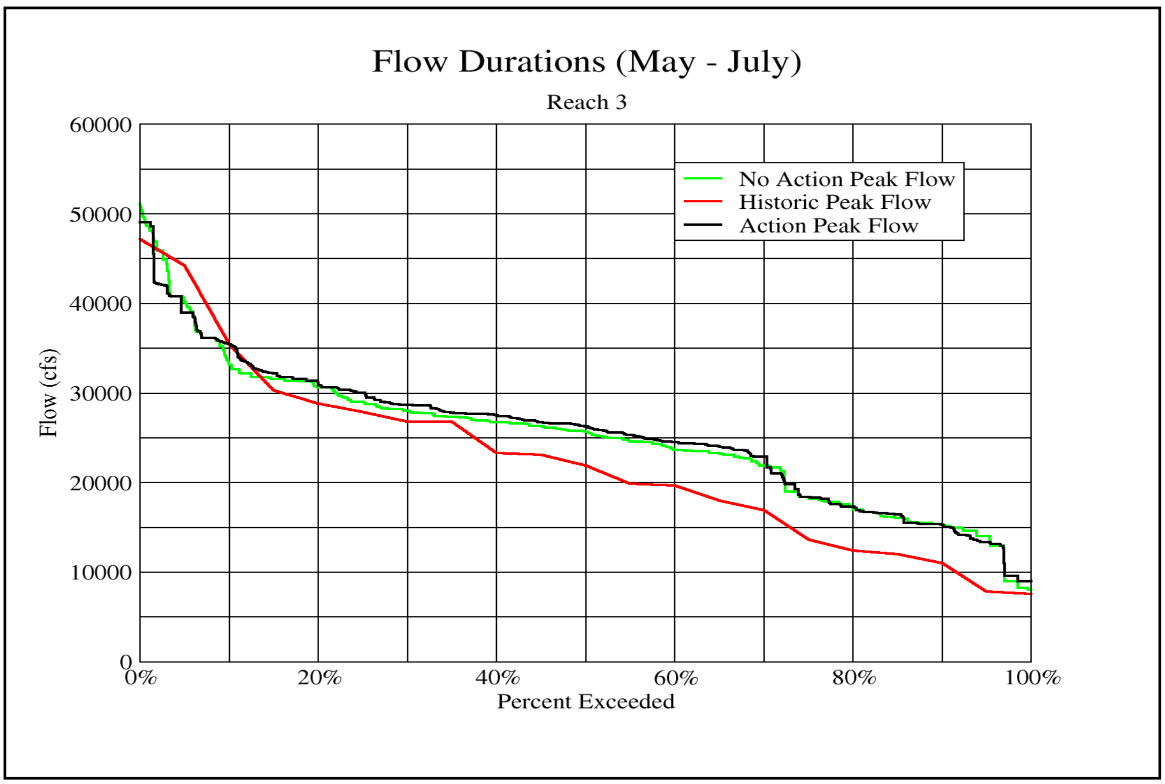


Figure 4-9.—Reach 3, 1-Day Average Peak Flow Distribution.

Table 4-3.—Reach 3 Flow Objective Comparison of Action and No Action Alternatives

Spring Peak Flow Recommendations	Target Frequency (%)	Action Ruleset (%)	No Action Ruleset (%)
Peak >= 39,000 cfs For at least 1 day	10	4.6	5.9
Peak >= 24,000 cfs For at least 2 weeks	10	22.0	14.4
Peak >= 22,000 cfs For at least 4 weeks	10	12.0	8.4
Peak >= 24,000 cfs For at least 1 day	30	65.2	59.4
Peak >= 22,000 cfs For at least 2 weeks	40	40.2	33.8
Peak >= 22,000 cfs for at least 1 day	50	70.3	69.4
Peak >= 8,300 cfs for at least 1 day	100	100	98.5
Peak >= 8,300 cfs for at least 1week	90	96.9	96.9
Peak >= 8,300 cfs for at least 2 days except in extreme dry years	98	100	98.5

the spring flow and duration targets specified in the 2000 Flow and Temperature Recommendations and the frequencies that these targets should be achieved in Reach 3. The frequencies of how the Action and No Action Alternatives will likely achieve these targets are also shown in the table.

A streamflow of 22,000 cfs in Reach 3 can be viewed as an index to the occurrence of overbank flooding in a 6-mile portion of Reach 3 from the White River confluence with the Green River to the confluence of Pariette Draw with the Green River. The frequency of flows of at least 22,000 cfs that are sustained for at least 2 weeks is greater under Action Alternative conditions relative to No Action Alternative conditions. For example, flood plain inundation lasting at least 2 weeks associated with flows of at least 22,000 cfs occurs more often under Action Alternative conditions (40% of the time) when compared to the frequency of occurrence under No Action Alternative conditions (34% of the time).

4.3.3 Water Quality, Flaming Gorge Reservoir

This section addresses impacts to water quality within the affected environment at Flaming Gorge Reservoir. Only direct impacts to water quality in the reservoir are considered in this section. Impacts to other resources as a result of changes in reservoir operations are reported in their respective sections.

4.3.3.1 No Action Alternative

Water quality in Flaming Gorge Reservoir would not deviate from current conditions as a result of operating Flaming Gorge Dam under the No Action Alternative. Since 1987, the operation of Flaming Gorge Dam to aid in the recovery of the native endangered fish downstream from the reservoir has resulted in a moderation of the annual drawdown of the reservoir elevation. This moderation significantly improved water quality in the reservoir by reducing the severity and frequency of algal blooms in the northern-most 20 to 30 miles of the reservoir. When reservoir elevations are drawn down near the elevation of 6010 feet above mean sea level (msl) (30 feet below the full pool elevation) during the late summer and fall months, large algal blooms are likely to occur. Operation of Flaming Gorge Dam to meet the flow objectives of the No Action Alternative would not likely increase the frequency that the reservoir elevation is drawn down to this level, because operations would be very similar to historic operations since 1987. This is evident in figure 4-10 which shows that, under the No Action Alternative, reservoir drawdowns by the end of September (critical time period for algal production) would likely be less than historic levels.

4.3.3.2 Action Alternative

The operation of Flaming Gorge Dam under the Action Alternative would likely reduce the frequency that the reservoir elevation is drawn down from what is expected to occur under the No Action Alternative. Figure 4-10 shows that it is not very likely that the reservoir elevation would ever be drawn down to 6010 feet above msl (less than 1% chance) under the Action Alternative during the month of September. By comparison, the reservoir elevation under the No Action Alternative would likely be drawn down to this level about 2% of the time during September. Since dam operation under the Action Alternative reduces the frequency and extent that the reservoir elevation would be drawn down to the critical level of 6010 feet above msl, water quality in Flaming Gorge Reservoir would not be adversely affected by this change in operations. Algal blooms during the fall would likely happen less often under this alternative.

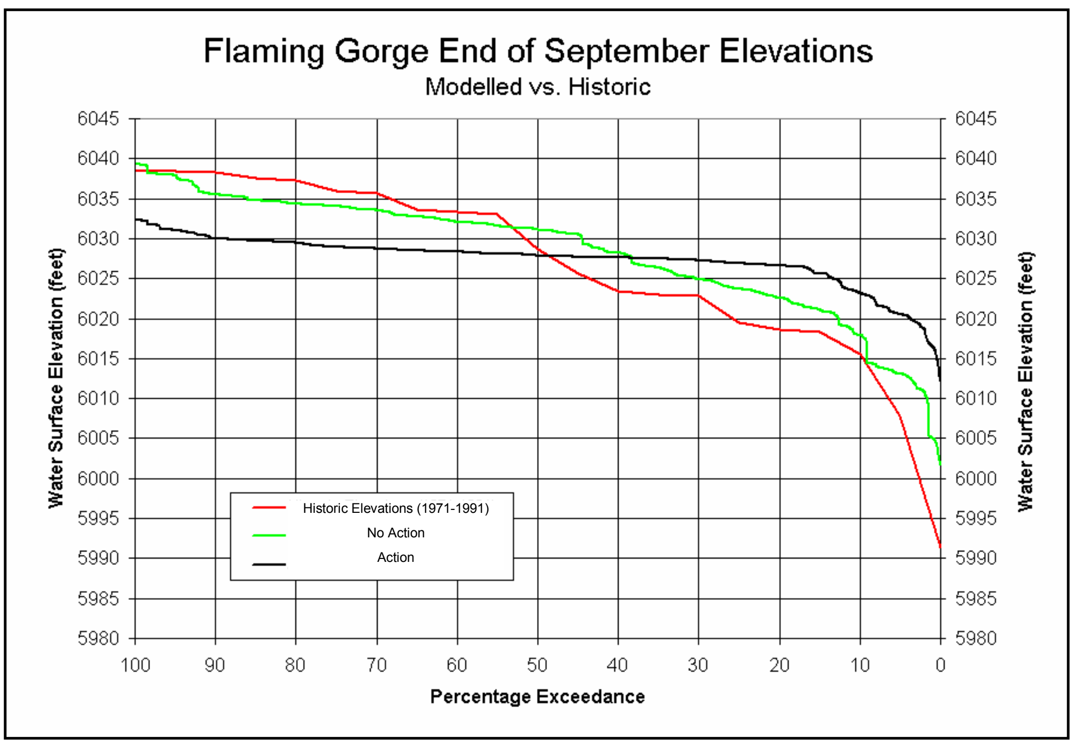


Figure 4-10.—Reservoir Elevation Comparison for the End of September.

4.3.4 Water Quality, Green River Reach 1

Water quality on the Green River in Reach 1 is associated with sediment transport and water temperature and is covered in the sediment and water temperature sections below. Water temperature impacts in Reach 1 are associated with a slight increase in release temperatures attempting to warm the river downstream for endangered fish in Upper Lodore Canyon and at the confluence with the Yampa River. These modifications and impacts are discussed in section 4.7.3.1, "Aquatic Animals" and summarized in table 4-8, later in this chapter.

4.3.4.1 Temperature Evaluation Methodology

The results of the Flaming Gorge Hydrologic Model were used to determine the consequences of operating Flaming Gorge Dam under the No Action and Action Alternatives. To determine the relationship among release volumes, release temperatures, and downstream temperatures up to 65 miles below the dam, the output of the Flaming Gorge Hydrologic Model was coupled with a River Temperature Model developed for the Bureau of Reclamation by Dr. John Carron, Hydrosphere Resource Consultants, Boulder, Colorado. This temperature model enables the prediction of main channel river temperatures at varying distances from the dam under a wide range of dam releases and water temperatures (table 4-4). For the purposes of this EIS, the temperature analysis focuses on the July/August time period under average meteorology (normal summer temperatures) and maximal meteorology (a hotter than normal summer temperatures). The model has been calibrated against various thermograph data, and its accuracy increases with closeness to the dam. Backwater temperatures, which are important to the early life stages of native fish, were not predicted with this model. The relationships between riverflows and temperatures and various aspects of the Green River fishes' life history were summarized in chapter 3, "Affected Environment," and serve as the basis for the following analyses.

4.3.4.1.1 No Action Alternative – The 2000 Flow and Temperature Recommendations for the Green River introduce a new target for Upper Lodore Canyon of 64-68 degrees Fahrenheit (°F) (18-20 degrees Celsius [°C]) or greater for 2-5 weeks in summer and fall, which has been incorporated into the Action Alternative for this EIS. Water temperatures measured at the Browns Park gauge provide the best available data for determining the extent to which the recommended temperatures were met during the period since the 1992 Biological Opinion. Neither daily mean or daily median temperatures in the months of June through October met this recommended target (table 3-4). Maximum-recorded daily mean temperatures exceeded 64 °F (18 °C) in June, July, and August, but this temperature was met or exceeded on more than 10% of days only in July.

Operating Flaming Gorge Dam to meet the water temperature requirements of the No Action Alternative would require releasing water temperature prescribed in the 1992 Biological Opinion during summer and fall months. Historically, the warmest available water temperatures have been in the range from about 54-68 °F (12-20 °C) during the months of June through October (table 3-2); however, releases have been held to 59 °F (15 °C) or less to protect turbine bearings and remain below the maximum temperature identified in the biological opinion. Under the No Action Alternative, release temperatures would be maintained near 59 °F (15 °C) as long as possible during the summer and fall. The only exception to this would be when releases are less than 1,200 cfs. When releases are this low, summer release

Table 4-4.—River Temperatures at Four Locations Downstream From Flaming Gorge Dam Under Varying Release Volumes and Release Temperatures (13 °C Represents the No Action Alternative and 15 °C Represents the Action Alternative) The release volumes correspond to the most likely base flow target for each hydrologic category (dry – wet) as identified in the Flaming Gorge Model. Results are presented for both the average meteorology and the maximal meteorology (under the "Met." heading). All temperatures represent the condition on July 15.

Site Location			Taylor Flat				Utah/Colorado State Line				Upper Lodore				Lower Lodore			
Dist. Below Flaming Gorge Dam			16 miles				29 miles				46 miles				65 miles			
Release Temperature (ºC)			13		15		13		15		13		15		13		15	
Met.	Hydrology Category	Release volume (CFS)	Average daily	Maximum daily	Average daily	Maximum daily	Average daily	Maximum daily	Average daily	Maximum daily	Average daily	Maximum daily	Average daily	Maximum daily	Avg daily	Maximum daily	Average daily	Maximum daily
Average Average Weather	Dry and moderate dry	800	16	19.8			18.3	21.4			20.3	22.7			21.3	23.7		
	Average	1,400	14.8	17.9	16.6	19.6	16.4	19	17.9	20.5	18.1	20	19.5	21.5	19.3	21.2	20.5	22.9
	Moderate Wet	2,000	14.3	16.9	16.1	18.7	15.5	17.8	17.2	19.4	16.9	18.8	18.4	20.6	18.1	21	19.4	22.9
	Wet	2,400	14.1	16.5	16	18.3	15.1	17.3	16.9	19	16.4	18.6	18	20.6	17.5	21	18.9	22.9
Maximal Hot Weather	Dry and moderate dry	800	17.1	20			20	22.3			22.5	24.7			23.7	26.2		
	Average	1,400	15.5	18	17.2	19.7	17.5	19.3	19	20.8	19.7	21.3	21	22.5	21.2	22.7	22.4	23.7
	Moderate Wet	2,000	14.8	16.9	16.6	18.7	16.3	18	18	19.6	18.2	19.3	19.6	20.8	19.6	21.1	20.9	23.1
	Wet	2,400	14.5	16.5	16.4	18.3	15.8	17.5	17.6	19.2	17.5	18.7	19	20.7	18.8	21.1	20.2	23

[1] Conversion to degrees Fahrenheit = C x 9/5 + 32.
Note: Blank cells indicate 15 ºC water temperature would not be released during dry and moderately dry years.

temperatures may be reduced to 55 °F (13 °C) to protect trout located in lower Browns Park from the effects of daily average water temperatures above 64 °F (18 °C).

When releases are this low, water temperatures increase sooner as the water moves down the river. This release temperature and volume combination would still provide the minimum 64 °F (18 °C) water temperature for endangered fish at Upper Lodore Canyon.

4.3.4.1.2 Action Alternative – Release temperatures under the Action Alternative would need to be greater than those under the No Action Alternative over a broader range of hydrologies to meet the recommended water temperatures in Upper Lodore Canyon and at the confluence of the Green and Yampa Rivers. During the summer and early fall months, release temperatures would be managed to provide daily mean water temperatures in Upper Lodore Canyon of at least 64 °F (18 °C) as the primary target.

Based on modeling results presented in table 4-4, this minimum temperature of 64 °F (18 °C) can be reached in all years during midsummer with dam releases of 800-1,200 cfs and water temperatures of 55-59 °F (13-15 °C). Higher release temperatures at these low flows jeopardize the trout fishery in Browns Park. Temperatures in Reach 2 that are too warm during low flows may also give greater advantage to nonnative fish. At flows greater than 1,200-1,400 cfs, the target release temperature would be 59 °F (15 ºC), but operational flexibility needs to maintain a range of about 57-60 °F (14-15.5 ºC). Data will need to be gathered by temperature sensors placed at appropriate locations during future operations to determine accuracy of the model's predictions and whether release temperatures above 59 °F (15 °C) are necessary to meet target water temperatures.

Analysis of the limited record of water temperatures near the confluence of the Green and Yampa Rivers suggests that a difference of less than or equal to 9 °F (5 °C) between the two flows will be achieved more consistently under the Action Alternative than the No Action Alternative.

4.3.4.2 Sediment Transport

This section addresses impacts to the transport of sediment in Reach 1 associated with operating Flaming Gorge Reservoir under the Action and No Action Alternatives. Impacts to other resources in Reach 1 that might be affected by sediment transport are assessed in other sections of this chapter.

4.3.4.2.1 No Action Alternative – Under the No Action Alternative, long-term average annual transport in Reach 1 is expected to be about 92,000 tons per year. This estimate was developed according to the procedure noted in Strand and Pemberton (1982) that requires flow duration and sediment rating curve data. This estimate was developed using the No Action flow output data from the Flaming Gorge Model described in section 4.3.2.1 and the total load sediment rating curve for the Green River near Browns Park, Colorado, as described by Martin et al. (1998). Seasonally, about 49% of the average annual sediment load, or 45,000 tons, is expected to be transported during May, June, and July under the No Action Alternative.

4.3.4.2.2 Action Alternative – Under the Action Alternative, long-term average annual transport in Reach 1 is expected to be about 105,000 tons per year. This estimate was developed according to the procedure noted in Strand and Pemberton (1982) that requires flow duration and sediment rating curve data. This estimate was developed using the Action Alternative flow output data from the Flaming Gorge Model and the total load sediment rating curve for the Green River near Browns Park, Colorado, as described by Martin, et al. (1998). Seasonally, about 67% of the average annual sediment load, or about 70,000 tons, is expected to be transported during May, June, and July under the Action Alternative. In comparison to the estimated average annual sediment load for Reach 1 under the No Action Alternative, sediment transport under the Action Alternative represents an increase of about 14%.

Seasonally, during May, June, and July, average annual sediment transport is about 56% greater under the Action Alternative relative to the No Action Alternative. Figure 4-11 illustrates the differences between monthly sediment loads in Reach 1 for both the No Action and Action Alternatives conditions.

As described in section 4.3.2.3, 1-day peak flows greater than or equal to 8,600 cfs in Reach 1 will occur much more frequently under Action Alternative conditions when compared to No Action Alternative conditions. Based on the channel erosion observations reported by Martin et al. (1998), it is likely that erosion of sandbars in portions of Reach 1 will be greater under the Action Alternative flow regime. Also, bank erosion in Reach 1 under the Action Alternative is likely to be greater than bank erosion under the No Action Alternative conditions.

4.3.5 Water Quality, Green River Reach 2

Water quality on the Green River in Reach 2 is associated with sediment transport and water temperature and is covered in the sediment and water temperature sections. Water temperature impacts in Reach 2 are associated with slight modifications in temperature attempting to warm the river downstream for endangered fish at the confluence with the Yampa River.

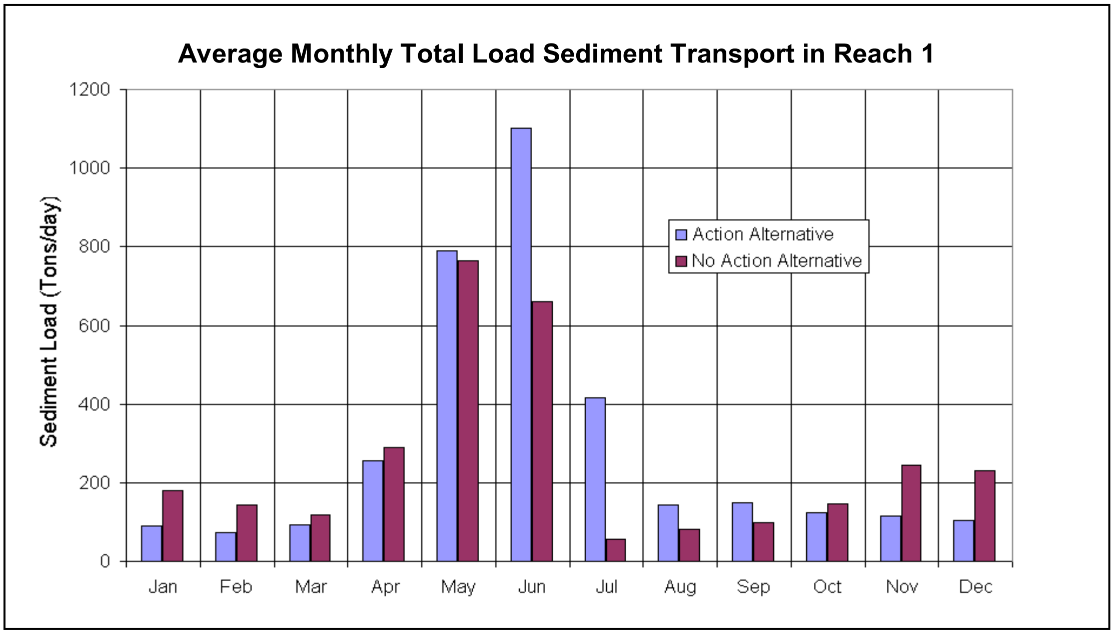


Figure 4-11.—Average Monthly Total Load Sediment Transport in Reach 1.

4.3.5.1 Water Temperature

This section discusses the potential impacts to the water temperature regime in Reach 2 of the Green River as a result of operating Flaming Gorge Dam to achieve the flow and temperature objectives of the two proposed alternatives. The primary concern for water quality in Reach 2 occurs at the confluence of the Green and Yampa Rivers where thermal shock from cold water may impact drifting larval fish emerging from the Yampa River into the Green River.

4.3.5.1.1 No Action Alternative – The desired 9 °F (5 °C) maximum difference between Green River and Yampa River waters would not be consistently attained under the No Action Alternative; however, based on past records, the deviation would seldom exceed 13.5 °F (7.5 °C). Results of research investigations on cold shock to endangered Colorado River fish (Berry, 1988; Childs and Clarkson, 1996) show that water temperature changes of less than 18 °F (10 °C) would have limited effect on drifting larvae, so minor exceedances slightly above 9 °F (5 °C) should have little consequence. Furthermore, drifting larvae would encounter these temperatures for only a brief time as they passed downstream into the combined Green River and Yampa River waters.

4.3.5.1.2 Action Alternative – Under the Action Alternative, emphasis would be placed on meeting the 64-68 °F (18-20 °C) or greater temperature minimum at Upper Lodore Canyon in Reach 1. This emphasis would result in increased Green River water temperatures at its confluence with the Yampa River and even fewer exceedances of the 9 °F (5 °C) difference in water temperatures that would be experienced by drifting larval endangered fish. The benefit experienced by larval fish from reduced temperature differences under the Action Alternative would likely be greatest in wetter hydrologies when cold temperatures persist further downstream due to higher current velocities.

4.3.5.2 Sediment Transport

This section discusses the potential impacts to the sediment transport in Reach 2 of the Green River as a result of operating Flaming

Gorge Dam to achieve the flow and temperature objectives of the two proposed alternatives.

4.3.5.2.1 No Action Alternative – Under the No Action Alternative, long-term average annual sediment transport in Reach 2 is expected to be about 1.2 million tons per year. This estimate was developed according to the procedure noted in Strand and Pemberton (1982) that requires flow duration and sediment rating curve data. In this case, a flow duration summary developed from the No Action Alternative flow output data for Reach 2 from the Flaming Gorge Model described in section 4.3.2.1 and the sand load sediment rating curve for the Green River near Jensen, Utah, as described by Andrews (1986) were used. Flow duration relationships were developed for each month of the year and coupled with the sediment rating curve, producing monthly estimates of sediment transport. These monthly estimates were summed to produce the estimate of annual sediment transport.

Seasonally, about 83% of the average annual sediment load, or about 1.0 million tons, is expected to be transported during May, June, and July under the No Action Alternative in Reach 2.

4.3.5.2.2 Action Alternative – Under the Action Alternative, long-term average annual sediment transport in Reach 2 is expected to be about 1.3 million tons per year. This estimate was developed according to the procedure noted in Strand and Pemberton (1982) that requires flow duration and sediment rating curve data. In this case, a flow duration summary developed from the Action Alternative flow output data for Reach 2 from the Flaming Gorge Model and the sand load sediment-rating curve for the Green River near Jensen, Utah, as described by Andrews (1986) were used. Flow duration relationships were developed for each month of the year and coupled with the sediment rating curve, producing monthly estimates of sediment transport. These monthly estimates were summed to produce the estimate of annual sediment transport. Seasonally, about 86% of the average annual sand load, or about 1.1 million tons, is expected to be transported during May, June, and July under the Action Alternative.

In comparison to the estimated average annual sediment load for Reach 2 under the No Action Alternative, annual sediment transport under the Action Alternative represents an increase of about 7%. Sediment transport during May, June, and July under the Action Alternative would average nearly 11% more than sediment transport under the No Action Alternative during the same season. Significant widespread changes in channel morphology trends are not expected to occur in Reach 2 under the Action Alternative relative to the No Action Alternative of flow and sediment transport.

Figure 4-12 illustrates the differences between expected monthly sediment loads in Reach 2 for both the No Action and Action Alternatives based upon the average monthly flows for Reach 2 under the No Action and Action Alternatives as described in figure 4-6.

4.3.6 Water Quality, Green River Reach 3

4.3.6.1 Water Temperature

This section discusses the potential impacts to the water temperature regime in Reach 3 of the Green River as a result of operating Flaming Gorge Dam to achieve the flow and temperature objectives of the two proposed alternatives.

4.3.6.1.1 No Action Alternative – Under the No Action Alternative, Green River temperatures will have reached an equilibrium with ambient environmental conditions by the time they travel the 264 miles from the dam to the beginning of the reach. Therefore, dam release temperatures will have no discernable effect on water temperatures in Reach 3.

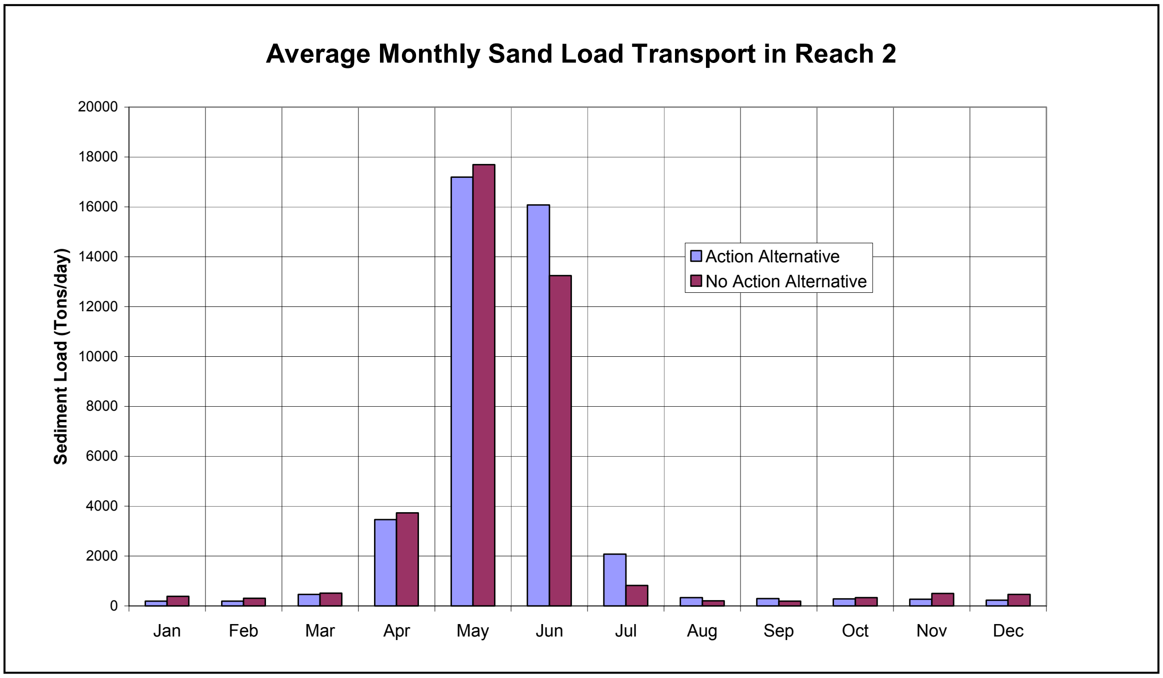


Figure 4-12.—Average Monthly Sand Load Transport in Reach 2.

4.3.6.1.2 Action Alternative – Green River temperatures in Reach 3 under the Action Alternative also will be controlled by ambient environmental conditions, due to the long travel time and distance from Flaming Gorge Dam. No discernable differences in water temperatures are expected from those that will occur under the No Action Alternative in this reach of the Green River.

4.3.6.2 Sediment Transport

This section discusses the potential impacts to the sediment transport in Reach 3 of the Green River as a result of operating Flaming Gorge Dam to achieve the flow and temperature objectives of the two proposed alternatives.

4.3.6.2.1 No Action Alternative – Under the No Action Alternative, long-term average annual sediment transport in Reach 3 is expected to be about 3.25 million tons per year. This estimate was developed according to the procedure noted in Strand and Pemberton (1982) that requires flow duration and sediment rating curve data. In this case, a flow duration summary developed from the No Action Alternative flow output data for Reach 3 from the Flaming Gorge Model described in section 4.3.2.1 and the sand load sediment rating curve for the Green River near Green River, Utah, as described by Andrews (1986) were used. Flow duration relationships were developed for each month of the year and coupled with the sediment rating curve, producing monthly estimates of sediment transport. These monthly estimates were summed to produce the estimate of annual sediment transport.

Seasonally, about 91% of the average annual sediment load, or 2.97 million tons, is expected to be transported during May, June, and July under the No Action Alternative in Reach 3.

4.3.6.2.2 Action Alternative – Under the Action Alternative, long-term average annual sediment transport in Reach 3 is expected to be about 3.5 million tons per year. This estimate was developed according to the procedure noted in Strand and Pemberton (1982) that requires flow duration and sediment rating curve data. In this case, a flow duration summary developed from the Action Alternative flow output data for Reach 3 from the Flaming Gorge Model and the sand load sediment rating curve for the Green River near Green River, Utah, as described by Andrews (1986) were used. Flow duration relationships were developed for each month of the year and coupled with the sediment-rating curve, producing monthly estimates of sediment transport. These monthly estimates were summed to produce the estimate of annual sediment transport. Seasonally, about 93% of the average annual sand load, or about 3.3 million tons, is expected to be transported during May, June, and July under the Action Alternative.

In comparison to the estimated average annual sediment load for Reach 3 under the No Action Alternative, annual sediment transport under the Action Alternative represents an increase of about 8%. Sediment transport during May, June, and July under the Action Alternative would average about 9% more than sediment transport under the No Action Alternative during the same season. Significant widespread changes in channel morphology trends are not expected to occur in Reach 3 under the Action Alternative relative to the No Action Alternative effects on flow and sediment transport.

Figure 4-13 illustrates the differences between expected monthly sediment loads in Reach 3 for both No Action and Action Alternatives, based upon the average monthly flows for Reach 3 under the No Action and Action Alternatives as described in figure 4-8.

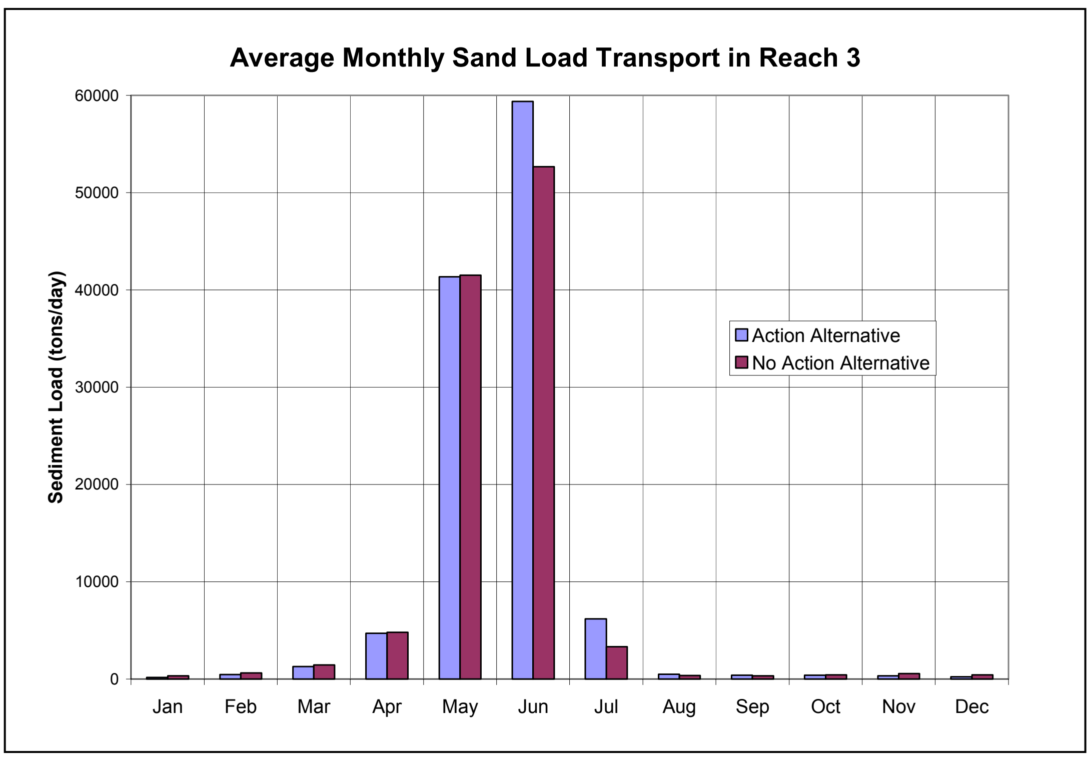


Figure 4-13.—Average Monthly Sand Load Transport in Reach 3.

4.4 Hydropower Generation

Hydropower generation analyses are based on two methodologies. The first is an economic analysis that represents the effects on a national perspective for each alternative. The results from the economic analysis provide values that reasonably represent national economic benefits, consistent with the Federal objective. The second analysis is a financial analysis representing the impact to the wholesale rates paid by the utility customers who purchase the electricity generated by Flaming Gorge Powerplant.

Hydropower analysis focuses on the potential impacts of the alternatives on powerplant operations at Flaming Gorge Dam. Daily maximum generation occurs during peak high demand periods as much as possible while still meeting operating restrictions, such as minimum flow requirements during other times of the day. Flaming Gorge Dam and Reservoir are operated to meet a wide range of authorized project purposes. Hydropower contributes significant project benefits. In evaluating changes in power generation attributed to implementation of the 2000 Flow and Temperature Recommendations represented by the Action Alternative, consideration was given only to the change in power generation from Flaming Gorge Dam without looking at the potential impact to other generation facilities.

4.4.1 Economic Analysis Methodology

This analysis used a computer model developed by Argonne National Laboratories in collaboration with Reclamation. The model uses an estimate of the quantity of energy injected into the power grid along with a forecasted hourly electricity spot price (market price) to determine the economic value for each alternative represented by the net present value of annual cash flows. Use of historic prices would not reflect the change in demand and changes in the electrical generation industry in recent years. The hydrology provided by Reclamation consisted of a 25-year period (2002-2026) of projected daily releases under the Action and No Action Alternatives that reflected an average hydrologic trace. The same hydrology trace was used for both alternatives. The model was designed to reflect the constraints and daily flow limitations and other restrictions as identified within the description of the alternatives. For a detailed description of the analysis, please refer to "Power System Modeling" in the Power System Analysis Technical Appendix of this EIS.

Green River Reach 2 flow objectives target conditions at the gauge near Jensen, Utah. Jensen gauge flows are primarily a function of releases from Flaming Gorge Dam and Yampa River flows. Flows on the Yampa River are not controlled, requiring releases from Flaming Gorge Dam to be regulated so that gauge flows are in compliance with each alternative. However, water releases from Flaming Gorge Dam are not required to compensate for large and unpredictable changes in Yampa River flows. These variations in the Yampa River flows make it impossible to always comply with the stringent Jensen gauge constraints, but the Flaming Gorge EIS alternatives require that the general pattern of Yampa River flows should be accounted for when scheduling Flaming Gorge Dam releases. Therefore, as prescribed in the hydrology data, it was assumed in this analysis that the Yampa River flows are constant during a monthly period.

For both the No Action and the Action Alternatives, allowable flows at the Jensen gauge remain constant for each month. The allowable flows at the Jensen gauge exactly matched those given by the Flaming Gorge Model; the average daily water volumes will not change from day to day. Although gauge constraints are not specified during the winter in either of the alternatives, for this analysis, it was assumed that gauge constraints would apply during this time period. This is consistent with historic operations.

While the minimum flow requirement to establish and maintain tailwater trout fisheries is approximately 400 cfs, Flaming Gorge Dam normally releases a continuous flow of 800 cfs. A continuous release of 800 cfs requires a minimum weekly water release of approximately 11,100 acre-feet. Any water releases above this level can be used at the discretion of power dispatchers, taking into account other dam operations and downstream flow constraints. Typically, the dispatcher schedules release of water through the turbines when it has the highest economic value as determined by electricity prices.

The economic analysis model of the two alternatives imposed two restrictions on the rate of water release from Flaming Gorge. The economic model included an up- and down-ramp rate limit of 800 cfs per hour and a single daily peak "hump" restriction. The hourly ramp rate restriction imposed on the economic analysis model limited the change in the water flow rate from 1 hour to the next. For example, if the water release from Flaming Gorge Dam is 2,400 cfs at noon, then releases at 1:00 p.m. would remain within a band that ranges from 1,600 cfs to 3,200 cfs. The single daily peak "hump" restriction ramped releases up from a low release at night to a higher release during the daytime and then back down to a lower release during the following night. That is, dam releases were permitted to change the ramp directions only twice per day—once in the up direction and once in the down direction. Constant flow periods in between the up and down ramp rate phases were allowed. Intermediate up and down fluctuations were not permitted except for automatic generation control. The one-hump restriction and ramping rate reduces the economic value of the hydropower resources and limits the amount of load following.

In general, these limitations have been used at Flaming Gorge Reservoir since 1993; however, there have been times when Reclamation has relaxed these restrictions based on the conditions of the various resources that are affected by fluctuating release patterns. Reclamation sets the appropriate level of the ramp rate as part of the decisionmaking process described in section 1.4, and there are no formalized restrictions that are currently in place with regard to the ramp rates when the powerplant is fluctuating releases for power generation. These restrictions were imposed on the economic analysis model to generally mimic the more frequent pattern of operation at Flaming Gorge Dam since 1993.

Monthly reservoir inflow hydrologies, as simulated by the Flaming Gorge Model, are the same for each alternative. The hydrologies affect monthly water release volumes and reservoir elevations at Flaming Gorge Reservoir. But the reservoir elevation of each alternative is very different, and this impacts the volume of water released each month by each alternative. Therefore, operable capability blocks and associated power conversion factors were estimated for each alternative. Although the powerplant is modeled as a single entity, power conversion factors and capability blocks were based on unit-level computations. Given daily operating guidelines, a mathematical computer program was written that optimized generation and water releases through each turbine, given a total water release from the dam.

4.4.2 Economic Analysis Results

Table 4-5 shows a summary of the results of the simulation runs. Annual values were generated for both the No Action and Action Alternatives. This table shows the generation levels along with the undiscounted nominal economic value of that generation for each year. The value of generation is computed by multiplying hourly electricity production by the hourly spot market price. As can be seen, for many years, the Action Alternative generates a higher value of energy than the

Table 4-5.—Comparison of the Annual Economic Benefits of the Flaming Gorge Powerplant Between the Action and No Action Alternatives

		No Action Alternative				Action Alternative						
Year	Average Spot Market Price ($/MWh[1])	Average Power Release (cfs)	Annual Generation (GWh)[2]	Nominal Value (Millions $)	Present Value (Millions $)	Average Power Release (cfs)	Annual Generation (GWh)	Nominal Value (Millions $)	Present Value (Millions $)	Generation Above the No Action Alternative (GWh)	Nominal Value Above No Action Alternative (Million $)	Present Value Above No Action Alternative (Million $)
2002	60.0	1,548	415.8	26.0	25.1	1,631	428.9	27.4	26.6	13.1	1.5	1.5
2003	47.5	1,750	471.0	21.8	20.1	1,456	386.3	18.9	17.5	-84.8	-2.8	-2.6
2004	42.6	1,222	321.3	13.5	11.8	1,257	330.2	14.5	12.7	8.9	1.1	0.9
2005	42.7	1,233	322.3	13.3	11.0	947	245.8	11.0	9.1	-76.5	-2.3	-1.9
2006	44.9	1,036	264.6	12.3	9.6	903	233.0	10.8	8.4	-31.6	-1.5	-1.2
2007	48.6	1,760	470.1	24.2	18.0	1,981	530.2	27.2	19.4	60.0	3.0	2.2
2008	53.3	1,381	366.2	18.9	13.4	1,150	304.0	18.1	12.7	-62.2	-0.8	-0.7
2009	61.1	1,619	431.4	25.9	17.3	1,674	441.0	29.1	19.4	9.6	3.2	2.2
2010	62.3	2,540	687.0	46.0	29.0	2,452	666.2	45.8	28.9	-20.8	-0.2	-0.1
2011	64.2	1,805	484.0	27.5	16.6	1,616	432.7	26.7	16.1	-51.3	-0.8	-0.5
2012	65.4	1,771	476.4	31.5	17.8	1,981	526.6	41.1	23.4	50.2	9.6	5.5
2013	67.6	1,875	506.0	32.3	17.5	1,620	427.4	32.6	17.6	-78.6	0.3	0.1
2014	68.6	1,843	495.6	35.1	17.9	1,766	467.5	35.6	18.2	-28.0	0.5	0.3
2015	70.3	1,467	391.0	27.2	13.2	1,510	401.0	32.7	15.8	10.0	5.5	2.6
2016	70.9	2,327	630.4	44.9	20.6	2,739	728.9	56.6	26.0	98.5	11.8	5.4
2017	71.6	2,793	757.3	51.5	22.4	2,812	749.2	58.4	25.5	-8.0	7.0	3.0
2018	78.5	2,275	622.3	50.2	20.7	2,027	545.4	46.7	19.2	-76.9	-3.5	-1.5
2019	78.3	2,272	614.6	48.0	18.8	2,372	628.7	50.9	20.0	14.2	2.9	1.2
2020	79.3	2,138	580.4	46.0	17.0	1,985	528.8	50.9	18.9	-51.6	4.9	1.8
2021	79.4	2,218	602.2	46.6	16.4	2,001	534.3	48.6	17.1	-68.0	2.0	0.7
2022	79.4	1,288	335.8	27.8	9.3	887	228.2	18.1	6.0	-107.6	-9.7	-3.2
2023	79.4	1,447	385.9	32.8	10.3	1,744	461.3	46.3	14.6	75.4	13.5	4.3
2024	79.3	1,406	373.5	28.2	8.5	1,204	316.7	28.1	8.4	-56.8	-0.1	-0.1
2025	79.4	1,886	509.7	43.7	12.4	2,069	556.2	49.5	14.0	46.5	5.8	1.7
2026	79.4	1,472	389.5	30.9	8.4	1,060	275.9	24.9	6.7	-113.6	-6.1	-1.7
Total			11,904	806.1	403.1		11,374.3	850.6	423.1	-529.8	44.5	20.0

[1] MWh = megawatthour.
[2] GWh = gigawatthour.

No Action Alternative. However, this is not true for all years, as the results vary from year to year.

Table 4-5 also shows a comparison of economic results of the Action and No Action Alternatives based on net present value (NPV) calculations of the hourly value of Flaming Gorge generation over the 25-year simulation period. All NPV calculations are based on a Federal water agency discount rate of 5.5%. The economic impact of implementing the 2000 Flow and Temperature Recommendations under the Action Alternative is measured as the difference in the NPV between the Action and the No Action Alternatives. The NPV for the No Action Alternative is about $403.1 million, while the NPV for the Action Alternative is about $423.1 million. The economic benefits of the Action Alternative exceed those of the No Action Alternative by about $20.0 million. While the Action Alternative has a higher economic value, it achieved this with 529.8 gigawatthours (GWh) less generation compared to the No Action Alternative over the 25-year simulation period. This higher economic value is due to the difference in the seasonal timing of the releases (the Action Alternative releases more water when energy is valued highest), the length of the spring flows, and the differences in the other operating constraints for the alternatives. The Action Alternative generates about 4.5% less power on average but has about a 5.0% higher economic value. This is not considered to be a significant change in generation or economic value.

The Action Alternative has slightly greater benefits with fewer GWh due to the fluctuations in the market price of energy. The Action Alternative calls for more generation in the summer months when energy sells at higher prices than in the fall, when the No Action Alternative generates more power. Given recent volatility in historical prices, there is uncertainty associated with future prices. Because there is less total annual generation with the Action Alternative, use of an alternative price set that does not assume as large a relative seasonal price difference could result in a negative rather than a positive impact. In any case, the impact is considered to be insignificant when the total value of Flaming Gorge generation is considered.

Because the total NPV for each alternative is within $20 million over a 25-year period and highly dependent on the assumed price set, the difference between the alternatives should be considered to be insignificant.

4.4.3 Financial Analysis of Power Generation

The Western Area Power Administration (Western) markets electrical power from federally owned hydroelectric facilities in the Western States. The Salt Lake City Area Integrated Projects (SLCA/IP) is a group of hydroelectric facilities marketed by Western. The SLCA/IP consists of the hydroelectric facilities of the Colorado River Storage Project (CRSP), Rio Grande Project, and Collbran Project. The largest of these three projects is the CRSP. The 152-megawatt (MW) hydroelectric powerplant at Flaming Gorge Dam is a CRSP facility.

4.4.3.1 Description of the Customers Who Buy Electricity Generated at Flaming Gorge

Western provides its customers with long-term, firm, electric service. On average, about 20% of these customers total electrical needs are supplied by CRSP. This differs significantly from customer to customer. Customers purchase CRSP power from Western and add it to other electrical generation to meet the needs of their retail customers.

Currently, CRSP firm electric customers pay a “combined rate” of $0.02072 per kilowatthour (kWh). This rate is a combination of a capacity fee and an energy charge. A CRSP customer pays $4.04 per kilowatt for electrical capacity. This capacity fee is paid every month regardless of the electricity a customer actually buys. It is a fee to reserve an amount of capacity that can be called upon by the customers to generate the electricity the customer may call upon during the month. Additionally, a CRSP customer pays $0.0095 per kWh delivered. This is the charge for electrical energy.

4.4.3.2 Method for Determining the SLCA/IP Rate Impact of the Action Alternative

Western's CRSP-Management Center sets the rate for SLCA/IP firm electric service using a Power Repayment Study (PRS). PRS methods are described in the law as part of Federal regulations and policy and in accord with sound business principles as determined by Western. The PRS is a 50-year or more study to ensure that the SLCA/IP rate is adequate to meet Western's obligations to pay for irrigation projects with long repayment periods.

Since the period of time examined in the PRS is long, forecasts of operating expenses beyond the next couple of years are speculative. Electrical purchases made by Western from the electrical market to supplement hydroelectric generation in "out years" are based on average hydrological conditions and average market prices. In order to assess the impact of changed operations at Flaming Gorge Dam, it was necessary to calculate an "average" change in the timing of generation at this facility. Since the PRS includes substantial amounts of purchases of electricity in the "out years," the changed generation pattern at Flaming Gorge as a result of the Action Alternative can be characterized as an "average" change in the amount of purchases required included in the PRS.

Using the prices for electricity purchased from the market used in the PRS, Western calculated that the Action Alternative would lessen Western's SLCA/IP purchase requirements by an average of approximately $950,000. This approximate reduction in SLCA/IP requirements' purchase would not have a significant impact on the rate CRSP customers pay.

4.4.3.3 Financial Analysis Results

Using the PRS, Western calculated the SLCA/IP rate impact of reducing the purchase electrical power requirement by $950,000 in each year of the PRS. Table 4-6 describes the result.

Table 4-6.—Change in SLCA/IP Electricity Price as a Result of the Action Alternative

	No Action Alternative	Action Alternative	Change
Composite (mills per kWh)	20.72	20.57	-0.15
Energy Charge (mills per kWh)	9.5	9.43	-0.07
Capacity Fee ($ per kW per month)	4.04	4.02	-0.02

4.5 AGRICULTURE

This section presents a comparative analysis of the effects of the No Action and Action Alternatives on agriculture.

4.5.1 Introduction and Methodology

Environmental consequences to the agricultural sector are projected as changes to the number of acres of alfalfa hay produced in Uintah County. Estimates of how many acres of agricultural land might be inundated by the selected riverflows were obtained from Reclamation personnel in the Provo Area Office. This acreage is found only in Reach 2 (and possibly Reach 3).

Alfalfa hay is the predominant crop in the county in terms of acreage and total value. Thus, alfalfa hay was selected as the representative crop for this analysis. All damage estimates were based on the costs and returns of alfalfa hay, even though some pasture and grass hay acreage was identified as being impacted by the riverflows in the Action Alternative. The selection of alfalfa hay as the representative crop placed this analysis on a worst-case scenario. In other words, the damage estimates would be higher using only alfalfa hay as the damaged crop than they would if a mix of crops were used. However, it can be presumed that, because alfalfa hay is such a dominant crop in terms of acreage, it is highly likely that acres currently producing corn silage, barley, or grass hay may soon be rotated into alfalfa hay.

A simple crop cost and returns budgeting methodology was used for estimating damages to the agricultural sector. Crop cost and return information for alfalfa hay was obtained from the Utah State University published *Extension Cost and Returns* bulletins.

4.5.2 Comparison of Impacts for the No Action and Action Alternatives

Estimates of changes to crop acres were available for three observed riverflow levels: 20,000 cfs; 22,000 cfs; and 25,000 cfs. These flow levels were evaluated under both the No Action and the Action Alternatives. The difference between the two alternatives is in the probability of seeing these flow levels and the duration of the high flows. For example, under the No Action Alternative, there is a 42.8% chance of a 20,000-cfs riverflow. By comparison, the probability of a 20,000-cfs flow increases to 46.5% under the Action Alternative. The duration of a 20,000-cfs flow also increases from 11.1 days on average to 13.7 days when comparing the Action Alternative to the No Action Alternative.

Table 4-7 shows the probability and duration of riverflows for the No Action and Action Alternatives.

When the threshold flow levels are imposed, the number of crop acres affected changes. Under the 20,000-cfs flow, 245 acres of crops are inundated. When the flow levels increase to 22,000 cfs, the number of inundated acres increases to 652 acres. At the 25,000-cfs flows, 792 acres are inundated. These changes in the number of acres of crops lost assume that the duration of flooding is such

Table 4-7.—Probability of Occurrence and Average Duration of Riverflows for the No Action and Action Alternatives

		No Action Alternative		Action Alternative			
Threshold (cfs)	Acres Affected	Probability (%)	Duration (Days)	Probability (%)	Change in Probability	Duration (Days)	Change in Duration (Days)
20,000	245	42.8	11.1	46.5	+ 3.7	13.7	+ 2.6
22,000	652	26.1	9.9	28.1	+ 2.0	11.0	+ 1.1
25,000	792	13.1	9.7	13.8	+ 0.7	7.8	- 1.9

that all production would be lost from these acres for the year in which the flow threshold is reached.

From table 3-2 in chapter 3, Uintah County averages 41,860 acres of cropland. Thus, at flow levels of 20,000 cfs, one-half of 1% of the county's crop acres are affected. At the 22,000- and 25,000-cfs thresholds, 1.5 and 1.9% of the county's acres are affected, respectively.

If all 41,860 acres of cropland in Uintah County are assumed to be producing alfalfa hay (the representative crop), the gross value of production would be $13,572,700. Taking 245 acres out of production (due to the 20,000-cfs flow level) would lead to a loss in gross value of production of $79,440. This change in gross value of production is calculated by multiplying the gross value per acre for alfalfa hay ($324.24) times the number of acres affected (245 acres). Subsequent changes to the gross value of production for the 22,000- and 25,000-cfs riverflows reduce the gross values of production by $211,400 and $256,800, respectively. Percentage-wise, these reductions to the gross value of production equate to 0.6, 1.6, and 1.9%, respectively.

On a probabilistic basis, going from the No Action to the Action Alternative increases both the probability and the duration of the flooding. For example, when the No Action Alternative is compared to the Action Alternative, the probability of having a riverflow of 20,000 cfs increases from 42.8% to 46.5%—an increase of 3.7%. Over a 100-year time span, this means that, under the Action Alternative, farmers would have crop losses in 46.5 of the 100 years. If the gross value ($324.24 per acre times 245 acres) lost in each of the 46.5 years is added up, crop losses would total $3,693,900 under the Action Alternative. This compares to a cumulative loss of $3,400,000 ($324.24 per acre times 245 acres times 42.8 years) under the No Action Alternative. On a percentage basis, the Action Alternative increases economic losses to farmers by 8.64% over a 100-year period.

Any perceived difference in losses accruing to farmers when evaluating the probability of economic damages is more than offset by the duration of the flooding, however. Alfalfa hay cannot withstand long periods of inundation. In all likelihood, crop losses for the affected acres would be complete under both the No Action and the Action Alternatives. Thus, the Action Alternative cannot be identified as the sole causal agent of additional economic damages to the agricultural sector.

4.6 LAND USE

Reclamation determined land ownership, land use, and the impacts to potentially affected lands by utilizing the U.S. Geological Survey (USGS) topographic maps, county plats, inundation overlays at various riverflows, conducting site visits, and meeting with property owners and various parks and facilities managers along the river.

4.6.1 Flaming Gorge Reservoir and National Recreation Area

The operational scenarios of either the Action or No Action Alternative would have little or no significant impacts to most land use around the reservoir and in the Flaming Gorge National Recreation Area above the dam. Figure 4-1 shows that the maximum mean monthly elevations (July) for both the Action Alternative and the No Action Alternative are very similar. Therefore, the effects to the land use from any maximum elevations in the reservoir will not be significantly different from the effects experienced for the past 10 years. In the winter and early spring, there may be positive effects from the Action Alternative since it maintains a mean monthly reservoir elevation almost 2 feet greater than the No Action Alternative (figure 4-1). Damage to land and resources can occur when water levels drop below certain elevations exposing lands normally inundated or causing problems at boat ramps.

At the upper end of Flaming Gorge Reservoir, there are many roads and access points to the reservoir that may be affected by fluctuations in the water level due to operational releases mandated by either alternative. However, these effects will not be significantly different than previous effects experienced during the past 10 years.

4.6.2 Green River Reach 1

The terrain features and land ownership throughout Reach 1 (see section 3.6.2) restrict its land use to limited recreational pursuits such as camping, hiking, boating, and rafting. This section will generally address some of the impacts to the facilities associated with these activities such as campsites, boat ramps, access roads, and recreational trails. For a more detailed assessment of the impacts to these recreational facilities, see section 4.11.

According to figure 4-5, under wet conditions, some facilities (e.g., campgrounds, boat ramps, portions of the recreation trails) will be impacted more frequently under the Action Alternative than under the No Action Alternative. Throughout Reach 1, there are campgrounds that might be impacted in the No Action Alternative scenario during an average year. In the Action Alternative, during an average year, these same campgrounds have an equal chance of being impacted as in the No Action Alternative. During the wet years, access roads, boat ramps, and campsites throughout Reach 1 have a greater chance of being impacted under the Action Alternative.

4.6.3 Green River Reach 2

The unchecked influx of the Yampa River greatly affects the potential impacts to land areas in Reach 2. In the No Action Alternative, peak releases in all scenarios (dry, average, and wet hydrology) would be made with the intent of achieving peak flows at Jensen, Utah, of 13,000 to 18,000 cfs. Studies (*Green River Floodplain Habitat Restoration Investigation* and *1998 Floodplain Habitat Restoration Status Report*) have shown inundation to begin in specific areas between 13,000 and 15,000 cfs, depending on levee placement. Although there may be some impacts to some of the private agricultural lands and the oil and gas well operations (mainly restricted access), adjacent landowners have become accustomed to these flows during peak runoff times. Also, because the influx of the Yampa River is unchecked, peak flows in the Green River in Reach 2 have exceeded 18,000 cfs in some years. Therefore, the No Action Alternative has little or no significant impacts.

In the Action Alternative average hydrology scenario, releases would provide a peak flow in Reach 2 that exceeds 18,600 cfs and would exceed 18,600 cfs for a duration of at least 2 weeks in some years. In the wet hydrology scenario, releases would provide a peak flow in Reach 2 that exceeds 26,400 cfs and would exceed 22,400 cfs for a duration of at least 2 weeks in some years. Since these flows exceed the desired peak flows of 13,000 to 18,000 cfs of the No Action Alternative, there is a potential for greater serious impacts to agricultural lands and oil and gas well operations.

The difference in impact to the four highway bridge crossings when comparing the Action and No Action Alternatives is insignificant. The bridges appear to have been designed, constructed, and maintained to withstand all the flow regimes being considered in this study and have proven that over time. The pipeline crossings also appear to be sufficiently engineered and constructed to withstand all possible flows being considered in this study.

4.6.4 Green River Reach 3

The impact of Reach 2 flows, along with the influx from the White River and San Rafael River, directly affect the potential impact to land areas in Reach 3. While flows may impact private, agricultural, oil and gas, and recreation lands, adjacent landowners have become accustomed to these flows during peak runoff times. Where unchecked peak flows in Reach 2 have exceeded 18,000 cfs in some years, with little or no significant impact, it is expected that the same will hold true in Reach 3.

In the Action Alternative, assuming an average hydrology scenario, releases would provide a peak flow in Reach 3 that exceeds 24,000 cfs and would exceed 24,000 cfs for a duration of at least 2 weeks in some years and a peak flow of 39,000 cfs for at least 1 day in 4.6% of the years. With the desired peak flow being 13,000 to 18,000 cfs, there is a potential for a more serious impact to agricultural lands (see section 4.5.2) under the Action Alternative.

4.7 ECOLOGICAL RESOURCES

This section describes the potential consequences to wildlife and vegetation, both land based and aquatic, of operating Flaming Gorge Dam under both the No Action and Action Alternatives.

4.7.1 Flaming Gorge Reservoir

4.7.1.1 Reservoir Fish

4.7.1.1.1 No Action Alternative – The No Action Alternative provides fewer benefits for kokanee than the Action Alternative. Reservoir drawdown in the winter (October to April) causes mortality of kokanee salmon eggs and embryos. Since dissolved oxygen declines with increasing depth, greater survival occurs in shallower water. As this shallow water is lost due to reservoir drawdown, the most viable embryos are lost. During wet years, reservoir elevation would fluctuate more between seasons under the No Action Alternative than under the Action Alternative. Under intense dry cycles, reservoir elevations decline further under the No Action Alternative (as much as 8 feet lower). Reservoir elevation and fluctuations would not significantly affect the reservoir fishery beyond existing conditions.

Entrainment of fish has been documented during the few times water was passed over the spillways. Fish that have been entrained from Flaming Gorge Reservoir include kokanee salmon, rainbow trout, lake trout, and smallmouth bass (Schneidervin, 2003). Little is known of the fate of these fish. Bypasses above powerplant capacity (4,600 cfs) are expected to occur in 23% of all years under the No Action Alternative.

4.7.1.1.2 Action Alternative – Under the Action Alternative, the winter reservoir pool will not be drawn down below levels that have occurred in the past. Therefore, kokanee recruitment would not be reduced beyond current levels. Reservoir elevations will fluctuate less between seasons, which would benefit kokanee egg incubation by inundating favorable substrates and reducing egg desiccation.

Hydrologic modeling shows that bypasses above powerplant capacity (4,600 cfs) will occur in 50% of all years to meet the 2000 Flow and Temperature Recommendations, with use of the spillways expected in 27% of all years. In other river systems, like the Columbia River, there are accounts of large losses of kokanee to entrainment from reservoirs (Maiolie and Elam, 1998). Small numbers of kokanee have been entrained at Flaming Gorge Dam during the infrequent spills in the past. However, based on the longitudinal and vertical distribution of kokanee in Flaming Gorge Reservoir, it is not expected that increased frequency of spills associated with the Action Alternative would result in significant losses of kokanee (Schneidervin, 2003). During the spring, when the spillway would be used, Utah Division of Wildlife Resources (UDWR) has determined that the closest concentrations of the kokanee are found 5 miles from the dam near Jarvies Canyon. These spring concentrations are comprised primarily of older fish, which are less susceptible to entrainment.

UDWR has determined that rainbow trout, lake trout, and smallmouth bass have also been entrained in past spill events. Rainbow trout are not commonly found near the dam during the spring. Therefore, the reservoir population is affected minimally by spillway losses. There is a small population of smallmouth bass very near the spillway, but as this is a very territorial species, UDWR suspects relatively few are entrained as well (Schneidervin, 2003).

Whereas the increased incidence of entrainment of reservoir fishes is not expected to present a measurable impact to the reservoir fishery, there are potential impacts to the native fish in the Green River downstream from the dam (discussed in section 4.7.2.4.2).

4.7.1.2 Aquatic Food Base

4.7.1.2.1 No Action Alternative – Due to the predominantly planktonic nature of the aquatic food base in Flaming Gorge Reservoir, operation of Flaming Gorge Dam under the No Action Alternative, as it impacts water elevations, is not expected to affect the aquatic food base in the reservoir beyond existing conditions.

4.7.1.2.2 Action Alternative – A significant fraction of the Flaming Gorge Reservoir aquatic food base is comprised of planktonic productivity. Since magnitude of drawdown is expected to be slightly less under the Action Alternative, the downlake extent of noxious algal blooms is expected to be less than under the No Action Alternative. Noxious algal forms such as cyanobacteria typically contribute little to production at higher trophic levels. Therefore, operation of Flaming Gorge Dam under the Action Alternative is expected to slightly benefit the aquatic food base in the reservoir.

4.7.1.3 Vegetation

4.7.1.3.1 No Action Alternative – Vegetation around the reservoir would continue to remain limited to those areas characterized by lower gradient slope, fine soils, and shallow groundwater connections. Riparian vegetation would continue to be predominately found at tributary mouths.

4.7.1.3.2 Action Alternative – In the near term (first 10-20 years), vegetation response would remain similar to the No Action Alternative. There would be little additional development of vegetation due to fluctuating reservoir levels remaining similar to the No Action Alternative. In the long term (30-year projection), the Flaming Gorge Model predicts decreasing reservoir water elevations. Under this scenario, opportunities for expansion of vegetation would likely increase. Invasive species such as tamarisk would likely take advantage of unvegetated areas for expansion downslope. If development of fine soils occurs, clonal species in the willow and sedge families would eventually expand downslope as well.

4.7.1.4 Terrestrial and Avian Animals

Terrestrial and avian animals are mobile and capable of following water related resources as they change with reservoir water level fluctuations. The ability of these animals to reach and exploit water or water related food or habitats would not be hampered under either alternative.

4.7.1.4.1 No Action Alternative – Operation of Flaming Gorge Dam under the No Action Alternative is not expected to affect land-based animals or birds. Food and habitat provided by vegetation linked to the reservoir and its fluctuations would remain available as currently distributed, especially near water connections to the reservoir like springs, seeps, and streams. Terrestrial and avian animal populations would not be expected to change due to reservoir operations under the No Action Alternative since these operations would not change these animals' access to, or the extent of, exploitable food or habitat resources.

4.7.1.4.2 Action Alternative – Operation of Flaming Gorge Dam under the Action Alternative is not expected to affect land-based animals or birds. Fluctuations in the reservoir's water level would be slightly reduced, and average reservoir elevations would vary by 1.5 feet when compared to the No Action Alternative (see figure 4-1). These variations could have some influence on vegetation surrounding the reservoir over the long term. This slight adjustment of habitat would occur slowly, allowing animal populations sufficient time to adjust home ranges and habits to suit prevailing conditions.

4.7.2 Green River Downstream From Flaming Gorge Dam – Reach 1

4.7.2.1 Aquatic Food Base

4.7.2.1.1 No Action Alternative – Provision for releases in excess of powerplant capacity is identified in the 1992 Biological Opinion and has occurred in recent years. Monitoring of the macroinvertebrate community indicates that during these high flows *Cladophora* beds can be reduced and the macroinvertebrate community can shift from amphipod-based to aquatic insect-based. This is not necessarily bad for the resident trout, which use aquatic insects throughout the year, and the *Cladophora* typically recovers within a year (Vinson, 1998).

Cladophora production is highest in permanently wetted zones and lowest in fluctuating zones with daily exposure. *Cladophora* production is highest in the summer. *Cladophora* standing crops are expected to vary little through continued implementation of the 1992 Biological Opinion flows with rare exceptions when releases occur in excess of powerplant capacity.

New Zealand mud snails have become established in recent years; however, their occurrence is not a result of current dam operations. This species is currently increasing in distribution and abundance in Reach 1. Dr. Mark Vinson (Utah State University) speculates that habitat may not be suitable downstream into Lodore Canyon. The ultimate effect this invasive species will have on the aquatic ecosystem is not yet known.

4.7.2.1.2 Action Alternative – Productivity within the river is controlled by many factors, including light transmittance through changes in water clarity. Sediment mixing from fluctuating releases and sediment supply from tributaries both affect river water clarity. Reducing daily fluctuations would improve water clarity. Improved water clarity would improve primary production of the systems food base.

The food base for trout increases as the minimum reliable discharge increases. Higher base flows and decreased daily flow fluctuations in average and wetter years would lessen the extent of dewatering (exposure) and increase the extent of habitat available for food base organisms. Some fluctuation in flows would still occur.

The increased variability in seasonal flows and the increased incidence of flows that exceed powerplant capacity would have the potential to reduce the standing crop of *Cladophora* and biomass of macroinvertebrates in the short term. However, macroinvertebrate sampling after the high flows of 1997 and 1999 indicated that the number of species increased (Vinson, 1998). Managing for warmer releases (up to 59 ºF) immediately following these high spring releases should serve to speed recovery of the aquatic food base and should also promote species richness.

The aquatic food base would likely experience short-term declines as a result of the more frequent peak release (greater than [>] 4,600 cfs) but would recover more quickly during the recommended base flows and thermal regime. Research by Utah State University and the State of Utah found that the trout population appeared to suffer little as a result of these high flows (Vinson, 1998).

New Zealand mud snails could be negatively impacted by the increased frequency of flow in excess of powerplant capacity. This invasive species has been found in highest concentrations on rooted aquatic vegetation. Higher flows would likely reduce the standing crop of rooted aquatics, thereby reducing the number of New Zealand mud snails. Continued monitoring would be required to determine whether the Action Alternative affects this recently introduced species.

4.7.2.2 Threatened and Endangered Fish

4.7.2.2.1 Colorado Pikeminnow –

4.7.2.2.1.1 No Action Alternative – Adult and late juvenile Colorado pikeminnow would continue to utilize habitats in Reach 1 as they do currently. Pikeminnow reproduction has not been documented in Reach 1 and would not be expected to occur in the future.

4.7.2.2.1.2 Action Alternative – Reach 1 provides habitat for adult and late juvenile Colorado pikeminnow. It is unlikely that early life stages use habitats in Reach 1, but the potential exists for spawning to occur there. Greater frequency of releases in excess of powerplant capacity could serve to benefit pikeminnow in the following manner:

(1) Maintain adult habitat in Lodore Canyon

(2) Cleanse potential spawning habitat in Lodore Canyon and aid in the formation of native fish nursery areas in Island and Rainbow Parks

(3) Reduce the numbers of nonnative fishes, particularly in Lodore Canyon

Expected benefits to other native fish from reduced fluctuations during the base flow period would likely also benefit pikeminnow by increasing their food base.

Implementing the 2000 Flow and Temperature Recommendations could benefit Colorado pikeminnow greatly in Reach 1. Recent investigations suggest that Colorado pikeminnow adults may have overwintered in Reach 1 during the extremely low flow year of 2002 (Kitcheyan, 2003). During the summer of 2002, when flows were at a steady 800 cfs, the main channel warmed to an average daily temperature of 73 ºF (23 °C) in lower Lodore Canyon.

Researchers with the U.S. Fish and Wildlife Service in Grand Junction, Colorado, have characterized river reaches throughout the Upper Colorado River Basin that hold Colorado pikeminnow year round in terms of "thermal units." Thermal units were calculated based on Colorado pikeminnow's relative growth as a function of temperature. In experimental trials, pikeminnow were found to stop growing at temperatures less than (<) 55 ºF (13 ºC) and were found to maximize growth at temperatures of 77 ºF (25 ºC). Therefore, a thermal unit can be calculated (a nonlinear relationship) for daily mean temperatures. Daily means of 55 ºF (13 ºC) result in a thermal unit of "0" (no growth) ranging up to a value of "1" (optimum growth) when daily temperatures averaged 77 ºF (25 ºC)

(Osmundson, 1999). Summing these daily thermal units, they found that reaches where Colorado pikeminnow establish home ranges characteristically have 40 annual thermal units (ATU).

The Flaming Gorge Temperature Model was used to generate a thermal regime for the months of July and August at upper Lodore Canyon, and then thermal units for those days were calculated. The Green River at Browns Park and the lower Yampa River accumulate roughly 60% of their annual thermal units in an average year during the months of July and August; therefore, the threshold for this analysis was 24 ATUs (60% of Osmundon's 40 ATU threshhold). Releasing water from Flaming Gorge Dam at a temperature of 59 ºF (15 ºC) (Action Alternative) results in more ATUs in Lodore Canyon, except in wetter years (figure 4-14).

Colorado pikeminnow are expected to benefit from implementing the 2000 Flow and Temperature Recommendations in the short and long terms. Whether this shift toward the natural hydrograph and thermograph is sufficient to result in Colorado pikeminnow spawning remains uncertain and should be monitored. Combined effects of the Action Alternative (increased spill frequencies and river warming) could result in the establishment or increased abundance of nonnative species in Reach 1. This potential outcome would be detrimental to Colorado pikeminnow in Reach 1 but remains an uncertainty that should be monitored.

4.7.2.2.2 Humpback Chub –

4.7.2.2.2.1 No Action Alternative – Humpback chub have not been collected in Reach 1 since the construction of Flaming Gorge Dam. A canyon-dwelling species, the humpback chub has not re-colonized Lodore Canyon, apparently due to the depressed summer water temperatures. Continued operations under the No Action Alternative would not likely result in the re-establishment of humpback chub in this portion of the river.

4.7.2.2.2.2 Action Alternative – Based on research conducted on other humpback chub populations, increased frequency of higher releases from Flaming Gorge Dam may benefit reproductive success should they become re-established in Reach 1 in the future. The humpback chub is a very sedentary species; however, implementation of the 2000 Flow and Temperature Recommendations may attract fish from nearby populations in the Yampa River and Whirlpool Canyon. Humpback chub spawn at temperatures above 63 ºF (17 ºC), which should be achieved in Lodore Canyon during the summer months under all hydrologic scenarios (table 4-4).

4.7.2.2.3 Razorback Sucker –

4.7.2.2.3.1 No Action Alternative – Razorback sucker adults have been collected in very low numbers in Lodore Canyon, but spawning has not been documented in Reach 1. Under the No Action Alternative, it is assumed that the future abundance of adult razorback sucker in Reach 1 would be directly linked to the larger Green River subbasin population. If the population of razorback suckers increases in Reach 2 as a result of the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) activities (stocking, nonnative control, and flood plain restoration), the incidence of adults in Reach 1 could be expected to also increase. Under the No Action Alternative, current flow and temperature regimes in lower Reach 1 may be adequate for main channel spawning. Razorback suckers in middle Green River (Reach 2) spawn at the same time and on similar habitats as flannelmouth sucker, as evidenced by hybridization between these two native species. Flannelmouth sucker currently spawn in Lodore Canyon; and, therefore, it is reasonable to assume that razorback sucker could as well.

More information needs to be gathered to better understand the relationship between environmental variables and reproductive

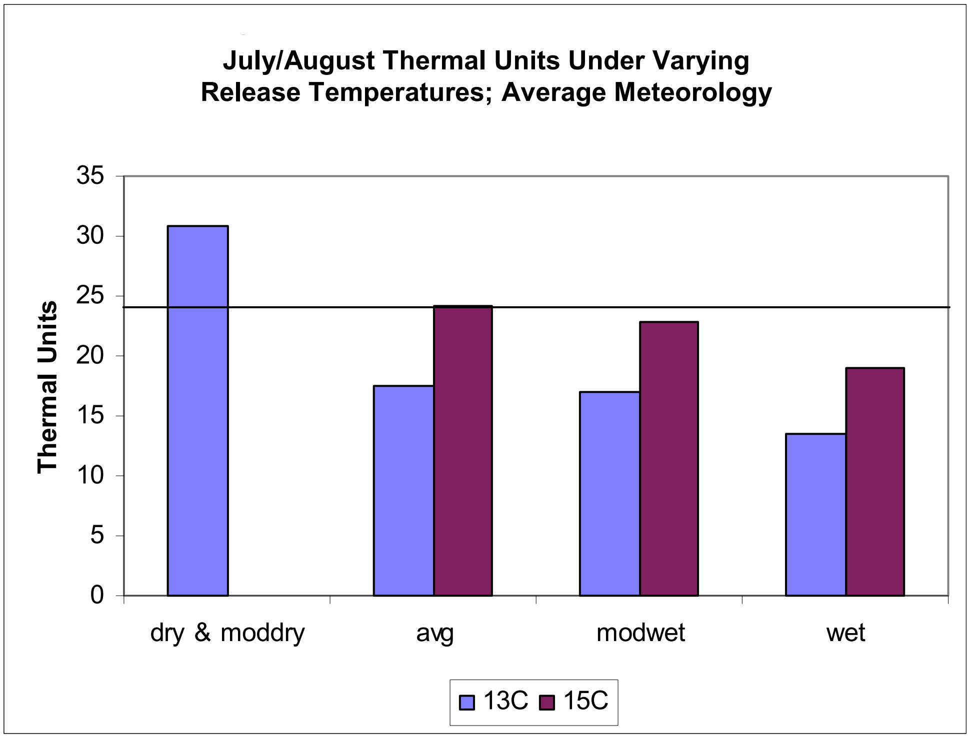


Figure 4-14.—Thermal Units Accumulated in Upper Lodore Canyon (46 Miles Below Flaming Gorge Dam) Under Various Hydrologic Scenarios. As indicated in the Flaming Gorge Model, likely base flow releases for each hydrologic category are as follows: dry and moderately dry (800 cfs); average (1,400 cfs); moderately wet (2,000 cfs); and wet (2,400 cfs). Average daily temperatures used to derive ATUs were excerpted from the Flaming Gorge Temperature Model (Dr. John Carron, Hydroshpere Resource Consultants). A horizontal line was drawn at 24 ATUs, which represents a threshold value that characterizes suitable Colorado pikeminnow home range. Note: There is no value for 59 °F (15 °C) during the dry and moderately dry years, which is consistent with the Action Alternative.

success. Based on the razorback sucker's apparent reliance on inundated flood plains to serve as nursery habitat for their young, it is unlikely that this species would ever complete its life cycle in Reach 1 under the No Action Alternative.

4.7.2.2.3.2 Action Alternative – The Green River subbasin population stands a greater chance of increasing through implementation of the flows identified in the Action Alternative (see Reach 2 discussion). As mentioned above, under the No Action Alternative, conditions may already be present for successful razorback sucker spawning. Therefore, the flows and temperatures called for under the Action Alternative would only increase the likelihood of successful razorback sucker spawning in Lodore Canyon. However, warmer releases identified in the Action Alternative could also improve conditions for razorback suckers upstream of Lodore Canyon. The alluvial channel through Browns Park and the potential flood plain habitat found there is a preferred habitat type of both young and adult razorback sucker. River warming could extend the range of razorback sucker upstream into these important habitats.

Flow and temperature management alone will not likely result in the recovery of this species. However, coupled with ongoing

Recovery Program efforts to effectively control nonnative fish, augment the existing population (stocking), and develop habitat, the 2000 Flow and Temperature Recommendations should benefit razorback sucker in the short and long terms.

4.7.2.2.4 Assumptions and Uncertainties Regarding Bonytail – The authors of the 2000 Flow and Temperature Recommendations did not factor the needs of the bonytail into their recommendations because information on the species' life history and the physical processes that affect its habitats was not available. The authors stated that "the flow and temperature recommendations that are made for the other endangered fishes would presumably benefit any bonytails that remain in the system and would not limit their future recovery potential."

4.7.2.3 Nonlisted Native Fish

4.7.2.3.1 No Action Alternative – Native suckers (flannelmouth and bluehead) and the roundtail chub occupy habitats in Lodore Canyon and likely occupy habitats in lower Browns Park. Current upstream distribution is limited by temperature more than by flow. Although all species reproduce successfully in Lodore Canyon, they are likely limited by both the current hydrology and the current thermal regime. Under the No Action Alternative, short-term changes in the distribution and abundance of these species are not expected.

There is increasing evidence of native sucker hybridization with the nonnative white sucker (Bestgen and Crist, 2000). Continued operation to meet the 1992 Biological Opinion flows and maintain the current thermal regime would likely result in a long-term increase in the incidence of native sucker/white sucker hybridization, which is expected to be detrimental to the native sucker population in Reach 1.

4.7.2.3.2 Action Alternative – Reproductive success of these three species increases during years of average and wetter spring flow in other Upper Colorado River Basin rivers and in the lower reaches of the Green River. The increased incidence of flows in excess of powerplant capacity should serve to cleanse spawning substrates for these native fish and could result in increased reproductive success.

In all but the driest years, base flows under the Action Alternative will be higher and more stable. The 2000 Flow and Temperature Recommendations call for extending these base flows through the winter, which results in lower but more stable base flows during that portion of the year when compared with the No Action Alternative. This new base flow prescription under the Action Alternative should benefit the resident native fish by creating more stable backwater habitat, increasing the aquatic food base during the summer and fall, and providing more stable overwintering habitats for young-of-the-year (YOY) native fish inhabiting Lodore Canyon and perhaps lower Browns Park.

Native suckers spawn in the spring on the ascending limb of the hydrograph when temperatures reach approximately 54-60 ºF (12-15 ºC). The current thermal regime has not likely been as limiting for spawning suckers as for roundtail chub, which prefer temperatures of 61-68 ºF (16-20 ºC) to spawn. Water temperatures in excess of 64 ºF (18 ºC) will be targeted in the upper portion of Lodore Canyon. During dry hydrology years, the minimum threshold should be exceeded by several degrees for several weeks. Temperature modeling predicts that this threshold can be met in all years. To meet the minimum 64 ºF (18 ºC), release temperatures would need to be 59 ºF (15 ºC) during average and wetter years (see table 4-4) to compensate for reduced warming rates at the higher base flows.

River warming associated with the Action Alternative is expected to benefit these native fish through an overall increase in productivity and increased growth rates. The resident population of roundtail chub in Lodore Canyon is expected to benefit from the river warming by increased reproductive success as well as increased growth rates for all life stages. During the dry hydrologies, there is potential to use high temperature to reduce brown trout, a nonnative predator in Lodore Canyon.

Hybridization between native suckers and nonnative white suckers could be reduced through implementation of the proposed temperature recommendations. White suckers prefer temperatures cooler than the native Colorado River suckers and have proliferated throughout Reach 1 in the artificially cooled waters. The return to a more natural hydrograph and thermal regime in this portion of the river may shift the distribution of nonnative white sucker upstream, reducing their overlap with the native suckers in Lodore Canyon.

Studies in other portions of the Upper Colorado River Basin suggest that speckled dace, a small bodied native species found in Lodore Canyon, would likely benefit from the return to a warmer, more variable flow regime. Mountain whitefish and mottled sculpin are categorized as cool water native species that have taken up residence in Lodore Canyon under historical dam operations. Implementation of the Action Alternative may result in restricting their distribution to the upper reaches of Reach 1, which would represent a return to more natural (pre-dam) conditions.

Overall, native species would be expected to benefit, in the long term, from a return to a more natural hydrograph and thermal regime as is proposed in the Action Alternative.

4.7.2.4 Nonnative Fish

4.7.2.4.1 Cold Water (Trout) –

4.7.2.4.1.1 No Action Alternative – Utah Division of Wildlife Resources biologists have identified concerns for the trout fishery when average daily temperatures reach and exceed 70 ºF (21 ºC) at the Colorado/Utah State line (Schneidervin, 2003). Their concerns are consistent with general temperature preferences for trout reported by researchers in other systems (see chapter 3, "Affected Environment"). Modeling indicates that the river at the Colorado/Utah State line reaches this critical level (see table 4-3) during dry years with hot summer temperatures, similar to conditions of the summer of 2002. During the summer of 2002, measured average daily temperatures at the Colorado/Utah State line warmed to approximately 66 ºF (19 ºC). Fishery data were not collected in the lower portion of the trout fishery in 2002 to determine if there were negative impacts.

The critical period for brown trout reproduction extends from early October to late May (Modde et al., 1991). Daily base flow fluctuations negatively impact reproductive success by desiccating redds (nests) and causing young fish to exert more energy in search of optimum habitats along the channel margins. Under the No Action Alternative, daily fluctuations during the summer base flow period are greater in wet years, the same as the Action Alternative in average years, and less in dry years. Fluctuations under the No Action Alternative are always less restricted during the winter.

Under the No Action Alternative, 23% of spring peak flows would be expected to exceed powerplant capacity (4,600 cfs) as compared with 50% under the Action Alternative. This reduced frequency of high flows contributes to a more stable environment, which benefits trout by providing more juvenile trout habitat and maintaining a stronger forage base.

Trout populations are expected to remain at high levels and the individual trout in good condition through maintenance of current release patterns and temperatures under the No Action Alternative.

The potential future occurrence of whirling disease in the Green River tailrace fishery is not influenced in any way by the No Action Alternative.

4.7.2.4.1.2 Action Alternative – Compared with the No Action Alternative, flows during the base flow period will vary less because restrictions that applied only to the summer and fall have been extended through the winter. Reduced flow fluctuations through the winter, particularly January through March, should greatly benefit overwinter survival of trout (Schneidervin, 2003). During the rest of the year, daily fluctuations during the base flow period would be reduced in wet years, the same as the No Action Alternative in average years, and greater in dry years.

Trout benefit from reduced daily fluctuations. A decrease in daily fluctuations (particularly during wetter years) would reduce the number of trout redds exposed and lost to these fluctuations. Lowering the number of lost or failed redds would aid in the development of a more self-sustaining trout fishery. Effects of reducing fluctuating flows are most prominent directly below Flaming Gorge Dam. Reducing frequent fluctuations reduces fish stranding, increases the potential for successful reproduction in trout, and may improve growth and condition of trout due to benefits to the food base. Another important benefit of reducing frequent fluctuations is decreased fish displacement and associated energy expenditures.

Increased summer and fall base flows during average to wet years would increase the amount of available spawning substrate for fall spawning trout. These areas would remain inundated throughout the period of egg development and hatching. Lower winter flows, particularly during January through March, should benefit the tailwater trout fishery by providing optimal winter habitat, according to Modde et al. (1991) and Johnson et al. (1987).

The increased variability in seasonal flows and the increased incidence of flows that exceed powerplant capacity under the Action Alternative would have the potential to reduce the biomass of macroinvertebrates (food base) and potentially displace young fish downstream. These impacts could be detrimental to the trout fishery.

Increased frequency of spillway releases raises concerns of nitrogen supersaturation and potential impacts to the tailrace trout fishery. UDWR biologists collected dissolved oxygen and nitrogen levels in the tailrace during spill events in the 1980s and again in 1997. The waters at the base of the dam were supersaturated with oxygen and nitrogen, 111% and 110%, respectively; however, these levels were reduced quickly downstream. The readings at the dam represent borderline levels of concern, but no adverse effects to trout were documented during the 1997 spill event in the Flaming Gorge tailrace. Fish kills due to supersaturation are generally associated with very deep plunge pools, approaching 100 feet, in the tailrace of larger river systems. It is rare to have fish kills due to gas supersaturation with shallow plunge pools in the tailrace such as Flaming Gorge Dam. It is the opinion of the UDWR fish biologists that supersaturation impacts to trout in the Flaming Gorge tailrace are a relatively minor concern (Schneidervin, 2004).

The downstream distribution of trout populations can be limited by temperature. River temperatures throughout Reach 1 are a function of the release temperature at Flaming Gorge Dam, the release volume, and ambient air temperatures (see table 4-4). In dry and moderately dry years, base flows under the Action Alternative will likely be 800 cfs. During those years, 55 °F (13 ºC) water would continue to be released from the dam, resulting in a modeled average daily temperature of 65 °F (19 ºC) in an average summer and 68 °F (20 ºC) in a hotter than normal summer at the Utah/Colorado State line. Release temperature would be raised to 59 °F (15 ºC) in average to wet years when base flows are >1,200 cfs. During those years, temperatures at the State line would likely be similar or slightly cooler than discussed above. There are always concerns for the cold water trout fishery when warming the river is discussed. However, the worst case No Action Alternative temperature scenario for the trout fishery near the State line remains the same under the Action Alternative. Warmer dam releases associated with the Action Alternative could result in increased production of macroinvertebrates (fish food) and improve trout growth, particularly in river sections closer to Flaming Gorge Dam. The benefit of increased productivity is expected to help offset the negative impact associated with higher spring releases. As is discussed under section 4.7.2.2, "Threatened and Endangered Fish," this management scenario should meet minimum temperature recommendations for native fish downstream in all years, while providing better temperatures for trout during average to wetter years.

The Action Alternative has the potential of causing both positive and negative short-term impacts to the trout fishery below Flaming Gorge Dam. In the long term, the trout fishery is not expected to be negatively impacted. Continued monitoring of this fishery by UDWR will be necessary to determine actual impacts.

The potential future occurrence of whirling disease in the Green River tailrace fishery would not be affected by operations under the Action Alternative.

4.7.2.4.2 Warm Water (Other – Large and Small Fish) –

4.7.2.4.2.1 No Action Alternative – Large nonnatives, carp and catfish, are expected to persist at current levels in the lower portion of Reach 1, primarily in Lodore Canyon. Nonnative minnows (red shiner, fathead minnow, sand shiner, and redside shiner) are abundant in the lower portions of Lodore Canyon as well. Their current distribution and abundance has likely reached an equilibrium and is not expected to change under the No Action Alternative.

4.7.2.4.2.2 Action Alternative – Resident nonnative fishes that compete with the native species could benefit during dry years from lower base flows and during wetter years from higher release temperatures. However, the higher spring releases, particularly during wetter years, would be expected to negatively impact nonnatives such as carp and catfish in Lodore Canyon.

Of additional concern is the potential for increased entrainment of nonnative reservoir species as a result of the increased frequency of spills under the Action Alternative. Most species that have been entrained in past spill events (1997 and 1999) are relatively innocuous (rainbow trout, kokanee salmon, and lake trout); however, smallmouth bass present a greater threat.

Smallmouth bass are found in Reach 1. Temperatures in Lodore Canyon would be more suitable for smallmouth bass under the Action Alternative than under the No Action Alternative (see table 4-4).

Smallmouth bass are among the species most often cited as endangering native fishes, and it has been identified as a species of increasing concern by Hawkins and Nesler (1991) and by Lentsch et al. (1996) in the Upper Colorado River Basin. Escapement from reservoirs has been identified as an important source of introduction for this piscivore (Tyus and Saunders, 1996). Smallmouth bass are problematic for endangered fish in the Green River.

Bestgen and Crist (2000) reported smallmouth bass present in very low numbers in lower Lodore Canyon in samples taken during 1994-1996. It is believed that these bass migrated up from the Yampa River. It is noted that smallmouth bass escaped from Elkhead Reservoir, an off channel impoundment in the Yampa River drainage, and became established in that river in the last 15 years. This species appears to flourish during dry years and is preying heavily on juvenile flannelmouth and bluehead suckers, roundtail chub, and speckled dace (Anderson, 2002). In a recent evaluation of the Yampa River smallmouth bass fishery, it was brought to the Recovery Program's attention that smallmouth bass had been released into the river for many years before the species became established. Only when a large release of fish from the reservoir coincided with favorable environmental conditions in the river (during a dry year when the riverflow was low and warm) did this occur (Martinez, 2003).

Flows, temperatures, and gradients available in Lodore Canyon, particularly during dry years, fall within preferred ranges for smallmouth bass. If smallmouth bass become well established in Lodore Canyon or elsewhere in Reach 1, they could have an adverse effect on the resident native fish community, including the endangered species. There are several uncertainties about the prospect for this situation (see section 4.19, "Uncertainties").

Returning the river to a more natural hydrologic and thermal regime should have similar short- and long-term impacts on the small-bodied nonnative fish. During drier years, lower releases from the dam, resulting in warmer temperatures downstream, should benefit this group of nonnatives. Due to their early maturation and ability to spawn multiple times each summer, a few individuals colonizing an unoccupied area can result in a strong local population within 1 year. Upstream expansion of these species and increased abundances in currently occupied habitat should be expected during dry years. The potential negative effects these species have on native fishes was discussed in section 3.7.2.3.4.3. In 2003, which represents the third consecutive year of extremely low and steady summer base flows (800 cfs), upstream expansion of red shiners was observed (reference *Recovery Program Project No. 115 Annual Report* online: <http://www.r6.fws.gov/crrip/arps/2003/isf/115.pdf>).

The greater frequency of high flows in Reach 1 under the Action Alternative, particularly in Lodore Canyon, should negatively impact small-bodied nonnative fish. The Recovery Program is currently studying the fish community and Colorado pikeminnow use in Lodore Canyon and lower Browns Park. Results of those studies and continued monitoring would be used to determine the effects of implementing the 2000 Flow and Temperature Recommendations in this portion of the river.

4.7.3 Green River Downstream From Flaming Gorge Dam – Reach 2

4.7.3.1 Aquatic Animals

4.7.3.1.1 Aquatic Food Base –

4.7.3.1.1.1 No Action Alternative – Productivity pathways described in Gourley and Crowl (2002) and Crowl et al. (2002) are expected to remain in place. Food items for fish in the main channel will largely come in the form of aquatic insects. Fish that can leave the main channel and access the flood plain during high flows will find aquatic insects as well as the highest densities of zooplankton found anywhere in the river ecosystem.

Backwaters are areas of high productivity in the main channel in alluvial reaches. Base flows called for in the 1992 Biological Opinion were designed to stabilize backwater habitats through Reach 2 to serve as nursery habitats for young Colorado pikeminnow and other native fish. The aquatic food base is not expected to change under the No Action Alternative.

4.7.3.1.1.2 Action Alternative – Crowl et al. (2002) stressed the importance of the connection of the Green River with its flood plain as a means of providing a diverse, rich food supply for fish (directly for young fish, which then serve as food for larger fish). The 2000 Flow and Temperature

Recommendations are designed to increase the connection of the river with its flood plain, which should represent improvement over the No Action Alternative from this perspective.

During the base flow period, backwaters are very productive habitats through Reach 2. The proposed pattern of linking the spring and summer base flows through the varying hydrologic categories in the 2000 Flow and Temperature Recommendations is, in part, designed to better create and maintain main channel backwater habitats through Reach 2. This aspect of the Action Alternative takes a concept put forth in the No Action Alternative and attempts to improve upon it. Therefore, it is assumed that the Action Alternative would increase the main channel food base and benefit the fish community more than the No Action Alternative.

Extremely abundant nonnative fish would also benefit from any increase in food base that is realized in Reach 2. The Recovery Program will need to weigh this cost against the previously mentioned benefits to determine the ultimate effect of implementing the 2000 Flow and Temperature Recommendations.

The extent of the aquatic food base in Reach 2 should increase as minimum discharge increases and daily fluctuations decrease under the Action Alternative. Higher base flows and decreased daily flow fluctuations in average and wetter years should lessen the extent of dewatering (exposure) and increase the extent of habitat available for food base organisms (Angradi and Kubly, 1993; Blinn et al., 1995).

4.7.3.2 Threatened and Endangered Fish

4.7.3.2.1 Colorado Pikeminnow –

4.7.3.2.1.1 No Action Alternative – No Action Alternative flows were based primarily on the needs of the Colorado pikeminnow and promoted a return to a more naturally shaped hydrograph. During the spring, Flaming Gorge Dam releases were timed to coincide with the Yampa River spring peak and base flow magnitudes, and fluctuations were reduced to simulate a more natural condition. The intent of base flow recommendations was primarily to stabilize important nursery habitats in the Uintah Basin (mid- and lower portion of Reach 2). Catch rate data, collected for the Interagency Standardized Monitoring Program since 1986, indicate that the abundance of Colorado pikeminnow in the Green River has increased (McAda, 2002). The general increase in abundance of Colorado pikeminnow can be attributed, at least in part, to the implementation of the 1992 Biological Opinion flows.

In contrast, the Action Alternative builds on the earlier pikeminnow research and goes on to further define the flow/habitat relationships set forth in the 1992 Biological Opinion. Reach 2 provides nursery habitat for YOY pikeminnow and pre-spawning flood plain habitat for adults in the spring. The Action Alternative would:

(1) Better define the process of developing and maintaining pikeminnow nursery habitat.

(2) Increase the magnitude and duration of flood plain connection.

Thus, continued implementation of the 1992 Biological Opinion (No Action Alternative) flows may well provide less benefit for Colorado pikeminnow populations in the Green River than can be attained under the Action Alternative.

The No Action Alternative also makes provisions for managing Green River temperature at its confluence with the Yampa River. The purpose of this recommendation is to reduce thermal shock (abrupt changes in water temperature) to Colorado pikeminnow larvae produced in the Yampa River and drifting downstream into Reach 2. Since installation of the selective withdrawal in

1978, Reclamation has targeted summer release temperatures of 55.5 ºF (13.0 ºC). Analysis of 4 years of data (1998-2002) taken from the confluence of the Yampa and Green Rivers indicates that this temperature differential has occasionally exceeded 9 ºF (5 ºC) but never reached 18 ºF (10 ºC). Research that served as the basis for this recommendation indicated that thermal shock (from warm water into cold water) of 18 ºF (10 ºC) resulted in slightly decreased larval pikeminnow mobility for several hours (Berry, 1988).

YOY Colorado pikeminnow have been collected in nursery habitats in Reach 2 every autumn since 1986 (Trammell et al., 1999); however, abundances vary greatly. Lack of a consistent temperature data set at the confluence precludes an analysis of how differences in Green and Yampa River temperatures may have factored into the varying abundances.

Future conditions under the No Action Alternative for larval Colorado pikeminnow drifting out of the Yampa River would be expected to remain the same as those experienced under operations to meet the 1992 Biological Opinion.

4.7.3.2.1.2 Action Alternative – Colorado pikeminnow spawn in the lower Yampa River and in the lower Green River (Reach 3) but have not been observed spawning in Reach 2. Larval pikeminnow drift downstream from spawning bars to occupy nursery habitats found in Reaches 2 and 3. Colorado pikeminnow use these nursery areas during their first year of life throughout the base flow period. Nursery habitats, or "backwaters," are characteristically low velocity areas associated with main channel sandbars. Young Colorado pikeminnow prefer the deeper, more persistent backwaters in both Reaches 2 (Day et al., 1999) and 3 (Trammell et al., 1999). Rakowski and Schmidt (1999) conducted a 2-year study (1993-1994) in Reach 2 to describe the process by which backwaters were formed and maintained. They determined that a single base flow target from year to year was inappropriate because the shape of sandbars varied based on magnitude of the annual spring flood. During their study, they found that the shape and height of sandbars was defined during the relatively high runoff of 1993 (approximately 20,000 cfs); and, consequently, the base flow, needed to maximize nursery habitat availability in both years, was much greater than the base flow called for in the 1992 Biological Opinion. Peak and base flow relationships identified in each hydrologic category (dry through wet years) in the 2000 Flow and Temperature Recommendations were based on this research and are designed to optimize the formation of nursery habitats in Reaches 2 and 3. Furthermore, restrictions in seasonal and daily base flow fluctuations under the Action Alternative are designed to maintain these backwater habitats. Young pikeminnow would be expected to benefit from the increased emphasis on creation and maintenance of deep, stable nursery habitats found in the 2000 Flow and Temperature Recommendations. Rakowski and Schmidt (1999) suggested that further study of the specific base flows, needed to maximize nursery habitat annually, was warranted due to the short term of their study.

Under the Action Alternative, the duration of the spring peak is extended to increase the duration of flood plain inundation. Adult pikeminnow do not spawn in flood plain habitats; however, they use them as staging areas (warmer water prepares the adults for reproduction) and as foraging areas. Greater availability of inundated flood plains is expected to benefit Colorado pikeminnow in the short and long term.

The Action Alternative temperature recommendation at the confluence of the Green and Yampa Rivers to benefit drifting larval Colorado pikeminnow is consistent with the No Action Alternative. Under the Action Alternative, warmer water (59 ºF [15 ºC]) would be released during average to wet years, which would result in meeting this recommendation more often.

Many aspects of the 2000 Flow and Temperature Recommendations were designed specifically to benefit adult, larval, and young Colorado pikeminnow. Colorado pikeminnow are expected to benefit in the short and long term under the Action Alternative.

4.7.3.2.2 Humpback Chub –

4.7.3.2.2.1 No Action Alternative – Humpback chubs are presumed to persist in very low numbers in Whirlpool and Split Mountain Canyons in Reach 2; however, specific sampling for this species has not occurred in Reach 2 since the 1980s. The Recovery Program recently funded a study to characterize the fish community in Whirlpool Canyon. This study will provide information needed to describe the current status of this species in this portion of the Green River.

If humpback chubs still inhabit these canyon-bound portions of Reach 2, they may persist, provided all other environmental factors remain unchanged. Unfortunately, recent information suggests that the smallmouth bass population on the Yampa River may be increasing, which has been implicated (along with northern pike) in the decline of juvenile native species. If predation pressures in Whirlpool Canyon are also increasing, humpback chub would be less likely to persist, particularly if the base population is small.

4.7.3.2.2.2 Action Alternative – Based on research results from other humpback chub populations (Desolation Canyon in Reach 3 and Westwater Canyon on the Colorado River), the return to a more natural hydrograph under the Action Alternative should benefit the resident humpback chub in Reach 2, particularly during the wetter hydrologies. Studies conducted there indicated that native chub reproduction (as evidenced by collections of YOY) was more successful in years when the spring peak approximated the historical average.

Historical collections of humpback chub have come from the upper portions of Whirlpool Canyon, only a few miles downstream from the Green and Yampa Rivers confluence. Therefore, humpback chub in Whirlpool Canyon could benefit from the proposed temperature recommendations (a return to a more natural thermal regime). However, the benefits of river warming are not expected to carry downstream to Split Mountain Canyon, the next purported population.

4.7.3.2.3 Razorback Sucker –

4.7.3.2.3.1 No Action Alternative – Reach 2 of the Green River holds the last concentration of wild razorback sucker in the entire Upper Colorado River Basin. This middle Green River population is very small and has been in decline for several years. This species is believed to have persisted longer here than in any other location due to the availability of flood plain habitats and their historical role as nursery areas for larvae and juveniles.

Recovery of this species will depend upon a variety of the Recovery Program actions (nonnative control, stocking hatchery reared fish, and flood plain management) which will likely require some change in current flow management policies. The Action Alternative incorporates spring flow targets with the specific intention of increasing the duration of flood plain inundation. Although the differences in the two alternatives are not great, razorback sucker recovery is less likely under the No Action Alternative in the long term.

4.7.3.2.3.2 Action Alternative – Inundated flood plains provide key nursery habitats for razorback sucker. Razorback sucker spawning has occurred at several locations but has been focused in an area 96-107 river miles below Flaming Gorge Dam (Green River, river miles 313-302) in

Reach 2. This spawning area is immediately upstream of the bulk of floodable habitat in the vicinity of the Ouray National Wildlife Refuge.

In Reach 2, the amount of flood plain inundation increases rapidly as flows exceed 18,600 cfs. Under the Action Alternative, flows in Reach 2 would reach or exceed 18,600 cfs for at least a 2-week duration in 41% of the years, as opposed to only 16% of the years under the No Action Alternative. This major difference between the two alternatives was designed specifically to benefit razorback sucker in the long term.

Temperature recommendations for the Action Alternative are designed to benefit native fishes in Lodore and upper Whirlpool Canyons and drifting Colorado pikeminnow larvae at the confluence with the Yampa River. These temperature recommendations are designed to benefit native fish at post spring peak. The relationship between release temperature during the pre-peak period and temperatures in Reach 2 where razorback sucker spawn has not been fully investigated. There remains both spatial (distance downstream) and temporal (seasonality) uncertainty as to how much of the Reach 2 thermal regime can be affected by dam releases.

The Recovery Program is conducting or has proposed research to address the following uncertainties:

(1) The relationship between the spring flows called for under the Action Alternative and the maintenance of razorback sucker spawning habitats

(2) The importance of flood plain habitats to early life stages of the razorback sucker

(3) Whether flood plains can be managed to benefit native fish over the overwhelming numbers of nonnative fish that use these habitats

Results of these studies will provide necessary information in the evaluation of the effects of implementing the Action Alternative.

4.7.3.2.4 Nonlisted Native Fish –

4.7.3.2.4.1 No Action Alternative – Native suckers (flannelmouth and bluehead) and roundtail chub are found throughout Reach 2. Although data are lacking to clearly indicate whether their populations are stable, results of studies conducted from 1996-1999 suggest that flannelmouth sucker are common, while bluehead sucker and roundtail chub are less abundant. Continued implementation of the 1992 Biological Opinion flows would not likely result in any change to their current distribution or abundance. Continued monitoring would be required to conclusively understand the long-term effect.

4.7.3.2.4.2 Action Alternative – Native fish evolved with, and are adapted to, natural flow regimes. Studies on the middle and lower Green River suggest that native sucker and roundtail chub reproduction is positively correlated with the magnitude of the spring flood. The recommended flow patterns, ranges of flow, and peak flow frequencies of the Action Alternative more closely approximate natural flow conditions than do those of the No Action Alternative.

Native species are found throughout Reach 2 and are known to successfully reproduce there. Increased duration of over bank flooding associated with the Action Alternative will provide greater access to warm, productive flood plain habitat for all adult native fish and serve as nursery areas for young native suckers. Increased emphasis on formation and maintenance of nursery habitats for Colorado pikeminnow in the main channel during the summer, fall, and winter also should benefit other native species—particularly roundtail chub—which, like the Colorado pikeminnow, spawns on the descending limb of the hydrograph.

This group of fish is expected to have varying short-term responses to implementation of the Action Alternative, positive during average to wet years and potentially negative during dry years. In the long term, the greater interannual variation in the Green River hydrograph under the Action Alternative is expected to favor native species in Reach 2.

4.7.3.2.5 Nonnative Fish (Cold Water Species) –

4.7.3.2.5.1 No Action Alternative – Densities of all trout species decrease in the Green River downstream from its confluence with the Yampa River because of increases in water temperature and turbidity. Rainbow and brown trout are abundant at the confluence of the Green River and Jones Hole Creek, which supports naturally reproducing trout populations. This small localized trout population is believed to be entirely dependent on tributary flows and temperatures and will not be affected by Green River conditions. Trout distributions and abundances are not expected to change under the No Action Alternative.

As mentioned in chapter 3, "Affected Environment," the presence of northern pike in Reach 2 has increased in recent times. Unless Recovery Program-sponsored control efforts are successful, their numbers will likely continue to increase.

4.7.3.2.5.2 Action Alternative – Implementing the 2000 Flow and Temperature Recommendations will not affect conditions for trout in this portion of the river due to their dependence on the tributary at Jones Hole. Conditions for coldwater species will likely be worse in Reach 2 under the Action Alternative (higher, sediment laden spring flows: probably very little change in thermal regime at this point in the river) than under the No Action Alternative. Increased flood plain inundation under this alternative will likely benefit northern pike. Whether or not their numbers increase will likely depend on the ability of the Recovery Program to control northern pike populations in the Yampa River and throughout Reach 2 of the Green River.

4.7.3.2.6 Nonnative Fish (Other – Large and Small Fish) –

4.7.3.2.6.1 No Action Alternative – Carp and catfish are currently the most abundant large-bodied fish species in the main channel throughout Reach 2. Unless the Recovery Program is effective with their nonnative control efforts, these species would be expected to remain dominant.

Nonnative minnows (red shiner, fathead minnow, and sand shiner) dominate low velocity habitats (backwaters, shorelines, and pools) throughout Reach 2. These species have likely reached some form of dynamic equilibrium throughout this reach. The abundance of these species has been negatively correlated with the magnitude of the spring peak, particularly in those portions of the river where the channel is confined (canyons and restricted meanders). Due to their capacity to spawn multiple times per summer, however, their numbers rebound almost immediately. Densities of these species can vary greatly in the short term but are expected to remain very high in the long term.

4.7.3.2.6.2 Action Alternative – The most noticeable change in the Reach 2 riverine environment as a result of implementing the 2000 Flow and Temperature Recommendations would be an increase in the duration of over bank flooding. Carp display an affinity for this type of habitat (feeding, spawning, and rearing); and unless the Recovery Program decides to increase efforts to control their access to these areas, they will likely benefit from the Action Alternative. Channel catfish use these off-channel habitats as well, but to a lesser extent than carp. In the canyon-bound areas of Reach 2 (Whirlpool and Split Mountain Canyons), the effect of high flows may result in negative impacts to these two species.

During the base flow period, managing to maximize backwater nursery habitat would likely also benefit populations of introduced fish, which may compete with native fish for food resources or prey on larval and juvenile native fish (Kaeding and Osmundson, 1988; Haines and Tyus, 1990; Karp and Tyus, 1990a; Tyus and Beard, 1990). Quiet-water habitats also are preferred by green sunfish, bluegill, and northern pike. Green sunfish and bluegill feed on a variety of food types, including larval fish, while the northern pike eats fish exclusively.

In summary, all the warm water nonnative species discussed above may be negatively impacted in the canyon-bound portions of Reach 2 during average to wet years. They may benefit during the same hydrologies in the alluvial portions of this reach. The Action Alternative flow regime does not differ enough from the current condition that the abundances and distributions of these extremely abundant species would change appreciably.

4.7.4 Green River Downstream From Flaming Gorge Dam – Reach 3

4.7.4.1 Aquatic Animals

The following impact analysis is based solely on a comparison of the predicted flows under the Action and No Action Alternatives. The proposed release temperatures under the two alternatives are not expected to result in measurable differences in the Reach 3 thermal regime.

4.7.4.1.1 Aquatic Food Base –

4.7.4.1.1.1 No Action Alternative – Considering the lack of baseline information for this resource in Reach 3, assessing environmental consequences for this resource is very difficult. The aquatic food base is expected to remain at current levels.

4.7.4.1.1.2 Action Alternative – Results of the hydrology modeling indicate that overbank flooding (which requires flows in excess of 22,000 cfs) can be sustained for a 2-week period at a slightly higher recurrence interval under the Action Alternative. However, the bulk of flood plain habitat that connects to the river is found only in the very upstream portions of Reach 3. These durations provide a greater period of time for zooplankton (fish food) to grow as was discussed in the Reach 2 section. These high flow durations provide a similar benefit in the lower Green River but on a much smaller scale where the river only floods the mouths of small tributary washes.

Under the Action Alternative, base flows in Reach 3 are expected to be a few hundred cfs higher at the 50% exceedence level during the month of September. These increased base flows are expected to maximize backwater habitat availability (a relationship based on research conducted in Reach 2). Backwaters are preferred by YOY Colorado pikeminnow, presumably because they provide good foraging areas as well as current refuge and perhaps optimum temperatures for growth. Backwater productivity, however, is directly linked to flow stability. Increases in flow during the base flow period (as results of dam operations or storm events) can re-connect backwaters, flushing abundant food items into the main channel and making them less available to young pikeminnow. The ability to ensure flow stability decreases dramatically in the Reach 3 nursery area because of storm events and tributary flow contributions.

It is believed that implementing the Action Alternative would result in a better food base in Reach 3; however, data is not available to substantiate that claim. Based on the relatively minor differences in the predicted flows under the two alternatives and the added flow variability in Reach 3, the question becomes whether these benefits would be measurable or attributable to dam operations.

4.7.4.2 Threatened and Endangered Fish

4.7.4.2.1 Colorado Pikeminnow –

4.7.4.2.1.1 No Action Alternative – YOY Colorado pikeminnow have been collected from lower Green River nursery habitats every year sampling has occurred (1986-1999). Some of those YOY may have been produced at the Yampa River spawning bar. This consistent YOY catch strongly suggests that adult Colorado pikeminnow have successfully spawned at the Gray Canyon spawning area in each of those years as well. Therefore, flows since 1992 and the flows projected under the No Action Alternative should maintain some unknown amount of spawning habitat, which is consistent with the flows identified to construct and cleanse these habitats (Harvey and Mussetter, 1994). McAda (2002), reports that catch rates of juvenile and adult Colorado pikeminnow have increased through the Green River from 1986-2000. The trend in the lower Green River data set is not as high but still is positive. Unfortunately, more recent data (preliminary at this point) indicate that catch rates of adult fish in the lower Green River have dropped, which reiterates the need for long-term monitoring to adequately describe the status of long-lived species.

If the recent decline in catch rates is real, the ability to predict the pikeminnow's response to flows under the No Action Alternative is severely compromised. If the recent catch rates fall within the existing realm of sampling variability and, more importantly, if they recover in the next several years, the forecast for Colorado pikeminnow under the No Action Alternative would be more optimistic. Regardless, these predictions only consider the effects of flow on this species and must be qualified because modeling does not take into account future depletions in the tributaries. Furthermore, other unforeseen shifts in environmental variables (e.g., further introductions of nonnative species or increased abundance of resident nonnative, further fragmentation of habitat, or degradation of water quality) could counter an otherwise positive response to flow management.

4.7.4.2.1.2 Action Alternative – Harvey and Mussetter (1994) report that the spawning bars in Reach 3 are constructed at high flows, but the actual spawning habitat is created and cleansed following the peak flow when discharge ranges between 2,800 and 8,020 cfs. The hydrology analysis indicates that peak flows (construction flows) occur with nearly the same frequency under the Action and No Action Alternatives; likewise, the lower flows on the descending limb that cleanse the spawning bars occur virtually every year. It is difficult to imagine that proposed changes in dam operation under the Action Alternative would result in a significant increase in amount or quality of spawning habitat in comparison with the No Action Alternative. Spawning habitat maintenance in Reach 3 is likely to be more dependent on tributary flow contributions than on Flaming Gorge Dam releases.

The comparative hydrologic analysis of summer base flows indicates slightly higher values in Reach 3 during average and wetter years. These higher base flows are consistent with the intent of Rakowski and Schmidt (1997) and the authors of the 2000 Flow and Temperature Recommendations to increase the availability of deep, stable backwaters. Sustaining these base flows through the winter should further benefit YOY pike-minnow. During dry years, summer base flows in Reach 3 will be lower than under the No Action Alternative, which could result in both benefits and adverse effects to the system. Lower summer flows in Desolation and Gray Canyons could result in more frequent and larger catfish die offs. However, native fish could suffer as well.

The Action Alternative will result in a more normative hydrograph throughout the river to varying degrees (greatest change in Reach 1, moderate change in Reach 2, relatively minor change in Reach 3). The Recovery Program operates under the premise that a return to a more normative hydrograph will benefit native fish. Therefore, it is assumed that implementing the Action Alternative would benefit Colorado pikeminnow over the No Action Alternative. It is likely that these benefits would be very minor in this portion of the river and may not be seen for many years.

4.7.4.2.2 Humpback Chub –

4.7.4.2.2.1 No Action Alternative – Monitoring data (1993-2000) collected by UDWR indicate that the adult humpback chub catch rates are quite low (ranging from 0.02-0.17 fish per net hour) and variable, but they do not appear to be in decline. In recent years, the Recovery Program has shifted the monitoring approach away from relying on catch indices to estimating population size through mark and recapture studies. Population estimation requires a much more rigorous sampling design but should provide a more confident assessment of how this population is doing.

YOY chubs were collected every year during a 5-year study (1992-1996). Catch rates were greatest during one of the higher water years. Chart and Lentsch (2000) reviewed all available data and observed that the wet hydrologies of the mid-1980s and mid-1990s appeared to benefit the Desolation and Gray Canyons native fish community. The hydrology analysis indicates that peak flows less than or equal to 39,000 cfs occur in Reach 3 with approximately the same frequency under the Action and No Action Alternatives. Therefore, the humpback chub population in Desolation and Gray Canyons would likely persist at current levels under the No Action Alternative flows, provided no further introductions of nonnative species or increases in resident nonnative species occur.

4.7.4.2.2.2 Action Alternative – Juvenile and adult humpback chub prefer eddy and eddy/pool habitats. Orchard and Schmidt (2000) described the availability of these habitats as a function of flows in Desolation Canyon. Their conclusion was that the total amount of these habitat types varied little as flows fluctuated, but the size and position of the eddies did. During low flows, small eddies were distributed throughout the canyon. As flow increased above 7,000 cfs, eddies increased in size and were only associated with channel constrictions. They speculated that, historically, a greater variety of habitats and substrates types were available to chubs under a wider range of flows than is currently available.

Humpback chub appear to spawn throughout the canyon, and specific habitat preferences have not been identified. Day et al. (2000) described the backwater habitats used by young chubs but recognized that they can be found in a variety of shoreline habitats at a relatively early life stage.

The 2000 Flow and Temperature Recommendations are not designed to specifically benefit a humpback chub life stage, primarily due to a lack of understanding of this species' specific habitat requirements. The high flows called for during the spring are designed to create flooded habitats in upper Reach 3 with the intention of providing habitat for larval razorback sucker and adult pikeminnow. Those same flows would assist with channel maintenance and provide large eddies for humpback chub in Desolation Canyon. The base flows are designed to benefit the early life stages of pikeminnow but are presumed to provide stable, warm habitat for young chubs as well.

The general intention of the 2000 Flow and Temperature Recommendations is to increase interannual flow variability and to restore a more natural hydrograph. Data suggest that this should benefit humpback chub in Desolation Canyon. However, based on the modeled differences between the Action and No Action Alternatives flows, implementing the 2000 Flow and Temperature Recommendations may not be enough to detect a change in the population. In Desolation Canyon, a positive shift in humpback chub populations would be more likely if the Action Alternative was implemented in combination with a successful Recovery Program nonnative control effort.

4.7.4.2.3 Razorback Sucker –

4.7.4.2.3.1 No Action Alternative – Razorback sucker in the upstream portions of Reach 3 are a component of the remnant population found in Reach 2. Please refer to the Reach 2 discussion in section 4.7.3.2.3 as it applies to razorback sucker in that area.

Wild razorback sucker have not been collected in Reach 3 since 1997. Sampling for larval razorback suckers was discontinued in 1999. This population was severely depleted before the 1992 Biological Opinion flows were implemented. Stocking Reach 3 with hatchery-reared fish would be necessary prior to determining any positive responses.

4.7.4.2.3.2 Action Alternative – The spring peak and duration flows for Reach 3 in the 2000 Flow and Temperature Recommendations are designed to increase flood plain inundation in a 6-mile stretch of the Green River between the White River and Pariette Draw. The hydrologic analysis indicates that the recommended durations would be achieved only slightly more under the Action Alternative than under the No Action Alternative. For this reason, it is assumed that razorback in this area would benefit, albeit minimally, from implementation of the Action Alternative.

Similarly, the increased duration of flooding in tributary mouth habitats should benefit razorback sucker in Reach 3. It remains uncertain whether such a small change in this type of habitat would result in a measurable response.

Throughout the Green River, recovery of this species will be contingent on the following suite of Recovery Program activities: a successful augmentation program, habitat development, flow management, and nonnative control.

4.7.4.2.4 Nonlisted Native Fish –

4.7.4.2.4.1 No Action Alternative – As stated in chapter 3, data are lacking to adequately describe trends in flannelmouth sucker, bluehead sucker, roundtail chub, and speckled dace in Reach 3 of the river. All species appear to successfully reproduce in this reach under the current flow regime based on consistent collections of YOY. Juvenile life stages of the larger-bodied species are not present every year, but they have been documented in various short-term studies in multiple areas (Desolation Canyon, near Tusher Wash Diversion, and in the lower Green River in Canyonlands National Park). Adult flannelmouth and bluehead suckers are routinely collected throughout Reach 3, but densities vary greatly. All life stages of roundtail chub adults are consistently collected in Desolation Canyon but are extremely rare in the remainder of Reach 3.

It is assumed that these species will persist throughout Reach 3 under the No Action Alternative. Based on the positive correlations found between flow and their reproductive success, varying short-term effects are expected, and unknown long-term responses are unknown. Considering the declines in range-wide distribution, these species have suffered in recent times (Bezzerides and Bestgen, 2002), and it would be prudent to track their response more closely.

4.7.4.2.4.2 Action Alternative – The differences in hydrologic modeling results for Reaches 2 and 3 reflect the intention of the authors of the 2000 Flow and Temperature Recommendations to restore a more natural hydrograph to the river. Implementing these recommendations in Reach 3 would result in slightly longer durations of moderately high flows and a more stable base flow regime. The predicted differences between the Action and No Action Alternatives are minor and are associated with a greater degree of variability in Reach 3 due to tributary inputs. The same short-term responses to varying hydrologies identified under the No Action Alternative would be expected under this alternative. However, native fish are expected to benefit in the long term under the Action Alternative.

4.7.4.2.5 Nonnative Fish (Cold and Cool Water Species) –

4.7.4.2.5.1 No Action Alternative – Northern pike use flood plain habitats in the upstream portion of Reach 3 and will continue to do so. Northern pike numbers have been reduced in this portion of the river in recent years due to the Recovery Program's active removal efforts (reference *Recovery Program Project No. 109 2003 Annual Report* online at http://www.r6.fws.gov/crrip/arpts/2003/nna/109.pdf>). In the lower Green River, northern pike have made a very small presence, probably due to the warmer temperatures and lack of extensive flood plain. Abundances of northern pike in the lower river should remain low and are not expected to increase as a consequence of the No Action Alternative.

4.7.4.2.5.2 Action Alternative – Northern pike will likely benefit from the increased durations of flood plain inundation associated with the Action Alternative in the upstream portions of Reach 3. This relatively minor change in flow could result in an increased distribution or abundance of this species throughout the remainder of the reach.

4.7.4.2.6 Nonnative Fish (Other) –

4.7.4.2.6.1 No Action Alternative – Channel catfish is the most abundant main channel species throughout much of Reach 3. Common carp are ubiquitous and often as abundant. Red shiner, fathead minnow, and sand shiners dominate all low velocity habitats throughout Reach 3.

Reproductive success of all these species appears to be negatively impacted in the short term during the wetter hydrologies. Long term, these species will likely persist at present levels unless specific Recovery Program control efforts are successful.

4.7.4.2.6.2 Action Alternative – Channel catfish have experienced die offs in Desolation Canyon during extremely low flow years. The minimum base flow target for Reach 2 under the No Action Alternative would be 1,100 cfs; under the Action Alternative (driest hydrologies), the minimum is 900 cfs. Although there is a specific base flow target for Reach 3 in the 2000 Flow and Temperature Recommendations, the Reach 2 target would likely take precedence in this situation. During the summer of 2002, a flow of 900 cfs at Jensen, Utah, (Reach 2) translated into less than 900 cfs in Reach 3 (explanation: virtually no tributary input and evaporation losses over these 246 river miles); and a channel catfish die off was reported in Desolation Canyon. For this reason, channel catfish could be negatively affected by the Action Alternative during the driest hydrologies.

As mentioned above, densities of red shiner, fathead minnow, and sand shiners in low velocity habitats are likely fluctuating around some level of carrying capacity. These species would likely thrive under the dry hydrology conditions described above.

These nonnative species have shown an ability to quickly rebound from any environmental setback. They are not expected to be affected long term by the predicted changes to Reach 3 hydrology under the Action Alternative.

4.7.4.3 Fish – Summary of Environmental Consequences

A summary of the environmental consequences of implementing the No Action and Action Alternatives to the riverine fish community is presented in table 4-8.

Table 4-8.—Summary of Environmental Consequences to the Riverine Fish Community (Most Common Species) of Implementing a No Action (1992 Biological Opinion Flows) or Action (2000 Flow and Temperature Recommendations [2000 FTR]) Alternative

Fish Species/Community Assemblage Group	Reach 1		Reach 2		Reach 3	
	No Action Alternative	Action[1] Alternative	No Action Alternative	Action Alternative	No Action Alternative	Action Alternative
Colorado Pikeminnow	Adult Colorado pikeminnow would be expected to continue to utilize habitats in Reach 1 as they do currently.	The more natural flow regime proposed in the 2000 FTR could cleanse substrates (for spawning and generally increase productivity) and reduce nonnatives. The river warming may increase the likelihood that pikeminnow would establish home ranges in Reach 1 and possibly spawn there.	Long-term monitoring indicates that the abundance of Colorado pikeminnow in the Green River has increased. The No Action Alternative represents an improvement over the pre-1992 Biological opinion operations and likely factored into that increase.	Many aspects of the 2000 Flow and Temperature Recommendations built on the 1992 BO recommendations and are designed specifically to benefit adult, larval, and young Colorado pikeminnow. Pikeminnow are expected to benefit in the short and long term under the Action Alternative.	Colorado pikeminnow appear to have successfully spawned at the Gray Canyon bar every year sampling occurred The No Action Alternative represents an improvement over the pre-1992 Biological opinion operations and likely factored into a reported increase in abundance.	Base flows are better matched with spring releases to maximize backwater habitats. Pikeminnow should benefit, but the relative increase over the No Action Alternative may not be immediately measurable.
Humpback Chub	Continued operations under this No Action Alternative are not expected to result in the re-establishment of humpback chub in this portion of the river.	Humpback chub are more likely to become re-established in Reach 1, primarily due to the river warming proposed in the 2000 FTR	Humpback chub persist in very low numbers, in Whirlpool Canyon and perhaps in Split Mountain Canyon in Reach 2. Sampling for this species in Reach 2 has been opportunistic at best and needs to be increased.	The Action Alternative should benefit the resident humpback chub in Reach 2.	Population in Desolation and Gray Canyons expected to persist at current, low level unless nonnatives increase.	Longer durations of moderately high flows and more stable base flows should benefit humpbacks, but these relatively minor changes in hydrology may not result in a measurable response.
Razorback Sucker	The abundance of adult razorback in Reach 1 would be directly linked to the larger Green River subbasin population. If the population of razorback suckers increases in Reach 2 (as result of stocking, nonnative control, and flood plain restoration), it is expected that the incidence of adults in Reach 1 would also increase.	The abundance of razorback sucker in Reach 1 will be directly linked to the larger Green River subbasin population. In Reach 1, the return to a more natural hydrograph and thermal regime could increase habitat suitability in Browns Park for various life stage of razorback sucker.	Recovery of this species is going to be contingent on a variety of actions: nonnative control, augmentation, and flood plain management, which will likely require some change in current flow management policies.	Recovery is going to require a multifaceted approach (see No Action Alternative). The increased duration of overbank flooding proposed in the 2000 Flow and Temperature Recommendations is designed to increase critical nursery habitat for razorback sucker, which is an important experiment that needs to be tested. Razorback sucker stand a better chance of recovery under the Action Alternative.	Recovery is going to require a suite of actions, not least of which is a successful augmentation program to re-establish razorback suckers in the lower river	Recovery is going to require a suite of actions, not least of which is a successful augmentation program to re-establish razorback suckers in the lower river. The longer durations at moderately high spring flows should provide more nursery habitat, but the resultant, relative increase in the lower river will be nearly insignificant.
Bonytail	The authors of the 2000 Flow and Temperature Recommendations did not choose to factor the needs of this species into their recommendations because information on the species life history and the physical processes that affect their habitats were not available. The authors go on to state ". . .the flow and temperature recommendations that are made for the other endangered fishes would presumably benefit any bonytails that remain in the system and would not limit their future recovery potential." To the best knowledge, there are no new data that would contradict the author's contention, and it would be useless to further speculate on the relative impacts of implementing one alternative over another. The hydrologic and temperature modeling indicates that the changes to the environment resulting from implementing the Action Alternative would be greatest in Reach 1, less in Reach 2, and it is assume of even less consequence in Reach 3. Therefore, based on the line of reasoning put forth in the 2000 Flow and Temperature Recommendations, it is assumed bonytail would benefit from the Action Alternative in Reaches 1 and 2.					
Nonlisted Native Species; (flannelmouth sucker, bluehead sucker, and roundtail chub)	Distribution and abundance of these species is not expected to change. However, in recent years, there is increasing evidence of native sucker hybridization with the nonnative white sucker. This trend in hybridization would be expected to continue.	These native species are expected to benefit under the return to a more natural hydrograph and thermal regime through increased reproductive success, better growth, and reduction of brown trout in Lodore Canyon. If reservoir species (smallmouth bass) become established in Reach 1, this group of fish would likely be affected most.	Native suckers and roundtail chub are found throughout Reach 2. Population trend data are lacking for these species. It is not expected that continued implementation of the 1992 BO flows would result in any change to their main channel distributions or abundances, long term.	The greater interannual variation in the Green River hydrograph under the Action Alternative should benefit the native species in Reach 2. Short-term effects could be positive during the wetter hydrologies and negative during the dry years	Native suckers and roundtail chub are found throughout Reach 3. Population trend data are lacking for these species. It is not expected that continued implementation of the 1992 BO flows would result in any change to their main channel distributions or abundances, long term.	Native suckers and roundtail would certainly benefit from a move toward a more natural hydrograph; however, the changes in Reach 3 are not likely to result in a measurable positive response.
Cold Water Nonnatives (trout and northern pike)	Trout populations are expected to remain at high levels and the individual trout in good condition.	The Action Alternative has obvious pros and cons in terms of the trout fishery below Flaming Gorge Dam. It is not expected for this resource to be greatly affected in the long term and may benefit.	Trout become extremely scarce in the lower portions of Reach 1 and are virtually nonexistent in Reach 2.	Trout are extremely scarce in Reach 2; therefore, the implementing the 2000 FTR should have no effect. Northern pike should benefit from the increased flood plain inundation (ongoing control measures should be continued)	Not applicable to trout. Northern pike will likely persist or increase unless Recovery Program control efforts are successful.	Not applicable to trout. Northern pike will benefit in the upper portions of the reach from the increased flood plain inundation. Pike are expected to increase unless Recovery Program control efforts are successful.
Warm Water Nonnatives; Large-Bodied (carp and channel catfish)	Carp and catfish would persist at current levels in the lower portion of the reach, primarily in Lodore Canyon	Carp and catfish are expected to experience short-term benefits during the drier years and as result of warmer release temperatures. Higher flows during wet hydrologies could reduce their numbers.	Carp and catfish are currently the most abundant large-bodied fish species in the main channel throughout reach 2. Unless effective control of these species is implemented, it is assumed that they would remain dominant.	Carp and catfish may be reduced in the canyon bound portions of Reach 2 during above average hydrologies. In the alluvial portions of the reach (Uintah Basin), their numbers are expected remain high.	Carp and catfish are currently the most abundant large-bodied fish species in the main channel throughout Reach 3. Unless effective control efforts are successful, it is assumed that they would remain dominant.	Similar to the No Action Alternative outcome. Channel catfish may be negatively impacted during the driest hydrologies but are not expected to be affected long term.
Warm Water Nonnative; Small-Bodied Minnows (red shiner, fathead, sand shiner, and redside shiner)	Nonnative minnows are abundant in the lower portions of Lodore Canyon. Their current distribution and abundance has likely reached some level of equilibrium and is not expected to change.	Nonnative minnow will likely benefit from the dry hydrology flows and temperatures, and the warmer releases during above average hydrologies. During the dry and moderately dry years, they could become established in Browns Park. Releases during average and wet years should serve to reduce their abundance and distribution.	Nonnative minnows dominate the low velocity habitats (backwaters, shorelines, pools) throughout Reach 2. These species have likely reached some form of dynamic equilibrium and are expected to remain abundant.	The slight increases in duration of high flows in Reach 2 under the 2000 FTR could result in short-term reductions of these nonnative minnows in the constricted channels of Whirlpool and Split Mountain Canyons. However, a significant reduction long term in the densities of these extremely abundant species is not expected.	Nonnative minnows dominate the low-velocity habitats (backwaters, shorelines, pools) throughout Reach 3. These species have likely reached some form of dynamic equilibrium and are expected to remain abundant.	This group of fish may suffer some short-term set backs during wetter period, but are not expected to be affected long term

[1] Environmental consequences that are expected to occur during the summer base flow period operating under the following temperature release schedule - during base flow releases of 800-1,200 cfs release 13-14 EC (55.4 -57.2 EF) as early as possible and maintain these temperatures as long as possible into the fall; during base flow releases >1,200 cfs release 15 EC (59EF) as early as possible and maintain this temperature through the summer and for as long as possible into the fall. It should be noted that the 1992 Biological Opinion also calls for release up to 15 EC (59 EF), and for no greater than a 5 EC (41 EF), difference between the Green and Yampa Rivers at their confluence during the month of July.

4.7.5 Vegetation

Differences between the Action and No Action Alternatives were based on the Flaming Gorge Model. Methods used to assess potential effects to vegetation involved several multiyear research projects and detailed plant surveys. These studies and surveys have occurred at specific areas along the Green River. Assumptions are made in this section that these studies and surveys are representative of the larger river. Indicators used to determine effects to vegetation were defined as changes in species composition, plant health and reproductive ability, and shifts in location. Analysis was simplified by placing plant communities in three broad landform categories, as described in chapter 3, section 3.7.2.6, "Vegetation."

(1) Post-dam flood plain composed of true wetland plants in close contact with surface and subsurface water

(2) Intermediate bench communities that proliferate just above the current operations annual floodflows

(3) The old high water zone

Research and inventories on the Green and Yampa Rivers were conducted by Colorado State University, Utah State University, USGS, Dinosaur National Monument, Reclamation, and the Bureau of Land Management (BLM).

Table 4-9, describes environmental differences between the No Action and Action Alternatives.

4.7.5.1 Reach 1

4.7.5.1.1 No Action Alternative – Under the No Action Alternative, peak flows would continue to cause erosion and sediment deposition (though to a lesser extent than in the Action Alternative) of the post-dam flood plain and intermediate bench areas. Cattail and sedge communities would infrequently be subjected to removal or burial by floodflows. With few areas scoured and deposition occurring close to the river's edge, cottonwood establishment opportunities would be few. Cottonwood seed production in Browns Park is greatly reduced compared to that of the Yampa River (Cooper et al., 1999). Without high flows necessary to maintain health of mature cottonwoods, seed production would continue to decrease as the health of these mature trees continues to decline and individual trees die. According to Merritt and Cooper (2000), the old high water zone of Reach 1 would continue to move further toward a desert community with cottonwood eventually replaced by desert shrubs. The islands of Browns Park would be maintained as wetland communities and continue to build in a downstream manner. Cottonwood establishment would not occur on these wetland islands and would continue to be extremely limited within Browns Park.

Under the No Action Alternative, base flows in Reach 1 would remain high and relatively stable, contributing to the maintenance of wet meadow communities that proliferate under stable water levels. Makeup of wetland species would remain distinct from the Yampa Canyon and from that of the vegetation community below the confluence of the Green and Yampa Rivers (Merritt and Cooper, 2000).

4.7.5.1.2 Action Alternative – The greatest potential for effects to vegetation from the Action Alternative would occur in Reach 1 due to the direct link to dam operations and to the greatest differences from current operations in both peak and base flows. The increased magnitude and frequency of floodflows in extreme wet years would likely produce the greatest changes to vegetation. Timing of peak flows under the Action Alternative would not be different from those of the No Action Alternative.

It is difficult to predict the amount of scouring/erosion that would occur during these extreme events. Erosion varies with the specific environment but tends to occur on those surfaces that are closest to the river channel—riverbanks, cobble bars, and

Table 4-9.—Summary of Effects to Vegetation Under the No Action and Action Alternatives for Reach 1 and Reach 2

	No Action	Action
Reach 1	▪ Infrequent erosion and deposition on post-dam flood plain and intermediate bench surfaces. ▪ Little to no opportunity for cottonwood establishment. ▪ Maintenance of island marshes. ▪ Wetland species remain distinct from that below confluence of Yampa River. ▪ Old high water zone continues trend toward desert community. ▪ Old-growth cottonwoods continue trend of premature die off. ▪ Invasive species presence continued with moderate increase in acreage.	▪ Increased erosion and scouring of wetland species in post-dam flood plain. ▪ Increased deposition on intermediate bench surfaces; some plant mortality, but vigorous re-growth likely for most plants. ▪ Increased opportunities for cottonwood establishment. ▪ Possible mortality of desert species in old high water zone with replacement by flood tolerant vegetation. ▪ Increased health of mature cottonwoods. ▪ Shift in location or possible accelerated expansion of invasive species.
Reach 2	▪ Infrequent flooding of flood plain forests, thereby benefiting invasive and desert type species. ▪ Limited opportunity for successful cottonwood establishment–only in extreme wet years. ▪ Islands and insert flood plains remain vegetated.	▪ Increased flooding of flood plain forests–leading to increased health of native forests. ▪ Increased opportunities for cottonwood seedling establishment. ▪ Increased removal of vegetation on islands and bars. ▪ Shift in location or possible accelerated expansion of invasive species.

islands. These are the surfaces and vegetation communities described in chapter 3 as post-dam flood plain and intermediate bench surfaces. Flows of 10,600 cfs (1999) removed vegetation in Lodore Canyon from upstream ends of gravel bars and debris fans. The greater magnitudes and velocities of the Action Alternative floodflows would result in removal of even more vegetation. Once vegetation is removed in an extreme high flow event, then smaller floodflows that follow would likely, if they occur with regularity, maintain some areas as unvegetated. Larson (2004) found that the majority of post-dam flood plain surfaces in Lodore Canyon are reworked by floodflows more frequently than the intermediate bench surfaces and, therefore, are more likely to remain unvegetated.

Response to scouring varies depending on growth form, age, and location. Stem removal would likely be highest among shallow-rooted, clonal species (those that reproduce or spread via shoots) such as cattail, common reed, sedges, and coyote willow. While stem removal may be high, the likelihood of plant survival is also high with the exception of cattail and sedge, which tend to suffer high mortality rates in large floodflow events (Stevens and Waring, 1986).

Plants with deep roots, such as tamarisk, show greatest resistance to scouring, and the presence of this anchoring root system limits scouring of neighboring plants. Once established (i.e., 3 years of age), tamarisk is extremely difficult to remove with floodflows at any location. The majority of tamarisk in Lodore Canyon is found on the intermediate bench. Larson (2004) suggests that this surface is unlikely to be reworked significantly by the moderate increases of the Action Alternative. Thus, the peak releases of the Action Alternative are unlikely to cause a large-scale decrease in tamarisk in Lodore Canyon.

The more likely effect to vegetation during flood events is burial from sediment deposition. Partial and complete burial of vegetation in Lodore Canyon was a common effect of the 1999 high flows. While erosion occurs along the river's edge, deposition occurs once flows overtop the riverbank and enter the flood plain, depositing sediment on the post-dam flood plain and on the intermediate bench surfaces. Clonal species such as willow, giant reed, and some sedges and rushes appear to respond more favorably to burial than nonclonal species (Stevens and Waring, 1986). Giant reed exhibits vigorous regrowth after burial. Coyote willow generally responds to burial with rapid colonization of newly deposited sediment beds. Tamarisk is highly resistant to burial. A Ute ladies'-tresses population in Lodore Canyon continued to produce flowers and seeds after partial burial. Many nonclonal riparian species would likely experience mortality if covered by more than half their height with sediment (Stevens and Waring, 1986). Low growing rushes and sedges that are highly susceptible to complete burial would likely face high degrees of mortality.

For floodflows maintained for 2 weeks or longer, the potential for effects from inundation exists. The more xeric (desert-type) species of the mid-elevation zone would likely experience reduced growth levels or possible mortality if inundated 4 weeks or more. Under extreme wet-year conditions, floodflows would reach the old high water zone. The desert species, such as greasewood and sagebrush, that have colonized the old flood plain in the alluvial reaches are very intolerant to flooding, with greasewood dying after 2-3 weeks of inundation. Under this scenario, replacement by more flood-tolerant species would likely occur. However, most of the extreme floodflows for Reach 1 are modeled for 1-day releases, so restoration of the old pre-dam flood plain would be highly limited.

Plants of the mid-elevation zone would likely show mixed results to extended inundation. Coyote willow exhibits high tolerance to drowning. Growth rates of tamarisk have not been affected by 4 weeks of inundation (Stevens and Waring, 1986). Immature box elder suffers high mortality rates with inundation of 85 days or more but tolerates 25-60 days of inundation (Friedman and Auble, 1999). Mature box elder typically survives the entire growing season under inundation.

The effects of extended inundation in the post-dam flood plain area would likely be minimal. These marsh type species (i.e., rushes, sedges, giant reed, and cattail) have a high tolerance to inundation and generally are adapted to extended periods of saturated soil conditions. Some species of sedge proliferate vigorously even with 1½ years of submergence.

As vegetation is removed by scouring or buried from sediment deposition, increased opportunities for establishment of riparian plants and invasive species would appear; but competition from other plants, especially nonnative, invasive species, makes cottonwood establishment tenuous. Floodflows must occur during the period of cottonwood seed rain to benefit that species. If flows are delayed, then tamarisk, giant whitetop, and yellow clover will likely have the establishment advantage.

Like tamarisk, giant whitetop can establish in a variety of disturbed site conditions. Once established, this plant spreads quickly via rhizomes. Giant whitetop is also drought and salt tolerant and appears to be on the increase in Browns Park and Island Park. Larger floodflows may shift the range of these invasive species, allowing them to establish at higher flood plain elevations. Coyote willow appears to be more successful than tamarisk in wet years or in early successional communities (Cleverly et al., 1997). Therefore, it may be that, on the post-dam flood plain surfaces, an increase in the frequency of high spring flows would favor willows over tamarisk.

Williams (2000) theorized that the lack of floodflow inundation is a probable cause of the premature die off of mature cottonwood forests of Browns Park. If this is the case, then large floodflow events would be needed for the flood plain forests of Browns Park to show an increase in the number of healthy older trees. The prolonged high flows of 1986 produced a greater growth response in the mature cottonwoods of Browns Park than the higher but shorter duration flows of 1983 and 1984 (Cooper et al., 1999a). Increased flooding also tends to reduce the population of herbivorous rodents that reside in or near the flood plain (Anderson and Cooper, 2000). These small animals can cause death and injury to young seedlings; population control by flooding would have a positive affect on the likelihood of successful cottonwood establishment.

Changes in base flows under the Action Alternative may affect the wetland plant community in several ways. With base flows higher in the latter half of the growing season, a shift in community composition may occur along with a slight shift in location or expansion upslope for some wetland species. These flows more closely resemble the regulated flows of 1971-1991, when the majority of wetlands species likely established. There is uncertainty as to what responses will result from the lower base flows of winter and early spring, especially following periods of higher fall flows. Some marsh-type species remain dormant under drawdown conditions, especially during the nongrowing season, while other species require exposure of the seedbank to trigger germination.

The rate of establishment for tamarisk near the water line of base flows is unknown but is likely to be low (Larson, 2004). With the exception of extremely dry years, the higher base flows of August and September would likely prevent tamarisk from expanding downslope. Drought conditions, especially if multiyear, would likely favor expansion of tamarisk under both the Action and No Action Alternatives.

4.7.5.2 Reach 2

4.7.5.2.1 No Action Alternative – Mature flood plain forests would continue to derive some benefits from short duration floodflows. In most locations, extended inundation of flood plains would be rare, likely giving tamarisk and other drought-tolerant species a competitive edge. Cottonwood establishment would continue to occur in accreting oxbows and abandoned channels. Scouring of bars and islands would occur under conditions of the infrequent floodflow, thereby limiting opportunities for cottonwood establishment on these formations and encouraging continued development of tamarisk stands. Fewer surfaces in high velocity areas would remain free of vegetation.

4.7.5.2.2 Action Alternative – Effects of the Action Alternative in Reach 2 are reduced but similar to those described above for Reach 1. Any increase in peak flow releases or duration would produce scouring, burial, and drowning effects similar to those of Reach 1. Deposition of sediments and, therefore, burial would increase especially in combination with sediment input from the Yampa River and other tributaries.

For there to be a measurable improvement in the health of riparian forests, floodflows must be of a great enough magnitude and duration to inundate flood plain forests for multiple days. The 2000 Flow and Temperature Recommendations include floodflows of this design. If these flows occur, there would be greater opportunities for cottonwood establishment via increased silt deposition and increased frequency of rewetting of these soils. This increase in flooding frequency, duration, and acreage would likely give cottonwoods and other native riparian species a competitive edge over the native, but more drought-tolerant, and desert shrub species that have moved into the area. For example, at the 10%-exceedence level with 2-week durations, an increase of 2,000 cfs will occur under the Action Alternative. On Ouray National Wildlife Refuge, this 2,000-cfs increase in flows equates to an increase of approximately

1,000 acres of inundated land. This change offers many benefits to native riparian forests and associated wildlife.

While increased flooding may be detrimental to desert shrubs, other invasive species, especially tamarisk and herbaceous plants such as giant whitetop and yellow clover, could spread as floodflows carry seeds into new areas. As previously mentioned, these invasive species are highly competitive with native vegetation. As described in chapter 3, Russian olive is not dependent on floodflows for establishment and appears to thrive under a wide range of conditions. Therefore, the location and rate of infestation of Russian olive under the Action Alternative is assumed to differ little from the No Action Alternative.

Increased frequency of extreme floodflows would also likely remove vegetation from some landforms that are directly in the path of high velocities and prevent re-establishment of vegetation. In Gray Canyon, the oldest tamarisk and cottonwood on gravel bars date to the 1984-86 years, indicating that during spring of 1984, the floodflows of 40,000-50,000 cfs removed all vegetation from these bars (Cooper, 2002).

4.7.5.3 Reach 3

4.7.5.3.1 No Action Alternative – Flood plain forests of the uppermost portion of Reach 3 are a continuation of those of lower Reach 2, and effects of the No Action Alternative would be similar to those described above.

Along the lower Green River, flows of 39,000 cfs are necessary to initiate inundation of flood plains in Canyonlands National Park between river mile 24 and 33 (FLO Engineering, 1996). Using a limited dataset (and, consequently, a large margin of error), hydrology modeling for Reach 3 reveals that minimum overbank floodflows would occur with less than 6% exceedence. Based on this information, it is expected that the native riparian plant community of the flood plain terraces would continue to transition into a more drought-tolerant plant community.

4.7.5.3.2 Action Alternative – Low elevation vegetation found along the river margins and islands would experience effects similar to those described for Reaches 1 and 2, increased erosion and deposition. Flood plains of the upper portions of Reach 3 would be inundated at increased durations and slightly increased frequencies. At the minimum flood plain inundation flow of 22,000 cfs, approximately 663 acres would receive floodflows more often. Effects to cottonwoods and opportunities for expansion of invasive species would be similar to those described for Reach 2.

Flows of 39,000 cfs are necessary to initiate inundation of flood plains in Canyonlands National Park. Approximately 5 acres are inundated at 39,000 cfs, but acreage increases substantially to a maximum of 400 acres at 53,000 cfs (FLO Engineering, 1996). Using very limited data, the hydrology model shows no measurable difference between the Action and No Action Alternatives. The 2000 Flow and Temperature Recommendations for the 1-day, 39,000-cfs recommended flow will not be achieved. Therefore, it is expected that the native riparian plant community of the flood plain terraces would continue to transition into a desert community.

4.7.6 Summary of Vegetation

In summary, under the No Action Alternative, erosion or scouring and deposition of vegetation would continue to occur infrequently under conditions of rare floodflows. There would be little to no cottonwood regeneration in Reach 1 and, in Reaches 2 and 3, only in extreme wet years. The old high water zone of Browns Park would continue to move toward a desert community, while the mature cottonwoods of this reach would continue their premature die off. Areas of marsh habitat would be maintained or, on islands, increase.

Under the Action Alternative, flow patterns would result in short-term effects through removal, burial, and/or possible drowning of vegetation. Most plant species would recover quickly. Burial would likely have the greatest impact to growth and mortality levels. If scoured clean, some low elevation bars and islands may remain free of vegetation. If large, overbank floodflows occur, any short-term effect would likely be offset by the opportunities provided for seedling establishment and cottonwood regeneration. There would be increased vigor in mature flood plain forests and a reduction in acres transitioning from flood plain forest to desert community. Extreme floodflows could increase the spread of invasive, nonnative species into a greater range of elevations. Most wetland and riparian species would be tolerant of late season drawdowns. During multiyear drought conditions, tamarisk may expand downslope under base flow conditions. During multiyear droughts, species with higher tolerance to drought conditions would begin to dominant the corridor.

4.7.7 Terrestrial and Avian Animals

4.7.7.1 Reach 1

Change in the riparian plant community due to operation of Flaming Gorge Dam would affect those terrestrial and avian wildlife species that are dependent on riparian habitat. Most wildlife habitat concerns can be addressed by considering the effects on riparian vegetation. Changes in riparian vegetation would follow changes in exposed sediment deposits resulting from daily water release patterns. Flood events affect vegetation and its suitability as habitat for different wildlife species. Vegetation traps sediment during high flows, and nutrients within the sediment become available for plant growth.

Most terrestrial animals would not be directly affected by daily operation of the dam. Most animals using the riparian area are mobile and would move in response to daily fluctuations.

Riparian habitats below Flaming Gorge Dam receive various levels of use from mule deer, elk, moose, pronghorn, and bighorn sheep. These species also use nonriparian habitats, thus, decreasing their reliance on riparian vegetation. Dam operations are unlikely to affect these game animals in any significant way.

Most birds (migratory or resident) use the riparian corridor as a travel lane through the desert and are not significantly affected by dam operations. Raptor populations likely are not limited within the area by lack of food. They likely are more limited by available nesting habitat. None of the alternatives would affect nest site availability. None of the alternatives would affect the river's suitability as a travel or foraging corridor for raptors.

4.7.7.1.1 No Action Alternative – Under the No Action Alternative, a trend toward a desert shrub community in the old high water zone would eventually decrease the extent and health of the riparian community within Reach 1. This decrease would negatively affect animals dependent on this riparian habitat.

4.7.7.1.2 Action Alternative – Dam operations affect flows and sediment transport that alter riparian habitats. The alteration of these riparian habitats would likely negatively impact terrestrial wildlife currently existing in the area. In time, balance would again be established with a somewhat different composition of species. Some woody vegetation and patches of emergent marsh plants would be lost through scouring or burial as sand is deposited on higher elevations during high flows of wet years. Some riparian vegetation would reestablish itself at suitable new sites in the years following such a flow.

Sudden increase in flows from steady flow patterns would negatively affect ground-dwelling, ground-nesting, and burrowing forms of wildlife by temporarily inundating occupied habitat.

Nongame wildlife species are dependent on the woody species common in the riparian zone of the Green River corridor. Reductions in riparian habitat could adversely impact nongame wildlife.

Birds that nest in the riparian zone along the river corridor would be affected to the extent that the riparian corridor is affected by the operations. Reductions in riparian vegetation should have only slight adverse effects on waterfowl because the amount of marsh available in riparian areas along the river is small compared with the thousands of acres of managed wet marsh in the nearby Browns Park wildlife refuges. The few species that prefer open shoreline habitats (e.g., killdeer and spotted sandpiper) could benefit from the increase in unvegetated shoreline that would occur.

Birds using the riparian zones as travel corridors would not be directly affected by dam operations. Bird species that nest in riparian zones would be indirectly affected by changes in area coverage of riparian plant species due to dam operation. This alternative would reduce some riparian communities in narrow canyon reaches of the Green River by increasing maximum flows that would cause more aggressive scouring of the river channel and burial of some riparian vegetation by initial maintenance floodflows. More open areas (areas with a broader flood plain) would experience some increase in riparian plant species cover and health by an increase in occurrence of flood plain inundation. As riparian zone patch size increases, species diversity and density will increase.

Wintering waterfowl could be adversely affected by a reduction in the availability of open, ice-free water. Reduced flow fluctuations discourage ice breakup once an ice cap has formed. Open, ice-free water would be maintained from the dam to the Gates of Lodore because of the relatively warm dam releases. Use of this river reach by waterfowl in the winter would continue. It is unlikely that peregrine falcon or osprey populations would be affected by this alternative.

Several bat species exist within the area. Although they are not directly affected by dam operations, they are attracted to the river corridor by the insects associated with the river and riparian vegetation. Amphibians would benefit wherever back water and flooded bottomland habitat is increased or improved due to this alternative.

4.7.7.2 Reach 2

4.7.7.2.1 No Action Alternative – Under this alternative, riparian habitat would decrease due to the continued reduction of flood plain inundation. The reduction in riparian habitat would have a negative effect on wildlife dependant on this habitat. Amphibians and riparian nesting birds would be negatively affected.

4.7.7.2.2 Action Alternative – Under the Action Alternative, inundation of the flood plain would occur on a more regular basis and cover a larger area of land. This would increase the health and extent of riparian habitats. Wildlife species dependent on these habitats would benefit. Amphibians would benefit to the extent that backwater and flooded bottomland habitat is improved or increased.

Extreme floodflows could increase the spread of invasive, nonnative species such as tamarisk into a greater range of elevations.

4.7.7.3 Reach 3

4.7.7.3.1 No Action Alternative – Effects to flows attributable to operation of Flaming Gorge Dam are negligible within this reach. This is due to the attenuating effects of distance from the dam and significant inflow of unregulated rivers, streams, and washes above and within this reach. Terrestrial and avian animals would be affected to the same extent and degree as riparian and wetland habitats. Under this alternative, the native riparian plant community would continue to transition into a more drought-tolerant community—thus, reducing important riparian wildlife habitat.

4.7.7.3.2 Action Alternative – In the Western United States, riparian habitat represents less than 1 percent of the total acreage of public lands. Approximately 80% of all terrestrial wildlife species routinely use these riparian areas for food, water, cover, or migration routs. About 30% of the region's bird species use wetlands and other aquatic areas to the exclusion of upland habitats. Wetlands and riparian habitats also support a disproportionate number of species that are of concern because they migrate to neotropical areas, have small continental populations, or are declining in numbers. Since settlement by Europeans, riparian and wetland habitats have suffered large declines due to destruction, conversion to other uses, or significant degradation in structure, function, or composition. Invasion of weed species has also decreased the health and extent of riparian wetland communities.

Effects to flows attributable to operation of Flaming Gorge Dam are less significant within this reach than upstream reaches. This is due to the attenuating effects of distance from the dam and significant inflow of unregulated rivers, streams, and washes above and within this reach. Terrestrial and avian animals would be affected to the extent and degree riparian and wetland habitats would be affected. Under this alternative, the native riparian plant community would continue to transition into a more drought-tolerant community—thus, reducing important riparian wildlife habitat.

4.7.8 Other Threatened and Endangered Species

4.7.8.1 Southwestern Willow Flycatcher

Differences between the Action and No Action Alternatives were based on the Hydrologic Modeling Report (see sections 4.3.1 and 4.3.2 on hydrology). Methodologies used to assess potential effects to southwestern willow flycatcher involved identifying presence/absence of species, identifying suitable and potentially suitable habitat, and determining where project conditions would alter these habitats. Habitat changes were then assessed in terms of their potential to adversely affect the species and the magnitude of such effect.

4.7.8.1.1 No Action Alternative – Large floodflows, though occurring with less frequency and duration than in the Action Alternative, would likely still have an impact on low elevation island habitat, burying vegetation and/or removing vegetation along island edges. With reduced frequency of larger floodflows, flycatcher habitat would remain intact for long periods of time but would eventually become unsuitable due to structural changes of aging vegetation. Opportunities for establishment of additional habitat would be infrequent. Floodflows would only rarely be of the magnitude or duration to leave behind areas of standing water. This lack of standing water is a limiting component of southwestern willow flycatcher habitat along the lower Green River.

4.7.8.1.2 Action Alternative – Implementation of the 2000 Flow and Temperature Recommendations under the Action Alternative would likely remove vegetation that constitutes southwestern willow flycatcher habitat, especially at habitat edges that interface with channel margins where erosion tends to be greatest. Three of the occupied flycatcher territories are located on a low elevation island that would likely be inundated at higher flows. With floodflows occurring more often, some edges may remain unvegetated. As described in the vegetation section, souring and deposition also create areas conducive to establishment of riparian vegetation. So although there may be short-term negative effects to willow flycatcher habitat, there may be an increase in long-term benefits through creation and maintenance of habitat. In the upper sections of Reach 3, increased frequency and duration of larger floodflows would facilitate creation and expansion of areas of standing water, an important southwestern willow flycatcher habitat component.

In summary, the Action Alternative may have short-term effects through removal or burial of habitat. However, these same disturbance events would promote vigorous regrowth and replacement of habitat. If large enough, floodflows should promote development of additional habitat.

4.7.8.2 Ute Ladies'-Tresses

4.7.8.2.1 Reach 1 –

4.7.8.2.1.1 No Action Alternative – Under No Action Alternative conditions, Ute ladies'-tresses would only rarely be subjected to erosion or deposition from infrequent high floodflows. At some suitable and potentially suitable sites, tamarisk would continue to compete and, possibly, out-compete Ute ladies'-tresses. Inundation of sites would continue at the current rate of a few days per year to 10 days per year (1-3% of the time), on average (Grams et al., 2002). These extreme floodflow events would create conditions similar to those described below for the Action Alternative; certain populations of Ute ladies'-tresses would be subjected to inundation, erosion, and partial or complete burial from sediment deposition. Some mortality of plants or populations could result. Since these extreme floodflow events would occur infrequently, populations would generally have ample time to re-establish at those areas negatively affected, and it is expected that populations would continue to proliferate under current conditions.

4.7.8.2.1.2 Action Alternative – The distribution and abundance of Ute ladies'-tresses can be affected by changes in the frequency or duration of inundation or by changes in patterns of erosion or deposition.

Depending on local geomorphologic characteristics, sediment responses at sites supporting existing Ute ladies'-tresses populations may range from increased sediment deposition to increased erosion.

Under the Action Alternative, floodflows would generally increase in magnitude and duration. Post-dam flood plain sites would be inundated for slightly longer periods under the Action Alternative, while intermediate bench sites may be inundated more frequently. Ute ladies'-tresses appear to tolerate occasional periods of extended inundation. All Ute ladies'-tresses populations inventoried in Red Canyon and Browns Park in 1999 were inundated by peak flows of 10,900 cfs held for 9 days, and most had been inundated at least 32 days (Grams et al., 2002). These populations had survived an average of 2.3 feet inundation and up to 3.9 feet at some sites. High flows in extreme wet years may result in some mortality on lower elevation surfaces, such as post-dam flood plain sites.

Deposition, resulting from peak flows, would vary depending on site location. Sediment deposition at sites supporting Ute ladies'-tresses in Red Canyon and Browns Park ranged from no deposition (majority of the sites) to less than 2 inches of very fine sediment during the high flows of 1999 (Grams et al., 2002). In Lodore Canyon, deposition did occur on occupied post-dam flood plain and intermediate bench surfaces. Partial and complete burial of Ute ladies'-tresses were recorded. Under the Action Alternative, sediment deposition may potentially increase on some occupied sites, such as in Lodore Canyon. However, occupied Ute ladies'-tresses sites tend to be located in positions with relatively low rates of sediment deposition. Ute ladies'-tresses appear tolerant of some sediment deposition. A population in Lodore Canyon flowered and produced seed after partial burial in 1999. Plants that are completely buried may not produce seed that year and/or may suffer mortality.

Increased peak flows under the Action Alternative may result in increased erosion of these Ute ladies'-tresses sites. Because occupied sites are generally characterized by stable substrates, such as cobble, that are not often mobilized, erosion and removal of Ute ladies'-tresses populations may be limited. Erosion at occupied sites in Red Canyon and Browns Park reaches is generally absent or minor. In Lodore Canyon, erosion and loss of plants did occur on post-dam flood plain and intermediate bench surfaces, on upstream portions of gravel and cobble bars, islands, and debris fans as a result of 10,900-cfs flows in 1999.

Post-dam flood plain or intermediate bench surfaces that experience erosion or deposition generally become available for development of early-succession vegetation. These sites could be colonized by Ute ladies'-tresses, and new reproductive populations could be established. However, some of these new populations might be temporary. For example, some areas that are subject to frequent disturbance from flooding (such as some post-dam flood plain surfaces) may not be stable for long enough periods for Ute ladies'-tresses establishment and reproduction (10-20 years) and may not develop beyond early-succession communities. In addition, new sites that are relatively stable for extended periods (such as some intermediate bench surfaces) may be colonized by native woody species (coyote willow, cottonwood, or invasive species such as tamarisk, whitetop, or yellow clover). Such sites may quickly become unsuitable for Ute ladies'-tresses survival due to moisture stress, shading, or other competitive forces.

New populations could become established on higher elevation sites in Red Canyon, upper Browns Park, or Lodore Canyon. Studies have indicated that Ute ladies'-tresses likely became established on the higher pre-dam terrace in Island Park following high flows in 1983 or 1984 (Grams et al., 2002). Deposition of fine sediments at these higher elevations may increase site suitability for Ute ladies'-tresses. Suitable substrates with 1-3% inundation may become available as a result of higher flows. However, some of these areas may currently support native woody species or invasive species, and shading induced by these species may prevent Ute ladies'-tresses establishment or survival.

The higher summer and early fall base flows of the Action Alternative could inundate some orchids. Inundation would not occur during the lower base flows of the No Action Alternative. Sites supporting Ute ladies'-tresses typically have a shallow water table during August. It is unknown if these higher flows would result in loss of individuals. Long-term effects may result in orchid populations establishing at slightly higher elevations. Lower base flows through the winter should not affect Ute ladies'-tresses since these flows fall outside the growing season. The month of May likely constitutes the beginning of the growing season. There is some uncertainty as to what the effects of these slightly lower early spring flows would be.

4.7.8.2.2 Reach 2 –

4.7.8.2.2.1 No Action Alternative – Conditions under the No Action Alternative for Reach 2 would be similar to those of Reach 1 (see above).

4.7.8.2.2.2 Action Alternative – Effects of flow changes in Reach 2 would be similar to those described for Reach 1. Increased peak flows in wet years could result in some mortality of Ute ladies'-tresses. Though far fewer in number than in Reach 1, sites occupied by Ute ladies'-tresses in Island Park and downstream from Split Mountain may potentially be subject to extended inundation, increased deposition, or increased erosion.

As in Reach 1, suitable sites for Ute ladies'-tresses establishment would potentially become available at higher elevations in Island Park/Rainbow Park, if suitable sediments were deposited. However, high peak flows in Reach 2 due to Yampa River input may decrease the potential suitability of some new sites on post-dam surfaces, such as intermediate bench surfaces.

4.7.8.2.3 Ute Ladies'-Tresses – Summary of Action Alternative – Reaches 1 and 2 – In summary, under the Action Alternative, occupied sites would be subject to some erosion, deposition, or extended inundation. Loss of individual plants would be expected. However, effects on many Ute ladies'-tresses populations, as a result of flow changes, would be expected to be small because of site characteristics that are protective, such as landscape position and substrate composition. The inundation zone of 1 to 3% would likely shift to a slightly higher position along the river margin, potentially resulting in losses to populations at lower elevations, such as post-dam flood plain surfaces. Locations at elevations slightly above the existing inundation zone of 1-3% would potentially become suitable for Ute ladies'-tresses establishment. Suitable substrates would potentially exist along this area or develop as a result of new deposition from changes in flow characteristics.

4.7.8.3 Bald Eagle

4.7.8.3.1 No Action Alternative – Under this alternative, the eventual loss of cottonwood tree roost sites would occur. This would negatively affect bald eagles.

4.7.8.3.2 Action Alternative – Bald eagles use trout as well as other nonnative and native fish species as food when available. However, any adverse effects of an alternative to the trout population would have little effect on the eagles due to the abundance of trout as a food item for eagles. The trout fishery would be maintained under any alternative.

Bald eagle and waterfowl could be adversely affected by steady flows during the winter. Steady flows would allow less ice-free water to be available for these species. Maintenance of ice cover during the winter protects endangered fish. This would reduce the availability of open water in important foraging areas such as Island and Rainbow Parks. Much of the river above the Gates of Lodore would remain open because the temperature of water released from the dam is sufficiently high to prevent freezing. Eagles would concentrate their use in this section of the river during the winter.

An increase in cottonwood regeneration would increase roosting habitat for bald eagles.

4.7.8.4 Black-Footed Ferret

4.7.8.4.1 No Action Alternative – Although black-footed ferret exist near the project area, their habitat requirements do not tie them to the Green River. Actions affecting the operation of the dam would have no effect on this species.

4.7.8.4.2 Action Alternative – The Action Alternative would have no effect on black-footed ferret for the same reason as the No Action Alternative.

4.7.8.5 Lynx

4.7.8.5.1 No Action Alternative – Although lynx may exist within the project area, their habitat requirements do not tie them to the Green River. Actions affecting the operation of the dam would have no effect on this species.

4.7.8.5.2 Action Alternative – The Action Alternative would have no effect on lynx for the same reason as the No Action Alternative.

4.7.8.6 Other Special Status Species

Both aquatic and terrestrial special status species occupy the Green River. Because the river is regulated by Flaming Gorge Dam, these species could be directly or indirectly affected by changes in dam operations. The effect on terrestrial species would be more indirect and occur through dam-induced changes in habitat.

4.7.8.6.1 Yellow-Billed Cuckoo – Methodologies used to assess potential effects to yellow-billed cuckoo involved identifying presence or absence of species, identifying suitable and potentially suitable habitat, and determining where project conditions would alter these habitats. Habitat changes were then assessed in terms of their potential to adversely affect the species and the magnitude of such effect. See section 3.7.2.6, "Vegetation" in chapter 3 and section 4.7.5, "Vegetation in chapter 4, for a full description of vegetation and effects to habitat from the alternatives. Differences between the Action and No Action Alternatives were based on the Hydrologic Modeling Report (see sections 4.3.1, "Hydrology, Flaming Gorge Reservoir," and 4.3.2, "Hydrology, Green River").

4.7.8.6.1.1 No Action Alternative – Reach 1 – In Reach 1, under current operations, flows would not be of sufficient magnitude or frequency to promote development of suitable habitat. The flood plain forests of Browns Park would continue to move toward a desert community with cottonwood eventually replaced by desert shrubs. There would be little opportunity for yellow-billed cuckoo colonization in Reach 1.

4.7.8.6.1.2 No Action Alternative – Reach 2 – In Reach 2, floodflows would continue to erode edges of suitable habitat, though with less frequency than under the Action Alternative. Cottonwood establishment would be limited to extreme floodflow years. Therefore, development of potential yellow-billed cuckoo habitat would occur under the No Action Alternative but would be very limited. Floodflows of sufficient duration and magnitude to maintain mature cottonwoods would continue to occur under infrequent conditions.

4.7.8.6.1.3 No Action Alternative – Reach 3 – Yellow-billed cuckoo habitat in the upper section of Reach 3 is contiguous with Reach 2, and the effects of the No Action Alternative would be very similar to those described above for Reach 1. Suitable habitat along the lower sections of Reach 3 would continue to receive floodflows only in extreme (less than 6% exceedence) wet years—limiting opportunities for maintenance of present habitat. Cottonwoods that are establishing on the lower insert flood plains are unlikely to form the large patch sizes required by yellow-billed cuckoo. The long-term effects of the No Action Alternative would likely result in a reduction of suitable habitat for yellow-billed cuckoo along the lower Green River.

4.7.8.6.1.4 Action Alternative – Reach 1 – Implementation of the Action Alternative may lead to changes in riparian vegetation that could eventually be characterized as suitable yellow-billed cuckoo habitat. The highest magnitude floodflows, as described in the 2000 Flow and Temperature Recommendations, would be required before establishment of yellow-billed cuckoo habitat could occur in Reach 1. Any changes would only contribute to the long-term development of suitable habitat; there would be no increase in suitable habitat in the short term.

4.7.8.6.1.5 Action Alternative – Reach 2 – Increased frequency of floodflows in Reach 2 would likely remove vegetation that constitutes yellow-billed cuckoo habitat. Most erosion would occur on the edges of yellow-billed cuckoo habitat, primarily affecting vegetation that would develop into potential yellow-billed cuckoo habitat with lesser effects to currently suitable habitat. If floodflow events are large enough, the more likely effect of the Action Alternative would be the creation of cottonwood and willow establishment sites through increased scouring and deposition. In addition, increased overbank flooding would contribute to maintenance of mature cottonwood and native riparian communities through increased wetting of flood plain forests. These actions would result in long-term benefits to yellow-billed cuckoo.

4.7.8.6.1.6 Action Alternative – Reach 3 – Effects to yellow-billed cuckoo habitat in the upper section of Reach 3 would be very similar to effects described above for Reach 2. Increased duration and frequency of larger floodflows would provide needed moisture and increased opportunity for development of suitable habitat.

When comparing the two alternatives, effects to yellow-billed cuckoo in the lower section of Reach 3 would be minimal. Hydrology analysis for Reach 3 demonstrate that there would be no measurable difference in floodflows between the No Action and Action Alternatives. Cottonwoods that are establishing on the lower insert flood plains are unlikely to form the large patch sizes required by yellow-billed cuckoo under either alternative. Therefore, yellow-billed cuckoo habitat would be unlikely to improve or increase in acreage under the Action Alternative.

4.7.8.6.2 Whooping Crane –

4.7.8.6.2.1 No Action Alternative – Flaming Gorge Dam operations under the No Action Alternative are not likely to adversely impact whooping crane populations. Use of the Green River by migrating cranes is low. Large areas are, and would continue to be, suitable habitat for these birds.

4.7.8.6.2.2 Action Alternative – Flaming Gorge Dam operations under the Action Alternative are not likely to impact the whooping crane because the probability that habitat along the river would be used by migrating cranes is low. The expected reduction in the amount of riparian vegetation in some reaches of the river could represent a slight adverse impact to this species if migrating birds began to use the confined canyon portions of the river corridor regularly during migration.

4.7.8.6.3 Mexican Spotted Owl –

4.7.8.6.3.1 No Action Alternative – Under the No Action Alternative, needed food and habitat sustained by riparian vegetation linked to the river and its fluctuations would remain available as currently distributed. Mexican spotted owl populations would not be expected to change due to reservoir operations under the No Action Alternative since these operations would not change these animals' access to or extent of exploitable food or habitat resources.

4.7.8.6.3.2. – Action Alternative. Under the Action Alternative, reservoir operations would have very little influence on Mexican spotted owl habitat within the Green River corridor. Mexican spotted owl habitats associated with vegetation or substrate that are dependent on the river and affected by flow fluctuations would not change in any appreciable manner that would affect owl populations. Suitable nesting sites are a much more significant limiting factor for these owls than any riparian feature. The owls' prey base would remain at levels far exceeding the owls' needs.

4.8 Cultural Resources

4.8.1 Flaming Gorge Reservoir

Effects to cultural resources located within a reservoir pool area may be caused by a combination of factors, including topography, slope, soil type, site type, and various mechanical, biochemical, or human impact agents (Lenihan et al., 1981). These agents have the greatest adverse effects on historic properties inundated near the shoreline (the wave-action zone). Historic properties in this zone are subject to mechanical erosion caused by high energy wave action resulting from wind and boat wake activity. For Flaming Gorge Reservoir, the shoreline elevation has fluctuated over time. In average years, the normal operation, low reservoir elevation is 6025 feet above msl, and the normal operation, high reservoir elevation is 6033 feet above msl. Infrequently, very high elevation has occurred at 6040 feet above msl and very low elevation at 5988 feet above msl. As a result, historic properties from 5988- to 6040-foot elevations have been damaged by inundation and mechanical effects from wave action since full operation of the dam began in 1967.

4.8.1.1 No Action Alternative

As shown in table 3-12, 13 known historic properties are located around the reservoir. In the reservoir portion of the project, fluctuation of water levels would not differ from the normal-range levels of the past 37 years under the No Action Alternative. Historic properties are affected more by human visitors than by possible indirect geomorphic effects of dam operations.

4.8.1.2 Action Alternative

Under the Action Alternative, Reclamation anticipates no need to conduct large or unusual drawdowns on Flaming Gorge Reservoir. Fluctuations of the water levels of the reservoir would not change from what has become a normal, although flexible, operation.

There are five historic properties which are eligible for the *National Register of Historic Places* (NRHP) (see table 3-12) within the reservoir area of potential effect (APE). These historic properties are more likely to be affected by visitors than by geomorphic or hydrological processes related to reservoir dam operations. Since visitor effects are managed by the land managing agencies and are not part of dam operations, indirect effects from impacts, like increased vandalism, would not be attributable to the proposed action.

The Wyoming and Utah State Historic Preservation Offices (SHPOs) have concurred with Reclamation's finding that there would be no historic properties affected by the implementation of the Action Alternative.

4.8.2 Green River – Reaches 1, 2, and 3

4.8.2.1 No Action Alternative

Prior to the construction of Flaming Gorge Dam, historic properties located in the Green River flood plain were primarily affected by peak spring floods. Such events probably destroyed many historic properties, especially those located directly on the river banks. In contrast, those historic properties still present in 1962 may have received some benefit from dam construction because the magnitude of spring flooding was reduced and long-term channel narrowing deposited new sediments on top of remnant cultural resources.

Under the No Action Alternative, historic properties located along the banks and in the Green River flood plain would continue to be affected by the same fluvial and geomorphic processes that have occurred over time. In addition, releases from Flaming Gorge Dam could continue to inundate those historic properties listed in tables 3-13 and 3-14.

4.8.2.2 Action Alternative

Under the Action Alternative, cultural resources in Reaches 1, 2, and 3 of the Green River could be subject to direct, indirect, and cumulative effects from inundation, pooling, and raising and lowering of water levels. Through most of the flood plain, these geomorphic and hydrologic processes would not affect the majority of historic properties because these resources are located well above the high water mark and are protected by channel narrowing and sediment deposition. Recent geomorphologic studies (Grams and Schmidt, 2002) conducted within the Green River corridor indicate that the oldest soils (and plausibly the oldest historic properties) along the river most likely occur in Reach 1 in the Browns Park area.

Based on the hydrology modeling results as presented in section 4.3.2, the Action Alternative would result in more frequent inundation of the historic properties listed in tables 3-13 and 14, when compared to the No Action Alternative. However, as previously noted, these historic properties were all subject to even greater flows of longer duration prior to the construction of Flaming Gorge Dam. Therefore, Reclamation concludes that there would be no significant impacts to cultural resources in Reaches 1 and 2 from the implementation of this alternative.

Due to the attenuated nature of the flows which will occur in Reach 3, effects to a terrestrial-based resource such as cultural resource sites would be insignificant. Similar to historic conditions in Reaches 1 and 2, cultural resource sites in Reach 3 which have been impacted in the past were probably much more affected prior to the construction of Flaming Gorge Dam than they have been since the dam was completed.

In Reach 3, there would be no direct or indirect effects to historic properties under either the No Action or the Action Alternatives. The Utah SHPO concurred with this determination on December 29, 2003.

During completion of cultural resource data analysis for this project and in cooperation with the relevant land managing agencies, the verification and testing of certain known sites were conducted. In Utah, Reclamation, in cooperation with BLM and the Utah SHPO, conducted nature and extent test excavations on four sites in Daggett County.

The tested sites were chosen by the BLM. Two of the tested sites are located within the APE for the proposed project, and two are outside of the APE. Three of the tested sites were prehistoric and one was historic. All were evaluated for eligibility and effect. Artifacts recovered during the testing will be curated at the Field Museum in Vernal, Utah. All four of the sites are recommended as being eligible for the NRHP. The Utah SHPO has been consulted on the eligibility determinations of these sites and has concurred (January 13, 2004) with Reclamation's recommendations of eligibility and no adverse effect.

In Colorado, Reclamation, in cooperation with the U.S. Fish and Wildlife Service and the Colorado SHPO, tested six sites in the Browns Park National Wildlife Refuge, Moffat County, for eligibility and effect.

The Colorado SHPO was consulted March 28, 2003, on this work and concurred that three historic properties are present within the APE and that Reclamation and the U.S. Fish and Wildlife Service should continue consultation regarding effects of both natural hydrology and dam operations on two of these properties. Artifacts recovered during the testing are curated at the Rocky Mountain Arsenal National Wildlife Refuge Collections Center in Colorado Springs, Colorado.

4.8.3 Summary of Effects to Cultural Resources

Within the reservoir area, the Wyoming and Utah SHPOs have been consulted on the eligibility determinations for historic properties. Both of these SHPOs have concurred with Reclamation's determination of eligibility regarding historic properties. Also, under 36 Code of Federal Regulations (CFR) 800.4(d)(1), the Utah (December 10, 2002) and Wyoming (November 19, 2002) SHPOs concurred with Reclamation's recommendation that there will be no historic properties affected by the implementation of the project. The Wyoming SHPO recommended annual monitoring of known historic properties near the high elevation of the reservoir.

For Reaches 1, 2, and 3, in consultation with the Colorado and Utah SHPOs; land managing agencies—including the United States Department of Agriculture (USDA Forest Service), BLM, National Park Service, U.S. Fish and Wildlife Service, relevant Indian tribes, and other interested parties—Reclamation applied the criteria of adverse effect to the listed and eligible properties within the APE. Because of the minor differences between the Action and the No Action Alternative flow models and because either alternative is likely to have less effect on historic properties than the pre-dam hydrography, Reclamation recommended that there will be no adverse effect to historic properties from the proposed action.

In cooperation with both the appropriate land-managing agencies and State SHPOs, Reclamation conducted nature and extent testing and rerecording of 10 historic properties, 6 in Colorado and 4 in Utah. The Colorado SHPO sent a letter to Reclamation on March 28, 2003, concurring that three of the six historic properties are eligible for the NRHP. They recommended that Reclamation and the U.S. Fish and Wildlife Service consult further on two of the eligible historic properties within the APE. That consultation is ongoing.

For Reaches 1 and 2, including the Uintah and Ouray Ute Reservation area, the Utah SHPO (January 13, 2004) agreed with Reclamation's recommendations of No Adverse Effect. Also, in Reach 3, December 29, 2003, Reclamation received a letter from the Utah SHPO concurring with the determination of No Historic Properties Affected. See the Cultural Resources Appendix for copies of SHPO concurrence letters. For Reach 3, in compliance with CFR 800.10, consultation has been completed with the National Park Service, the Utah SHPO, and the Advisory Council on Historic Preservation concerning effects of the alternatives on Desolation Canyon which is a National Historic Landmark.

4.9 Paleontological Resources

4.9.1 No Action Alternative

For the No Action Alternative, there would be no effect to paleontological resources from the proposed project since current water releases from the dam and reservoir levels would continue to take place. Fluctuating water levels in Flaming Gorge Reservoir have exposed paleontological resources for the past 36 years.

Fossil resources located within the Green River corridor downstream from Flaming Gorge Reservoir, including Reaches 1, 2, and 3, are less likely to be impacted by fluctuating water levels than those in the reservoir pool area. Prior to dam construction, these resources were exposed to greater water flows than presently exist.

4.9.2 Action Alternative

Fluctuating reservoir levels under the Action Alternative are not expected to have an adverse impact on paleontological resources in and around the reservoir. For the Green River, there would be no effect that could be isolated from the Action Alternative, when compared to the No Action Alternative as well as pre-dam riverflows. For example, where the river passes through bedrock, such as Split Mountain in Dinosaur National Monument, the effect of riverflows under any scenario consists of polishing of exposed invertebrate fossils.

4.10 Indian Trust Assets

4.10.1 No Action Alternative

Tribal fishing rights are an Indian trust asset. The species of fish most commonly harvested by tribal members is channel catfish, a nonnative sport fish. Channel catfish are extremely abundant throughout the Green River in Reaches 2 and 3. A continuation of the 1992 Biological Opinion flows would not likely affect channel catfish catchability. As noted in section 4.6, "Land Use," the landowners adjacent to Reach 2 of the Green River have become accustomed to the flows associated with this alternative. No adverse impacts to the resources associated with Indian trust assets have been identified.

4.10.2 Action Alternative

Under the 2000 Flow and Temperature Recommendations, conditions are expected to favor native fish over nonnatives in the long term. Nonnative channel catfish may be negatively impacted in canyon bound reaches during wetter hydrologies. However, channel catfish are so abundant throughout the Green River that unless the Recovery Program can successfully reduce their numbers through an active control project, this trust asset (tribal fishing rights) likely would not be affected. Wildlife and vegetation resources would not be adversely affected by implementation of the Action Alternative; thus, tribal hunting and gathering rights would not be affected.

Under the Action Alternative, the private and reservation lands adjacent to the Green River in Uintah County would continue to experience inundation during peak runoff times as they have in the past. The adjacent landowners have become accustomed to effects to agricultural lands and the oil and gas well operations during these peak runoff times. Under the Action Alternative, in some years, flows would exceed what adjacent landowners have experienced in the past. While effects to reservation agricultural lands and oil and gas well operations could affect Indian trust assets, the Northern Ute Tribe advised Reclamation during a meeting April 20, 2004, at tribal headquarters in Fort Duchesne, Utah, that advance notice from Reclamation would resolve issues of well access and effects to cattle utilizing agricultural lands within the area of potential inundation. During the spring when high flows occur, there would be limited access just as it now occurs. There would be no significant difference between the Action and the No Action Alternatives. Thus, there would not be any adverse effects to Indian trust assets.

4.11 RECREATION

This section describes the methodology and presents the results of the recreation analysis both on the Green River and Flaming Gorge Reservoir. The recreation analyses evaluate effects by alternative in terms of visitation, recreation facility (infrastructure) availability, economic value, and recreation safety.

4.11.1 Visitation, Recreation Infrastructure, and Economic Value Methodology

The recreation visitation and value analysis compares estimates of total visitation and value by recreation activity for the Action Alternative to those of the No Action Alternative. The driving force behind the visitation and valuation analyses is changes in alternative specific hydrology as measured by riverflows and reservoir water levels. Recreation visitation, measured in terms of visits, reflects the sum of recreator round trip recreation excursions to the river or reservoir. Recreation value per visit, measured in terms of consumer surplus, reflects the increment in per visit recreator willingness-to-pay over and above actual per visit costs. Multiplying and summing hydrology influenced visits and values per visit by recreation activity for each alternative provides estimates of total recreation value by alternative. The gain or loss in recreation visitation and value, compared to the No Action Alternative, provides one measure of the Action Alternative's effect on recreation.

Initially, attempts were made to gather and apply existing information in the development of the visitation and value analyses. However, lack of adequate data led the USDA Forest Service, one of the cooperating agencies for this EIS, to contract with Colorado State University to gather additional recreation information. The contractor conducted a survey within the Flaming Gorge National Recreation Area at both the Green River and Flaming Gorge Reservoir during the summer of 2001. Recreators were contacted onsite from May through September 2001 and asked a series of questions about their recreation behavior over the past year. The survey provided information by recreation activity in terms of riverflow and reservoir water level, visitation, and value under four scenarios: current, preferred, low end, and high end. Preferred flows/water levels portray an upper bound of visitation and value. The low and high end flow/water level thresholds illustrate the point where visitation and value goes to zero due to insufficient or excess flows/water levels. In many cases, survey responses were adjusted downward using a conservative, but frequently applied, approach of assuming nonrespondents equal to zero. As a result, differences exist between certain estimates used in the analysis and those presented in the survey report (Aukerman and Schuster, 2002).

The four data points based on low end, current, preferred, and high end scenarios were used to sketch out an inverted U-shaped distribution for estimation of visitation and value through a process of linear interpolation. The "current" data point typically fell between the low end and preferred conditions data points, thereby creating a skewed or lopsided distribution. Given this would have an effect on the visitation and valuation estimates, another data point, referred to as the "high end kink," was added to the process. The high end kink was calculated to be proportional with the location of the "current" data point so as to provide a symmetric distribution. The linear interpolation process made use of all five data points when developing estimates. Linear interpolation simply involves developing estimates using percentages. For example, if an alternative's flow falls 75% of the way between the preferred and current flow data points, then that same alternative's visitation and valuation would also be estimated to fall 75% of the way between the preferred and current visitation and valuation data points. The estimates of flow/water level, visitation, and value for the five data points for both the No Action and Action Alternatives under average, wet, and dry hydrologic conditions were developed from a combination of existing data and survey data.

The average condition refers to average monthly flows and water levels across all years found in the hydrologic model output. Wet and dry conditions refer to the flows and water levels that represent the highest and lowest 10% of the hydrologic output. In all three cases, the flows and water levels do not align exactly with the average, wet, and dry water year types as described in the 2000 Flow and Temperature Recommendations. However, the intent is to measure recreation effects for each alternative using similar concepts capable of being described by the hydrologic model.

The linear interpolation procedure was used to develop all the visitation and value estimates by activity, month, alternative, and hydrologic condition for Green River analysis. The procedure also was used to develop the value per visit estimates in the Flaming Gorge Reservoir analysis. However, lack of reservoir visitation data for the relevant survey period from June 2000 through September 2001 precluded use of the interpolation approach for estimating Flaming Gorge Reservoir visitation. Instead, a facilities availability approach was used to develop reservoir visitation estimates.

The facility availability approach focuses purely on the influence of water access on recreation visitation. Water access is determined by the availability of recreation facilities as reservoir water levels fluctuate.

The basic concept that recreation visitation varies with availability of facilities is well founded, but it only applies to water-based activities. In addition, by focusing purely on access, the approach fails to consider other influential factors, such as aesthetics and safety concerns. Nevertheless, facilities availability approaches are often used to estimate changes in visitation.

The facility availability approach involves gathering information on when water-based recreation facilities become unusable due to low or high water. In the case of Flaming Gorge Reservoir, for the alternatives of interest, only the low end facility thresholds were of concern. See table 4-10 for a list of Flaming Gorge Reservoir recreation facilities and low end usability thresholds.

Comparing end-of-month water levels for each alternative and hydrologic condition, with the low end thresholds for each facility, provides an indication as to when facilities would be unavailable. Linking facility availability with recent visitation estimates by facility, month, and recreation activity provides a preliminary estimate of visitation by facility, alternative, and hydrologic condition. These initial visitation estimates were reviewed by Flaming Gorge Reservoir recreation managers from the perspective of potential facility substitution. As a given facility becomes unusable, it is likely that recreators will move or substitute to other available facilities around the reservoir. Based on information provided by recreation managers, estimates of Flaming Gorge Reservoir visitation by month, activity,

Table 4-10.—Flaming Gorge Reservoir Facility Usability Thresholds (Elevation in feet above mean sea level)

Site	Facility Type	Low End Threshold
Antelope Flat	Boat Ramp Swim Beach	6015 6012
Anvil Draw[1]	Boat Ramp	6020
Buckboard Crossing	Marina Boat Ramp	6015 6000
Cedar Springs	Marina Boat Ramp	6018 6018
Firehole	Boat Ramp Swim Beach	6019 6012
Hideout	Boat Camp	6014
Jarvies Canyon	Boat Camp	6012
Kingfisher Island	Boat Camp	6010
Lucerne Valley	Marina 2 Boat Ramps Swim Beach	6010 5994 6014
Mustang Ridge	Boat Ramp	6000
Sheep Creek	Boat Ramp	6015
Squaw Hollow	Boat Ramp	6015
Sunny Cove	Swim Beach	6018
Upper Marsh Creek	Boat Ramp	6000

[1] The Anvil Draw boat ramp was extended in 2003 such that the low end threshold changed from 6020 to 6015. This change is not reflected in the analysis because it would not substantially affect the results (impacts only this low use ramp during dry conditions).

alternative, and hydrologic condition were developed taking into account facility substitution.

In addition to the visitation and economic value analysis, evaluations were also made as to the availability of recreation facilities for each alternative. As noted above, facility availability provided the basis for estimating visitation effects for the reservoir. Although not used to estimate the visitation effects on the Green River, facility availability was also reviewed on the Green River downstream from Flaming Gorge Dam, all the way to the confluence with the Colorado River. As with the reservoir visitation analysis, high and low end usability thresholds were obtained for each facility from the various managing entities (i.e., USDA Forest Service, BLM, State of Utah, U.S. Fish and Wildlife Service, National Park Service). Average, wet (90^{th} percentile), and dry (10^{th} percentile) flows from the hydrology model for each alternative were compared to the high and low usability thresholds for each facility. In addition, the raw hydrologic output data was searched to determine the percent of time each usability threshold was exceeded for each alternative. Table 4-11 presents the high and low end usability thresholds for each potentially impacted facility on the Green River. Note that after further analysis, many of the recreation facilities identified in chapter 3, "Affected Environment," were assumed to be unaffected by riverflows given their historical use across a wide range of flow conditions. This facility availability information is presented for each alternative along with the visitation and valuation information.

For a detailed discussion of the intricacies of the Green River or Flaming Gorge Reservoir methodologies, see the Recreation Visitation and Valuation Analysis Technical Appendix.

4.11.2 Recreation Safety Methodology

Safety of recreation activities on Flaming Gorge Reservoir correlates directly with access to the reservoir's surface rather than boating on the reservoir. Boating hazards on the reservoir occur at all elevations and are a problem to boat operators at all times. Therefore, the safety of boating on the reservoir is not related directly to reservoir elevation fluctuations. The recreation safety hazards associated with changes in reservoir elevations at Flaming Gorge Reservoir are related to the recreation users' ability to safely access developed boat ramps, docks, marinas, shoreline fishing areas, and beach areas. The thresholds used for this analysis are from Aukerman and Shuster, 2002. Reservoir elevations higher or lower than these elevations would stop visitors from pursuing their primary activity. Reservoir elevations outside the identified threshold will require recreation users to find their own access, which increases the risk and safety of the recreation users.

Examples of safety concerns on the reservoir occur during launching and takeout of watercraft. When the reservoir is above the high end and below the low end thresholds, launching becomes more difficult overall. These high and low thresholds impact the marinas, beach areas, bank fishing, and swimming, because access is more difficult and the facilities were not designed to function well outside the thresholds.

4.11.3 Annual Recreation Visitation and Valuation Results

This section presents the results of the annual recreation visitation and valuation analysis for each alternative. Under each alternative,

Table 4-11.—Green River Facility Usability Thresholds

Site Name	Facility Type	Managing Entity	Low End Usability Threshold (cfs)	High End Usability Threshold (cfs)
Green River - Reach 1 (Dam to Confluence With Yampa River)				
Spillway	Boat Ramp	USDA Forest Service	600	6,000
Little Hole	Boat Ramp	USDA Forest Service	600	8,000
	Fishing Pier	USDA Forest Service	600	6,000
	Trail	USDA Forest Service	N/A	6,000
	9 of 18 Campgrounds	USDA Forest Service	n/a	5,000
Indian Crossing	Boat Ramp	BLM	800	None
Bridge Hollow	Boat Ramp	BLM	800	None
	Campground	BLM	n/a	10,000
Swallow Canyon	Boat Ramp	BLM	800	None
Bridge Port Camp	Boat Ramp	State of Utah – UDWR	800	None
Green River – Reach 2 (Yampa River to Confluence With White River)				
Ouray NWR	Boat Ramp	U.S. Fish and Wildlife Service	None	25,000
Green River – Reach 3 (White River to Confluence With Colorado River)				
Sand Wash	Boat Ramp	BLM	800	50,000
Swasey's Beach	Boat Ramp	BLM	2,000	50,000
Nefertiti	Boat Ramp	BLM	800	[1]27,000
Butler Rapid	Boat Ramp	BLM	800	[1]27,000
Mineral Bottom	Boat Ramp	BLM	800	[1]30,000
Green River State Park	Boat Ramp	State of Utah	800	25,000
	Campground	State of Utah	None	25,000
	Golf Course	State of Utah	None	19,000

[1] Access road to the facility becomes inundated, not the facility itself.

separate subsections are presented for hydrology, visitation, and value.

4.11.3.1 No Action Alternative

Monthly average Green River flows and end-of-month Flaming Gorge Reservoir water levels were obtained from the hydrology models for each alternative. Detailed tables of Green River flows and Flaming Gorge Reservoir water levels are presented to provide an indication of where No Action Alternative flows and water levels fall within the range of interpolation data points.

Within the recreation analysis, comparisons were made of recreation effects between alternatives under average, wet, and dry hydrologic conditions. The monthly average flows under average conditions simply depict the average flows for that particular month across all years within the hydrologic output. As a result, average flows do not necessarily equate to information related to average water year types presented within the context of the Green River flow recommendations. Similarly, the wet and dry flows used in the recreation analysis are not based on information by water year type but reflect the 90% and 10% thresholds associated with the output from the hydrologic model. The dry flows represent the flow threshold describing the lowest 10% of monthly flow estimates (10% flow level); the wet flows represent the flow threshold describing the highest 10% of monthly flow estimates (90% flow level).

Table 4-12 presents the average, wet, and dry Green River monthly flows for Reach 1 for the No Action Alternative. The table includes the five flow data points used in the interpolations. Comparing the alternative flows to the data points indicates where the alternative flow falls within the inverted U-shaped flow distribution. For example, the No Action Alternative average condition flow of 1,484 for scenic floating in March falls between the current flow data point (1,036) and the preferred flows data point (2,170). The visitation interpolation for the No Action Alternative scenic floating March average condition would, therefore, also result in estimates falling between the current and preferred visit data points.

Although applying the same overall interpolation approach, the value interpolations were based on the annual current and high end kink data point flows as presented at the bottom of table 4-12. For the valuation analysis, the average March flow for scenic floating of 1,484 also falls between the current (1,096.9) and preferred (2,170) flow valuation interpolation data points.

End-of-month Flaming Gorge Reservoir water levels were also obtained from the hydrology models for each alternative. As with the river hydrology, reservoir water levels were obtained by alternative for average, wet, and dry hydrologic conditions.

Table 4-13 presents the average, wet, and dry reservoir water levels by month for the No Action Alternative. Note that the Flaming Gorge Reservoir recreation analysis was conducted across all months and not only March through October, as was the case for the river analysis.

4.11.3.1.1 Annual Recreation Visitation and Infrastructure – Based on the approaches described above under the methodology section, table 4-14 presents annual water-based visitation estimates by recreation activity for the No Action Alternative under average, wet, and dry hydrologic conditions for both the Green River and Flaming Gorge Reservoir.

Visitation at the reservoir far surpasses that of the river, representing from 87 to 96% of the combined total depending on the hydrologic condition. Power boating/waterskiing and boat fishing on the reservoir are the dominant activities accounting for 80 to 90% of the combined total visitation and nearly 95% of visitation on the reservoir. Shoreline fishing/trail use, scenic floating, and private boat fishing account for most of the visitation on the river. These three activities, while significant on the river given they reflect from 82 to 87% of river visitation, account for, at most, about 11% of the combined total visitation. Boat camping and swimming are relatively minor activities across all conditions.

For Flaming Gorge Reservoir, all facilities were expected to be available based on end-of-month water levels across all months under No Action Alternative average and wet conditions. However, under No Action Alternative dry conditions, several facilities are expected to be unusable. The Anvil Draw boat ramp has a low end usability threshold of 6020 and becomes unusable on average for all months except April during dry conditions. The Cedar Springs marina and boat ramp are expected to experience problems under dry

Table 4-12.—No Action Alternative, Green River Reach 1 Average Monthly Flows (in cfs) by Hydrologic Condition

Month	Recreation Activity	Interpolation Data Points					No Action Alternative		
		Low End Threshold Flow	Current Flow	Preferred Flow	High End Kink Flow	High End Threshold Flow	Average	Wet	Dry
		Monthly Oriented Flow Data Points for Visitation Analysis Interpolation							
March	Scenic Floating	953	1,036.0	2,170	3,786.7	3,905	1,484	1,898	800
	Guide Boat Fishing	854	“ ”	1,837	3,380.3	3,731	“ ”	“ ”	“ ”
	Private Boat Fishing	879	“ ”	1,808	3,343.7	3,656	“ ”	“ ”	“ ”
	Shore Fishing/Trail Use	825	“ ”	1,624	3,158.4	3,709	“ ”	“ ”	“ ”
	Camping	836	“ ”	2,000	3,273.7	3,538	“ ”	“ ”	“ ”
April	Scenic Floating	“ ”	1,145.0	“ ”	3,631.3	“ ”	2,207	3,290	800
	Guide Boat Fishing	“ ”	“ ”	“ ”	3,170.3	“ ”	“ ”	“ ”	“ ”
	Private Boat Fishing	“ ”	“ ”	“ ”	3,126.9	“ ”	“ ”	“ ”	“ ”
	Shore Fishing/Trail Use	“ ”	“ ”	“ ”	2,874.0	“ ”	“ ”	“ ”	“ ”
	Camping	“ ”	“ ”	“ ”	3,129.7	“ ”	“ ”	“ ”	“ ”
May	Scenic Floating	“ ”	1,954.0	“ ”	2,478.0	“ ”	3,463	5,100	1,400
	Guide Boat Fishing	“ ”	1,504.3	“ ”	“ “	“ ”	“ ”	“ “	“ “
	Private Boat Fishing	“ ”	1,471.2	“ ”	“ “	“ ”	“ ”	“ “	“ “
	Shore Fishing/Trail Use	“ ”	1,296.7	“ ”	“ “	“ ”	“ ”	“ “	“ “
	Camping	“ ”	1,638.2	“ ”	“ “	“ ”	“ ”	“ “	“ “
June	Scenic Floating	“ ”	1,215.2	“ ”	3,531.2	“ ”	2,710	5,917	800
	Guide Boat Fishing	“ ”	“ ”	“ ”	3,035.1	“ ”	“ ”	“ ”	“ “
	Private Boat Fishing	“ ”	“ ”	“ ”	2,987.3	“ ”	“ ”	“ ”	“ “
	Shore Fishing/Trail Use	“ ”	“ ”	“ ”	2,690.8	“ ”	“ ”	“ ”	“ “
	Camping	“ ”	“ ”	“ ”	3,037.0	“ ”	“ ”	“ ”	“ “
July	Scenic Floating	“ ”	1,007.0	“ ”	3,828.0	“ ”	983	1,200	800
	Guide Boat Fishing	“ ”	“ ”	“ ”	3,436.2	“ ”	“ ”	“ ”	“ “
	Private Boat Fishing	“ ”	“ ”	“ ”	3,401.4	“ ”	“ ”	“ ”	“ “
	Shore Fishing/Trail Use	“ ”	“ ”	“ ”	3,234.1	“ ”	“ ”	“ ”	“ “
	Camping	“ ”	“ ”	“ ”	3,312.1	“ ”	“ ”	“ ”	“ “
Aug	Scenic Floating	“ ”	1,122.2	“ ”	3,663.7	“ ”	1,251	1,531	931
	Guide Boat Fishing	“ ”	“ ”	“ ”	3,214.2	“ ”	“ ”	“ ”	“ ”
	Private Boat Fishing	“ ”	“ ”	“ ”	3,172.1	“ ”	“ ”	“ ”	“ ”
	Shore Fishing/Trail Use	“ ”	“ ”	“ ”	2,933.3	“ ”	“ ”	“ ”	“ ”
	Camping	“ ”	“ ”	“ ”	3,159.8	“ ”	“ ”	“ ”	“ ”
Sept	Scenic Floating	“ ”	1,118.0	“ ”	3,669.7	“ ”	1,374	1,639	1,039
	Guide Boat Fishing	“ ”	“ ”	“ ”	3,222.3	“ ”	“ ”	“ ”	“ ”
	Private Boat Fishing	“ ”	“ ”	“ ”	3,180.5	“ ”	“ ”	“ ”	“ ”
	Shore Fishing/Trail Use	“ ”	“ ”	“ ”	2,944.3	“ ”	“ ”	“ ”	“ ”
	Camping	“ ”	“ ”	“ ”	3,165.3	“ ”	“ ”	“ ”	“ ”
Oct	Scenic Floating	“ ”	1,024.0	“ ”	3,803.8	“ ”	1,654	2,075	1,039
	Guide Boat Fishing	“ ”	“ ”	“ ”	3,403.5	“ ”	“ ”	“ ”	“ ”
	Private Boat Fishing	“ ”	“ ”	“ ”	3,367.6	“ ”	“ ”	“ ”	“ ”
	Shore Fishing/Trail Use	“ ”	“ ”	“ ”	3,189.7	“ ”	“ ”	“ ”	“ ”
	Camping	“ ”	“ ”	“ ”	3,289.6	“ ”	“ ”	“ ”	“ ”
		Annually Oriented Flow Data Points for Valuation Analysis Interpolation							
		Low End Threshold Flow	Annual Current Flow	Preferred Flow	Annual High End Kink Flow	High End Threshold Flow			
All months	Scenic Floating	953	1,096.9	2,170	3,699.8	3,905	Monthly flows are as above		
	Guide Boat Fishing	854	1,359.0	1,837	2,757.9	3,731			
	Private Boat Fishing	879	1,373.3	1,808	2,672.7	3,656			
	Shore Fishing/Trail Use	825	1,298.6	1,624	2,473.1	3,709			
	Camping	836	1,115.5	2,000	3,168.7	3,538			

Table 4-13.—No Action Alternative, Flaming Gorge Reservoir Average End-of-Month Water Levels (in Feet Above msl) by Hydrologic Condition

Month	Recreation Activity	Annually Oriented Water Level (WL) Data Points for Valuation Analysis Interpolation					No Action Alternative Water Levels		
		Low End Threshold WL	Annual Current WL	Preferred WL	Annual High End Kink WL	High End Threshold WL	Average	Wet	Dry
January	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6024.3	6028.1	6017.4
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5	“.........”	“.........”	“.........”
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7	“.........”	“.........”	“.........”
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7	“.........”	“.........”	“.........”
February	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6024.0	6026.8	6017.8
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
March	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6024.0	6027.9	6019.0
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
April	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6024.1	6028.5	6020.1
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
May	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6023.8	6029.4	6017.6
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
June	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6026.6	6031.7	6018.5
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
July	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6029.1	6035.5	6019.3
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
August	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6028.9	6036.0	6018.5
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
September	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6028.3	6035.5	6017.9
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
October	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6027.5	6034.9	6017.3
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
November	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6026.3	6032.9	6017.5
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
December	Power Boating/Skiing	“.........”	“.........”	“.........”	“.........”	“.........”	6025.1	6030.3	6017.3
	Boat Fishing	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Boat Camping	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”
	Swimming/Waterplay	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”	“.........”

Table 4-14.—No Action Alternative Annual Water-Based Visitation[1]

Recreation Activity	Average Condition Visits	Average Condition % of Combined Total	Wet Condition Visits	Wet Condition % of Combined Total	Dry Condition Visits	Dry Condition % of Combined Total
I. Green River Visitation:						
Scenic Floating	20,885	3.2	20,349	3.2	85	0.0
Guide Boat Fishing	10,108	1.5	7,548	1.2	3,606	.6
Private Boat Fishing	16,309	2.5	13,360	2.1	7,600	1.3
Shoreline Fishing/Trail Use	33,927	5.2	26,722	4.2	10,509	1.9
Boat Camping	2,229	.3	1,674	.3	458	.1
Total:	83,458	12.7	69,653	10.9	22,258	3.9
II. Flaming Gorge Reservoir Visitation:						
Power Boating/Waterskiing	359,278	54.8	359,278	56.0	340,615	60.2
Boat Fishing	181,348	27.7	181,348	28.2	171,969	30.4
Boat Camping	10,374	1.6	10,374	1.6	10,374	1.9
Swimming and Waterplay	21,291	3.2	21,291	3.3	21,.034	3.7
Total:	572,291	87.3	572,291	89.1	543,992	96.1
III. Combined Total:	655,749	100	641,944	100	566,250	100

[1] Numbers may not add due to rounding.

conditions during January, February, May, and September through December. The Firehole boat ramp would only be available under dry conditions during March, April, and July. Finally, the Sunny Cove swim beach follows a pattern similar to Cedar Springs during dry conditions experiencing problems in January, February, May, and September through December. The problems of facility unavailability, tempered by the potential for facility substitution, results in the reduced Flaming Gorge visitation estimates under dry conditions. While facility availability is presented across all months, the analysis takes into account low visitation levels during the winter months.

Although unrelated to the interpolation based Green River visitation analysis, for comparison purposes with reservoir facilities, an analysis of facility availability was also conducted for Green River recreation facilities. Within Reach 1, all river facilities were expected to be available based on average monthly flows across all months under No Action Alternative average and dry conditions. However, under No Action Alternative wet conditions, 9 of the 18 riverside campgrounds were expected to be unavailable in May and June due to high flows. Facility unavailability due to low water levels on the reservoir implies little damage to the facilities; however, facility unavailability on the river due to high flows can imply substantial damage. River facility unavailability was based on the point where significant impacts were expected to occur. However, in most cases, erosion damage begins prior to the significant impact flow level (e.g., impacts begin at: 4,200 cfs to Little Hole ramp foundations; 5,000 cfs to trail tread/boardwalk footings and campground banks and vegetation; and 6,000 cfs to spillway boat ramp protective riprap and foundations).[1] Within Reach 2, the boat ramp at Ouray National Wildlife Refuge remains available under average, dry, and wet conditions across all months for the No Action Alternative. Within Reach 3, all facilities remain available under average conditions for the No Action Alternative. However, under dry conditions, the Swasey's Beach boat ramp would be unavailable during the months of January, February, and July through December. Under wet conditions, the facilities at Green River State Park would be affected during May and June (golf course during both May and June and the campground and boat ramp during June).

4.11.3.1.2 Annual Recreation Valuation – Table 4-15 presents annual water-based valuation estimates by recreation activity for the No Action Alternative under average, wet, and dry hydrologic conditions for both the Green River and Flaming Gorge Reservoir.

As with the visitation estimates, reservoir valuation far surpasses that of the river, representing from 81 to 86% of the combined total valuation depending on the hydrologic condition. Power boating/waterskiing and boat fishing on the reservoir are the dominant activities accounting for over 80% of the combined total valuation and nearly 99% of valuation on the reservoir. The dominant activities in terms of value vary on the river depending on the hydrologic condition. Scenic floating and guide boat fishing are most significant under average and wet conditions (65% of river value); but guide boat fishing, private boat fishing, and shoreline fishing/trail use account for nearly all of the value (99%) under dry conditions. These activities, while significant on the river, do not account for more than 14% of the combined total valuation under any hydrologic condition. Boat camping and swimming are relatively minor activities across all conditions.

4.11.3.2 Action Alternative

This section describes recreation effects for the Action Alternative in terms of hydrology, visitation, and value. Action Alternative results are compared to the No Action Alternative to estimate the impact of implementing the alternative.

Green River average monthly flows and Flaming Gorge Reservoir end-of-month water levels are described in this section for the Action Alternative. The implications of these flows and water levels in terms of changes in visitation and value will be discussed in subsequent sections.

Table 4-16 presents average Green River flows by month for the Action Alternative under average, wet, and dry hydrologic conditions. Information is also presented on the difference between the Action and No Action Alternatives in terms of flow (cfs) and percentage. Also included in the table are the five flow data points used in the interpolations. Comparing the alternative flows to the data points indicates where the alternative flow falls within the inverted U-shaped flow distribution. For example, the Action Alternative average condition flow for March of 1,270 cfs falls between the current flow data point (1,036 cfs or 1,096.9 cfs) and the preferred flow data point (2,170 cfs) for scenic floating. The scenic floating visitation and value interpolation for the Action Alternative March average condition would, therefore, also result in estimates falling

[1] Although not directly related to the rest of the analysis, the monthly frequency across all years where the five most impacted Flaming Gorge Reservoir facilities (Anvil Draw boat ramp, Cedar Springs marina and boat ramp, Firehole boat ramp, and Sunny Cove swim beach) may be unavailable ranges from 7.4% (once very 13.5 years) to 15.9% (once every 6.3 years) under the No Action Alternative. For the Green River facilities, within Flaming Gorge National Recreation Area, the unavailability percentage ranges from 0 to 15.5% (once every 6.5 years). For a detailed presentation of the monthly unavailability percentages for all reservoir facilities, see the Recreation Visitation and Valuation Analysis Technical Appendix. (Corresponding table is on the following page.)

Table 4-15.—No Action Alternative Annual Valuation ($1,000s)[1]

Recreation Activity	Average Condition Values	Average Condition % of Combined Total	Wet Condition Values	Wet Condition % of Combined Total	Dry Condition Values	Dry Condition % of Combined Total
I. Green River Valuation:						
Scenic Floating	1,013.6	4.0	1,174.9	5.9	3.8	.1
Guide Boat Fishing	1,600.9	6.3	1,283.0	6.4	425.9	7.4
Private Boat Fishing	636.7	2.5	620.2	3.1	174.8	3.0
Shoreline Fishing/Trail Use	691.8	2.7	661.4	3.3	192.1	3.3
Boat Camping	22.7	.1	20.0	.1	2.8	.1
Total:	3,965.7	15.6	3,759.5	18.8	799.3	13.8
II. Flaming Gorge Reservoir Valuation:						
Power Boating/Waterskiing	14,723.6	58.1	11,341.7	56.8	3,567.6	61.6
Boat Fishing	6,281.9	24.8	4,646.3	23.3	1,368.2	23.6
Boat Camping	197.8	.8	151.1	.8	49.7	0.9
Swimming and Waterplay	173.1	.7	83.5	.4	8.8	.2
Total:	21,376.3	84.4	16,222.6	81.2	4,994.4	86.2
III. Combined Total:	25,342.0	100	19,982.1	100	5,793.7	100

[1] Numbers may not add due to rounding.

Footnote Table:

No Action Alternative High Recreation Season Selected Facility Unavailability Percentages

Site	Area	Facility	Threshold	Mar	Apr	May	June	July	Aug	Sept	Oct
Flaming Gorge Reservoir	Anvil Draw	Boat Ramp	6020	12.3	9.7	15.9	11.2	12.7	12.6	12.6	12.7
	Cedar Springs	Marina	6018	8.1	7.4	10.5	8.2	9.2	9.2	10.5	10.7
		Boat Ramp	6018	8.1	7.4	10.5	8.2	9.2	9.2	0.5	10.7
	Firehole	Boat Ramp	6019	10.0	7.9	12.0	10.6	9.4	11.1	11.6	12.2
	Sunny Cove	Swim Beach	6018	8.1	7.4	10.5	8.2	9.2	9.2	10.5	10.7
	Buckboard Crossing	Marina	6015	7.4	6.0	4.8	2.1	4.7	7.1	9.1	9.1
		Boat Ramp	6000	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	Lucerne Valley	Marina	6010	3.2	2.9	2.1	1.5	1.5	1.5	1.6	3.0
		Boat Ramps	5994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Green River	Spillway	Boat Ramp	6000	0.0	0.0	6.3	9.9	0.0	0.0	0.0	0.0
	Little Hole	Boat Ramp	8000	0.0	0.0	2.8	4.0	0.0	0.0	0.0	0.0
		Fishing Pier	6000	0.0	0.0	6.3	9.9	0.0	0.0	0.0	0.0
		Recreation Trail	6000	0.0	0.0	6.3	9.9	0.0	0.0	0.0	0.0
		9 of 18 Riverside Campgrounds	5000	0.0	0.0	10.3	15.5	0.0	0.0	0.0	0.0

[1] Thresholds: Reflects low end water level (msl) for reservoir and high end flow (cfs) for river.

between the current and preferred visit and value data points. Also note that the Action Alternative March average flow condition is 214 cfs less than the No Action Alternative. This implies that the Action Alternative March average condition visitation and value estimates will be less than those of the No Action Alternative since No Action Alternative March flows are closer to the preferred flow. Generally speaking, the closer an alternative's flow is to the preferred flow, the higher the visitation and value estimate.

Comparing the average condition flows between the Action and No Action Alternatives indicates that from June through September, Action Alternative average flows exceed No Action Alternative flows. The largest differences occur in June and July where the Action Alternative flow exceeds the No Action Alternative flow by more than 1,000 cfs.

During wet conditions, Action Alternative average flows exceed No Action Alternative flows across the entire March through October period. The largest difference occurs in July where the Action Alternative exceeds the No Action Alternative by 3,400 cfs or 283%.

During dry conditions, the difference between the alternatives is less severe in terms of both cfs and percentage. In 4 of the 8 studied months (May, August, September, October), No Action Alternative average monthly flows exceed those of the Action Alternative. The largest difference (-600 cfs, -42.9%) occurs in May.

Table 4-17 presents end-of-month Flaming Gorge Reservoir water levels for the Action Alternative under average, wet, and dry hydrologic conditions as obtained from the hydrology model. Information is presented on the difference between the Action and No Action Alternatives in terms of water levels.

Comparing average condition end-of-month water levels between the Action and No Action Alternatives indicates very little difference between the two alternatives. The largest difference occurs in April and May with the Action Alternative only 2 feet higher than the No Action Alternative.

Water levels under wet conditions were not evaluated within the reservoir visitation analysis since they do not create any problems in terms of recreation access. However, water level differences were evaluated via the interpolation procedure within the reservoir valuation analysis. Action Alternative water levels fell below those of the No Action Alternative in 8 of the 12 months, with the most significant differences being in July through November.

Under dry conditions, Action Alternative water levels in the reservoir exceed those of the No Action Alternative across all months. The differences between the alternatives range from a low of 2.9 feet to a high of 6.0 feet. These differences are substantially greater than those seen under average conditions and may be more significant given the lower water levels.

4.11.3.2.1 Annual Recreation Visitation and Infrastructure – Table 4-18 presents information on annual water-based visitation combined for both the Green River and Flaming Gorge Reservoir for the Action Alternative under average, wet, and dry conditions. Reservoir visitation accounts for anywhere from 87 to 98% of the total, depending on the hydrologic condition. For information on what these changes in recreation visitation mean in terms of expenditures, jobs, and other measures of regional economic activity, see section 4.12, "Socioeconomics and Regional Economics."

For the Action Alternative average condition, the combined visitation barely changes from the No Action Alternative average condition.

Table 4-16.—Action Alternative Green River Reach 1 Flows (in cfs) by Hydrologic Condition and Month

Month	Recreation Activity	Interpolation Data Points: Low End Threshold Flows	Current Flows	Preferred Flows	High End Kink Flows	High End Threshold Flows	Average Condition: Average Monthly Flows	Change from No Action Alternative: Cfs	%	Wet Condition: Average Monthly Flows	Change from No Action Alternative: Cfs	%	Dry Condition: Average Monthly Flows	Change from No Action Alternative: Cfs	%
		Monthly Oriented Data Points for Visitation Interpolation													
March	Scenic Floating	953	1,036.0	2,170	3,786.7	3,905	1,270	-214	-14.4	2,030	132	7.0	800	0	0
	Guide Boat Fishing	854	“ ”	1,837	3,380.3	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	3,343.7	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	3,158.4	3,709	“ ”			“ ”			“ ”		
	Camping	836	“ ”	2,000	3,273.7	3,538	“ ”			“ ”			“ ”		
April	Scenic Floating	953	1,145.0	2,170	3,631.3	3,905	1,904	-303	-13.7	3,981	691	21.0	800	0	0
	Guide Boat Fishing	854	“ ”	1,837	3,170.3	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	3,126.9	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	2,874.0	3,709	“ ”			“ ”			“ ”		
	Camping	836	“ ”	2,000	3,129.7	3,538	“ ”			“ ”			“ ”		
May	Scenic Floating	953	1,954.0	2,170	2,478.0	3,905	3,233	-230	-6.7	5,537	437	8.6	800	-600	-42.9
	Guide Boat Fishing	854	1,504.3	1,837	“ ”	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	1,471.2	1,808	“ ”	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	1,296.7	1,624	“ ”	3,709	“ ”			“ ”			“ ”		
	Camping	836	1,638.2	2,000	“ ”	3,538	“ ”			“ ”			“ ”		
June	Scenic Floating	953	1,215.2	2,170	3,531.2	3,905	3,862	1,152	42.5	7,038	1,121	19.0	893	93	11.6
	Guide Boat Fishing	854	“ ”	1,837	3,035.1	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	2,987.3	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	2,690.8	3,709	“ ”			“ ”			“ ”		
	Camping	836	“ ”	2,000	3,037.0	3,538	“ ”			“ ”			“ ”		
July	Scenic Floating	953	1,007.0	2,170	3,828.0	3,905	2,185	1,202	122.2	4,600	3,400	283.3	893	93	11.6
	Guide Boat Fishing	854	“ ”	1,837	3,436.2	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	3,401.4	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	3,234.1	3,709	“ ”			“ ”			“ ”		
	Camping	836		2,000	3,312.1	3,538	“ ”			“ ”			“ ”		
Aug	Scenic Floating	953	1,122.2	2,170	3,663.7	3,905	1,626	375	29.9	2,131	600	39.2	906	-25	-2.7
	Guide Boat Fishing	854	“ ”	1,837	3,214.2	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	3,172.1	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	2,933.3	3,709	“ ”			“ ”			“ ”		
	Camping	836		2,000	3,159.8	3,538	“ ”			“ ”			“ ”		
Sept	Scenic Floating	953	1,118.0	2,170	3,669.7	3,905	1,639	265	19.3	2,239	600	36.6	939	-100	-9.6
	Guide Boat Fishing	854	“ ”	1,837	3,222.3	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	3,180.5	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	2,944.3	3,709	“ ”			“ ”			“ ”		
	Camping	836		2,000	3,165.3	3,538	“ ”			“ ”			“ ”		
Oct	Scenic Floating	953	1,024.0	2,170	3,803.8	3,905	1,487	-167	-10.1	2,172	97	4.7	800	-239	-23.0
	Guide Boat Fishing	854	“ ”	1,837	3,403.5	3,731	“ ”			“ ”			“ ”		
	Private Boat Fishing	879	“ ”	1,808	3,367.6	3,656	“ ”			“ ”			“ ”		
	Shore Fishing/Trail Use	825	“ ”	1,624	3,189.7	3,709	“ ”			“ ”			“ ”		
	Camping	836	“ ”	2,000	3,289.6	3,538	“ ”			“ ”			“ ”		
		Annually Oriented Data Points for Valuation Interpolation													
		Low End Threshold Flow	Annual Current Flow	Preferred Flow	Annual High End Kink Flow	High End Threshold Flow									
All	Scenic Floating	953	1,096.9	2,170	3,699.8	3,905	Monthly Flow Information as Above.								
	Guide Boat Fishing	854	1,359.0	1,837	2,757.9	3,731									
	Private Boat Fishing	879	1,373.3	1,808	2,678.7	3,656									
	Shore Fishing/Trail Use	825	1,298.6	1,624	2,473.1	3,709									
	Camping	836	1,115.5	2,000	3,168.7	3,538									

Table 4-17.—Action Alternative Flaming Gorge Reservoir Water Levels (in Feet Above msl) by Hydrologic Condition and Month

Month	Recreation Activity	Annually Oriented Water Level Data Points for Valuation Interpolation					Action Alternative Water Levels					
							Average Condition		Wet Condition		Dry Condition	
		Low End Threshold Water Level	Annual Current Water Level	Preferred Water Level	Annual High End Kink Water Level	High End Threshold Water Level	Average Monthly Water Levels	Change from No Action Alternative (Feet)	Average Monthly Water Levels	Change from No Action Alternative (Feet)	Average Monthly Water Levels	Change from No Action Alternative (Feet)
January	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.8	1.5	6028.4	.3	6023.4	6.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
February	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.7	1.7	6028.0	1.2	6023.7	5.9
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
March	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.8	1.8	6027.9	0	6023.5	4.5
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
April	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.0	1.9	6028.5	0	6023.0	2.9
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
May	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.8	2.0	6029.2	-.2	6022.8	5.2
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
June	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6027.8	1.2	6030.3	-1.4	6024.5	6.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
July	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6029.2	.1	6030.7	-4.8	6024.7	5.4
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
August	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6028.4	-.5	6030.5	-5.5	6023.8	5.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
September	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6027.4	-.9	6030.0	-5.5	6023.2	5.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
October	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.8	-.7	6029.8	-5.1	6023.1	5.8
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
November	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.5	.2	6029.5	-3.4	6023.3	5.8
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
December	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.1	1.0	6029.1	-1.2	6023.3	6.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						

Table 4-18.—Annual Water-Based Visitation for Green River and Flaming Gorge Reservoir for Action Alternative[1]

Site	Recreation Activity	Action Alternative Visitation by Hydrologic Condition								
		Average			Wet			Dry		
		Visits	Change from No Action Alternative Average Condition		Visits	Change from No Action Alternative Wet Condition		Visits	Change from No Action Alternative Dry Condition	
			Visits	%		Visits	%		Visits	%
Green River	Scenic Floating	23,434	2,549	12.2	9,694	-10,655	-52.4	0	-85	-100
	Guide Boat Fishing	9,151	-957	-9.5	4,521	-3,027	-40.1	1,526	-2,080	-57.7
	Private Boat Fishing	16,116	-193	-1.2	9,515	-3,845	-28.8	1,614	-5,986	-78.8
	Shoreline Fishing/ Trail Use	34,803	876	2.6	13,876	-12,846	-48.1	6,552	-3,957	-37.7
	Boat Based Camping	1,772	-507	-22.7	1,038	-636	-38.0	594	136	29.7
	Total:	85,226	1,768	2.1	38,644	-31,009	-44.5	10,286	-11,972	-53.8
Flaming Gorge Reservoir	Power Boating/ Waterskiing	359,278	0	0	359,278	0	0	35,9278	18,663	5.5
	Boat Fishing	181,348	0	0	181,348	0	0	181,348	9,379	5.5
	Boat Based Camping	10,374	0	0	10,374	0	0	10,374	0	0
	Swimming/ Waterplay	21,291	0	0	21,291	0	0	21,291	257	1.2
	Total:	572,291	0	0	572,291	0	0	572,291	28,299	5.2
Both Sites	Combined Total:	657,517	1,768	.3	610,935	-31,009	-4.8	582,577	16,327	2.9

[1] Numbers may not add due to rounding.

The Action Alternative's approximately 1,770 additional visits represent less than a 1% change compared to the No Action Alternative. This change in visitation from the No Action Alternative was not considered significant. Since the facility availability approach indicated no visitation changes on the reservoir, the gains in visitation are completely attributable to the river. Gains in scenic floating and shoreline fishing/trail use in July and August slightly outweigh losses to guide boat fishing, private boat fishing, and boat-based camping which occur primarily in June.

To evaluate gains or losses on the river, one needs to compare Action Alternative flows to No Action Alternative flows as well as to the interpolation data points. Reviewing table 4-16, July and August flows for the Action Alternative average condition (2,185 and 1,626, respectively) exceed those of the No Action (983 and 1,251, respectively). More importantly, Action Alternative average condition flows for July and August are closer to the preferred flows for each recreation activity, thereby resulting in gains compared to the No Action Alternative. The opposite is true for the month of June, thereby resulting in losses compared to the No Action Alternative. Another factor that needs to be considered in estimating the degree of impact is the amount of visitation occurring in each month. For example, a low percentage change in a high use month may outweigh a high percentage change in a low use month.

For the Action Alternative wet condition, combined visitation declines about 31,000 or nearly 5% compared to the No Action Alternative wet condition. This change in visitation from the No Action Alternative was not considered significant, especially given that wet conditions are expected to occur not more than 10% of the time. Since the facility availability approach indicated no visitation changes on the reservoir, all of this decline stems from visitation losses experienced on the river. While these losses could be considered significant exclusively from the perspective of the river (nearly a 45% loss), the river accounts for only 6% of the total visitation under wet conditions. All river activities were estimated to experience losses compared to the No Action Alternative with the majority of the losses (over 75%) accruing to scenic floating and shoreline fishing/trail use. Across all river activities, the months of April and July generate the largest losses. Both April and July involve situations where Action Alternative flows exceed the high end threshold for all activities, therefore implying zero visitation; whereas, No Action Alternative flows do not exceed the thresholds implying positive visitation.

For the Action Alternative dry condition, combined visitation is estimated to increase by over 16,300 visits or just under 3% compared to the No Action Alternative dry condition. This change in visitation from the No Action Alternative was not considered significant, especially given that dry conditions are expected to occur not more than 10% of the time. Visitation on the reservoir is estimated to increase by about 28,300 visits; whereas, visitation on the river is estimated to decline by nearly 12,000 visits. The largest gains are expected for reservoir power boating and boat fishing during the months of May, September, and October, with the largest losses expected for river private boat fishing and shoreline fishing/trail use during the month of May. Gains in reservoir visitation under Action Alternative dry conditions occur due to improved facility availability compared to No Action Alternative conditions. On average, all reservoir facilities are expected to be available across all months under Action Alternative dry conditions.[2] Losses in river visitation under Action Alternative dry conditions occur mainly in the month of May due to the -600-cfs flow differential compared to No Action Alternative conditions.

As noted above, an analysis of facility availability was also conducted for Green River recreation facilities. Within Reach 1, all river facilities were expected to be available based on average monthly flows across all months under Action Alternative average and dry conditions. However, under wet conditions, the following USDA Forest Service facilities are expected to be unavailable in June due to high flows: the spillway boat ramp, fishing pier, trail, and 9 of 18 riverside campgrounds. In addition, 9 of the 18 riverside campgrounds are also expected to be unavailable in May under wet conditions. The June unavailability of the spillway ramp, the Little Hole fishing pier, and the recreation trail reflect additional facility unavailability compared to the No Action Alternative (also see footnote for information across all years). Erosion of river facilities is similar to that discussed under the No Action Alternative but occurs to a greater degree due to higher flows. Within Reach 2, the boat ramp at Ouray National Wildlife

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[2] Although not related to the rest of the analysis, the monthly frequency across all years where the five most impacted Flaming Gorge Reservoir facilities (Anvil Draw boat ramp, Cedar Springs marina and boat ramp, Firehole boat ramp, and Sunny Cove swim beach) may be unavailable ranges from 1.2% (once every 83.3 years) to 6.7% (once every 14.9 years) under the Action Alternative. These unavailability percentages are considerably lower than those of the No Action Alternative. For the Green River facilities within the Flaming Gorge National Recreation Area, the unavailability percentage ranges from 0 to 27.2% (once every 3.7 years). These unavailability percentages for the Green River are somewhat higher than those of the No Action Alternative. For a detailed presentation of the monthly unavailability percentages for all reservoir facilities, see the Recreation Visitation and Valuation Analysis Technical Appendix. (Corresponding table is on the following page.)

Refuge remains available under average, dry, and wet conditions across all months for the Action Alternative. This implies no change in facility availability within Reach 2 between the alternatives. Within Reach 3, all facilities remain available under average conditions for the Action Alternative. However, under dry conditions, the Swasey's Beach boat ramp would be unavailable during the months of January, February, and July through December. Under wet conditions, the facilities at Green River State Park would be affected during May and June (golf course during both May and June and the campground and boat ramp during June). The facility unavailability for the Action Alternative within Reach 3 mirrors that of the No Action Alternative, implying no change in facility availability between the alternatives within Reach 3.

4.11.3.2.2 Annual Recreation Valuation – Table 4-19 presents the sum of the annual Green River and Flaming Gorge Reservoir recreation values for the Action Alternative under average, wet, and dry conditions. In addition to the total values by hydrologic condition, the table also presents changes from the No Action Alternative both in terms of values and percentage.

For the Action Alternative average condition, the combined valuation was estimated at $27.7 million. This reflects nearly a $2.4-million or 10% increase from the No Action Alternative average condition. Gains in value occur on both the river and reservoir with the largest gains accruing to scenic floating on the river and power boating/waterskiing on the reservoir. The majority of the gains on the river occur from July through September and on the reservoir from April through June.

Footnote Table:

Action Alternative High Recreation Season Selected Facility Unavailability Percentages

Site	Area	Facility	Threshold[1]	Mar	Apr	May	June	July	Aug	Sept	Oct
Flaming Gorge Reservoir	Anvil Draw	Boat Ramp	6020	5.0	2.9	3.2	3.0	1.9	2.3	3.8	5.4
	Cedar Springs	Marina	6018	3.0	2.0	2.5	1.9	1.2	1.5	1.8	2.1
		Boat Ramp	6018	3.0	2.0	2.5	1.9	1.2	1.5	1.8	2.1
	Firehole	Boat Ramp	6019	4.3	2.4	3.0	1.9	1.5	1.7	2.4	3.2
	Sunny Cove	Swim Beach	6018	3.0	2.0	2.5	1.9	1.2	1.5	1.8	2.1
	Buckboard Crossing	Marina	6015	2.1	1.5	1.5	0.4	0.2	0.2	0.4	0.5
		Boat Ramp	6000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Lucerne Valley	Marina	6010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		Boat Ramps	5994	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Green River	Spillway	Boat Ramp	6000	0.0	0.0	7.5	14.6	7.0	0.0	0.0	0.0
	Little Hole	Boat Ramp	8000	0.0	0.0	4.2	8.5	1.2	0.0	0.0	0.0
		Fishing Pier	6000	0.0	0.0	7.5	14.6	7.0	0.0	0.0	0.0
		Recreation Trail	6000	0.0	0.0	7.5	14.6	7.0	0.0	0.0	0.0
		9 of 18 Riverside Campgrounds	5000	0.0	0.0	13.0	27.2	2.8	0.0	0.0	0.0

[1] Thresholds: Reflects low end water level for reservoir and high end flow for river.

Table 4-19.—Annual Water-Based Activity Valuation for Green River and Flaming Gorge Reservoir for Action Alternative ($1,000s)[1]

Site	Recreation Activity	Action Alternative Valuation by Hydrologic Condition								
		Average			Wet			Dry		
		Total Value	Change from No Action Alternative Average Condition		Total Values	Change from No Action Alternative Wet Condition		Total Value	Change from No Action Alternative Dry Condition	
			Value	%		Value	%		Value	%
Green River	Scenic Floating	1,933.9	920.3	90.8	897.6	-277.2	-23.6	0	-3.8	-100
	Guide Boat Fishing	1,890.9	289.8	18.1	991.1	-291.9	-22.8	31.4	-394.4	-92.6
	Private Boat Fishing	851.6	2,14.9	33.8	531.9	-88.4	-14.2	6.1	-168.7	-96.5
	Shoreline Fishing/ Trail Use	1,012.0	320.2	46.3	383.0	-278.4	-42.1	25.7	-166.4	-86.6
	Boat-Based Camping	22.5	-.2	-.9	14.2	-5.8	-29.2	1.6	-1.1	-41.6
	Total:	5,710.7	1,745.0	44.0	2,817.7	-941.8	-25.1	64.8	-734.5	-91.9
Flaming Gorge Reservoir	Power Boating Waterskiing	15,203.7	480.1	3.3	15,301.0	3,959.3	34.9	11,743.1	8,175.5	229.2
	Boat Fishing	6,428.6	146.7	2.3	6,462.5	1,816.1	39.1	5346.1	3,977.9	290.7
	Boat-Based Camping	207.7	9.9	5.0	212.8	61.7	40.8	166.0	116.3	233.8
	Swimming/ Waterplay	185.6	12.5	7.2	178.2	94.8	113.6	96.5	87.7	998.2
	Total:	22,025.5	649.2	3.0	22,154.5	5,931.9	36.6	17,351.8	12,357.4	247.4
Both Sites	Combined Total:	27,736.2	2,394.2	9.5	24,972.2	4,990.1	25.0	17,416.6	11,622.9	200.6

[1] Numbers may not add due to rounding.

Note that total values for the Action Alternative average condition increased compared to the No Action Alternative for both guide boat and private boat fishing on the river, despite the losses in visitation displayed in table 4-18. This result stemmed from the fact that the annual loss in visitation included certain months with gains (mainly July, August, and September) as well as the months with losses (mainly June). As it turns out, the losses in visitation were associated with months of relatively low value per visit and the gains with months of high value per visit.

As previously stated, values per visit increase when flows approach the preferred flow level for each activity. When combined, the influence of the higher values per visit outweighed the influence of the lost visitation.

Given the insignificant increase in visitation for the Action Alternative average condition, virtually all of the increase in value stems from increases in value per visit. While the facility availability approach predicts no change in reservoir visitation for the Action Alternative average condition compared to the No Action Alternative, the interpolation approach predicts sometimes sizable gains in reservoir values per visit. This highlights a disadvantage of the facility approach in that this access issue only approach cannot predict potential increases in visitation beyond the water level where all facilities are available. Comparing the visitation and valuation analyses, it becomes evident that the facility availability approach is much less sensitive to changes in water levels compared to the interpolation approach.

For the Action Alternative wet condition, combined valuation was estimated at nearly $25 million. This reflects an increase of almost $5 million or 25% compared to the No Action Alternative wet condition. Despite no change in reservoir visitation, the

$5.9-million increase in reservoir value, due to increases in value per visit associated with higher water levels, outweighs the $940,000 loss in river value. Power boating/waterskiing and boat fishing on the reservoir account for the majority of the increase in value. The largest gains on the reservoir occur in the months of June through October. Losses on the river are seen across all activities with the majority occurring in the month of July.

For the Action Alternative dry condition, combined valuation is estimated at $17.4 million. This reflects an increase of over $11.6 million or 200% compared to the No Action Alternative dry condition. The nearly $12.4 million of increased value for the reservoir outweighs the $735,000 of lost value on the river. Power boating/waterskiing and boat fishing on the reservoir account for the majority of the increase in value. The largest gains in value occur on the reservoir in the months of May through October. Losses on the river are seen across all activities with the majority occurring in the month of May.

4.11.3.2.3 Summary of Visitation and Value Analysis – Based on the applied methodologies, the Action Alternative combined visitation across both the Green River and Flaming Gorge Reservoir did not vary significantly from the No Action Alternative regardless of the hydrologic condition. The average condition showed hardly any change in total visitation. The wet and dry conditions resulted in minor losses (-4.8%) and gains (+2.9%), respectively. Given the wet and dry conditions are each only expected to occur no more than 10% of the time, these changes were considered insignificant.

The Action Alternative combined valuation across the river and reservoir increased under all hydrologic conditions compared to the No Action Alternative. For average and wet conditions, the gain was approximately 10 and 25%, respectively; whereas, under dry conditions, the gain was 200%. Keep in mind the 200% gain associated with the dry condition is in comparison to the low No Action Alternative dry valuation and would be expected to occur not more than 10% of the time.

As mentioned above, the facility availability approach used to estimate Flaming Gorge Reservoir visitation tends to understate visitation when water levels rise beyond the low end usability thresholds of all facilities. Since this was the case under all Action Alternative hydrologic conditions, it is possible that reservoir visitation estimates may be somewhat understated based on the facility availability analysis. Should this be the case, one could surmise that visitation gains compared to the No Action Alternative might accrue to the Action Alternative under average and wet conditions. Furthermore, additional gains in visitation under the Action Alternative dry condition may also be possible. These potential visitation gains would have the effect of amplifying the gains in valuation already identified.

4.11.4 Flaming Gorge Reservoir Recreation Safety Results

Safety of recreation activities on Flaming Gorge Reservoir correlates directly with access to the reservoir's surface rather than boating on the reservoir. Boating hazards on the reservoir occur at all elevations and are a problem to boat operators at all times. Therefore, the safety of boating on the reservoir is not related directly to reservoir elevation fluctuations. The recreation safety hazards associated with changes in reservoir elevations at Flaming Gorge Reservoir are related to the recreation users' ability to safely access developed boat ramps, docks, marinas, shoreline fishing areas, and beach areas. The thresholds used for this analysis (table 4-20) are from a recreation survey conducted during the summer of 2001 (Aukerman and Shuster, 2002). Reservoir elevations higher or lower than these thresholds would stop visitors from pursuing their primary activity and impact recreation opportunities at the reservoir. Reservoir

Table 4-20.—Percent of Time Flaming Gorge Reservoir Recreation Activities Are Unsafe (When Water Levels by Alternative Fall Outside Usable Thresholds)

Recreation Activity (Usability Thresholds)	Alternative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Motor Boating	No Action	9.3	9.1	7.5	7.4	8.2	6.8	7.9	9.2	10.8	11.1	12.4	9.6
Usable Elevation: 6017 to 6039	Action	2.9	2.9	2.9	1.8	1.5	1.4	0.5	0.7	1.5	1.9	1.8	2.8
	Difference	+6.4	+6.2	+4.6	+5.6	+6.7	+5.4	+7.4	+8.5	+9.3	+9.2	+10.6	+6.8
Guide Boat Fishing	No Action	10.4	10.4	8.0	7.4	11.1	8.2	10.2	10.2	14.8	13.5	17.5	10.7
Usable Elevation: above 6018	Action	3.9	4.5	3.0	2.9	2.5	1.9	1.2	1.5	1.8	2.2	2.1	3.1
	Difference	+6.5	+5.9	+5.0	+4.5	+8.6	+6.3	+9.0	+8.7	+13.0	+11.3	+15.4	+7.6
Private Boat Fishing	No Action	9.3	9.1	7.5	7.4	8.8	6.8	8.9	10.2	13.5	12.4	12.4	9.6
Usable Elevation: 6017 to 6038	Action	2.9	2.9	2.9	1.8	1.5	1.4	0.5	0.7	1.5	1.9	1.8	2.8
	Difference	+6.4	+6.2	+4.6	+5.6	+7.3	+5.4	+8.4	+9.5	+12.0	+10.5	+10.6	+6.8
Bank Fishing and Sightseeing	No Action	10.6	9.1	9.1	7.4	16.0	42.7	43.3	65.8	64.7	55.4	55.5	23.1
Usable Elevation: 6017 to 6030	Action	6.8	2.9	2.9	1.8	3.1	16.7	73.4	27.1	11.8	10.4	10.4	4.6
	Difference	+3.8	+6.2	+6.2	+5.6	+12.9	+26.0	-33.1	+38.7	+52.9	+45.4	+45.5	+18.5
Kayaking/ Canoeing, Sailing, Wildlife Viewing	No Action	12.1	12.2	12.5	9.7	23.7	47.1	68.2	68.2	68.1	56.6	58.6	26.0
Usable Elevation: 6018 to 6030	Action	6.6	7.2	5.0	2.9	4.8	18.3	74.8	28.7	14.1	10.6	14.0	8.4
	Difference	+5.5	+5.0	+7.5	+6.8	+18.9	+28.8	-6.6	+39.5	+54.0	+46.0	+44.6	+17.6
Waterskiing	No Action	10.4	10.4	8.0	7.4	11.5	9.2	10.9	17.1	16.4	15.4	15.4	10.7
Usable Elevation: 6018 to 6037	Action	3.9	4.5	3.0	2.9	2.5	1.9	1.2	1.5	1.8	2.2	2.1	3.1
	Difference	+6.5	+5.9	+5.0	+4.5	+9.0	+7.3	+9.7	+15.6	+14.6	+13.2	+13.3	+7.6
Jet Skiing	No Action	8.9	8.6	7.4	6.6	8.0	7.5	60.5	47.3	41.3	33.2	33.2	10.7
Usable Elevation: 6016 to 6033	Action	2.5	2.9	2.8	1.7	1.5	3.9	1.2	2.1	0.6	1.2	1.1	1.8
	Difference	+6.4	+5.7	+4.6	+4.9	+6.5	+3.6	+59.3	+45.2	+40.7	+32.0	+32.1	+8.9
Swimming and Camping	No Action	9.3	9.1	7.5	7.4	8.8	8.4	9.6	17.1	16.3	14.3	14.3	9.6
Usable Elevation: 6017 to 6037	Action	2.9	2.9	2.9	1.8	1.5	1.4	0.5	0.7	1.5	1.9	1.8	2.8
	Difference	+6.4	+6.2	+4.6	+5.6	+7.3	+7.0	+9.1	+16.4	+14.8	+12.4	+12.5	+6.8
House Boating	No Action	12.1	12.2	12.5	9.7	23.7	47.1	68.2	68.2	68.1	58.6	26.0	12.1
Usable Elevation: 6020 to 6030	Action	6.6	7.2	5.0	2.9	4.8	18.3	74.8	28.7	14.1	13.9	14.0	8.4
	Difference	+5.5	+5.0	+7.5	+6.8	+18.9	+28.8	-6.6	+39.5	+54.0	+44.7	+12.0	+3.7

elevations outside the identified threshold will impact recreation users by requiring them to find their own access, which increases the risk and safety of the recreation users since 79% of those using the reservoir use the boat ramp, 42% use the beaches, 35% use the floating docks, and 62% use the marinas (Aukerman and Schuster, 2002).

4.11.5 Green River Recreation Safety Results

Impacts to the safety of recreation activities on the Green River below Flaming Gorge Dam within the Flaming Gorge National Recreation Area will occur when identified flows in the Green River would stop visitors from pursuing their primary activity. When flows in the Green River exceed the upper and lower identified thresholds shown on table 4-21 for each identified activity, the recreation users will no longer recreate on the river because of perceived safety concerns. The thresholds used for this analysis are from a recreation survey conducted during the summer of 2001 (Aukerman and Shuster, 2002).

Examples of impacts to safety concerns on the Green River would be those activities that occur during launching and takeout of floating water craft which are hurried activities and require greater attention at higher flows; also, the swifter water limits the boaters' ability to control the water craft and increases encounters with floating debris. The higher the riverflows, the deeper the water and more dangerous the currents. These higher riverflows increase the displacement of riverbanks for shoreline fishermen and shoreline camping. Low riverflows create problems with exposed rocks and boulders that cause difficulties for boaters.

4.12 SOCIOECONOMICS AND REGIONAL ECONOMICS

This section provides detailed results of a regional economic analysis. The analysis ultimately attempts to describe effects of changes in recreation activity upon the overall economy as well as possible alternative preferences of commercial operators.

This EIS includes two types of economic analyses—one measuring economic benefits and the other regional economic impacts. Regional economic impacts, presented in this section, are based on recreation effects. Economic benefits are described separately for agriculture (section 4.5), hydropower (section 4.4), and recreation (section 4.11).

Regional economic impact analyses attempt to measure changes in total economic activity within a specified geographic region stemming from changes in within-region expenditures. Regional economic impacts are typically described using such general measures as total industry output, labor income, and employment.[3] Conversely, economic benefits attempt to measure

[3] Regional Economic Impact Measures:

Total Industry Output: Dollar value of production (sales revenues and gross receipts) from all industries in the region. Total industry output includes the value of interindustry trade of intermediate goods prior to final manufacture and sale.

Total Labor Income: Employment income derived at the workplace, including wages and benefits (employee compensation) plus self-employed income (proprietary income).

Employment: Total of hourly wage, salary, and self-employed jobs (part-time and full-time), measured in terms of jobs, not full-time equivalents.

Table 4-21.—Percent of Time Green River Recreation Activities Are Unsafe (When Flows by Alternative Fall Outside Usable Thresholds[1])

Recreation Activity	Alternative	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Scenic Floating	No Action	57.8	44.2	78.6	75.4	55.2	22.7	30.8	81.9	97.3	99.8	69.5	65.1
	Action	53.5	46.8	65.3	57.1	40.9	21.9	48.5	89.3	84.7	76.8	69.2	59.7
	Difference	+4.3	-2.6	+13.3	+18.3	+14.3	+0.8	-17.7	-7.4	+12.6	+23.0	+0.3	+5.4
Guide Boat Fishing	No Action	58.0	46.6	80.3	74.6	51.5	22.0	30.9	95.2	100.0	100.0	72.0	68.7
	Action	54.6	47.2	71.1	58.0	41.3	36.7	69.5	91.3	84.7	77.4	69.8	60.2
	Difference	+3.4	-0.6	-9.2	+16.6	+10.2	-14.7	-38.6	+3.9	+15.3	+22.6	+2.2	+8.5
Private Boat Fishing	No Action	56.6	45.9	79.1	74.7	51.0	21.5	30.8	95.2	100.0	100.0	70.8	66.3
	Action	54.3	47.1	69.3	57.5	41.5	36.6	69.6	90.7	90.5	77.3	69.7	60.2
	Difference	+2.3	-1.2	+10.6	+17.2	+9.5	-15.1	-38.8	+4.5	+9.5	+22.7	+1.1	+6.1
Shoreline Fishing/ Trail Use	No Action	58.5	47.1	80.6	74.7	51.5	21.9	30.9	95.2	100.0	100.0	73.8	69.7
	Action	54.8	47.3	71.8	58.4	41.7	36.6	69.6	94.4	90.7	77.5	69.9	60.3
	Difference	+3.7	-0.2	+8.8	+16.3	+9.8	-14.7	-38.7	+0.6	+9.3	+22.5	+3.9	+9.4
Kayaking/ Canoeing	No Action	54.4	41.7	78.7	73.4	50.4	20.5	30.8	81.9	97.3	99.8	70.6	62.1
	Action	53.5	46.9	65.5	54.7	40.6	21.3	47.2	89.3	84.7	76.9	69.2	60.3
	Difference	+0.9	-5.2	+13.4	+18.7	+9.8	-0.8	-16.4	-7.5	+12.6	+22.9	+1.4	+1.8
Camping	No Action	57.2	43.7	80.4	74.2	50.7	21.1	30.9	95.2	100.0	100.0	70.2	68.1
	Action	54.8	47.2	71.4	57.1	40.7	35.7	68.4	91.7	90.6	77.5	69.8	60.2
	Difference	+2.4	-3.5	+9.0	+17.1	+10.0	-14.6	-37.5	+3.5	+9.4	+22.5	+0.4	+7.9

[1] Preferred Flow/Usability Thresholds by Recreation Activity:
- Scenic Floating (953 to 3,905 cfs)
- Guide Boat Fishing (854 to 3,731 cfs)
- Private Boat Fishing (879 to 3,656 cfs)
- Shoreline Fishing/Trail Use (825 to 3,709 cfs)
- Kayaking and Canoeing (950 to 3,500 cfs)
- Camping (836 to 3,538 cfs)

changes in societal or national welfare based on net value concepts including consumer surplus and producer profitability.[4]

One way to visualize the difference between regional economic impacts and economic benefits is to consider how each reacts to increases in regional expenditures. Regional economic impacts typically increase as in-region expenditures increase; whereas, consumer surplus/profitability benefits tend to decrease as costs or expenditures alone increase. It should be noted that regional economic impacts and benefits often move in unison, since they both typically rise or fall with levels of production (including recreation visitation). On the benefit side, as production changes, so do both production costs/expenditures and revenues/total consumer benefits; the net effect is that benefits generally move in the same direction as production changes. Nevertheless, there are many situations where changes in benefits and economic impacts diverge. This potential for divergence, along with the fact that different user groups are often interested in different economic measures, creates a need for both analyses.

Theoretically, nationally oriented economic benefit analyses attempt to provide a broader geographic focus compared to regional economic impact analyses. Unfortunately, in practice, the geographic difference between the analyses may be less pronounced, given the difficulty in evaluating national implications of an action. If an action is relatively small from a national perspective, repercussions outside the directly impacted area may be insignificant. If the opposite is true, nationwide displacement or substitution effects may need to be taken into consideration. The difficultly lies in trying to estimate these substitution affects. For this analysis, the changes in economic benefits within the directly affected areas were assumed to be small enough so as not to create significant changes in national benefits. As a result, evaluation of nationwide substitution effects was deemed unnecessary.

Given the above discussion, the basic objective of the regional economic analysis is to measure changes in total economic activity within the affected region for the Action Alternative as compared to the No Action Alternative. The Action Alternative potentially affects regional economic activity through changes in:

(1) Costs of agricultural production due to flooding effects on irrigated acreage

(2) Recreational expenditures due to the effects of changes in reservoir water levels and riverflows on recreation visitation

(3) Costs of electricity as the timing and production of hydropower varies with the fluctuation in releases from Flaming Gorge Dam

Flooding effects upon agricultural lands along the Green River proved to be relatively minor and were, consequently, dropped from the regional analysis. Regional impacts due to losses in hydropower generation were also deemed to be relatively insignificant locally, given any increased costs of power generation would be distributed across thousands of power users throughout the Western United States. Also, given that this EIS is primarily a reservoir re-operation study, the lack of structural adjustments to the dam implies that construction costs would be minimal. Other typically encountered project purposes, such as municipal and industrial uses, were either not applicable or not significantly affected. The only factor used to evaluate changes in regional economic activity was the changes in recreation expenditures.

[4] For consumers, economic welfare reflects the value of goods and services consumed above what is actually paid for them. Such consumer welfare estimates are measured in terms of willingness-to-pay in excess of cost, otherwise referred to as consumer surplus. For producers or businesses, economic welfare is generally reflected in terms of gross revenues minus operating costs, otherwise referred to as profitability.

Regional economic impacts were measured using input-output analysis. Input-output estimates regional economic impacts based on a region's inter-industry trade linkages. The analyses present changes in total economic impact as measured by the sum of direct effects (impacts to initially affected industries), indirect effects (impacts to industries providing inputs to directly impacted industries), and induced effects (impacts from employees spending wages within the region), all caused by the initial change in demand. For example, if $1,000 in agricultural product is lost from irrigated acreage idled by flooding (direct effect), the farmer buys $500 less in seed and fertilizer from the local store (indirect effect), the farm workers spend $100 less for household goods and services within the region (induced effect), then the total loss in regional agricultural output is $1,000, but the total regional output loss is $1,600.

The majority of the regional analysis discussion is based on the results of a regional modeling effort. In addition to the regional modeling results, a brief discussion is presented at the end of the Action Alternative section on the results of surveys conducted with commercial guide operators on both the Green River and Flaming Gorge Reservoir. It was anticipated that commercial guide operators, particularly those on the Green River, may be adversely affected by the Action Alternative. Because the regional analysis focused on a three-county area, impacts to commercial guide operators would not be directly discernable. As a result, surveys of commercial guide operators were conducted to identify impacts. Other tourist oriented sectors, such as lodging and restaurants, were not anticipated to be as adversely affected as commercial guide operators since they cater to both river and reservoir recreators.

4.12.1 Methodology

This section describes the methodology used to measure both recreational regional economic impacts and commercial operator impacts.

4.12.1.1 Regional Economics Modeling Methodology

The regional economic impact analysis involves running alternative specific estimates of recreation expenditures through the IMpact analysis for PLANning (IMPLAN) input-output model of the three-county regional economy. As stated in chapter 3, the regional economy was defined as Sweetwater County, Wyoming, and Daggett and Uintah Counties, Utah. The IMPLAN model was originally developed back in the late 1970s by the USDA Forest Service to assist in land and resource planning. This personal computer-based software has been updated several times and now is widely used for the development of regional economic analyses.

Input-output analysis is a procedure for examining relationships both between businesses and between businesses and consumers. The analysis captures all the monetary market transactions within a specified region for a given period of time via the interindustry transaction table. The resulting mathematical formulas allow for examination of the effects of a change in one or more economic activities upon the overall regional economy (Minnesota IMPLAN Group, Inc., 2000).

Regional economic effects stemming from river and reservoir recreational activities within the three-county area are driven by levels of within region recreation expenditures. The recreation analysis developed visitation results by month and activity for each alternative and hydrologic condition (i.e., average, dry, and wet water conditions). This information, combined with estimates of recreational expenditures per visit by month and activity for each alternative and hydrologic condition, allowed for calculation of total within-region recreational expenditures by alternative and hydrologic condition. Changes in recreational expenditures for the Action Alternative compared to the No Action Alternative for each hydrologic condition were entered into the IMPLAN model. The resulting differences in regional economic activity between the Action Alternative and No Action Alternative for each hydrologic condition provide a measure of the regional economic impacts associated with the Action Alternative.

As described under the affected environment current conditions section, the latest available IMPLAN data reflects regional economic activity during 1999. While the total recreation expenditure information reflects visitation and per visit expenditures during 2000-2001, the difference in years was considered insignificant from the perspective of economic development within the region. The assumption was made that the 1999 version of the regional economy was reflective of the No Action Alternative. Given that 1999 was a wet year for both the river and reservoir, the underlying picture of the economy was considered analogous to the No Action Alternative wet condition. To estimate regional economic conditions for the No Action Alternative under average and dry conditions, differences in recreation expenditures for the No Action Alternative average and dry conditions were estimated as compared to No Action Alternative wet conditions. The expenditure differences were entered into IMPLAN to calculate regional economic activity under No Action Alternative average and dry conditions. As noted above, the differences in Action Alternative expenditures compared to No Action Alternative expenditures under average, wet, and dry conditions were run through IMPLAN to estimate impacts for the Action Alternative.

Average per visit current total recreation expenditures by activity within the region were obtained from the recreation survey described within the recreation section. Information was also gathered from the survey as to the breakdown of expenditures by expenditure category. Expenditure categories include camping fees, lodging, restaurants, groceries and liquor, gasoline, recreation supplies, guide services, car rental, other rentals, public transportation, and other. Expenditure categories varied somewhat by activity. For example, guide boat fishing was the only activity that included guide services.

In addition to the current recreation expenditure information, the survey also asked if the recreator's length of visit might increase under preferred riverflow and reservoir water level conditions. The results of this preferred conditions length of trip question were adjusted downward using the conservative, but often applied, approach of assuming nonrespondent responses would be equal to zero. The preferred conditions length of visit was divided by the current average length of visit to estimate a percentage increase in length of visit under preferred conditions for each recreation activity. These activity specific percentage increases were applied to current per visit expenditures to estimate per visit expenditures by activity under preferred conditions.

Low end and high end thresholds, points where riverflows or reservoir water levels were so low or high as to prevent use, were also obtained from the survey. As with the recreation analysis, current and preferred conditions, along with the low and high end thresholds, were used to develop recreation expenditures per visit by activity for each alternative using an interpolation approach. Assuming length of stay per visit—and, consequently, expenditures per visit—peak under preferred conditions, an inverted U-shaped distribution, was assumed to hold for recreation expenditures as it did for recreation visitation and value. A high end kink expenditure estimate was developed as in the recreation analysis. The high end kink was assumed to fall the same percentage distance from the preferred flow/water level as the current conditions data point. If current conditions fell 75% of the way between preferred conditions and the low end threshold, then the high end kink was also assumed to fall 75% of the way between preferred conditions and the high end threshold. Including the high end kink, five data points now exist for conducting a linear interpolation of per visit recreation expenditures.

Instead of interpolating using all five data points, a modified interpolation was done using only the current conditions, preferred conditions, and high end kink data points. The logic for this was that, below current conditions or above high end kink conditions, the full scale interpolation would predict recreation expenditures per visit to fall below current expenditures. While this may sound reasonable, at the extremes where conditions approach the low or high end thresholds, per visit expenditures would be estimated to approach zero. While the values per trip used in the recreation analysis may indeed approach zero for the last few visits taken, the expenditures for those visits will obviously not decline to zero. As a result, the decision was made to only interpolate between current conditions and the high end kink. This results in expenditures per visit falling within the range of current conditions to preferred conditions (note that the expenditures for the high end kink are equivalent to current conditions). For cases where riverflows or reservoir water levels fall below current conditions or above high end kink conditions, the expenditures per visit were assumed to hold at current/high end kink levels. For more detailed discussion of the expenditure interpolation methodology, see the Socioeconomics Technical Appendix.

4.12.1.2 Commercial Operator Survey Methodology

Because the regional analysis focused on a three-county area, and lack of county specific expenditure data precluded the development of county level regional economic impact models, potential adverse impacts to commercial guide operators concentrated within Daggett County would not be directly discernable. As a result, surveys of commercial guide operators were conducted to identify impacts. The results of the surveys of both Green River and Flaming Gorge Reservoir recreational commercial operators are presented at the end of the Action Alternative subsection in terms of:

(1) Average visitation and revenue

(2) High end, low end, and preferred flows/water levels

(3) Preferred flow/water level visitation and revenue

Unfortunately, the survey data did not provide enough information to estimate impacts by alternative. However, the high end, low end, and preferred flows/water levels obtained from the survey were compared to flows and water levels from March to October for each alternative under average, wet, and dry conditions. Attempts were made to evaluate which alternative would be preferred for each commercially supported recreation activity.

4.12.2 Results

This section presents the results of both the regional economic analysis and the commercial operator analysis.

4.12.2.1 Results of Regional Economic Analysis

This section presents the results of the recreation expenditure based regional economic analysis. For a discussion of recreation visitation and values, see section 4.11 on recreation. The results are presented by alternative, starting with the No Action Alternative.

4.12.2.1.1 No Action Alternative – Information on No Action Alternative total recreation expenditures by expenditure category, hydrologic condition, site (river versus reservoir), and recreation activity are presented in table 4-22. These estimates portray the product of recreation visits from the recreation analysis times the expenditures per visit from the expenditure interpolations. Due to the large volume of recreation expenditure estimates by expenditure category, recreation activity, month, alternative, and hydrologic condition, the individual monthly estimates are not presented.

Given that the IMPLAN 1999 base data is considered reflective of No Action Alternative wet conditions, table 4-22 also includes estimates of the differences in No Action Alternative average and dry expenditures as compared to No Action Alternative wet conditions. The gain in No Action Alternative average condition expenditures compared to No Action Alternative wet condition expenditures of $23.6 million reflects almost a 20% increase. The decline in No Action Alternative dry condition expenditures compared to No Action Alternative wet condition expenditures of $39 million reflects a 32.6% decline.

These expenditure differences were run through the IMPLAN model to estimate regional economic conditions under No Action Alternative average and dry hydrologic conditions. As presented in table 4-23, differences in the overall three-county regional economy were insignificant between No Action Alternative average, wet, and dry conditions. Looking at employment, the most volatile regional economic measure on a percentage basis indicates that the 330 and 908 job declines compared to average conditions under wet and dry conditions, respectively, reflect only a 0.9 and 2.3% reduction in overall employment.

Focusing on the overall economy is important, but it can gloss over industry-by-industry changes. To address this issue, reviews were also made of the eight most affected economic sectors, those sectors directly impacted by changing recreational expenditures. Comparing employment for the No Action Alternative from average to wet conditions shows a minor decline of 294 jobs or 4.4% within the eight most affected sectors. The loss of 805 jobs from average to dry conditions for these sectors was more noticeable reflecting a 12.0% drop. The nearly 44% decline in recreation expenditures under dry conditions compared to average conditions generated a much less severe decline in regional economic activity, even for the eight most affected sectors, implying that a significant share of recreation expenditures must pass through the economy without creating much impact. This is not surprising since the three-county economy has a relatively small manufacturing base, suggesting much of the inputs to the most affected sectors likely come from outside the region.

4.12.2.1.2 Action Alternative – This section describes changes in regional economic activity associated with implementing the Action Alternative under average, wet, and dry conditions. For each hydrologic condition, changes in annual recreation expenditures compared to the No Action Alternative were run through the IMPLAN model. As a result, impacts are measured for the Action Alternative compared to the No Action Alternative within the context of the same hydrologic condition. In no instances are impacts measured across hydrologic conditions.

Table 4-24 presents recreation expenditures by category, recreation activity, site, and hydrologic condition for the Action Alternative. The table presents total expenditures as well as changes compared to the No Action Alternative in both dollar and percentage terms. Under all three hydrologic conditions, total Action Alternative expenditures are higher than those of the No Action Alternative. The gain in expenditures is about 5.6% under average conditions, 13.7% under wet conditions, and 22.7% under dry conditions.

While the overall change in annual expenditures is positive, this doesn't imply consistent expenditure gains for both the river and reservoir. The change in Action Alternative expenditures for the Green River follow the direction of the change in visitation, positive for the average condition and negative for the wet and dry conditions. Annual losses in river recreation expenditures compared to the No Action Alternative were estimated at 38% and 60% under wet and dry conditions, respectively. Conversely, changes in annual Action Alternative expenditures for Flaming Gorge Reservoir were estimated to be positive under each hydrologic condition despite the lack of visitation change under average and wet conditions. This seemingly odd result is due to the use and interaction of the facility availability and interpolation approaches within the analysis.

Recreation expenditures are estimated by multiplying visitation by expenditures per trip. The facility availability approach, used to measure changes in reservoir visitation, is less sensitive than the interpolation approach for measuring gains in visitation as water levels rise. Once water levels rise above the low end usability threshold of all reservoir facilities, no additional increase in reservoir visitation would be estimated by the facility availability approach. For this reason, no changes in visitation were estimated for the reservoir under average and wet conditions. However, expenditures per trip are based on an interpolation, which allows for variation across the entire range of water levels. Expenditures per trip rise due to increased length of stay as water levels approach preferred conditions. When applied to unchanging visitation levels, the increasing expenditure per trip results in gains in recreation expenditures at the reservoir under both average and wet conditions. Under wet conditions, these gains in reservoir expenditures exceeded the losses in river expenditures leading to the odd situation of an estimated overall loss in visitation coupled with an overall gain in expenditures. Under dry conditions, gains in reservoir visitation and expenditures outweigh losses on the river.

While the overall level of expenditures shows gains compared to the No Action Alternative, the individual expenditure categories include both gains and losses. This is because expenditure categories vary by recreation activity; and the visitation by activity varies by month, alternative, and hydrologic condition. Some activities may post gains, while others show losses. The potential for both gains and losses in recreation visitation and recreation expenditures per trip across activities and months creates the possibility of both positive and negative expenditures in comparison to No Action Alternative expenditures. For example, losses in recreator expenditures for river guides under wet and dry conditions are not offset because they are applicable only to the guide boat fishing activity.

The impacts of the Action Alternative under average, wet, and dry conditions are described in three separate tables to allow for presentation of totals by industry and the changes compared to the No Action Alternative in terms of both dollars/jobs and percentage for all three regional economic impact measures.

Table 4-25 reports the effects of the Action Alternative under average conditions. The "total" columns for total industry output, employment, and labor income portray overall estimates of economic activity for each industry and for the economy as a whole. The "change from No Action" columns depict changes in both dollars/jobs and percent.

The overall change in Action Alternative total output, employment, and income compared to No Action Alternative average conditions was

TABLE 4-22.—No Action Alternative Recreation Expenditures ($1,000s)
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(2000–2001 $)

Hydrologic Condition	Site	Recreation Activity	Expenditures Categories											
			Camping Fees	Lodging	Restaurants	Groceries	Gas	Supplies	Guides	Car Rental	Other Rentals	Public Transit	Other	Total
Average	Green River	Scenic Floating	565.9	1,440.6	1,125.5	1,254.9	1,228.5	731.8	0	516.5	435.1	224.2	201.5	7,724.4
		Guide Boat Fishing	221.3	563.1	439.9	490.6	480.3	286.1	4,796.5	202.0	170.1	87.7	78.7	7,816.2
		Private Boat Fishing	318.0	809.2	632.2	705.0	690.1	411.1	0	290.2	244.5	126.0	113.2	4,339.5
		Shoreline Fishing/Trail Use	385.7	981.8	767.1	855.4	837.5	499.0	0	352.0	296.7	152.8	137.4	5,265.6
		Boat Based Camping	23.7	0	0	52.6	51.5	30.7	0	0	18.2	0	8.4	185.0
		Total:	1,514.6	3,794.7	2,964.8	3,358.4	3,287.9	1,958.7	4,796.5	1,360.7	1,164.6	590.6	539.3	25,330.7
	Flaming Gorge Reservoir	Power Boating/Waterskiing	8,928.7	8,029.1	11,261.9	18,292.6	27,470.6	5,769.5	0	0	2,961.1	0	7,170.2	89,883.7
		Boat Fishing	2,491.3	2,241.3	3,143.0	5,104.1	7,668.6	1,609.2	0	0	826.8	0	2,002.7	25,087.0
		Boat Camping	203.5	0	0	416.9	626.2	131.4	0	0	67.6	0	163.5	1,609.2
		Swimming/Waterplay	168.2	0	0	344.4	517.5	108.6	0	0	55.9	0	135.0	1,329.6
		Total:	11,791.7	10,270.4	14,404.9	24,158.1	36,282.9	7,618.7	0	0	3,911.4	0	9,471.4	117,909.4
		FGNRA[1] Total:	13,306.3	14,065.1	17,369.7	27,516.5	39,570.8	9,577.4	4,796.5	1,360.7	5,076.0	590.6	10,010.7	143,240.1
		Change from No Action Wet:	+2200.6	+2185.4	+2846.9	+4534.4	+6643.2	+1514.7	+977.7	+125.8	+792.4	+54.6	+1703.1	+23,578.3
Wet	Green River	Scenic Floating	546.0	1,389.9	1,086.0	1,210.8	1,185.3	706.0	0	498.3	419.8	216.3	194.4	7,453.0
		Guide Boat Fishing	176.2	448.3	350.2	390.6	382.4	227.8	3,818.8	160.8	135.4	69.8	62.7	6,223.1
		Private Boat Fishing	290.2	738.5	577.0	643.5	629.9	375.3	0	264.8	223.2	114.9	103.4	3,960.6
		Shoreline Fishing/Trail Use	340.7	867.1	677.5	755.4	739.6	440.7	0	310.9	262.0	134.9	121.4	4,650.1
		Boat Based Camping	18.1	0	0	40.2	39.4	23.5	0	0	14.0	0	6.5	141.6
		Total:	1,371.2	3,443.9	2,690.7	3,040.5	2,976.6	1,773.2	3,818.8	1,234.9	1,054.4	536.0	488.2	22,428.4
	Flaming Gorge Reservoir	Power Boating/Waterskiing	7,223.2	6,494.8	9,110.0	14,796.4	22,221.2	4,667.5	0	0	2,395.7	0	5,801.1	72,709.9
		Boat Fishing	2,157.6	1,941.0	2,722.1	4,420.2	6,640.7	1,393.5	0	0	716.0	0	1,734.0	21,725.1
		Boat Camping	196.8	0	0	403.1	605.5	127.1	0	0	65.3	0	158.1	1,555.8
		Swimming/Waterplay	157.2	0	0	321.9	483.7	101.4	0	0	52.2	0	126.2	1,242.6
		Total:	9,734.8	8,435.8	11,832.1	19,941.6	29,951.0	6,289.5	0	0	3,229.2	0	7,819.4	97,233.4
		FGNRA Total:	11,106.0	11,879.7	14,522.8	22,982.1	32,927.6	8,062.7	3,818.8	1,234.9	4,283.6	536.0	8,307.6	119,661.8
Dry	Green River	Scenic Floating	2.2	5.7	4.4	4.9	4.8	2.9	0	2.0	1.7	.9	.8	30.4
		Guide Boat Fishing	75.2	191.4	149.5	166.8	163.3	97.3	1,630.5	68.7	57.8	29.8	26.8	2,657.0
		Private Boat Fishing	138.0	351.3	274.5	306.1	299.6	178.5	0	126.0	106.1	54.7	49.2	1,883.9
		Shoreline Fishing/Trail Use	119.6	304.6	238.0	265.4	259.8	154.8	0	109.2	92.0	47.4	42.6	1,633.5
		Boat Based Camping	4.7	0	0	10.5	10.2	6.1	0	0	3.6	0	1.7	36.9
		Total:	339.9	853.0	666.4	753.6	737.8	439.5	1,630.5	305.8	261.3	132.8	121.0	6,241.7
	Flaming Gorge Reservoir	Power Boating/Waterskiing	5,361.2	4,819.7	6,761.2	10,981.4	16,492.5	3,464.0	0	0	1,778.0	0	4,305.3	53,963.3
		Boat Fishing	1,767.8	1,590.7	2,230.4	3,621.6	5,441.1	1,141.9	0	0	586.4	0	1,420.5	17,800.4
		Boat Camping	180.7	0	0	370.1	555.9	116.7	0	0	60.0	0	145.1	1,428.6
		Swimming/Waterplay	147.0	0	0	301.0	452.2	94.9	0	0	48.8	0	118.0	1,161.9
		Total:	7,456.8	6,410.4	8,991.6	15,274.1	22,941.7	4,817.5	0	0	2,473.2	0	5,988.9	74,354.3
		FGNRA Total:	7,796.7	7,263.4	9,658.0	16,027.7	23,679.5	5,257.0	1,630.5	305.8	2,734.5	132.8	6,109.9	80,596.0
		Change from No Action Wet:	-3,309.3	-4,616.3	-4,864.8	-6,954.4	-9,248.1	-2,805.7	-2,188.3	-929.1	-1,549.1	-403.2	-2,197.7	-39,065.8

[1] FGNRA = Flaming Gorge National Recreation Area.

Table 4-23.—No Action Alternative
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(Data Year: 1999)

Primary Industries/Sectors	IMPLAN Industry Number	Average Condition			Wet Condition			Dry Condition		
		Total Industry Output ($M)	Employment (Jobs)	Labor Income ($M)	Total Industry Output ($M)	Employment (Jobs)	Labor Income ($M)	Total Industry Output ($M)	Employment (Jobs)	Labor Income ($M)
Agriculture, Forestry, Fishing	1-27	50.8	1,340	15.9	50.8	1,340	15.9	50.8	1,339	15.9
Mining	28-47, 57	1,349.8	4,146	283.9	1,349.7	4,146	283.9	1,349.6	4,146	283.9
Construction	48-56	335.6	3,212	111.3	335.5	3,210	111.3	335.2	3,207	111.2
Manufacturing	58-432	322.2	1,729	85.4	322.1	1728	85.4	322.0	1,727	85.4
Other Transportation	433-436, 438-440	472.0	2,901	187.5	471.8	2,899	187.4	471.5	2,894	187.3
- Air Transportation:	437	6.4	74	2.7	6.4	74	2.7	6.3	72	2.7
Communications	441-442	45.9	195	11.1	45.7	194	11.1	45.4	192	11.0
Utilities	443-446	285.4	626	45.4	285.2	625	45.4	284.8	623	45.3
Wholesale Trade	447	89.4	1,076	36.9	89.3	1,074	36.9	89.0	1,070	36.8
Other Retail Trade	448-449, 452-453	53.0	1,582	25.9	52.9	1,579	25.8	52.7	1,574	25.7
- Food Stores:	450	33.4	914	19.6	32.2	882	18.9	30.4	833	17.9
- Automotive Dealers and Service Stations:	451	56.8	1,103	25.9	55.4	1,076	25.3	53.5	1,038	24.4
- Eating and Drinking:	454	69.0	2,382	23.5	66.5	2,292	22.6	62.0	2,139	21.1
- Miscellaneous Retail:	455	17.5	945	8.7	17.1	921	8.4	16.4	883	8.1
Finance, Insurance, and Real Estate (FIRE)	456-462	206.8	1,776	27.3	206.2	1,769	27.2	205.0	1,754	27.0
Other Services	464-476, 478-487, 489-509	346.4	6,907	152.4	345.7	6,891	1,52.1	344.6	6,864	151.5
- Hotels and Lodging Places:	463	39.4	1,096	15.7	36.1	1004	14.4	30.2	838	12.0
- Automobile Rental and Leasing:	477	0.5	14	0.1	.435	13	0.1	0.2	5	0.0
- Amusement and Recreation Services:	488	3.8	177	1.6	3.2	149	1.4	1.9	91	0.8
Federal, State, and Local Government	510-515, 519-523	261.8	6,660	207.2	261.7	6,659	207.1	261.5	6,657	207.1
TOTAL:		4,008.8	38,853	1,288.2	3,993.7	38,523	1,283.3	3,966.4	37,945	1,275.1
Change from Average Condition ($M, Jobs):					-15.1	-330	-4.9	-42.4	-908	-13.1
(Percent):					-0.4	-0.9	-0.4	-1.1	-2.3	-1.0
MOST AFFECTED SECTORS:		226.9	6704	97.8	217.3	6410	93.8	200.8	5899	87.0
Change from Average Condition ($M, Jobs):					-9.6	-294	-4.0	-26.1	-805	-10.8
(Percent):					-4.2	-4.4	-4.1	-11.5	-12.0	-11.0

Table 4-24.—Action Alternative Recreation Expenditures ($1,000s)
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(2000–2001 $)

Hydrologic Condition	Site	Recreation Activity	Expenditures Categories											
			Camping Fees	**Lodging**	**Restaurants**	**Groceries**	**Gas**	**Supplies**	**Guides**	**Car Rental**	**Other Rentals**	**Public Transit**	**Other**	**Total**
Average	Green River	Scenic Floating	722.2	1,838.7	1,436.6	1,601.7	1,568.1	934.1	0	659.2	555.2	286.0	257.1	9,858.9
		Guide Boat Fishing	236.0	600.6	469.2	523.2	512.3	305.1	5,116.0	215.4	181.4	93.5	84.0	8,337.0
		Private Boat Fishing	363.9	926.0	723.6	806.9	789.9	470.5	0	332.1	279.8	144.2	129.6	4,966.4
		Shoreline Fishing/Trail Use	475.5	1,210.2	945.7	1,054.4	1,032.3	615.0	0	433.9	365.6	188.3	169.4	6,490.3
		Boat Based Camping	19.5	0	0	43.3	42.4	25.2	0	0	15.0	0	7.0	152.3
		Total:	1,817.1	4,575.7	3,575.0	4,029.5	3,944.9	2,350.0	5,116.0	1,640.6	1,397.1	712.0	647.0	29,805.0
	Flaming Gorge Reservoir	Power Boating/Waterskiing	9,216.0	8,286.3	11,623.3	18,878.6	28,351.9	5,954.2	0	0	3,057.0	0	7,400.8	92,768.1
		Boat Fishing	2,545.3	2,289.7	3,211.3	5,214.7	7,834.2	1,644.3	0	0	844.8	0	2,045.6	25,629.9
		Boat Camping	207.2	0	0	424.4	637.4	133.8	0	0	68.8	0	166.4	1,637.9
		Swimming/Waterplay	169.9	0	0	347.9	522.7	109.7	0	0	56.5	0	136.4	1,343.0
		Total:	12,138.4	10,575.9	14,834.6	24,865.6	37,346.2	7,841.9	0	0	4,027.0	0	9,749.2	121,378.9
	FGNRA[1] Total:		13,955.5	15,151.6	18,409.6	28,895.1	41,291.1	10,191.9	5,116.0	1,640.6	5,424.1	712.0	10,396.2	151,183.9
	Change from No Action Alternative:	$:	649.2	1,086.5	1,039.9	1,378.6	1,720.3	614.5	319.5	279.9	348.1	121.4	385.5	7,943.8
		%:	4.9	7.7	6.0	5.0	4.4	6.4	6.7	20.6	6.9	20.6	3.9	5.6
Wet	Green River	Scenic Floating	312.3	795.2	621.3	692.7	678.2	403.9	0	285.2	240.1	123.7	111.2	4,263.8
		Guide Boat Fishing	119.4	303.7	237.3	264.6	259.1	154.3	2,587.1	108.9	91.7	47.3	42.5	4,216.0
		Private Boat Fishing	216.6	551.3	430.8	480.4	470.2	280.1	0	197.7	166.6	85.8	77.1	2,956.7
		Shoreline Fishing/Trail Use	173.7	442.2	345.5	385.3	377.2	224.8	0	158.5	133.6	68.8	61.9	2,371.6
		Boat Based Camping	12.0	0	0	26.7	26.1	15.5	0	0	9.2	0	4.3	93.8
		Total:	834.0	2,092.5	1,634.9	1,849.6	1,810.8	1,078.7	2,587.1	750.3	641.3	325.6	296.9	13,901.8
	Flaming Gorge Reservoir	Power Boating/Waterskiing	9,273.5	8,338.4	11,696.1	18,997.0	28,529.7	5,991.8	0	0	3,076.5	0	7,446.6	93,349.6
		Boat Fishing	2,557.7	2,300.7	3,227.0	5,239.7	7,872.4	1,652.2	0	0	849.1	0	2,055.9	25,754.5
		Boat Camping	209.1	0	0	428.2	643.3	135.0	0	0	69.4	0	167.9	1,652.9
		Swimming/Waterplay	169.0	0	0	345.8	519.6	109.0	0	0	56.1	0	135.6	1,335.1
		Total:	12,209.2	10,639.1	14,923.0	25,010.7	37,565.0	7,888.1	0	0	4,051.0	0	9,806.0	122,092.1
	FGNRA Total:		13,043.2	12,731.6	16,557.9	26,860.3	39,375.8	8,966.8	2,587.1	750.3	4,692.3	325.6	10,102.9	135,993.9
	Change from No Action Alternative:	$:	1,937.2	851.9	2,035.1	3,878.2	6,448.2	904.1	-1,231.7	-484.6	408.7	-210.4	1,795.3	16,332.1
		%:	17.4	7.2	14.0	16.9	19.6	11.2	-32.3	-39.2	9.5	-39.3	21.6	13.7
Dry	Green River	Scenic Floating	0	0	0	0	0	0	0	0	0	0	0	0
		Guide Boat Fishing	31.3	79.6	62.2	69.3	67.9	40.4	677.7	28.5	24.0	12.4	11.1	1,104.4
		Private Boat Fishing	29.0	73.7	57.6	64.2	62.9	37.5	0	26.4	22.3	11.5	10.3	295.4
		Shoreline Fishing/Trail Use	69.0	175.6	137.2	153.0	149.8	89.2	0	63.0	53.1	27.3	24.6	941.7
		Boat Based Camping	6.1	0	0	13.6	13.3	7.9	0	0	4.7	0	2.2	47.9
		Total:	135.4	328.9	257.0	300.1	293.8	175.1	677.7	117.9	104.1	51.2	48.2	2,489.3
	Flaming Gorge Reservoir	Power Boating/Waterskiing	7,150.4	6,428.6	9,018.6	14,647.6	21,998.2	4,620.8	0	0	2,371.6	0	5,741.7	71,977.5
		Boat Fishing	2,147.9	1,933.0	2,709.7	4,400.4	6,611.7	1,387.8	0	0	713.0	0	1,726.6	21,630.2
		Boat Camping	191.9	0	0	393.1	590.4	123.9	0	0	63.7	0	154.1	1,517.2
		Swimming/Waterplay	157.8	0	0	323.0	485.3	101.9	0	0	52.5	0	126.7	1,247.1
		Total:	9,647.9	8,361.6	11,728.3	19,764.1	29,685.7	6,234.4	0	0	3,200.8	0	7,749.1	96,371.9
	FGNRA Total:		9,783.3	8,690.5	11,985.3	20,064.2	29,979.5	6,409.5	677.7	117.9	3,304.9	51.2	7,797.3	98,861.2
	Change from No Action Alternative:	$:	1,986.6	1,427.1	2,327.3	4,036.5	6,300.0	1,152.5	-952.8	-187.9	570.4	-81.6	1,687.4	18,265.2
		%:	25.5	19.7	24.1	25.2	26.6	21.9	-58.4	-61.5	20.9	-61.5	27.6	22.7

[1] FGNRA = Flaming Gorge National Recreation Area.

Table 4-25.—Action Alternative Average Condition
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(Data Year: 1999)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output: Total ($M)	Total Industry Output: Change from No Action Alternative $M	Total Industry Output: Change from No Action Alternative Percent	Employment: Total (Jobs)	Employment: Change from No Action Alternative Jobs	Employment: Change from No Action Alternative Percent	Labor Income: Total ($M)	Labor Income: Change from No Action Alternative $M	Labor Income: Change from No Action Alternative Percent
Agriculture, Forestry, Fishing	1-27	50.8	.0058	0.0	1,340	0	0	15.9	.0021	0.0
Mining	28-47, 57	1,349.8	.0185	0.0	4,146	0	0	284.0	.0039	0.0
Construction	48-56	335.7	.0538	0.0	3,213	1	0.0	111.4	.0257	0.0
Manufacturing	58-432	322.2	.0273	0.0	1,729	0	0	85.5	.0052	0.0
Other Transportation	433-436 438-440	472.1	.0744	0.0	2,902	1	0.0	187.5	.0266	0.0
- Air Transportation:	437	6.4	.0353	0.6	74	0	0	2.8	.0151	0.6
Communications	441-442	46.0	.0623	0.1	195	0	0	11.2	.0151	0.1
Utilities	443-446	285.5	.0848	0.0	626	0	0	45.5	.0158	0.0
Wholesale Trade	447	89.5	.0570	0.1	1,076	1	0.1	37.0	.0235	0.1
Other Retail Trade	448-449 452-453	53.0	.0343	0.1	1,583	1	0.1	25.9	.0165	0.1
- Food Stores:	450	33.7	.3547	1.1	923	10	1.1	19.8	.2085	1.1
- Automotive Dealers and Service Stations:	451	57.2	.3713	0.7	1,111	7	0.7	26.1	.1692	0.7
- Eating and Drinking:	454	70.0	.9469	1.4	2,414	33	1.4	23.8	.3219	1.4
- Miscellaneous Retail:	455	17.7	.1414	0.8	952	8	0.8	8.7	.0700	0.8
Finance, Insurance, and Real Estate (FIRE)	456-462	207.1	.240	0.1	1,779	3	0.2	27.3	.0320	0.1
Other Services	464-476 478-487 489-509	346.7	.2458	0.1	6,913	6	0.1	152.5	.1155	0.1
- Hotels and Lodging Places:	463	40.7	1.303	3.3	1,132	36	3.3	16.2	.5181	3.3
- Automobile Rental and Leasing:	477	.55	.0792	16.8	16	2	16.8	.2	.0229	16.8
- Amusement and Recreation Services:	488	4.0	.2212	5.9	187	10	5.9	1.7	.0945	5.9
Federal, State, and Local Government	510-515 519-523	261.9	.0428	0.0	6,660	0	0.0	207.2	.0146	0.0
TOTAL:		4,014.6	5.72	0.1	38,974	120	0.3	1,289.9	1.72	0.1
MOST AFFECTED SECTORS:		230.3	3.45	1.5	6,810	107	1.6	99.3	1.42	1.5

positive but quite small, reflecting less than a 1% change. Looking at the sum of the eight most directly affected sectors, the gains are somewhat higher in percentage terms, indicating about a 1.5% change. The largest percentage change (gain) occurred in the automotive rental and leasing and the amusement and recreation services sectors, both small sectors in the three-county economy. From an employment perspective, the largest numeric gains are seen in the hotel and eating/drinking sectors. These gains in economic activity associated with the Action Alternative under average conditions were considered insignificant from both the overall and most affected sector perspectives.

Table 4-26 reports the effects of the Action Alternative under wet conditions. The overall change in Action Alternative total output, employment, and income compared to No Action Alternative wet conditions was also positive but very small, again reflecting less than a 1% change. Looking at the sum of the eight most directly affected sectors, the gains were slightly higher in percentage terms, indicating nearly a 3% change. The largest percentage change (loss) occurred in the automotive rental and leasing and the amusement and recreation services sectors, both small sectors in the three-county economy. From an employment perspective, the largest numeric gains are seen in the hotel and eating/drinking sectors. These gains in economic activity associated with the Action Alternative under wet conditions were considered insignificant from both the overall and most affected sector perspectives.

Table 4-27 reports the effects of the Action Alternative under dry conditions. The overall change in Action Alternative total output, employment, and income compared to No Action Alternative wet conditions was again positive but very small, reflecting less than a 1% change. Looking at the sum of the eight most directly affected sectors, the gains were slightly higher in percentage terms, indicating about a 3.5% change. The largest percentage change occurred in the automotive rental and leasing, hotel and lodging places, and the amusement and recreation services sectors. The hotel and lodging places sector is relatively large compared to the other two sectors. From an employment perspective, the largest numeric gains are seen in the hotel and eating/drinking sectors. These gains in economic activity associated with the Action Alternative under dry conditions were considered insignificant from both the overall and most affected sector perspectives.

While the lack of expenditure data by county precluded county specific analyses, it is possible that certain impacts could be centered within certain counties. For example, negative impacts estimated for the amusement and recreation services sector under the Action Alternative during wet and dry conditions stem from losses in guide boat fishing services expenditures which appear to be centered in and around the town of Dutch John in Daggett County. A corresponding loss of jobs during wet and dry conditions, while not overly apparent from a three-county perspective, could occur in Daggett County including Dutch John.

4.12.2.2 Results of Commercial Operator Analysis

As mentioned in the introduction to the socioeconomic section, it was anticipated that commercial guide operations, particularly those on the Green River, could be adversely affected by the Action Alternative. Because the regional analysis focused on the three-county area, impacts to commercial guides were not directly discernable. As a result, surveys of commercial guide operations on both the river and reservoir were conducted during the summer of 2001 to identify impacts.

Commercial operations on the Green River include rafting/scenic floating and boat fishing guides. Commercial operations on Flaming Gorge Reservoir include fishing guides and marinas.

Table 4-26.—Action Alternative Wet Condition
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(Data Year: 1999)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output			Employment			Labor Income		
		Total ($M)	Change from No Action Alternative		Total (Jobs)	Change from No Action Alternative		Total ($M)	Change from No Action Alternative	
			$M	Percent		Jobs	Percent		$M	Percent
Agriculture, Forestry, Fishing	1-27	50.8	.0098	0.0	1,340	0	0	15.9	.0035	0.0
Mining	28-47, 57	1,349.7	.0299	0.0	4,146	0	0	283.9	.0064	0.0
Construction	48-56	335.6	.0933	0.0	3,211	1	0.0	111.3	.0441	0.0
Manufacturing	58-432	322.1	.0466	0.0	1,729	0	0	85.5	.0087	0.0
Other Transportation	433-436 438-440	471.9	.1217	0.0	2,900	2	0.1	187.5	.0426	0.0
- Air Transportation:	437	6.3	-.0465	-0.7	73	-1	-0.7	2.7	-.0199	-0.7
Communications	441-442	45.8	.1086	0.2	194	1	0.3	11.1	.0263	0.2
Utilities	443-446	285.4	.1505	0.1	625	0	0	45.4	.0279	0.1
Wholesale Trade	447	89.4	.1008	0.1	1,075	1	0.1	36.9	.0416	0.1
Other Retail Trade	448-449 452-453	53.0	.0624	0.1	1,581	2	0.1	25.8	.0301	0.1
- Food Stores:	450	33.2	.9785	3.0	909	27	3.0	19.5	.5752	3.0
- Automotive Dealers and Service Stations:	451	56.8	1.337	2.4	1,102	26	2.4	25.9	.6092	2.4
- Eating and Drinking:	454	68.3	1.846	2.8	2,356	64	2.8	23.2	.6275	2.8
- Miscellaneous Retail:	455	17.5	.3703	2.2	941	20	2.2	8.8	.1832	2.2
Finance, Insurance, and Real Estate (FIRE)	456-462	206.6	.4156	0.2	1,773	5	0.3	27.2	.0541	0.2
Other Services	464-476 478-487 489-509	346.2	.4243	0.1	6,901	10	0.1	152.2	.1980	0.1
- Hotels and Lodging Places:	463	38.2	2.097	5.8	1,062	58	5.8	15.2	.8336	5.8
- Automobile Rental and Leasing:	477	.3	-.1360	-31.3	9	-4	-31.3	.1	-.0393	-31.3
- Amusement and Recreation Services:	488	2.9	-.2642	-8.3	137	-12	-8.3	1.2	-.1129	-8.3
Federal, State, and Local Government	510-515 519-523	261.8	.0797	0.0	6,659	1	0	207.2	.0266	0.0
TOTAL:		4,001.8	8.15	0.2	38,724	201	0.5	1,286.5	3.17	0.2
MOST AFFECTED SECTORS:		223.5	6.2	2.8	6,588	178	2.8	96.5	2.66	2.8

Table 4-27.—Action Alternative Dry Condition
(Impact Area Counties: Daggett and Uintah, Utah; Sweetwater, Wyoming)
(Data Year: 1999)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output			Employment			Labor Income		
		Total ($M)	Change from No Action Alternative		Total (Jobs)	Change from No Action Alternative		Total ($M)	Change from No Action Alternative	
			$M	Percent		Jobs	Percent		$M	Percent
Agriculture, Forestry, Fishing	1-27	50.8	.0117	0.0	1,339	0	0	15.9	.0042	0.0
Mining	28-47, 57	1,349.6	.0362	0.0	4,146	0	0	283.9	.0077	0.0
Construction	48-56	335.3	.1102	0.0	3,208	2	0.1	111.2	.0523	0.1
Manufacturing	58-432	322.0	.0551	0.0	1,728	1	0.0	85.4	.0104	0.0
Other Transportation	433-436, 438-440	471.6	.1471	0.0	2,896	2	0.1	187.4	.0519	0.0
- Air Transportation:	437	6.3	-.0122	-0.2	72	0	0	2.7	-.0052	-0.2
Communications	441-442	45.5	.1277	0.1	193	1	0.3	11.1	.0309	0.3
Utilities	443-446	285.0	.1765	0.1	624	1	0.1	45.4	.0328	0.1
Wholesale Trade	447	89.1	.1184	0.1	1,072	1	0.1	36.8	.0489	0.1
Other Retail Trade	448-449, 452-453	52.8	.0725	0.1	1,576	2	0.1	25.8	.0349	0.1
- Food Stores:	450	31.5	1.0228	3.4	861	28	3.4	18.5	.6012	3.4
- Automotive Dealers and Service Stations:	451	54.8	1.3160	2.5	1,063	26	2.5	25.0	.5995	2.5
- Eating and Drinking:	454	64.1	2.1127	3.4	2,212	73	3.4	21.8	.7182	3.4
- Miscellaneous Retail:	455	16.8	.3922	2.4	904	21	2.4	8.3	.1940	2.4
Finance, Insurance, and Real Estate (FIRE)	456-462	205.5	.4913	0.2	1,760	6	0.3	27.1	.0646	0.2
Other Services	464-476, 478-487 489-509	345.1	.5011	0.1	6,875	12	0.2	151.7	.2343	0.2
- Hotels and Lodging Places:	463	32.7	2.5646	8.5	909	71	8.5	13.0	1.0197	8.5
- Automobile Rental and Leasing:	477	.1	-.0523	-40.0	3	-2	-40.5	.0	-.0151	-30.5
- Amusement and Recreation Services:	488	1.8	-.1192	-6.6	85	-6	-6.6	.8	-.0510	-6.2
Federal, State, and Local Government	510-515, 519-523	261.6	.0921	0.0	6,658	1	0.0	207.1	.0309	0.0
TOTAL:		3,976.6	10.23	0.3	38,185	240	0.6	1,278.8	3.67	0.3
MOST AFFECTED SECTORS:		208.1	7.2	3.6	6111	212	3.6	90.0	3.1	3.5

Green River boat fishing and scenic floating operators within Reach 1 are similar in some ways to the commercial rafting operations within Dinosaur National Monument. They both require special use permits which limit the number of outfitters. The number of daily launches is limited in both areas. Guests must make long-term commitments when making reservations. However, differences exist between Green River Reach 1 fishing and floating recreators and Dinosaur National Monument white water rafters, primarily in terms of flow preferences. Generally speaking, fishermen and floaters within Reach 1 typically prefer lower flows.

The survey response rate was fairly good overall, and the results were deemed sufficiently representative for presentation purposes. Despite the reasonable response rates, the survey data did not provide enough information to estimate impacts by alternative since not all respondents answered all the questions. While it would have been useful to separately identify impacts to commercial operations on both the river and reservoir, it should be noted that the regional modeling analysis incorporates, but does not specifically identify, most of the impacts to the commercial operators by addressing changes in visitation and recreation expenditures (including guide fees and marina rentals). The difficulty with the regional modeling results is that they are aggregated by economic sector and industry and do not provide detailed impacts for specific businesses.

For both the river and reservoir, the surveys did provide some useful commercial operator information by recreation activity in terms of:

(1) Average visitation and revenue

(2) High end, low end, and preferred flows/water levels

(3) Preferred flow/water level visitation and revenue

The site and activity specific high end, low end, and preferred flow/water level information was compared to average flow/end-of-month water level information for each alternative under average, wet, and dry conditions for the months from March to October to evaluate alternative preferences (see tables 4-28 and 4-29).

In addition, assuming historical averages for visitation and revenue reflect No Action Alternative average conditions, the additional visitation and revenue under preferred conditions may provide an indicator of possible impacts under average conditions. In the typical case where Action Alternative flows/water levels are closer to preferred flows/water levels than the No Action Alternative, the difference between average and preferred conditions presented below could be used as an upper bound on possible Action Alternative visitation and revenue impacts. In cases where No Action Alternative flows/water levels are closer to preferred flows/water levels, the additional visitation and revenue data presented below provide little information.

In table 4-28, for Green River scenic floating operations, the survey indicated that preferred flows for Reach 1 from Flaming Gorge Dam to the confluence with the Yampa River averaged 4,040 cfs with a range from 2,000 to 10,000 cfs. High end and low end thresholds, depicting the points where flows are either too high or too low for rafting, averaged 15,200 and 715 cfs, respectively.

Comparing the high end/low end flow thresholds to average condition flows for both the No Action and Action Alternatives indicates that average flows for both alternatives for the March through October months fall within the usable range for scenic floating. For each month, an evaluation was also made as to which alternative's flows were closer to the preferred flow (monthly comparison). Of the 8 months studied, no preference resulted since each alternative would be preferred for 4 months. Finally, differences between the preferred flow and both the No Action and Action Alternatives flows were calculated for each month. The absolute value of these differences was summed, and the alternative with the lowest total difference was considered preferred (seasonal comparison). The Action Alternative was judged to be the preferred alternative by commercial rafters based on this seasonal comparison.

The Action Alternative was deemed to be the preferred alternative by commercial rafting operators under wet conditions. Both alternatives fell within the usable flow ranges for all months. The results suggest the Action Alternative would be preferred under wet conditions based on both the overall seasonal flow difference as well as 6 of the 8 months studied.

Conversely, the No Action Alternative would appear to be preferred by commercial rafting operators under dry conditions. Both alternatives fell within the usable flow ranges for all months. It appears the No Action Alternative would be preferred, based both on the overall seasonal flow difference as well as 4 of the 6 months indicating differences.

Rafting operators indicated an average of 40 boat trips a year with a range from 10 to 90. Note that boat trips would include multiple rafters. Average annual revenues were estimated at about $235,000 with a range from $35,000 to $476,000. Average additional annual trips under preferred flows were estimated at about 17 trips with a range from zero to 54. Some operators noted that visitation is controlled within Dinosaur National Monument so that the number of trips could not increase under preferred flows, but the number of clients per trip could increase. Average additional annual revenues under preferred flows were estimated at about $39,000 (+16.6%) with a range from $0 to $90,000.

For Green River boat fishing operations, table 4-28 indicates that preferred flows for the portion of Reach 1 associated with boat fishing (from Flaming Gorge Dam to the Utah/Colorado State line) averaged 2,338 cfs with a range from 1,400 to 2,800 cfs. High and low end thresholds for boat fishing averaged 7,530 and 1,030 cfs, respectively. Based on comments received from the Green River Outfitter and Guide Association, the low end threshold was further reduced to 800 cfs.

The Action Alternative was deemed to be the preferred alternative by commercial boat fishing operators on the Green River under average conditions based on comparisons to preferred flows since both alternatives fell within the usable range across all months. The comparisons to preferred flows resulted in the Action Alternative being preferred, based on the overall seasonal flow difference. Individual monthly comparisons resulted in no obvious preference since 4 of the 8 months were preferred by each alternative. The lower use months of March and October showed a preference for No Action, implying the higher use months of April thru September preferred the Action Alternative.

The No Action Alternative was deemed to be the preferred alternative by commercial boat fishing operators under wet conditions. Both alternatives fell within the usable flow ranges for all months. The preferred flow comparisons resulted in the No Action Alternative being preferred, based on the overall seasonal flow difference; but both alternatives appear to be equally attractive based on the monthly comparisons. Looking at the higher use months of April thru September, the No Action Alternative would be preferred.

Similarly, the No Action Alternative would appear to be preferred by commercial boat fishing operators under dry conditions. While both alternatives fall within the usable range in all months, the No Action Alternative would be preferred by commercial boat fishing operators based on comparisons to preferred flow. The No Action Alternative

Table 4-28.—Green River Commercial Operator Hydrology Comparisons

Recreation Activity	Flow Levels	Month	Average Conditions: No Action Alternative Flow	Beyond Usable Range?	Action Alternative Flow	Beyond Usable Range?	Closest to Preferred Flow	Wet Conditions: No Action Alternative Flow	Beyond Usable Range?	Action Alternative Flow	Beyond Usable Range?	Closest to Preferred Flow	Dry Conditions: No Action Alternative Flow	Beyond Usable Range?	Action Alternative Flow	Beyond Usable Range?	Closest to Preferred Flow
Scenic Floating	Preferred: 4,040	Mar	1,484	No	1,270	No	No Action	1,898	No	2,030	No	Action	800	No	800	No	Same
	High End: 15,000	Apr	2,207	No	1,904	No	No Action	3,290	No	3,981	No	Action	800	No	800	No	Same
	Low End: 715	May	3,463	No	3,233	No	No Action	5,100	No	5,537	No	No Action	1,400	No	800	No	No Action
		June	2,710	No	3,962	No	Action	5,917	No	7,038	No	No Action	800	No	893	No	Action
		July	983	No	2,185	No	Action	1,200	No	4,600	No	Action	800	No	893	No	Action
		Aug	1,251	No	1,626	No	Action	1,531	No	2,131	No	Action	931	No	906	No	No Action
		Sept	1,374	No	1,639	No	Action	1,639	No	2,239	No	Action	1,039	No	939	No	No Action
		Oct	1,654	No	1,487	No	No Action	2,075	No	2,172	No	Action	1,039	No	800	No	No Action
						Overall:	Action				Overall:	Action				Overall:	No Action
Boat Fishing	Preferred: 2,338	Mar	1,484	No	1,270	No	No Action	1,898	No	2,030	No	Action	800	No	800	No	Same
	High End: 7,530	Apr	2,207	No	1,904	No	No Action	3,290	No	3,981	No	No Action	800	No	800	No	Same
	Low End: 800	May	3,463	No	3,233	No	Action	5,100	No	5,537	No	No Action	1,400	No	800	No	No Action
		June	2,710	No	3,962	No	No Action	5,917	No	7,038	No	No Action	800	No	893	No	Action
		July	983	No	2,185	No	Action	1,200	No	4,600	No	No Action	800	No	893	No	Action
		Aug	1,251	No	1,626	No	Action	1,531	No	2,131	No	Action	931	No	906	No	No Action
		Sept	1,374	No	1,639	No	Action	1,639	No	2,239	No	Action	1,039	No	939	No	No Action
		Oct	1,654	No	1,487	No	No Action	2,075	No	2,172	No	Action	1,039	No	800	No	No Action
						Overall:	Action				Overall:	No Action				Overall:	No Action

Table 4-29.—Flaming Gorge Reservoir Commercial Operator Hydrology Comparisons

Recreation Activity	Reservoir Levels	Month	Average Conditions					Wet Conditions					Dry Conditions				
			No Action Alternative Flow	Beyond Usable Range?	Action Alternative Flow	Beyond Usable Range?	Closest to Preferred Flow	No Action Alternative Flow	Beyond Usable Range?	Action Alternative Flow	Beyond Usable Range?	Closest to Preferred Flow	No Action Alternative Flow	Beyond Usable Range?	Action Alternative Flow	Beyond Usable Range?	Closest to Preferred Flow
Boat Fishing	Preferred: 6029	Mar	6024.0	No	6025.8	No	Action	6027.9	No	6027.9	No	Same	6019.0	No	6023.5	No	Action
	High End: 6040	Apr	6024.1	No	6026.0	No	Action	6028.5	No	6028.5	No	Same	6020.1	No	6023.0	No	Action
	Low End: 6006	May	6023.8	No	6025.8	No	Action	6029.4	No	6029.2	No	Action	6017.6	No	6022.8	No	Action
		June	6026.6	No	6027.8	No	Action	6031.7	No	6030.3	No	Action	6018.5	No	6024.5	No	Action
		July	6029.1	No	6029.2	No	No Action	6035.5	No	6030.7	No	Action	6019.3	No	6024.7	No	Action
		Aug	6028.9	No	6028.4	No	No Action	6036.0	No	6030.5	No	Action	6018.5	No	6023.8	No	Action
		Sept	6028.3	No	6027.4	No	No Action	6035.5	No	6030.0	No	Action	6017.9	No	6023.2	No	Action
		Oct	6027.5	No	6026.8	No	No Action	6034.9	No	6029.8	No	Action	6017.3	No	6023.1	No	Action
						Overall:	Action				Overall:	Action				Overall:	Action
Marinas	Preferred: 6031	Mar	6024.0	No	6025.8	No	Action	6027.9	No	6027.9	No	Same	6019.0	Yes	6023.5	No	Action
	High End: 6035	Apr	6024.1	No	6026.0	No	Action	6028.5	No	6028.5	No	Same	6020.1	Yes	6023.0	No	Action
	Low End: 6023	May	6023.8	No	6025.8	No	Action	6029.4	No	6029.2	No	No Action	6017.6	Yes	6022.8	Yes	Range
		June	6026.6	No	6027.8	No	Action	6031.7	No	6030.3	No	Same	6018.5	Yes	6024.5	No	Action
		July	6029.1	No	6029.2	No	Action	6035.5	Yes	6030.7	No	Action	6019.3	Yes	6024.7	No	Action
		Aug	6028.9	No	6028.4	No	No Action	6036.0	Yes	6030.5	No	Action	6018.5	Yes	6023.8	No	Action
		Sept	6028.3	No	6027.4	No	No Action	6035.5	Yes	6030.0	No	Action	6017.9	Yes	6023.2	No	Action
		Oct	6027.5	No	6026.8	No	No Action	6034.9	No	6029.8	No	Action	6017.3	Yes	6023.1	No	Action
						Overall:	Action				Overall:	Action				Overall:	Action

would be preferred in 4 of 6 months with preferred flow based differences.

Two of the four boat fishing operators who responded to the survey indicated an average of 210 boat trips a year. Average annual revenues across all four operators were estimated at about $245,600 with a range from $32,000 to $500,000. Average additional annual trips under preferred flows were estimated at about 54 trips with a range from 23 to 108. Average additional annual revenues under preferred flows were estimated at about $17,000 (+6.9%) with a range from $7,200 to $35,000.

In table 4-29, for Flaming Gorge Reservoir boat fishing operations, preferred water levels averaged 6029 feet above msl. High and low end thresholds averaged 6040 and 6006, respectively.

The Action Alternative was deemed to be the preferred alternative by commercial boat fishing operators on Flaming Gorge Reservoir under average conditions. Both alternatives fell within the usable water level ranges for all months. The comparisons to preferred water levels resulted in the Action Alternative being preferred, based on the overall seasonal water level difference and in 4 of the 8 months in comparison.

The Action Alternative was deemed to be the preferred alternative by commercial boat fishing operators under wet conditions. Both alternatives fell within the usable water level ranges for all months. The preferred water level comparisons resulted in the Action Alternative being preferred, based on the overall seasonal water level difference and in 6 of 6 months indicating differences.

The Action Alternative would appear to be preferred by commercial boat fishing operators under dry conditions. Both alternatives fell within the usable water level ranges for all months. The Action Alternative would be preferred, based on both the overall seasonal water level difference and the monthly comparisons for all months studied.

Reservoir boat fishing operators indicated an average of 107 clients a year with a range from 20 to 220. Average annual revenues were estimated at about $12,800 with a range from $4,000 to $38,000. Average additional annual trips under preferred water levels were estimated at 5 trips with a range from 0 to 18. Average additional annual revenues under preferred water levels were estimated at only $650 (5.1%) with a range from $0 to $2,250.

For Flaming Gorge Reservoir marina operations, table 4-28 indicates preferred water levels across all boat-based activities averaged 6031 feet. High and low end thresholds averaged 6035 and 6023, respectively.

The Action Alternative was deemed to be the preferred alternative by commercial boat fishing operators on Flaming Gorge Reservoir under average conditions. Both alternatives fell within the usable water level ranges for all months. The comparisons to preferred water levels resulted in the Action Alternative being preferred, based on the overall seasonal water level difference and in the 5 of the 8 months in comparison.

The Action Alternative was deemed to be the preferred alternative by commercial boat fishing operators under wet conditions. No Action water levels for July through September fell outside the usable range. The preferred water level comparisons resulted in the Action Alternative being preferred based on the overall seasonal water level difference and in 4 of 5 months indicating differences.

The Action Alternative would appear to be preferred by commercial boat fishing operators under dry conditions. This is primarily because the No Action Alternative falls outside the usable water level range in all months compared to only 1 month (May) for the Action Alternative.

Marina operators responded with an average of 97,200 clients a year. Average annual revenues were estimated at about $915,800. Average additional annual trips under preferred water levels were estimated at 10,600 trips. Average additional annual revenues under preferred water levels were estimated at $225,400 (+24.6%). These additional revenues include cost savings associated with reduced operation and maintenance related to moving and shoring up docks, moorings, etc., under preferred water levels. In general, the cost of operating and maintaining marinas, boat ramps, and boat camps increases as water levels drop below preferred water levels. The annual operation and maintenance costs savings under preferred conditions at the two marinas averaged $46,000.

Comparing the high and low end thresholds provided by the commercial operators to those from the recreator surveys for the same recreation activity indicates that, generally speaking, the commercial operators were willing to pursue visits over a wider range of flows/water levels. In other words, the high end thresholds were higher and the low end thresholds were lower for the commercial operators. The preferred flows/water levels for the commercial operators were higher than those from the recreator surveys.

4.13 PUBLIC SAFETY AND PUBLIC HEALTH

This section presents the environmental consequences to public safety and public health of operating Flaming Gorge Dam under the No Action and Action Alternatives. This section focuses on the risk to public health and safety for workers, residents, and the general public who may be traveling in the area but not necessarily participating in recreational activities associated with the Flaming Gorge facility. A discussion of potential impacts to recreation safety can be found in section 4.11.5.

4.13.1 Public Safety on Flaming Gorge Reservoir

The analysis of the hydrologic modeling of the Action and No Action Alternatives indicates that fluctuation of the reservoir elevation would occur less frequently under the Action Alternative. Unsafe conditions around Flaming Gorge Reservoir and at Flaming Gorge Dam increase as a result of the changing environment when the reservoir elevation changes. It is likely that these unsafe conditions would occur less often under the Action Alternative because of the reduced magnitude and frequency of reservoir elevation fluctuations.

Risks to dam workers under the Action Alternative do not appear to be greater than under the No Action Alternative. Bypass releases may be more frequent under the Action Alternative; however, they would tend to be of less magnitude and would be systematically scheduled under the operating procedures at the dam. Existing safety procedures are adequate, and no additional workplace safeguards would be needed under either the Action or No Action Alternative.

4.13.2 Public Safety on the Green River

The risks to public safety associated with high flows along the Green River are not substantially different under the Action and No Action Alternatives. Under both alternatives, public notification of anticipated riverflows would be provided through communication channels established within the Flaming Gorge Working Group.

High flows have the potential to cause erosion around the abutments of bridges and pipelines that cross the river. Under the Action Alternative, high flows would likely occur more often and for longer durations than would occur under the No Action Alternative. It is not anticipated, however, that the increased frequency and duration of high flows in the Green River under the Action

Alternative (compared to the No Action Alternative) would have an impact on the structural integrity of these bridges and pipelines that cross the Green River.

There are several trailer homes located in the flood plains near Jensen, Utah. These homes are susceptible to flooding when riverflows exceed 18,000 cfs. Under the Action Alternative, it is likely that these homes could be impacted by flooding more often than under the No Action Alternative, as a result of releases made from Flaming Gorge Dam that attempt to achieve target flows in Reach 2 that exceed 18,000 cfs. It is not anticipated, however, that there would be an increased risk to the health and safety of people inhabiting these homes because notification of potential high flows will allow ample evacuation time.

4.13.3 Disease Vectors

Both the No Action and Action Alternatives would result in temporary elevated flows in Reaches 1 and 2 of the Green River in the May-July period. At the end of the targeted peak flows period, the river elevation should drop, inundated flood plains should drain, and most of the new mosquito habitat would vanish. Some small depressions may continue for a time and provide habitat, but they also would dry up.

Reclamation has no control over the management of the mosquito problem in the Jensen, Utah, area. It is expected that existing State and county mosquito control programs would continue. This section analyzes the impacts of the Action and No Action Alternatives on mosquito populations in Reaches 1 and 2.

4.13.3.1 No Action Alternative

4.13.3.1.1 Reach 1 – Irving and Burdick (1995) conducted an inventory, largely based on aerial photography, and determined that about 1,591 acres of potential flooded bottomland habitat exist in Reach 1 of the Green River. Under the No Action Alternative, existing flows would not change; and the flooded bottomlands should continue to produce the same number of mosquitoes.

4.13.3.1.2 Reach 2 – As in Reach 1, flows in the Green River should not change. Irving and Burdick (1995) conducted an inventory, largely based on aerial photography, and determined that about 8,648 acres of potential flooded bottomland habitat exist in Reach 2 of the Green River. Under the No Action Alternative, existing flows would not change, and the flooded bottomlands should continue to produce the same numbers of mosquitoes.

In Reach 2, the Uintah County Mosquito Abatement District provides mosquito control treatment for about 50 river miles of Green River between the Dinosaur National Park boundary and Ouray, Utah. The amount of mosquito control greatly depends on the volume and duration of flows in the Green River. The Uintah County Mosquito Abatement District's mosquito control is not expected to change.

4.13.3.1.3 Reach 3 – As in Reaches 1 and 2, implementing the No Action Alternative would not change the amount of bottomlands flooded and the mosquito breeding areas. Irving and Burdick (1995) conducted an inventory, largely based on aerial photography, and determined that about 8,154 acres of potential bottomlands were present in Reach 3, including 2,718 areas between the White River confluence and Pariette Draw and 1,878 acres in Canyonlands.

4.13.3.2 Action Alternative

4.13.3.2.1 Reach 1 – In most cases, implementing the Action Alternative would increase the peak flows in Reach 1. Peak release in Reach 1 that reaches 8,600 cfs for 1 day occurs about 27% and 6.5% of the time in the Action Alternative and No Action

Alternative, respectively. The 1-day duration peak flows should create most of the flood plain mosquito habitat in Reach 1 for the flood plain mosquitoes, such as *Aedes* sp. Implementing the Action Alternative would increase the amount of adjacent flood plains inundated and provide adequate habitat for many different species of mosquitoes.

The longer duration flows in the Action Alternative would benefit the mosquitoes that lay their eggs on water surfaces. In those areas where there are adequate environmental conditions, such as standing water in depressions or along vegetative areas, mosquitoes would be expected to be productive. There are many species of mosquitoes that lay their eggs on water surfaces, including the *Culex* sp. mosquitoes that are responsible for the transmission of the encephalitis virus. In some mosquito producing areas, environmental conditions and fish could reduce mosquito populations.

4.13.3.2.2 Reach 2 – Generally, the 1-day duration flows in the Action Alternative and the No Action Alternative are about the same. However, the highest targeted peak flows in Reach 2, 1-day duration at 26,400 cfs, should occur about 14% and 7% in the Action Alternative and No Action Alternative, respectively. Implementing the Action Alternative for the 1-day duration peak flows would not have a major impact on the mosquito production in most years (14% versus 7%). The targeted 2-week and 4-week duration peak flows are generally higher under the Action Alternative. Targeted 2-week peak flows of 18,600 cfs in Reach 2 should occur about 41.1% and 15.6% for the Action Alternative and No Action Alternative, respectively. The Uintah County Mosquito Abatement District estimated that, at a flow of 18,000 cfs, they can expect to treat about 30,000 acres of mosquito habitat. The 30,000 acres include repeated treatments of the same area. The Uintah County Mosquito Abatement District would need to provide treatment at this level nearly three times as often under the Action Alternative (41.1% versus 15.6%). Implementing the Action Alternative would increase mosquito habitat production in Reach 2 in some years, but not as large or as often as in Reach 1.

4.13.3.2.3 Reach 3 – In nearly all cases, implementing the Action Alternative would slightly increase the frequency of higher flows in Reach 3 and flood river bottom lands more often. Flooding river bottom lands has the potential to create good mosquito habitat. It is expected that large numbers of mosquitoes could be produced in both the Action and No Action Alternatives. Implementing the Action Alternative in Reach 3 should not have a major impact on the mosquito populations in the area when compared to existing conditions.

4.13.4 Air Quality

Negative impacts on regional air quality from reductions in output from the Flaming Gorge Powerplant could occur if losses of energy from this source are replaced by other sources in the region that generate high levels of pollutants. One advantage of hydropower is that it is a clean source of power relative to other sources, especially coal-fired powerplants. Variations in air pollutants from electricity generation are dependent on the source of the power. Reduction in the generation from hydropower or increase in the generation from other sources such as coal-fired powerplants can increase pollution levels.

Changes in air quality are dependent on changes in energy prices, production levels of other powerplants, purchases from outside the region, other generation factors, and the weather. While the results from the simulation of power output from the Flaming Gorge Powerplant show that the Action Alternative would generate slightly fewer megawatthours on average, the difference appears to be insignificant, and the level of difference would vary depending on many conditions. This reduction in output would be less than 5% of the generation at Flaming Gorge powerplant and a small fraction of 1%

of the sales for the SLCA/IP customers. Due to the size of the region and number of generators supplying power to the region's grid, any emission changes would be spread over a large area and likely have an insignificant effect on regional air quality or air quality in one location.

4.14 VISUAL RESOURCES

4.14.1 Flaming Gorge Reservoir

The desired visual resource management goal on the national recreation area would be for a "naturally appearing" landscape. There is a "cultural" setting where concentrations of people and developments exist, such as the Cedar Springs area, at Flaming Gorge Dam, and the Dutch John townsite.

At the heart of discussion is the visual difference between the No Action Alternative operating levels and the Action Alternative operating levels during the summer recreational season, which is considered by the USDA Forest Service from Memorial Day to Labor Day, or approximately 100 days.

People do notice the draw down level of the reservoir, along with the white line, but it does not detract from their recreational experience in the area. The low water marks and white line effects are only noticeable along some segments of the entire 300 miles of shoreline. During winter months, any visual impacts are naturally mitigated with a covering of snow.

4.14.1.1 No Action Alternative

The reservoir high water line is at 6040 feet above msl. Under the No Action Alternative, average monthly water levels for May, June, July, and August range between 6023.8 and 6029.1 (see section 4.3). The high water elevation during the same timeframe was 6038.6. Present water levels are around 6013. For the past 10 years, the average reservoir water level was managed at approximately 11 to 16 feet below high water level.

4.14.1.2 Action Alternative

The average monthly water levels for May, June, July, and August would range between 6025.8 and 6029.2 under Action Alternative conditions. The minimum water elevation would be 6008.5. The maximum water elevation would be 6033.8 (see section 4.3).

The difference from the No Action Alternative in the average end-of-month elevations would be 2 feet higher than minimum levels and essentially the same at average high levels. This would result in slightly less exposed overall shoreline.

Under both alternatives, there would be about 11-16 feet of exposed shoreline. The difference of 0-2 feet in exposed shoreline is negligible.

4.14.2 Green River

The USDA Forest Service visual management goal for the Green River corridor would be for a "natural appearing landscape character."

The BLM visual resource management goal, downstream from the forest boundary to Browns Park, is Class II management. Some altering of the landscape can occur, but management activities and structures should not attract a viewer's attention.

4.14.2.1 No Action Alternative

The average riverflows for May, June, July, and August range from 983 to 3,463 cfs under No Action riverflow conditions. The low flows would be about 800 cfs, and the high flows could reach 12,600 cfs (see section 4.3).

There are few to no visual effects on the streambanks, from the perspective of the casual visitor. In many cases, vegetation is growing in the zone between high and low water flows. Some mud banks and exposed rocks stick out of the water; however, they appear as a natural occurrence under low water conditions. Very few indications of a white mineral buildup are apparent on the cobble rocks or along the streambanks.

4.14.2.2 Action Alternative

The average riverflows for May, June, July, and August under Action Alternative conditions would range between 1,626-3,862 cfs. The low flows would be 800 cfs, and the high flows could reach 15,000 cfs (see section 4.3).

As compared with the No Action Alternative, low flows would go to 800 cfs. The average riverflow would range from 643 to 399 cfs above the No Action Alternative. The proposed high flows would be 2,400 cfs higher than the No Action Alternative.

The result of visual impacts would be less exposed streambank during the recreation season. The difference in visual impact from the No Action Alternative is considered negligible.

4.15 ENVIRONMENTAL JUSTICE

The Council on Environmental Quality's *Environmental Justice Guidance Under the National Environmental Policy Act* states minority population should be identified where either the minority population of the affected area exceeds 50% or the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population. Data from the U.S. Census of Population 1990 and 2000 were used to determine the minority population in the project area. *U.S. Census Bureau Estimates for People of All Ages in Poverty for 1989 and 1999* were used as a proxy for low income. Professional expertise and judgment were used to review impacts of implementing the Action Alternative to determine whether minority or low-income populations would be disproportionately adversely affected.

The minority populations of the study area are less than 50% of the total population; however, any potential adverse impacts to the Indian population must be considered.

4.15.1 No Action Alternative

The current trends for minority and low-income populations would continue.

4.15.2 Action Alternative

No adverse impacts with the potential to affect minority and low-income populations have been identified at Flaming Gorge Reservoir.

As discussed in section 3.6.2, lands within Reach 1 adjacent to the Green River are publicly owned. Since no one lives on these lands, there would not be any adverse environmental justice impacts in Daggett County or this portion of Uintah County.

All of Reach 2 is located within Uintah County. Public lands within the Dinosaur National Monument compose the first part of Reach 2. As described in section 3.6.2, the lands adjacent to the Green River downstream from Dinosaur National Monument to the Ouray National Wildlife Area are privately owned. The remainder of Reach 2 and the first portion of Reach 3 are Uintah and Ouray Reservation lands in Uintah County. Under the No Action Alternative, the private and reservation lands adjacent to the Green River in Uintah County would continue to experience inundation during peak runoff times as they have in the past. The adjacent landowners have become accustomed to impacts to agricultural lands and the oil and gas well operations during these peak runoff times. Under the Action Alternative, in some years, flows could exceed what adjacent landowners have experienced in the past. While impacts affecting reservation agricultural lands and oil and gas well operations have the potential to be an adverse environmental justice impact, the Northern Ute Tribe advised Reclamation during a meeting in April 2004 that advance notice from Reclamation would resolve issues of well access and impacts to cattle utilizing agricultural lands within the area of potential inundation. During the spring when high flows occur, there would be limited access just as it now occurs. There would be no significant difference between the Action and the No Action Alternatives. Thus, there would not be any adverse environmental justice impacts.

4.16 CUMULATIVE IMPACTS

This section analyzes the potential cumulative effects of the proposed action. As defined at 40 CFR 1508.7, a "cumulative impact" is an impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time. It focuses on whether the proposed action, considered together with any known or reasonable foreseeable actions by Reclamation, the Recovery Program, other Federal or State agencies, or some other entity combined to cause an effect. There is no defined area for potential cumulative effects.

Historically, human use of the Green River presumably began to have some impact on the riverine environment in the 19th century. Greater impacts likely began occurring with the construction of the Tusher Wash diversion near Green River, Utah, in 1906. Construction of Flaming Gorge Dam from 1958 through 1964 resulted in a profound change to the riverine environment, which contributed to the decline of native fish species in the Green River and native vegetation along the Green River. The filling of Flaming Gorge Reservoir also inundated an unknown number of cultural and paleontological resources.

Alternatively, the creation of Flaming Gorge Reservoir, the establishment of the Flaming Gorge National Recreational Area, and the establishment of the trout fishery below Flaming Gorge Dam constitute significant benefits to recreation and the regional economy. Additional benefits were realized with the establishment of hydropower production and water storage capability.

Recognizing that construction of Flaming Gorge Dam caused both adverse and beneficial outcomes, implementation of the Action Alternative would, along with other Recovery Program efforts discussed in this document, improve the riverine environment for native fish, including the four threatened and endangered species, without causing significant impacts to any of the other resources potentially affected by the Action Alternative. Operations under the No Action Alternative could also benefit the endangered fish and the riverine environment, but the beneficial effects might not be sufficient or timely in assisting with the recovery of the four endangered Colorado River fish species.

The following sections address cumulative impacts by resource. These analyses focused on the Action Alternative considered in combination with related and ongoing actions identified in chapter 1 and other relevant activities or conditions. The question addressed in this section is whether the Action Alternative causes or contributes to a significant cumulative effect.

4.16.1 Water Resources and Hydrology

4.16.1.1 Water Consumption

The 2000 Flow and Temperature Recommendations for Reaches 1, 2, and 3 are based on the needs of the endangered fish, and they do not account for any future change in water consumption. As consumption increases over time, it may become more difficult to achieve the 2000 Flow and Temperature Recommendations through the re-operation of Flaming Gorge Dam. Because of increasing water consumption in the tributaries of the Green River below Flaming Gorge Dam, it is anticipated that releases from Flaming Gorge Dam will have to be greater in the future than what would be required now to achieve the 2000 Flow and Temperature Recommendations under similar hydrologic conditions. Increasing release requirements would reduce the ability of Flaming Gorge Dam to store water during wet periods. During dry periods, drawdown conditions would become more severe as a result of increased release requirements to meet downstream flow recommendations.

With increased water consumption in the basin, flows in Reaches 2 and 3 during the base flow period might achieve the 2000 Flow and Temperature Recommendations at lower levels than would occur at current water consumption levels. Increased pressure on reservoir storage could cause Reclamation to target lower flows within the range of acceptable flows for Reaches 2 and 3 to reduce the impact to reservoir storage. During the transition period, releases potentially could be lower in the future than they would be now as a result of increasing water consumption.

Water consumption above Flaming Gorge Reservoir is also expected to increase, and this could reduce the inflows to Flaming Gorge Reservoir. With less water flowing into Flaming Gorge Reservoir, pressure on water storage could increase in the future.

It is noted that the Action Alternative is a component of the Recovery Program's overall effort to recover the four endangered fish species. As such, the Action Alternative would contribute to offsetting the impacts of continued development and consumption of water resources while maintaining compliance with the Endangered Species Act.

4.16.1.2 Water Temperature

Past, present, and reasonably foreseeable future actions that could affect the thermal environment in the Green River below Flaming Gorge Dam include diversions and depletions of water from the Green River and its tributaries above and below Flaming Gorge Dam. Most depletions are interceptions of flow that are held in storage reservoirs, whereas diversions move water out of stream channels for offsite uses. Water usually is accumulated in storage reservoirs during the spring runoff period, whereas diversions occur over a lengthier period of time. Irrigation diversions occur during growing seasons for crops; municipal and industrial diversions can occur year round.

The thermal environment of the Green River below Flaming Gorge Dam has been highly impacted by perennial releases of cold water from the dam. Construction and operation of the selective withdrawal structure has diminished this effect, and the Action Alternative would further improve the thermal regime by increasing release temperatures. Depletions held in storage reservoirs are expected to have little effect on Green River water temperatures during spring runoff except in extremely dry years. Water released from the depths of these reservoirs during summer would likely be cooler than if it were not impounded, but this effect will persist only for a limited distance downstream from the reservoir. Little effect is anticipated on Green River temperatures from reservoirs releases in its tributaries.

Diversions from the Green River, or its tributaries, during summer could have a greater effect on water temperature. Diversions that decrease base flow would increase downstream water temperatures by reducing flow volume. If these diversions occur on the Yampa River, the relationship between the Green River and Yampa River water temperatures could be affected (warmer Yampa River temperatures). Additional instances of exceeding the recommended 9 °F (5 °C) temperature difference would likely occur. Similar responses may occur downstream at confluences of other tributaries, such as the Duchesne, White, and Price Rivers.

4.16.1.3 Sediment Transport and Channel Morphology

The construction of Flaming Gorge Dam significantly reduced the sediment source area for downstream reaches of the Green River by trapping the entire incoming sediment load. Flow frequency and sediment transport conditions downstream from Flaming Gorge Dam under the Action Alternative will not return to pre-reservoir conditions partly because of the continued existence of Flaming Gorge Dam and its sediment-trapping role. The Action Alternative represents a change from existing conditions of flow frequency and sediment transport for each reach, although the relative effect in these reaches will differ.

Within Reach 1, channel narrowing in Lodore Canyon has been associated with decreased sediment loading and decreased flow magnitude following completion of Flaming Gorge Dam. Under the Action Alternative, more frequent occurrence of high flows during the snowmelt runoff season will occur in Reach 1. In Lodore Canyon, channel areas that have become vegetated under present-day Flaming Gorge Dam operations could be eroded upon implementation of the Action Alternative. Thus, under the Action Alternative, channel width in Lodore Canyon may not approach pre-dam conditions but could be increased relative to existing conditions of channel width.

Within Reach 2, channel narrowing following initiation of water storage at Flaming Gorge Dam has been documented. In Reach 2, average annual sediment loading would be slightly increased under the Action Alternative. The Action Alternative targets flood plain habitats in Reach 2 by increasing the frequency of bankfull discharges. The increased frequency of bankfull flow conditions, when coupled with local levee removals under consideration by the Colorado River Recovery Program within the Green River channel and flood plain, could result in local channel changes including width, depth, and pattern beyond similar changes anticipated to occur as a result of the Action Alternative flow changes alone. These geomorphic adjustments could result in local changes in velocity and direction of flow as well as the duration of inundation for flood plain areas.

Former flood plains in portions of Reach 3 are no longer connected to the main channel of the Green River. With vegetation encroachment on these natural levees and a diminished frequency of overbank flooding under post-dam flow conditions, only extremely rare, high magnitude flows can reach these areas. Changes in flow frequency and sediment transport in Reach 3 under the Action Alternative are expected to be similar to those described for Reach 2. The modified frequency of high flows attributable to the Action Alternative alone is not likely to result in a reconnection between the Green River channel and its flood plain in Reach 3.

4.16.2 Hydropower

To analyze cumulative effects, additional hydropower analysis was performed to simulate the economic benefits from Flaming Gorge Dam and Reservoir operation, assuming a removal of most of the biological constraints. This simulation is generated for comparison purposes only and is not an alternative under consideration. Instead, it reflects the impacts from changes made in operations since 1973 and represents a cumulative impact of all constraints imposed in the past. This simulation used the same modeling as was used in the No Action and Action Alternatives, except for modifications in the reservoir operation policies, to reflect the lack of biological constraints.

This simulation is not restricted by any flow constraints except for a minimum flow rate of 800 cfs. This analysis reflects the increased operational flexibility, yielding more water being released during the summer months, when power prices are highest. With constraints removed, the economic value of the output over a 25-year simulation is greater, compared to the No Action and Action Alternatives.

The 25-year simulation of operations with few biological constraints shows that the economic value of the generation from Flaming Gorge powerplant would be greater than under the two alternatives with only slightly greater generation. This greater economic value would occur due to the lack of restraints on operation of the reservoir. This difference in economic value represents a simulation of changes since 1973. It does not reflect actual differences as the model made no attempt to calculate actual economic value for the hypothetical scenario since 1973, but used the forecasted model from the two alternatives as the basis for this simulation. Actual prices or generation (under the alternatives) since 1973 are not known or used. If actual prices from 1974 to 2000 time period had been used, the economic value for the hydropower cumulative impact may have been substantially less.

Table 4-30 provides the results. The data in the No Action and Action Alternatives columns are the same data shown previously in this chapter and presented for comparison purposes. The next column represents the summary of results from the "cumulative impacts" run. As shown, the cumulative impacts run simulates almost 29% more economic value compared to the No Action Alternative, with a $521.4-million output of power. This larger economic value occurs with only 2.7% increase in generation, due to the ability to simulate generation when prices are highest. In effect, the generators are run with almost no constraints other than to follow demand for electricity in the marketplace.

While the economic analysis is based on the benefits accrued to the Nation as a whole and the financial analysis refers to the cost of the power sold to customers of SCLA/IP, there is similarity in the results of the two analyses. The economic analysis shows that the value of the generation of electricity for the Action Alternative is greater than the value of the No Action Alternative by a small percentage based on the simulations. Similarly, the financial analysis shows a reduced cost to the customers of this power under the Action Alternative, reflecting this increased economic value that the customers would receive. Because of the increased economic value of the generation, the customers would receive higher valued power under the Action Alternative, requiring Western's purchases of electricity in the out years to be lower valued electricity, on average.

The fewer the constraints on the operation of the hydropower plant at Flaming Gorge Reservoir, the more likely that the market purchases of electricity by Western for the customers will be lower cost electricity.

4.16.3 Land Use

When considering the Action Alternative in conjunction with past, present, and reasonably foreseeable actions, there are no unacceptable cumulative effects for land use around the reservoir and along the Green River.

Table 4-30.—Comparisons of the Alternatives and a Cumulative Impact Simulation

	No Action Alternative	Action Alternative	Cumulative Impacts	Comparison of Cumulative Impacts to No Action Alternative
Net Present Value	$403.1 million	$423.1 million	$521.4 million	-29.3%
Generation in GWh	11,904.1	11,374.3	12,229.7	2.7%

4.16.4 Ecological Resources

4.16.4.1 Native Fish

Impacts to the native fish in the Green River Basin come in many forms and were present long before the Colorado pikeminnow was recognized as an endangered species some 35 years ago. To assess the cumulative effects (both negative and positive) associated with these impacts, it is necessary to consider historical, present, and reasonably foreseeable projects and actions. For the purposes of this cumulative analysis, impacts have been described in six general categories (flow depletions, loss/entrainment of fish at diversions structures, water quality, loss or fragmentation of habitat, Flaming Gorge Dam operations, and interactions with nonnative species). The cumulative effect of these impacts through time and into the reasonably foreseeable future are discussed below and summarized in table 4-31.

4.16.4.1.1 Flow Depletions – The U.S. Fish and Wildlife Service has recognized, in multiple biological opinions, that flow diversions and depletions have affected the Colorado River fishes and contributed to the original listing of the four endangered species. Flow depletions affect the ability of the river to create and maintain habitat.

Reductions in peak flows can also affect the behavior of fish that key in on rising flows to spawn during that time of the year. Through State and Federal laws, the Upper Basin States are entitled to develop 7.5 million acre-feet of Colorado River flows, and water development will no doubt continue. Historic and reasonably foreseeable future depletions have been summarized in table 4-31. The most profound effects of these depletions have occurred in the Duchesne River and some of the other tributaries to the Green River.

In 1987, the Recovery Program was established and since has served as the major offset for the impacts of historic and future water development projects in the Upper Colorado River Basin.

One of the specific objectives of the Recovery Program Green River Action Plan is the re-operation of Flaming Gorge Dam to provide flows needed for endangered fish recovery. The Recovery Program has also developed flow recommendations for the Yampa and the Duchesne Rivers, and is in the process of developing recommendations for the White and Price Rivers. Implementation of the Yampa River flow recommendations is underway as the U.S. Fish and Wildlife Service and the States of Colorado and Wyoming complete environmental compliance of their *Management Plan for Endangered Fishes in the Yampa River Basin*.

The Recovery Program will seek to secure, enhance, and protect recommended flows on many of the Green River tributaries.

In summary, flow depletions can have a significant cumulative effect on Colorado River fish populations. Re-operation of Flaming Gorge Dam is expected to contribute to other Recovery Program activities in supporting the recovery of the four endangered fish species.

Table 4-31.—Cumulative Impacts on Native Fish (Including Threatened and Endangered Species)[1]

Impact Category	Past	Present	Proposed Action	Reasonably Foreseeable	Cumulative
Flow Depletions[2]		(--)		(---)	(---)
Yampa[3]		125,271acre-feet per 10.9%		53,562 acre-feet additional; 178,833 acre-feet per 15.5% total	(-)
Duchesne[4]		567,000 acre-feet per 73.8%		25,300 acre-feet additional; 592,000 acre-feet per 77.1.% total	(---)
White[5, 6]		131,456 acre-feet per 22%		Unknown; 22% total	(-)
San Rafael[5, 7]		89,000 acre-feet per 44.5%		Unknown; 44.5% total	(--)
Price[8]		82,412 acre-feet per 52.4%		5,717 acre-feet additional; 88,219 acre-feet per 56% total	(--)
Green Reach 1[5]		372,331 acre-feet per 19.7%		42,100 acre-feet	(-)
Green Reach 2[9]		497,602 acre-feet		95,662 acre-feet (Reach 1 and Yampa)	(-)
Green Reach 3[5]		1,583,960 acre-feet per 32%		126,679 acre-feet (Yampa, Reach 1, Duchesne, and Price)	(-)
Loss of entrainment of native fish at diversions structures	(-)	(-)	(+)	(+)	(+)
Water Quality	(-)	(-)	(+)	(+)	(+)
Habitat Loss					
Diversions/Dams	(--)	(+)	(+)	(+)	(+)
Flood Plain Diking	(--)	(-)	(+)	(+)	(+)
Flaming Gorge Operations	(---)	(+)	(++)	(+)	(++)
Nonnative Species	(---)	(---)	(-,+)	(+)	(--)

[1] Negative effects to native fish are represented as follows: (-) relatively minor, (--) moderate, (---) strongly negative. Positive effects are presented in a similar format.

[2] Presented as average annual depletions in acre-feet per % of average annual natural flow–periods of record vary by basin.

[3] *Draft Management Plan for the Endangered Fishes in the Yampa River Basin.*

[4] Depletion estimates from Final Biological Opinion, Duchesne River Basin, Utah (6-UT-97-F-007), July 29, 1998. Average annual pre-depletions flow (768,000 acre-feet) reported in *Flow Recommendations for the Duchesne River with a Synopsis of Information Regarding Endangered Fish* (Modde and Keleher, 2003).

[5] Depletion estimates from Final Biological Opinion on the Operation of Flaming Gorge Dam, November 25, 1992.

[6] Average annual flow from Schmidt et al., 2002 Draft Report.

[7] Average annual flow from Price-San Rafael Rivers Unit, Utah; *Planning Report/Final Environmental Impact Statement*, December 1993.

[8] Biological Opinion for the Proposed Narrows Project – A Small Reclamation Project Act Loan, August 24, 2000.

[9] Represents the sum of the depletion figures used for Reach 1(Green River above Flaming Gorge Dam) and the Yampa River.

4.16.4.1.2 Entrainment/Loss of Native Fish at Diversion Structures – An unknown number of native fish has been entrained at irrigation diversions throughout the Upper Colorado River system for many years. Although this impact poses less of a threat to the fishes in the Green River than those in other parts of the Colorado River system where diversions are more plentiful, the threat remains. The Recovery Program has constructed screens on diversion structures in parts of the Colorado River Basin and has recently decided to screen the Tusher Wash diversion on the Green River in Reach 3. Tusher Wash, which diverts between 600-700 cfs, likely poses the greatest threat for native fish entrainment in the Green River Basin. In addition, the higher base flow targets associated with the Action Alternative would result in a smaller percentage of the Green River being diverted at Tusher Wash. If Tusher Wash is screened and the 2000 Flow and Temperature Recommendations are implemented, this threat to the native fish of the Green River system will have been removed.

4.16.4.1.3 Water Quality – Water quality in the Colorado River watershed, particularly in tributaries, has been degraded as a result of human uses and depletions. To address this threat to both humans and biological communities, salinity control efforts (Colorado River Water Quality Improvement Program) and selenium remediation programs (National Irrigation Water Quality Program) have been implemented to improve water quality in the Green River and the Colorado River system as a whole. In addition, higher base flows requested under the Action Alternative during most years would improve water quality in Reaches 2 and 3. The degree to which these efforts would result in water quality improvement, in light of ongoing depletions, remains to be seen.

4.16.4.1.4 Habitat Loss – The loss of aquatic habitat, due to river regulation, comes in many forms, including barriers to migration, construction of levees and dikes, thermal modification, and the inundation of riverine habitat during reservoir filling. The completion of Flaming Gorge Reservoir inundated over 90 miles of the Green River. The majority of that distance was occupied by native fish. Cold, hypolimnetic (bottom) releases from the dam subsequently rendered 65 miles of river downstream unsuitable for native fish. Similar types of habitat loss (on a smaller scale) have occurred on the White and Duchesne Rivers. Penstock modifications at Flaming Gorge Dam and temperature release recommendations implemented as a result of the 1992 Biological Opinion have improved conditions in Reach 1. It is likely that implementation of the 2000 Flow and Temperature Recommendations would substantially improve conditions for native fish in that portion of the river.

The Recovery Program, Utah Reclamation Mitigation and Conservation Commission, and local water user groups are currently investigating the benefits of providing fish passage at some of the smaller, low head diversion structures on the Duchesne River and other tributaries. Since native fish have been eliminated from many miles of historic habitat throughout the Green River Basin, efforts are being made to address the threat of continued habitat loss.

Aquatic habitat loss often stems from manipulations of streamside habitats (diking levee construction) that were altered to prevent lowland flooding of agricultural and livestock grazing lands. Flooded bottomlands provide important habitats for the native fish. Near Ouray, Utah, in excess of 2,500 acres of flood plain have been disconnected from the Green River when flows are less than 18,000 cfs. Another more natural form of diking, which is more prevalent in the lower Green River, is caused by the encroachment of nonnative vegetation (tamarisk). During the past 10 years, the Recovery Program has successfully acquired riverside properties, removed levees, and, as a result, restored portions of this important rearing habitat for native fish. The Recovery Program is planning similar efforts to secure and protect more of these flood plain areas. The spring peak flow and duration targets in the 2000 Flow and Temperature Recommendations are designed to create longer periods of flood plain inundation. Proposed Recovery Program efforts and implementation of the Action Alternative would further restore flood plain connectivity, reversing, to some degree, the loss of this crucial habitat. However, a confounding aspect of flood plain restoration is that nonnative species can also benefit; therefore, it is recommended that the cumulative effects of these efforts be monitored.

4.16.4.1.5 Flaming Gorge Dam Operations – Historical operations at Flaming Gorge Dam greatly impacted native fish by reducing and, in some years, eliminating spring peaks' elevating base flows and altering the temperature regime of the Green River. The 1992 Biological Opinion restored a more natural hydrograph through spring, summer, and fall and partially restored water temperatures to their pre-dam state. Implementing the Action Alternative would take the 1992 Biological Opinion a step further by prescribing year-round flows for the entire river and manipulating temperatures throughout a larger reach of the river. Although there are uncertainties associated with the Action Alternative, as there are with any large system experiment, the expected outcome is an increased benefit to native fish populations. Flaming Gorge Dam operations have been greatly improved over the course of the past 40 years.

4.16.4.2 Nonnative Fish

The 2000 Flow and Temperature Recommendations reported that introductions of 25 species of nonnative fish in the Green River Basin seriously impacted native fish. In recent years, the States of Colorado and Utah have adopted the Nonnative Fish Stocking Procedures, which were developed by the Recovery Program to eliminate introductions of additional nonnative species. Unfortunately, recent data show that the range and abundance of nonnative species in the system have expanded during the drought that is currently being experienced in the Western States. To address this threat, the Recovery Program has conducted studies to identify effective methodologies to control invasive fish species. Recovery Program efforts are currently underway to determine if some of the more problematic species can be effectively controlled in portions of the Green River Basin. The 2000 Flow and Temperature Recommendations are intended to benefit native fish; however, certain aspects may actually benefit nonnatives in the short term. At the present time and in the reasonably foreseeable future, nonnative fish pose a critical threat to the native fish and, as such, are a primary concern for the Recovery Program.

4.16.4.2.1 Trout – Construction of Flaming Gorge Dam created Flaming Gorge Reservoir which has become famous for its fishing opportunities. The clear, cool, deep water produces populations of large lake trout, brown trout, and rainbow trout. The reservoir also supports populations of cutthroat trout, kokanee salmon, smallmouth bass, and channel catfish.

The Green River below the dam is famous for trout fishing. The clear, cold tailwater releases provide excellent conditions for trout. Implementation of the 2000 Flow and Temperature Recommendations would likely improve conditions for this trout fishery by reducing daily flow fluctuations. Reducing flow fluctuations would reduce energy expenditures for these fish, thus reducing stress levels.

4.16.4.2.2 Summary of Cumulative Impacts to Fish – The Green River ecosystem has been and continues to be greatly altered. Long-term monitoring indicates that populations of Colorado pikeminnow and humpback chub in the Green River are relatively stable. Wild populations of razorback sucker and bonytail have been functionally extirpated. Hatchery-produced fish are surviving in the river and will hopefully respond to recovery actions. The

Action Alternative represents an effort to benefit native fish species. The Recovery Program and others are trying to address threats to the endangered fish on a variety of fronts. Whether future implementation of the Action Alternative and the other recovery efforts of the Recovery Program and others are sufficient to lead to the eventual recovery of these species remains an uncertainty. Specific uncertainties associated with implementation of the Action Alternative are identified in section 4.19 and will be monitored through an adaptive management approach.

4.16.4.3 Vegetation

4.16.4.3.1 Riparian/Wetland – Historical impacts and changes to riparian and wetland systems in the Colorado Plateau have been ongoing for many years. Grazing and streamflow depletion and regulation have been the major activities affecting riparian and wetland systems. With closure of Flaming Gorge Dam, the riparian community along the Green River began to change in character, with decreases in cottonwood regeneration especially notable. Water depletions in the Uinta Basin have led to reductions in size and quality of riparian and wetland areas. In addition, changes in hydrology and lowered water tables have encouraged the expansion of nonnative species that are more tolerant of altered, drier environments. With additional depletions planned for most streams in the region, the downward trend in quantity and quality of riparian and wetland systems is likely to continue. Under the Action Alternative, implementation of the recommended flows could result in small, positive changes for riparian and wetland areas and, therefore, would not contribute to a cumulative effect.

Tamarisk began to invade the lower Green River in the 1920s and continued to spread upstream before river regulation. This invasion is expected to continue throughout the region. Implementation of the Action Alternative may contribute to the spread of tamarisk in the higher flood plain areas and result in a cumulative effect. Giant whitetop seeds could also be expected to spread under the Action Alternative and contribute to a cumulative effect. It is unlikely that there would be a cumulative effect associated with Russian olive and the Action Alternative.

4.16.4.4 Terrestrial Wildlife

Present and future actions that alter stream channel and flow characteristics have and will continue to have negative impacts on the riparian habitat of terrestrial and avian species that depend on these areas. Although it is unlikely that re-operation of Flaming Gorge Dam will completely compensate for the effects of all future and past water projects, the implementation of the 2000 Flow and Temperature Recommendations will likely prove to be beneficial to wildlife species that use riparian, wetland, flood plain, and riverine habitats.

4.16.4.5 Other Threatened and Endangered Species

4.16.4.5.1 Southwestern Willow Flycatcher – Implementation of the Action Alternative would not contribute to a cumulative effect for southwestern willow flycatcher. Regional cumulative effects are largely those associated with loss of riparian habitat. As stated above, historical water depletions and regulation along the tributaries to the Green and Colorado Rivers have led to a substantial decrease in the amount and quality of native riparian habitat. Because southwestern willow flycatchers are dependent on riparian corridors to fulfill a significant portion of their lifecycle, the loss of streamside vegetation had adversely affected these populations in the Colorado River watershed. Proposed increases in oil and gas drilling may also contribute to a decrease in suitable habitat. At present, suitable habitat is not seen as a limiting factor for southwestern willow flycatcher on the Green River. As recovery of the species occurs and populations rebound, increasing the amount of suitable habitat may become increasingly important.

4.16.4.5.2 Ute Ladies'-Tresses – Historical impacts to Ute ladies'-tresses sites in the Uinta Basin and Colorado Plateau have largely stemmed from agricultural activities. Water depletions in the region have resulted in, and are likely to continue to result in, reductions in size and quality of riparian wetlands, upon which Ute ladies' -tresses depends. Additionally, continued water depletions have decreased water tables causing a reduction in the amount of riparian areas, allowing more drought tolerant and upland vegetation communities to dominate. Floodflows, as well, have been reduced on some Green River tributaries, thereby limiting the resetting of vegetation succession—a component needed for establishment of Ute ladies'-tresses. Flow alteration projects, such as that proposed in the Action Alternative for the re-operation of Flaming Gorge Dam, provide stable summer flows and have likely contributed to the persistence of Ute ladies'-tresses at some sites. Under pre-dam conditions, colonies likely winked in and out of existence over long time periods as rivers migrated back and forth throughout their flood plains.

The U.S. Army Corp of Engineers' proposed restoration of Ashley Creek in the Uinta Basin may have a temporary negative effect on Ute ladies'-tresses. The draft Ute ladies' tresses recovery plan is supportive of a restoration project and states that loss of any single Ute ladies'-tresses colony or group of colonies is acceptable if the ecosystem is benefited as a result of the action. In summary, the proposed Action Alternative, combined with continued regional impacts, may result in a cumulative effect to Ute ladies'-tresses.

4.16.4.6 Special Status Species

4.16.4.6.1 Yellow-Billed Cuckoo – Long-term and regional cumulative effects to yellow-billed cuckoo are largely those associated with the loss of riparian habitat. As stated in chapter 3, historical water depletions, water regulation, and livestock grazing along the tributaries to the Green and Yampa Rivers have led to a substantial decrease in the amount and quality of riparian habitat, especially cottonwood forests. Little cottonwood regeneration occurs on most tributaries in the region. Grazing has altered otherwise suitable habitat through the loss of or reduction in the thick shrub understory that characterizes suitable habitat for nesting yellow-billed cuckoo. With additional depletions planned for most streams in the region, the downward trend in quantity and quality of riparian and wetland systems is likely to continue.

Under the Action Alternative, positive benefits to riparian vegetation in Reach 2 and the upper portion of Reach 3 may provide a small reprieve in the rate of cottonwood forest decline in the region. The lower portion of Reach 3 would continue to decline in quality and quantity of suitable habitat. The results would likely be a cumulative effect for this section of the river.

4.16.5 Cultural Resources

To accurately assess cumulative effects, Reclamation has evaluated its operation of Flaming Gorge Dam over time and under the Action Alternative, combined with long-term actions and plans issued by other land managing agencies. Baseline conditions of cultural resources in 1984 and 1994 were addressed in two management plans issued by the BLM*: The Final EIS on the Book Cliffs Resource Management Plan*, issued in November 1984, and the *Diamond Mountain Resource Area Resource Management Plan and Record of Decision*, 1994.

4.16.5.1 Flaming Gorge Reservoir

Cultural resource sites located within the normal range of fluctuation were already impacted by inundation from Flaming Gorge Reservoir and will not be subjected to a new or different change in impacts due to Flaming Gorge Dam operation under the Action Alternative. The surrounding greater Flaming Gorge Reservoir area may receive more visitors in the future. This has the potential to cause more unintentional and/or intentional alterations to sites; however, as the land management agency at Flaming Gorge Reservoir, the USDA Forest Service has responsibility for the protection of cultural resources. There are no effects from the proposed action that would affect visitation or visitor impacts. No past, present, or reasonably foreseeable actions are expected to result in cumulative impacts to sites located in and around Flaming Gorge Reservoir. Thus, there would be no cumulative effects to cultural resources from the Action Alternative.

4.16.5.2 Reaches 1 and 2

Inundation from the highest historical release from Flaming Gorge Dam defines the past impact to cultural resources from dam operations. The highest historical release from Flaming Gorge Dam was 12,300 cfs in July 1983, which defined the largest area affected along Reaches 1 and 2 in the past 37 years since Flaming Gorge Reservoir filled. Based on the hydrology modeling results presented in chapter 4, under the Action Alternative, statistically there is a 6% chance of exceeding the 12,300-cfs high release over the next 100 years in Reach 1; less of a chance for exceeding the 12,300-cfs threshold exists in Reach 2. In other words, there is a chance of exceeding the highest historical release for at least 1 day six times over the next 100 years. Therefore, there is very little chance of a cumulative impact of the Action Alternative resulting in additional impacts to cultural resources in Reaches 1 and 2.

4.16.5.3 Reach 3

Cumulative effects in Reach 3 from either the No Action or the Action Alternative will be negligible since the area in which it is located is so far removed from Flaming Gorge Reservoir. Cultural resources in parts of this reach have been analyzed by the BLM in the 1984 and 1994 reports previously mentioned in this section. Measures proposed by the BLM for the Green River corridor addressed in these two documents would be beneficial in the long term for cultural resources.

4.16.6 Paleontological Resources

According to the sensitivity assessment maps produced for this project (DeBlieux et al., 2002), the Flaming Gorge Reservoir pool area has the most sensitive paleontological areas within the Action Alternative area for this project. Paleontological sites exposed along the shoreline of the reservoir will not be exposed to cumulative impacts which are accelerated beyond what has occurred for the past 37 years. The most precarious situation for paleontological resources exposed by fluctuating water levels in the reasonably foreseeable future may be the exposure to unintentional and intentional vandalism from visitation. In the future, occasional surveys of the shoreline around Flaming Gorge Reservoir are planned by the Ashley National Forest. Such surveys may locate significant sites which would add valuable knowledge to what is presently known about paleontology in the Flaming Gorge Dam region.

4.16.7 Indian Trust Assets

The development and operation of oil and gas wells associated with tribal mineral rights, which have also been identified as Indian trust assets, are expected to continue. No present or reasonably foreseeable actions are expected to result in adverse cumulative impacts to Indian trust assets. Thus, there would be no adverse cumulative impacts to Indian trust assets from implementation of the Action Alternative.

4.16.8 Recreation

The BLM (Vernal Office) and USDA Forest Service (Ashley National Forest) have initiated several resource and river management plans along the Green River over the past 25 years. All of these efforts appear to have had either a negligible or positive effect on water-based recreation on or along the river. None of the plans appear to have impacted recreation at Flaming Gorge Reservoir in any significant way. As a result, the cumulative effects of the Action Alternative, in conjunction with these past actions appears insignificant. In addition, the only current action other than the Action Alternative that is likely to significantly affect water-based recreation within the Flaming Gorge National Recreation Area is the proposed relocation of the Little Hole National Recreation Trail along the Green River immediately downstream from Flaming Gorge Dam. The recreation analysis found in this report assumes the trail will be relocated, thereby reducing river access problems during high water conditions. As a result, the recreation analysis already reflects cumulative effects of both the Action Alternative and the proposed relocation of the recreation trail. Actual relocation of this trail is dependent on adequate funding to the Ashley National Forest through the USDA Forest Service budgeting process. In addition, the Ashley National Forest, USDA Forest Service unit charged with managing recreation activities within Flaming Gorge National Recreation Area, will be revising its Land and Resource Management Plan in the near future. Given recreation is one of the primary objectives of a national recreation area, it is assumed that the management plan revision will likely result in improved conditions for recreation, including water-based recreation.

4.16.9 Socioeconomics

The small town of Dutch John, Utah, originally developed as a staging area during the construction of Flaming Gorge Dam, has recently been the focus of a legislative exchange between Reclamation, USDA Forest Service, and Daggett County, whereby most land, infrastructure, and utilities were transferred from the two U.S. Government agencies to Daggett County. Daggett County now has the responsibility of administering the majority of Dutch John. The county is presently developing a planning process for Dutch John, with the overall goal of making the community self-sufficient in terms of economic opportunities for its residents as well as generating the necessary tax base for maintenance of public facilities. Since the town is completely surrounded by Flaming Gorge National Recreation Area, it is assumed that the majority of economic development will cater to tourist activities. Furthermore, on average, the Action Alternative is expected to result in increased recreation visitation and expenditures compared to the No Action Alternative on both the river and reservoir. It is therefore likely that the Action Alternative and the legislative exchange of Dutch John could result in increases in regional economic activity. During wet and dry conditions, while the overall result in terms of recreation expenditures is positive, it is not possible to determine whether the gains on the reservoir would outweigh the losses on the river from the perspective of Dutch John.

4.16.10 Public Safety

4.16.10.1 Vectors

The principle health concern related to this action and past, present, or reasonably foreseeable actions in the Green River Basin is the establishment of West Nile virus, a neurological pathogen that, in severe cases, can cause encephalitis or meningitis in humans. Discovered in Africa and the

Middle East in the 1930s, West Nile virus was first reported in the United States in 1999. The virus is being spread primarily by blackbirds from the east coast of the United States to the west coast and is creating, and will likely continue to create, a major public health concern. It is possible that mosquitoes and other vectors are already present in the United States, which may transmit other diseases to animals and people. It is not expected that the Action Alternative would have a significant increase in the mosquito population, which could, in turn, lead to an increase risk of exposure to West Nile virus.

4.16.11 Environmental Justice

No present or reasonably foreseeable actions have been identified that would significantly impact minorities or the income levels of populations around or downstream from Flaming Gorge Dam and Reservoir. Implementation of the Action Alternative would not create any cumulative effects to minority and low-income populations. Thus, there would be no cumulative impacts to environmental justice from implementation of the Action Alternative.

4.17 RELATIONSHIP BETWEEN SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

Operating Flaming Gorge Dam under the Action Alternative would generally result in higher spring peak flows, for longer periods of time, than operating the dam under the No Action Alternative. During periods of high flow on the river, recreational use of the river corridor might be precluded for periods of 1 day to several weeks. Long-term productivity of the river corridor would be enhanced under the Action Alternative for the endangered fish species as well as for nonnative fish and riparian vegetation and habitat.

4.18 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Water released from the dam through the bypass tubes or spillway to meet the recommended spring peak flows under the Action Alternative would constitute an irreversible and irretrievable loss of that water for electrical generation.

4.19 UNCERTAINTIES

The analyses presented in this EIS identify impacts to resources based on the best available data. Uncertainties regarding both Reclamation's ability to meet flow and water temperature targets specified for the Action Alternative and the potential effects of meeting those flow and temperature targets are identified throughout the EIS. This section summarizes the uncertainties associated with implementing the Action Alternative. Section 4.20, below, sets forth an adaptive management process for addressing these uncertainties under future operations.

The authors of the 2000 Flow and Temperature Recommendations recognized uncertainties in their general approach and specific recommendations (2000 Flow and Temperature Recommendations). Their recommendations are based on a model that the ecological integrity of river ecosystems is linked to their dynamic character (Stanford et al., 1996; Poff et al., 1997) and that restoring more natural flow and thermal regimes is a key element to rehabilitating an impaired system. They recognized, however, that the response of the endangered fishes of the Green River to a more natural flow regime and water temperatures remains largely unmeasured and that factors other than modifications to physical habitat are impacting these species.

4.19.1 Hydrology

There are many uncertainties associated with the Flaming Gorge Model that were dealt with through modeling assumptions. This section details the assumptions inherent to the Flaming Gorge Model that are, in reality, uncertainties that cannot be fully characterized.

There was an inherent assumption in the Flaming Gorge Model that it would be possible to select the most ideal candidate years for achieving the high level spring flow recommendations in Reach 2. The Flaming Gorge Model used post processed information for making these decisions. In reality, making the decision of which years to attempt to achieve the higher level spring flow recommendations will be difficult. In general, the Flaming Gorge Model was optimized so that the high level objectives were targeted only when the most ideal Yampa River runoff patterns occurred. Basin indicators such as snow levels, temperature, and climate will be useful for making the yearly decision in the future; however, it is uncertain how accurately these decisions will be made when under real time operation.

During the spring peak release under the Action Alternative, it would be necessary to match the flows of the Yampa River optimally to achieve specific targets in Reach 2 of the Green River. The Flaming Gorge Model had an inherent assumption that daily average releases could be managed to achieve targets in Reach 2 to within 300 cfs. It is uncertain that this level of precision can be obtained under normal springtime operations.

The Flaming Gorge Model assumed that water development in the Upper Green River Basin and the Yampa River Basin would continue at the rate projected by the Upper Colorado River Commission. The Flaming Gorge Model achieved the flow objectives of the 2000 Flow and Temperature Recommendations independent of the level of future water development in the Yampa River Basin. Under the Action Alternative, as development in this basin increases, the releases required to meet the flow objectives increase. It is uncertain what resource impacts would occur as a result of future water development in the Green River Basin above and below Flaming Gorge Reservoir.

The analysis of Reach 3 flows, presented in this EIS, was an aggregation of the predicted Reach 1 flows from the Flaming Gorge Model and the estimated historic inflow from all tributaries on the Green River. In the future, water development in these tributaries will be at a higher level than in the past. It is uncertain that achieving the flow objectives for Reach 2 will provide flows high enough to achieve the flow objectives for Reach 3 in the future as shown in this EIS.

The Flaming Gorge Model inherently assumed that releases from Flaming Gorge Dam could be made from the powerplant, bypass tubes, and spillway at all times during the model run. While it is unlikely that these water release methods would not be available under real time operations, it is a possibility which could impact how Flaming Gorge Dam would be operated under the Action Alternative. There is a remote possibility that under real time operations, Flaming Gorge Dam could have a physical restriction that might prevent enough water from being released to achieve the 2000 Flow and Temperature Recommendations objectives. The Flaming Gorge Model did not account for this remote possibility.

4.19.2 Operational Limitations for Temperature of Water Released From the Dam

Reservoir modeling using CEQUAL-W2 shows that desired reservoir water temperatures for endangered fish are available for release when needed through the Flaming Gorge Dam selective withdrawal structure. Because release water is used to cool turbine bearings, temperature limitations associated with the turbine bearings may at times limit the ability to release warmer water. Recent (2002) changes in lubricants used to cool the bearings and maintenance of screens through which these waters pass have allowed warmer water to be released from the dam. An additional increment of warming might be gained by adjusting the temperature levels at which alarms are tripped in the powerplant without compromising dam operations. (Vermeyen). How much additional increase in release temperatures can be realized would have to be determined through testing at Flaming Gorge Dam.

4.19.3 Uncertainties Associated With Increased Spillway Use

Under the Action Alternative, with increased spillway use, there is greater opportunity for degradation of concrete in the spillway. The potential magnitude of this degradation is difficult to quantify. Reclamation would inspect the spillway following each period of use and evaluate the need for repairs. If damage to the spillway were to become excessive in operations under the Action Alternative, repairs would be made or, if necessary, usage would be limited to hydrologically necessary operations.

Nitrogen saturation within the tailwater area is a phenomenon that has occurred during spillway use at other dams and could occur at Flaming Gorge Dam. The potential for nitrogen saturation to affect the trout fishery would need to be assessed. Reclamation would consult with the UDWR to ascertain whether monitoring, as part of their ongoing management of the trout fishery, would provide the necessary information to identify any potential problems.

4.19.4 Fish Responses to Flow and Temperature Modifications

Reclamation would coordinate with the Recovery Program in developing the appropriate studies through an adaptive management process to evaluate effects of increased release temperatures on the downstream fish community. Section 4.7 of this EIS discussed the uncertainty as to how the fish community, in particular the nonnative fish community, would respond to the proposed changes in Flaming Gorge Dam operations. The proposed 2000 Flow and Temperature Recommendations in the Action Alternative would benefit both native species and nonnative species. It is possible that releases of warmer water could result in the expansion of cool water nonnatives in Reach 1, an area where their current populations are comparatively low; and warm water nonnative species could benefit from the increased warm water flood plain habitats that will result from increased overbank flooding. The authors of the 2000 Flow and Temperature Recommendations recommended to the Recovery Program that continued monitoring of these uncertainties, including the response of the endangered species to their proposed flow and temperature recommendations, would be required. Reclamation agrees that future monitoring through the Recovery Program would be appropriate if the Action Alternative is implemented. Nonnative fish control, which presently is being undertaken by the Recovery Program, would also be an important future component if nonnative fish species benefit from the proposed 2000 Flow and Temperature Recommendations.

Nonnative fish colonization of flood plain depressions inundated through the Action Alternative may interfere with survival of endangered fish in those habitats.

Christopherson and Birchell (2004) documented survival of both razorback sucker and bonytail larvae in a flood plain depression in the presence of nonnative fish. The study simulated conditions in a "reset" flood plain whereby both native and nonnative fish are entrained into a previously dry depression. Valdez and Nelson (2004) identified interactions with nonnative fish as an uncertainty in the success of flood plain management and advocated periodic desiccation of key flood plain depressions to alleviate those interactions. Reclamation would thus coordinate with the Recovery Program in developing the appropriate studies and actions through an adaptive management process to address management of nonnative fish in flood plain depressions.

The 2000 Flow and Temperature Recommendations also recognized uncertainty with their base flow recommendations. They felt relatively confident with the general relationship between the spring peaks and the necessary base flows to maximize nursery habitats, but they understood that base flows could vary from year to year as a function of variation in tributary inputs. They also mentioned that the effects of within-day fluctuations on nursery habitat conditions warranted further investigation. The Recovery Program and Western are currently funding research to better understand these relationships.

An uncertainty that arose during the development of this EIS was the extent to which operations under the Action Alternative, specifically the increased frequency of bypassing water, would result in increased entrainment of reservoir nonnative species. If the Action Alternative is implemented, Reclamation believes that future monitoring through the Recovery Program would be appropriate. The 2000 Flow and Temperature Recommendations, including monitoring their effects on the fish community in Reach 1 would be evaluated. This Reach 1 monitoring should include specific efforts to evaluate the potential for establishing undesirable reservoir fishes, such as smallmouth bass, in the tailwater. Nonnative fish control, which presently is being undertaken by the Recovery Program, would also be an important future component in determining the extent to which nonnative fish species benefit from the proposed flow and temperature recommendations.

Regarding temperature preferences for Colorado pikeminnow, temperature modeling indicates that, during wet years, releasing 59 ºF (15 ºC) water at Flaming Gorge Dam will result in barely meeting the minimum threshold of 64.5 ºF (18.0 ºC) in Upper Lodore Canyon (table 4-3). Furthermore, an analysis of accumulated thermal units (figure 4-15), as derived from Green River temperature modeling, indicates the river may not warm enough during wet years to provide suitable conditions for year-round Colorado pikeminnow use. If warmer water could be released at the dam during wet years, the Green River would approach the threshold of 24 ATUs (July/August timeframe) in a greater number of years. Attaining this threshold potentially could improve Colorado pikeminnow survivorship due to higher growth rates and larger size of the fish.

Reclamation personnel consulted with the authors of the 2000 Flow and Temperature Recommendations for some clarification on why they identified "releasing up to 59 ºF (15 ºC) at the dam" to meet their temperature recommendation. The authors stated that their intent was to get as much warming in Lodore Canyon as possible without harming the trout fishery. They wrote the document with the understanding that 59 ºF (15 ºC) water was all that was available at the dam, which represented the best available information at that time. Recent reservoir temperature modeling indicates that warmer water is available in Flaming Gorge Reservoir (section 3.3.2) and can be released through the selective withdrawal structure. An analysis of releasing 61 ºF (16 ºC) water indicates that conditions for adult Colorado

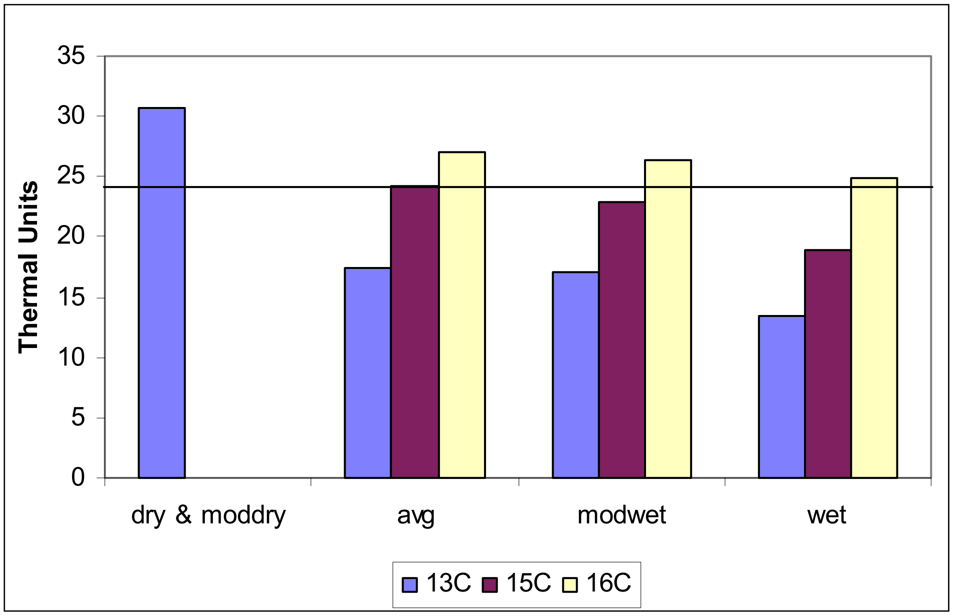

Figure 4-15.—Thermal Units Accumulated in Upper Lodore Canyon (46 Miles Below Flaming Gorge Dam) Under Various Hydrologic Scenarios. Hydrologic categories: dry and moderately dry (moddry) = 800 cfs; average (average) = 1,400 cfs; moderately wet (modwet) = 2,000 cfs; and wet = 2,400 cfs. Average daily temperatures used to derive ATUs were excerpted from the Flaming Gorge Temperature Model (Dr. John Carron, Hydrosphere Resource Consultants). A horizontal line was drawn at 24 ATUs, which is used to represent a threshold value that characterizes suitable Colorado pikeminnow home range. There are no values for 15 °C (or 16 °C) during the dry and moderately dry years, which is consistent with the Action Alternative as described.

pikeminnow could be improved in Lodore Canyon during wetter years (figure 4-12). This release temperature has not been included in the Action Alternative because it exceeds what was specified the 2000 Flow and Temperature Recommendations. However, subsequent communication from the authors of the 2000 Flow and Temperature Recommendations indicates they likely would have recommended a higher release temperature if they had known it was possible to do so. The 61 ºF (16 ºC) release temperature analysis is discussed here to illustrate the potential added benefit of exceeding the 59 ºF (15 ºC) release temperature identified in the Action Alternative.

4.19.5 Uncertainties Associated With Flood Plain Inundation

Peak flows recommended for Reach 2 were intended to provide inundation of flood plain nursery habitats in wetter years and to promote access to those flood plains by newly hatched razorback sucker larvae drifting from upstream spawning areas. Specific frequencies of flood plain connection to the main channel were recommended to ensure that razorback sucker juveniles overwintering in flood plains were allowed an opportunity to return to the main channel in subsequent years.

The 2000 Flow and Temperature Recommendations recommended that peak flows in Reach 2 should have the magnitude, timing, and duration that would provide flood plain inundation for at least 2 weeks in 40% of all years. Under average hydrologic conditions, the recommendations call for instantaneous peak flows ≥18,600 cfs in 50% of average years and peak flows ≥18,600 cfs for at least 2 weeks in 25% of average years. In moderately wet years, the recommendations call for flows ≥18,600 cfs for 2 weeks or more. In wet years, it was recommended that flows ≥22,700 cfs be maintained for 2 weeks or more and that flows ≥18,600 cfs be maintained for at least 4 weeks. The 2000 Flow and Temperature Recommendations also state that the duration of peak flows <18,600 cfs should be limited, because the area of flood plain habitats was greatly increased at flows above this level on the basis of aerial photographs, flood plain elevations, and site reconnaissance (Irving and Burdick, 1995; Irving and Day, 1996; Bell [undated]; Bell et al., 1998; Cluer and Hammack, 1999). These studies identified potentially inundated areas but did not determine direct surface connection with the main channel.

In general, most drifting larvae are present over a period of approximately 2 weeks (2000 Flow and Temperature Recommendations). Because larvae will likely starve within days (Popoulias and Minckley (1990, 1992) if they are not entrained into suitable nursery habitats, it is imperative that these habitats are connected to the river when larvae are drifting. This 2-week period of drift is the basis of the recommendation that flows of at least 18,600 cfs be maintained for a period of 2 weeks or more in 40% of years.

The 2000 Flow and Temperature Recommendations recognized that access to flood plain habitats could be achieved through a combination of increased peak flows, prolonged peak flow duration, lower bank or levee heights, and constructed inlets. Although their recommendations were based on the relationships for inundation with levees in place, they identified the relationships between flood plain inundation and flow with and without existing levees in place. Their report indicated that substantially more flood plain habitat could be inundated with lower peak flows if levees were removed.

Studies conducted since publication of the 2000 Flow and Temperature Recommendations have led to a better understanding of the flood plain habitats that are most important as razorback sucker nursery habitats and how those habitats could be managed to improve survival of native fish. In addition, a number of important flood plain habitats have been altered to allow inundation to occur at lower peak flows. This information recently has been summarized and incorporated into a flood plain management plan for the Green River subbasin (Valdez and Nelson, 2004). This new information and these developments identify potential flood plain habitats available at flows other than the peak flow recommendations of the 2000 Flow and Temperature Recommendations.

Flood plain habitats in the Green River can be classified as depression flood plains or terrace flood plains (Valdez and Nelson, 2004). Depression flood plains are considered to be far more valuable as razorback sucker nursery areas than terrace flood plains. Depression flood plains are typically separated from the main channel by an elevated levee (natural or constructed). Terrace flood plains are sloping features that are separated from the main channel only by elevation (Valdez and Nelson, 2004). Both of these flood plain habitat types may become inundated during annual spring peak flows. As peak flows recede, depression flood plain habitats retain water at an elevation determined by the elevation of associated levee features. Some depression flood plains can hold water through one or more years. For these habitats, subsequent spring peak flows of sufficient magnitude reconnect the habitat to the main channel before the water in the habitat has been entirely depleted. In contrast, terrace flood plains drain as flows recede, do not retain water for long, and dry out each year once peak flows recede.

When the Flaming Gorge 2000 Flow and Temperature Recommendations were developed, recommended peak flow levels were based on the relationship between flow and the total area of flood plain habitat inundated with levees in place. This relationship did not differentiate between depression and terrace flood plain types and did not consider the duration with which these habitats would hold water. Valdez and Nelson (2004) compiled site-specific information on depression and terrace flood plains in the middle Green River, and this new information suggests that 13,000 cfs may provide sufficient and comparable levels of connection and inundation of depression flood plain habitats relative to 18,600 cfs.

Valdez also developed a model (Valdez and Nelson, 2004) to evaluate the potential for flood plain habitats to entrain drifting larvae. The model indicates that the probability of entrainment decreases exponentially in a downstream fashion and predicts that only about 1% of the drifting larvae would be available for entrainment 36 miles downstream from the spawning bar.

The information provided in Valdez and Nelson (2004) indicates that the area of depression flood plains potentially inundated by 13,000-cfs and 18,600-cfs flows is identical (about 2,200 acres) for the first 52 miles downstream from the only known razorback spawning bar in Reach 2 (figure 4-16). At greater distances, 18,600-cfs flows would inundate an additional 1,186 acres of depression flood plains.

Inundation and connection of priority depression flood plains might be provided in

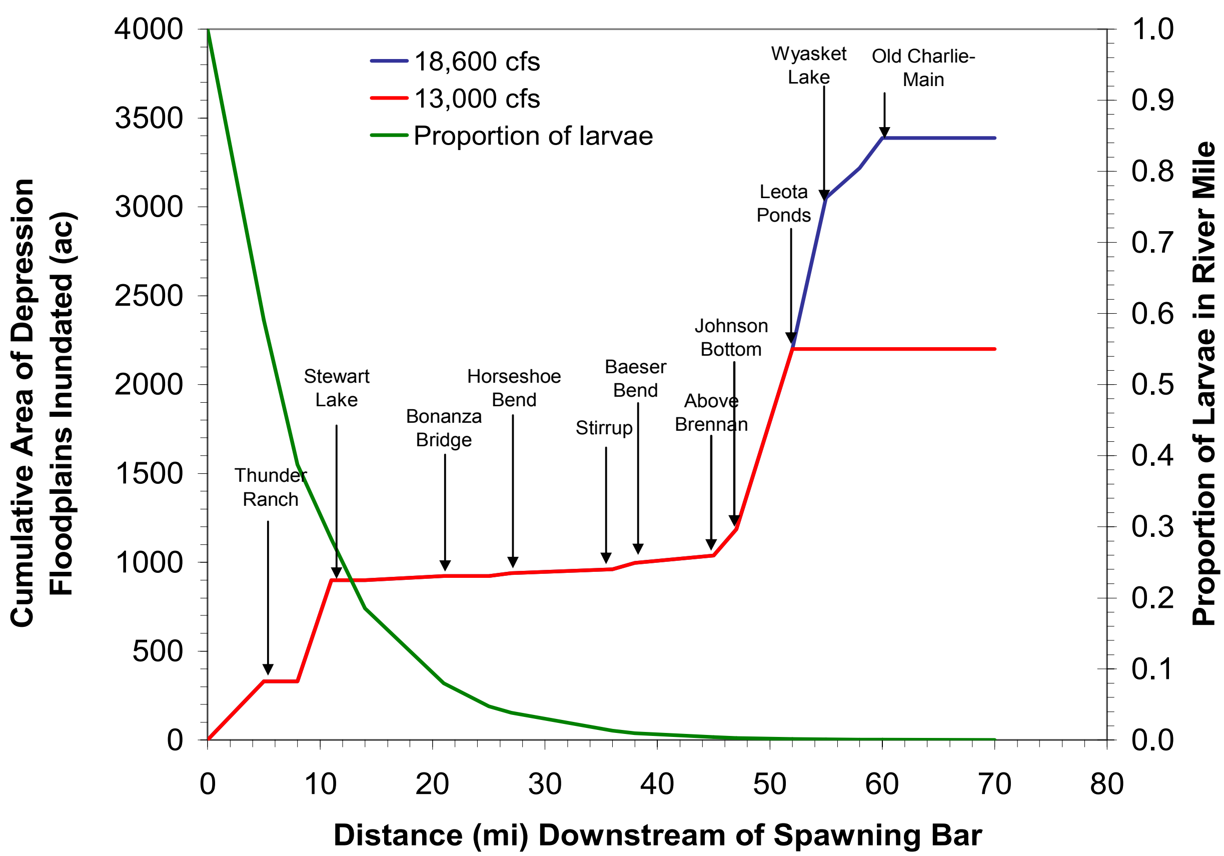

Figure 4-16.— Cumulative Area of Priority Depression Flood Plain Inundated at 13,000 cfs and 18,600 cfs and Proportion of Larvae Entering River Mile According to Distance Downstream From the Razorback Spawning Bar. Source: Modified from Valdez and Nelson (2004).

most years (about 70%) with a release of ≥13,000 cfs. Thus, connection and inundation could potentially be achieved with ≥13,000 cfs would have a corollary benefit of requiring fewer bypasses or spills at Flaming Gorge Dam, thus reducing conflicts with other authorized purposes of the dam.

While information in Valdez and Nelson (2004) suggests that it may be possible to inundate considerable acreage of flood plain depression wetlands at elevations below those identified in the 2000 Flow and Temperature Recommendations, it is uncertain that other flow recommendation objectives (native fish habitat, channel maintenance, nutrient exchange, and natural variability in the hydrograph) can be met if flood plain inundation were the only criteria for spring flow elevations. In response to the issue of inundation at flow levels below those identified in the 2000 Flow and Temperature Recommendations, Recovery Program biologists believe that assumptions underlying predictions of Valdez and Nelson (2004) regarding downstream declines in larval density and larval entrainment rates have not been validated and, in some cases, conflict with existing data (Muth, 1995). Also, functions apart from flood plain inundation for razorback sucker larvae also have direct links with habitat for other endangered fishes such as backwaters for early life stages of Colorado pikeminnow and bonytail. Thus, testing hypotheses of flood plain inundation at any flow elevation would need to occur as part of an adaptive management process and in consultation with the Recovery Program.

To resolve uncertainties associated with flows and nonflow actions that may be required for flood plain inundation, Reclamation would coordinate these studies through the Recovery Program. These studies would be conducted using an adaptive management approach as described in section 4.20. Topics that would be addressed include, but are not limited to:

- ❖ Expected differences in the area of depression flood plains inundated at different flows with levees removed, notched, or modified
- ❖ Flow and stage at which flood plains with levee breaches actually become sufficiently inundated to provide nursery habitat for razorback suckers
- ❖ Total flood plain area inundated at 13,000 cfs and 18,600 cfs
- ❖ Area of depression flood plain habitat inundated at 13,000 cfs and 18,600 cfs
- ❖ Area of flood plain depression habitat that persists after peak flows recede and the relationship, if any, between that and the magnitude of the peak flow
- ❖ Abundance of drifting razorback sucker larvae as a function of distance from the razorback sucker spawning bar
- ❖ Entrainment of larvae into flood plain nursery habitats as a function of distance from the razorback sucker spawning bar
- ❖ Entrainment and retention of larvae into flood plain nursery habitats as a function of the physical characteristics of the habitat including size, volume, local hydraulic conditions, inlet(s), and outlet(s)
- ❖ Temporal relationships between drifting larvae and hydrology during the runoff period with special attention to the duration needed to entrain most drifting larvae.

Resolving these uncertainties along with other uncertainties in flow recommendations is a priority of the Recovery Program. The above studies would be incorporated into the flow evaluation process of the Recovery Program. To increase the effectiveness of resolving these uncertainties, controlled experiments, and associated studies could be performed that capitalize on hydrologic conditions in a given year and that address as many topics as practicable in any one year. For instance, some differences between 13,000 cfs and 18,600 cfs could be tested in a given year if flows were stepped such that 13,000 cfs and 18,600 cfs were provided for sufficient time to test differences. Uncertainties and research needs are identified in Valdez and Nelson (2004) and provide an overview of research needs to better understand the relationship of riverflow to proper functioning flood plains. The completion of controlled experiments, gathering and analyzing data, and the modification of flow recommendations, if warranted, could be completed in 3 to 5 years, depending on hydrological conditions.

4.19.6 Riparian/Vegetation

As discussed in section 4.7.5, there are uncertainties associated with the response of invasive species to the Action Alternative. Recent research suggests that the floodflows may prevent additional tamarisk establishment on post-dam flood plain surfaces in Lodore Canyon but may push establishment to higher elevations. Information is lacking on the degree to which these responses would occur. In addition, there are concerns that the higher base flows, if coupled with several years of drought, will promote extensive tamarisk establishment along base flow elevations.

Uncertainties were described in section 4.7.5 for response of certain native plant communities to the Action Alternative. Such uncertainties include duration and magnitude of floodflows necessary to stimulate a positive response in mature cottonwoods and response of wetland species to the higher base flows of late summer and lower base flows of winter and early spring.

4.20 Addressing Uncertainties Through Adaptive Management

The uncertainties associated with operating Flaming Gorge Dam under the Action Alternative, summarized in section 4.19 above, would be monitored and addressed through an adaptive management process if the Action Alternative is implemented. This adaptive management process would consist of an integrated method for addressing uncertainty in natural resource management. It is an ongoing, interactive process that not only reduces but benefits from uncertainty (Holling, 1978).

The use of adaptive management does not imply establishment of a separately funded and staffed program to oversee operations at Flaming Gorge Dam. Rather, the adaptive management process would be integrated into the current framework of dam operations, while maintaining the authorized purposes of the dam. It would involve using research and monitoring to test the outcomes of modifying the hydrology and temperature of releases from Flaming Gorge Dam. It is expected that such research and monitoring would be achieved within the framework of the ongoing Recovery Program with regard to native fish and undesirable nonnatives and related habitat issues. For example, results of Recovery Program research on flood plain inundation and larval entrainment, conducted during the 2005 spring peak runoff season, would be incorporated into the ongoing adaptive management process, and any new information yielded by this research could be applied to refinement of the recommended releases under the Action Alternative.

As a participant in the Recovery Program, Reclamation would be involved in any identification or discussion of the need for new tasks within the Recovery Program to address Flaming Gorge Dam operational considerations or experimental flows. Issues associated with the trout fishery would be monitored by the Utah Division of Wildlife Resources as part of their management of that fishery and with ongoing consultation and coordination with Reclamation through the Flaming Gorge Working Group and interagency communication. As has occurred in the past, proposed releases for experimental purposes that deviate from the prescribed flows would be disclosed to stakeholders at Flaming Gorge Working Group meetings and closely coordinated with the U.S. Fish and Wildlife Service and the Utah Division of Wildlife Resources.

4.21 ENVIRONMENTAL COMMITMENTS

This section summarizes Reclamation's future commitments related to the Action Alternative. Commitments 1 through 4 and 8 would apply if either the Action or No Action Alternative is implemented.

(1) The Flaming Gorge Working Group, which meets two times per year, would continue to function as a means of providing information to and gathering input from stakeholders and interested parties on dam operations, as described in section 1.5.

(2) The adaptive management process would rely on ongoing or added Recovery Program activities for monitoring and studies to test the outcomes of modifying the flows and release temperatures from Flaming Gorge Dam. It would rely on the Flaming Gorge Working Group meetings for exchange of information with the public.

(3) Reclamation would develop a process for operating the selective withdrawal structure consistent with the objective of improving temperature conditions for the endangered native fish. Such a process would include identification of lines of communication for planning and making changes to selective withdrawal release levels, coordination with other agencies, recognition of equipment limitations that may affect the ability to release warmer water, and the costs and equipment impacts associated with operating at higher temperatures.

(4) Reclamation would continue to annually coordinate the peak flow releases from Flaming Gorge Dam with the appropriate Federal, State, and county officials. This would include continued communication with county officials to assist in their mosquito control activities.

(5) As recommended by the Wyoming State Historic Preservation Office, Reclamation would periodically inspect eligible historic properties around Flaming Gorge Reservoir to determine if there are any effects from the Action Alternative.

(6) Reclamation would consult with Federal, State, and local officials and the interested public to determine whether additional signage or other means of public notification of higher spring riverflows are needed.

(7) A Ute ladies'-tresses recovery team geomorphology working group, consisting of the National Park Service, Reclamation, and several independent researchers, is currently in place. As part of Reclamation's efforts to monitor and understand the effects of the proposed action on Ute ladies'-tresses, this group will be expanded to include interested Federal and State agency geomorphologists, riparian ecologists, and botanists who choose to participate on a voluntary basis. This working group could assist in designing and implementing a monitoring program to gain additional knowledge about Ute ladies'-tresses. Reclamation will oversee this Ute ladies'-tresses workgroup and insure that the workgroup meets regularly to discuss and prioritize monitoring, assist with data interpretation, and prioritize any needed research. As part of the development of the annual operational plan (as discussed in section 2.5 of the EIS), this workgroup will also provide

recommendations to the Flaming Gorge Technical Working Group.

(8) Reclamation would continue to participate in the Recovery Program efforts.

(9) Reclamation would support the Recovery Program, in coordination with the U.S. Fish and Wildlife Service and Western, in developing and conducting Recovery Program studies associated with flood plain inundation identified in section 4.19.5.

(10) Reclamation would establish the Technical Working Group consisting of biologists and hydrologists involved with endangered fish recovery issues. The Technical Working Group would meet at various times throughout the year to comment and provide input concerning endangered fish needs to Reclamation's operational plan.

5.0 Consultation, Coordination, and Public Involvement

This chapter details the consultation and coordination between the Bureau of Reclamation and other State, Federal, and local agencies, Native American tribes, and the public in the preparation of this environmental impact statement (EIS). Since the Notice of Intent to prepare this EIS was published in June 2000, input has been actively solicited from a broad range of public constituencies as part of the ongoing public involvement process. Comments and involvement in the planning for and preparation of the Flaming Gorge EIS were generally sought through two broad efforts: communication and consultation with a variety of Federal, State, and local agencies, Native American tribes, and interest groups; and the formal EIS scoping process and draft EIS comment process, both of which invited input from the general public.

5.1 Consultation and Coordination With Other Agencies and Organizations and Native American Tribes

In June and July 2000, Reclamation invited a number of State and Federal agencies and the Northern Ute Tribe to become cooperating agencies in the preparation of this EIS. The eight agencies that agreed to become cooperating agencies for this EIS are listed in section 1.2. Reclamation has hosted periodic cooperating agency meetings throughout the preparation of this EIS, to ensure that all of the agencies were informed of and involved in the issues and analyses related to the EIS. Other interested tribes, government agencies, and public organizations and individuals have been kept informed on the status and progress of EIS preparation, as requested.

In July 2000, Reclamation initiated consultation under various cultural resource laws, Executive orders, and regulations with the following tribes: the Southern Ute Tribe, the Ute Mountain Tribe, the Northern Ute Tribe, the Northwest Band Shoshone Tribe, the Wind River Shoshone Tribe, the Hopi Tribe, the Paiute Indian Tribe of Utah, the Kaibab Paiute Tribe, the Pueblo of Nambe, the Pueblo of Zia, the Pueblo of Laguna, and the Pueblo of Zuni. Consultation with interested tribes has been an ongoing process and included a briefing on the EIS for the Northern Ute Business Council and a field visit with representatives of the Wind River Shoshone Tribe. None of the tribes expressed concerns regarding either traditional cultural properties or sacred sites within the area of potential effect.

5.2 PUBLIC INVOLVEMENT

Section 1.3 details the scoping process for this EIS. As stated during the scoping hearings, meetings with Reclamation staff were available to the interested public throughout the period of EIS scoping and preparation. Throughout the preparation of this EIS, the Flaming Gorge EIS Home Page on the Upper Colorado Region, Bureau of Reclamation Web site has been updated and available to all with Internet access. In November 2001, a newsletter regarding the development of the EIS was sent to those on the EIS mailing list.

The draft EIS was mailed to the interested public for review and comment in early September 2004, and a Notice of Availability of the draft EIS was published in the *Federal Register* on September 10, 2004. The 60-day review and comment period for the draft EIS ended on November 15, 2004.

During the public comment period, five public hearings were held to receive oral comments on the draft EIS: Moab, Utah, October 12, 2004; Salt Lake City, Utah, October 13, 2004; Rock Springs, Wyoming, October 19, 2004; Dutch John, Utah, October 20, 2004; and Vernal, Utah, October 21, 2004. All written and oral comments received during the comment period were considered in preparing the final EIS. These comments, along with Reclamation's responses, may be found in the separate volume, Comments on the Draft Environmental Impact Statement and Responses.

This final EIS, like the draft EIS, has been mailed to the over 600 agencies, organizations, and individuals on the mailing list (see section 5.3 below), and notice of its availability has been published in the *Federal Register.* It has also been made available on the Flaming Gorge EIS Web page. A Record of Decision, to be prepared no sooner than 30 days after publication of this final EIS, will also be published in the *Federal Register*, mailed to the interested public, and posted on the Flaming Gorge EIS Web page.

5.3 DISTRIBUTION LIST

This EIS has been sent to the following agencies, groups, and individuals for their information and review. Those who commented on the draft EIS are noted with an asterisk (*).

Federal Agencies

Advisory Council on Historic Preservation
Department of Agriculture
    USDA Forest Service
    Natural Resources Conservation Service
Department of Army
    Corps of Engineers

Department of Energy
Office of Policy, Safety, and Environment
*Western Area Power Administration
Argonne National Laboratory
Department of the Interior
Bureau of Indian Affairs
Bureau of Land Management
*National Park Service
*U.S. Fish and Wildlife Service
U.S. Geological Survey
*Environmental Protection Agency
Office of Management and Budget

U.S. Congressional Delegation

Colorado
Representative John Salazar, 3rd District
Senator Wayne Allard
Senator Ken Salazar
Utah
Representative Chris Cannon, 3rd District
Representative Rob Bishop, 1st District
Representative James Matheson, 2nd District
Senator Bob Bennett
Senator Orrin Hatch
Wyoming
Representative Barbara Cubin
Senator Mike Enzi
Senator Craig Thomas

American Indian Tribal/National Governments

Kaibab Paiute Indian Reservation, Pipe Spring, Arizona
Northern Ute Tribe of the Uintah and Ouray Reservation, Fort Duchesne, Utah
Pueblo of Zuni, Zuni, New Mexico

State Legislators

Colorado
Representative Al White, District 57, Denver
Senator Jack Taylor, District 8, Denver
Utah
Representative John G. Mathis, District 55, Naples
Representative Gordon E. Snow, District 54, Roosevelt
Representative David Ure, District 53, Kamas
Senator Beverly Evans, Altamont
Senator Allen M. Christenson, North Ogden
Wyoming
Representative John M. Hastert, District 39, Green River
Representative Mick Powers, District 18, Lyman
Representative Marty Martin, District 48, Rock Springs
Representative Stephen Watt, District 17, Rock Springs
Representative Bill Thompson, District 60, Green River
Representative Pete Jorgenson, District 16, Rock Springs
Senator Tex Boggs, District 13, Rock Springs
Senator Stan Cooper, District 14, Kemmerer
Senator Rae Lynn Job, District 12

State Agencies

Arizona
Governor
Arizona Department of Water Resources, Phoenix
Colorado
Governor
Local Affairs Department/Division of Local Government, Department of Law, Denver
*Colorado Department of Natural Resources, Denver
Utah
Governor
Department of Natural Resources, Salt Lake City
*Governor's Office of Planning and Budget, Salt Lake City
*Office of the Attorney General, Salt Lake City
State of Utah Trust Lands, Salt Lake City
State Parks and Recreation, Salt Lake City

*Utah Associated Municipal Power Systems, Salt Lake City
Utah Division of Water Resources, Salt Lake City
Utah Division of Wildlife Resources, Salt Lake City
Utah Farm Bureau Federation, Payson
Utah State Clearing House, Salt Lake City
Utah State University, Logan, Utah
*Utah State University Extension, Vernal

Wyoming

*Governor
Wyoming Department of Environmental Quality, Cheyenne
Wyoming Department of State Parks and Cultural Resources, Cheyenne
Wyoming Division of Economic and Community Development, Cheyenne
*Wyoming Game and Fish, Cheyenne, Wyoming, and Green River, Utah
Wyoming Office of Federal Land Policy, Cheyenne
*Wyoming State Engineer's Office, Cheyenne
*Wyoming State Geological Survey, Laramie
Wyoming State Historic Preservation Office, Cheyenne

Local Agencies

*Daggett County Commission, Manila, Utah
Uintah Basin Association of Governments, Roosevelt, Utah
*Rock Springs Chamber of Commerce, Rock Springs, Wyoming
Sweetwater Commission, Green River, Wyoming
*Town of Manila, Utah
*TriCounty Health Department, Vernal, Utah
*Uintah County Commission, Vernal, Utah
*Uintah County Mosquito Abatement District, Vernal, Utah
Uintah County Public Lands, Vernal, Utah

Irrigation Districts and Water Users Organizations

Carbon Water Conservancy District, Helper, Utah
*Central Utah Water Conservancy District, Orem, Utah
Colorado River Board of California, Glendale, California
Colorado River Commission of Nevada, Las Vegas, Nevada
*Colorado River Energy Distributors Association (CREDA), Tempe, Arizona
*Colorado River Water Conservation District, Glenwood Springs, Colorado
Colorado River Water Users Association, Coachella Valley Water District, Coachella, California
Colorado Water Conservation Board, Denver, Colorado
*Duchesne County Water Conservancy District, Roosevelt, Utah
Metropolitan Water District of Southern California, Los Angeles, California
Moon Lake Water Users Association, Roosevelt, Utah
Provo River Water Users Association, Orem, Utah
*Sweetwater County Conservation District, Rock Springs, Wyoming
Upper Colorado River Commission, Salt Lake City, Utah
Utah Water Users Association, Murray, Utah

Libraries

Colorado

Denver Public Library, Denver
Mesa County Public Library, Grand Junction
Norlin Library, University of Colorado, Boulder

Utah

Daggett County Library, Manila
Duchesne County Library, Roosevelt
Grand County Library, Moab
Green River City Library, Green River
Harold B. Lee Library, Brigham Young University, Provo
J. Reuben Clark Law School, Brigham Young University, Provo
Merrill Library, Utah State University, Logan
Salt Lake City Public Library, Salt Lake City

Uintah County Library, Vernal
Ute Indian Tribe Library, Fort Duchesne

Wyoming
Hay Library, Western Wyoming Community College, Rock Springs
Rock Springs Library, Rock Springs
Sweetwater County Library, Green River
White Mountain Library, Rock Springs

Interested Organizations

Action Network Activist, Eden Prairie, Minnesota
American Fisheries Society, Garden City, Utah
American Rivers, Lincoln, Nebraska; Washington, DC
Basin Sports, Vernal, Utah
Boyle Engineering, Lakewood, Colorado
*Burnell Slaugh Ranch, Jensen, Utah
Cedar Springs Marina, Flaming Gorge, Utah
Clipper Publishing Company, Bountiful, Utah
Colorado Energy Distributors Association, Tempa, Arizona
Colletts Recreation Service
Cooper Printing and Publishing, Magna, Utah
Dinosaur Expeditions, Park City, Utah
Dinosaurland Travel Board, Vernal, Utah
Don Hatch River Expeditions, Vernal, Utah
*Eagle Outdoors Sports, Kayesville, Utah
Eagle Outfitters Inc., Layton, Utah
Engineering and Planning Consultants, Loveland, Colorado
Flaming Gorge Chapter-PFUSA, Rock Springs, Wyoming
Flaming Gorge Corporation, Manila, Utah
Flaming Gorge Lodge, Dutch John, Utah
Flaming Gorge Yacht Club, Bountiful, Utah
Foundation of North American Wild Sheep, Salt Lake City, Utah
*Franson Noble Engineering, Provo, Utah
Future Resources, Vernal, Utah
Grand Canyon Monitoring and Research Center, Flagstaff, Arizona
Grand Canyon River Guides, Flagstaff, Arizona
Grand Canyon Trust, Flagstaff, Arizona
Green River Drifters Inc., Dutch John, Utah
*Green River Outfitters, Dutch John, Utah
*Green River Outfitter and Guides Association, Dutch John, Utah
Holiday Expeditions, Salt Lake City, Utah
Interstate Stream Commission, Santa Fe, New Mexico
JBR Environmental Consultants, Murray, Utah
*Living Rivers, Colorado Riverkeeper, Moab, Utah
National Parks Conservation Association, Visalia, California; Long Branch, New Jersey
*Old Moe Guide Service, Dutch John, Utah
Questar, Rock Springs, Wyoming
Pinedale Roundup, Pinedale, Wyoming
Quad/Photo, New York, New York
Red Canyon Lodge, Dutch John, Utah
Rocky Mountain Elk Foundation, Missoula, Montana
Southwest Rivers, Flagstaff, Arizona
Sweetwater Economic Development Association, Rock Springs, Utah
The Nature Conservancy, Boulder, Colorado; Arlington, Virginia; Madison, Wisconsin
*Thunder Ranch, LLC, Jensen, Utah
Tidal View, West Tremont, Maine
*Trout Bum 2, Park City, Utah
*Trout Creek Flies, Dutch John, Utah
*Trout Unlimited, Salt Lake City, Utah
*Uintah Mountain Club, Vernal, Utah
Utah Associated Municipal Power Systems, Salt Lake City, Utah
Utah Council Trout Unlimited, South Weber, Utah
Utah Farm Bureau Federation, Payson, Utah
Utah Habitat Council, Salt Lake City, Utah
Utah Municipal Power Agency, Spanish Fork, Utah
Utah Rivers Council, Salt Lake City, Utah
Utah Water Project Trout Unlimited, Sandy, Utah
*Utah Waters, Salt Lake City, Utah
*Water Consult Engineering and Planning Consultants, Loveland, Colorado
*Western Resource Advocates and The Nature Conservancy, Boulder, Colorado
*Western Rivers Flyfisher, Salt Lake City, Utah
White Water Canoe Colorado, Greeley, Colorado

Interested Individuals

*G. Howard Abplanalp, Vernal, Utah
Brad Adams, Greensboro, North Carolina
*Deloy Adams, Dutch John, Utah
*Lew Albright
*John and Mickey Allen, Rangely, Colorado
*Mark Allen, Orem, Utah
Jeanelle Adamson, Rock Springs, Wyoming
Patrick Adcock, Norfork, Arkansas
Evan Albright, San Luis Obispo, California
Cheryl Alfakyani, Melrose, Maryland
Thomas Allgaier, Palm Bay, Florida
Joe Alston, Page, Arizona
*Dick Apedalle
Michael H. Anderson, Sr., Ohatchee, Alabama
Warren Anderson, Rock Springs, Wyoming
Nicholas Angarone, Hamilton, New Jersey
Angelde Armendi, Miami, Florida
Dave Armstrong, Salt Lake City, Utah
Cheryl Arredondo, Apache Junction, Arizona
Jim Aton, Cedar City, Utah
Gina Baker, Star City, Indiana
Scott Baker, Draper, Utah
D. Barbero, Rock Springs, Wyoming
*Justin Barker, Pleasant Grove, Utah
*Lynn Barlow
Terry Barnes, Jr., Funkstown, Maryland
Scott Barnes, Redlands, California
M. Dale Barningham, Bountiful, Utah
Cliff Barrett, Stansbury Park, Utah
Kevin Barry, Carlsbad, California
G. Basham-Barnes, Rogers, Arkansas
Karl Bass, Glen Gardner, New Jersey
Marcia Battles, Pontiac, Michigan
Yasmin Bauer, Houston, Texas
Tony R. Bavry, Columbus, Ohio
Mark Belles, Rowlett, Texas
Nathan Bennett, Selinsgrove, Pennsylvania
Rebecca Bennett, Delhi, Louisiana
Tina Bennington, Manila, Utah
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Cache Citizen, Logan, Utah
Casper Star Tribune, Green River, Wyoming
Daily Rocket-Miner, Rock Springs, Wyoming
Daily Spectrum, St. George, Utah
Deseret News, Salt Lake City, Utah
Hilltop Times, Hill Air Force Base, Utah
Journal Publications, Springville, Utah
KVEL Radio 920, Vernal, Utah
Lakeside Review, Layton, Utah
Logan Herald Journal, Logan, Utah
Millard County Chronicle Progress, Delta, Utah
Newtah News Group, American Fork, Utah
Orem-Geneva Times, Orem, Utah
Park Record, Park City, Utah
Provo Daily Herald, Provo, Utah
Richfield Reaper, Richfield Utah
Salt Lake City Weekly, Salt Lake City, Utah
Salt Lake Tribune, Salt Lake City, Utah
San Juan Record, Monticello, Utah
Spanish Fork Press, Spanish Fork, Utah
Sun Advocate, Price, Utah
The Event News Weekly, Salt Lake City, Utah
The Leader, Tremonton, Utah
The Ogden Standard Examiner, Ogden, Utah
The Orem Daily Journal, Springville, Utah
The Times Independent, Moab, Utah
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Operation of Flaming Gorge Dam
Final Environmental Impact Statement
Conversion Tables

U.S. Customary to Metric

Multiply	By	To Obtain
inches(inches)	25.4	millimeters
inches (inches)	2.54	centimeters
feet (ft)	0.3048	meters
miles (mi)	1.609	kilometers
square feet (ft^2)	0.0929	square meters
acres	0.4047	hectares
square miles (mi^2)	2.590	square kilometers
gallons (gal)	3.785	liters
cubic feet (ft^3)	0.02832	cubic meters
acre-feet	1,233.0	cubic meters
pounds (lb)	0.4536	kilograms
tons (ton)	0.9072	metric tons

Temperature in degrees Fahrenheit (°F) can be converted to degrees Celsius (°C) as follows: °C = 5/9 (°F - 32)

Metric to U.S. Customary

millimeters (mm)	0.03937	inches
centimeters (cm)	0.3937	inches
meters (m)	3.281	feet
kilometers (km)	0.6214	miles
square meters (m^2)	10.76	square feet
square kilometers (km^2)	0.3861	square miles
hectares (ha)	2.471	acres
liters (L)	0.2642	gallons
cubic meters (m^3)	35.31	cubic feet
cubic meters (m^3)	0.0008110	acre-feet
grams (g)	0.03527	ounces
kilograms (kg)	2.205	pounds
metric tons (t)	1.102	tons

Temperature in degrees Celsius (°C) can be converted to degrees Fahrenheit (°F) as follows: °F = 1.8 (°C) + 32

Other Useful Conversion Factors

acre-feet	43,560	cubic feet
acre-feet	325,851	gallons
cubic feet per second (cfs)	1.98	acre-feet per day

Glossary

A

Acre-foot: The volume of water that would cover 1 acre, 1 foot deep.

Age-0, age 1: The first and second full years of life, respectively.

B

Base load: Demand level of a utility that is continuous throughout the season.

Biological opinion: A document stating the opinion of the U.S. Fish and Wildlife Service or National Oceanic and Atmospheric Administration – Fisheries (NOAA Fisheries) on whether or not a Federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

Bypass tubes: Two 8-foot diameter conduits through Flaming Gorge Dam that are used to release water in addition to the releases made through the powerplant. These conduits, each with a rated capacity of 2,000 cfs each, are controlled by hollow jet valves that control the flow.

C

Candidate species (candidate): A plant or animal species for which the U.S. Fish and Wildlife Service or NOAA Fisheries has on file sufficient information on biological vulnerability and threats to support a proposal to list as endangered or threatened.

Capacity: The amount of electric power for which a generating unit is rated by the manufacturer.

Cavitation: A physical process that can occur when water flows across a surface at high velocity.

Consumer surplus: A measure of recreation value based on the increment of recreator willingness-to-pay over and above the incurred cost per visit.

Control area: An area comprised of an electric system or systems, bounded by interconnection metering and telemetry, capable of controlling generation to maintain its interchange schedule with other control areas, and contributing to frequency regulation of the interconnection.

Critical habitat: Specific geographic areas, whether occupied by a listed species or not, that are essential for its conservation and that have been formally designated by rule published in the *Federal Register*.

Cubic foot per second (cfs): Rate of streamflow; a cubic foot of water passing a reference section in 1 second of time; 1 cfs = 0.0283 cubic meters per second.

Cultural resources: Any buildings, sites, districts, structures, or objects significant in history, architecture, archaeology, culture, or science.

Cyanobacteria: Blue green algae.

E

Economic benefits: Economic benefits attempt to measure changes in societal or national welfare based on net value concepts, including consumer surplus and producer profitability.

Employment: Total of hourly wage, salary, and self-employed jobs (part-time and full-time), measured in terms of jobs, not full-time equivalents.

Endangered species: An animal or plant species in danger of extinction throughout all or a significant portion of its range.

Energy: Electric capacity generated and delivered over time, usually measured in kilowatthours.

Entrainment: Process by which fish or plankton are transported by strong water currents.

F

Facility availability approach: A methodology used to calculate reservoir recreation visitation. The approach evaluates changes in visitation as a function of changing facility availability as water levels fluctuate.

Facility substitution: The potential for recreators to move between facilities at a site as a given facility becomes unusable.

***Federal Register* (FR):** The official daily publication for actions taken by the Federal Government, such as rules, proposed rules, and notices of Federal agencies and organizations, as well as Executive orders and other Presidential documents.

Formal consultation: The required process under section 7 of ESA between the U.S. Fish and Wildlife Service or NOAA Fisheries and a Federal agency or applicant conducted when a Federal agency determines its action is likely to adversely affect a listed species or its critical habitat; used to determine whether the proposed action is likely to jeopardize the continued existence of listed species or adversely modify critical habitat. This determination is stated in a biological opinion.

G

Gigawatt (GW): 1,000 megawatts or 1 billion watts.

Gigawatthour (GWh): A unit equal to 1,000 megawatthours.

H

Historic properties: Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the *National Register of Historic Places* maintained by the Secretary of the Interior. This term includes artifacts, records, and remains that are related to and located within such properties. The term includes properties of traditional religious and cultural importance to an Indian tribe and that meet the *National Register of Historic Places* criteria.

I

Indian tribe: An Indian tribe, band, nation, or other organized group or community, which is recognized as eligible for the special programs and services provided by the United States to Indians because of their status as Indians.

Inflow: Water that flows into a body of water. The amount of water entering a reservoir expressed in acre-feet per day or cubic feet per second.

Input-Output (IO) analysis: IO estimates regional economic impacts based on a region's interindustry trade linkages. The analyses present changes in total economic impact as measured by the sum of direct effects (impacts to initially affected industries), indirect effects (impacts to industries providing inputs to directly impacted industries), and induced effects (impacts from employees spending wages within the region), all caused by the initial change in demand.

Insectivorous: Feeding on insects.

Invertebrate: Animals lacking a spinal column.

J

Jeopardy biological opinion: A U.S. Fish and Wildlife Service or NOAA Fisheries section 7 biological opinion determining that a Federal action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat.

Jeopardize the continued existence of: To engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.

K

Kilowatt (KW): Unit of electric power (capacity) equal to 1,000 watts, or 1.34 horsepower.

Kilowatthour (KWh): Basic unit of electric energy equaling an average of 1 kilowatt of power applied over 1 hour.

L

Larvae: Plural form of larva; the early, immature form of any animal.

Limnology: The study of freshwater ecosystems.

Linear interpolation approach: A procedure used in the recreation analysis to calculate visitation and value. The procedure uses percentages based on five data points (low end thresholds, current conditions, preferred conditions, high end kink conditions, and high end thresholds), measured in terms of river flows/reservoir water levels, visitation, and valuation. If an alternative's flows fall 75 percent of the way between current and preferred flow conditions, the procedure calculates visitation and value to also fall 75 percent of the way between the current and preferred visitation and value data points.

Listed species: A species, subspecies, or distinct population segment that has been added to the Federal list of endangered and threatened wildlife and plants.

Littoral: Pertaining to the shore.

Littoral zone: The zone or strip of land along the shoreline between the high and low water marks. That portion of a body of freshwater extending from the shoreline lakeward to the limit of occupancy of rooted plants.

M

Mean sea level: Average level of the ocean between high and low tide.

Megawatt (MW): 1,000 kilowatts or 1 million watts.

Megawatthour (MWh): A unit equal to 1,000 kilowatthours.

Mesic: Characterized by moderately moist conditions; neither too wet nor too dry.

N

National Register of Historic Places (NRHP): A federally maintained register of districts, sites, buildings, structures, architecture, archaeology, and culture.

Net present value: The total current value determined from a comparison of costs and benefits from different time periods, such that all dollar amounts are discounted to present time, using an appropriate discount rate. The sum of the present value of the costs is subtracted from the sum of the present value of the benefits to determine the net present value. The appropriate discount rate is the rate that equates the value of a dollar in the present time with the value of a dollar in another time.

Non-jeopardy biological opinion: A U.S. Fish and Wildlife Service or NOAA Fisheries section 7 biological opinion that determines that a Federal action is not likely to jeopardize the existence of a listed species or result in the destruction or adverse modification of critical habitat.

Nonrenewable resources: Resources such as prehistoric campsites which will not be regenerated in the future. These resources are finite.

P

Paleocene: Relating to the oldest series or epoch of the Tertiary period (57,000,000 to 65,000,000 year B.P.).

Paleontology: Study of life in past geological periods by means of fossil remains.

Passerine birds: Songbirds of perching habits.

Penstock: A pipeline or conduit designed to withstand pressure surges leading from a forebay or reservoir to power-producing turbines or pump units. Conduit used to convey water under pressure to the turbines of a hydroelectric plant. A pressurized pipeline or shaft between the reservoir and hydraulic machinery.

Piscivorous: Feeding on fishes.

Planktonic: Relating to small plant and animal organisms that float or drift in great numbers in freshwater or saltwater.

Power: Electrical capacity generated, expressed in kilowatts.

Powerplant capacity: Maximum flow that can pass through the turbines, given a full reservoir.

Preference: Priority access to Federal power by public bodies and cooperatives.

Preference customers: Publicly owned systems and nonprofit cooperatives that, by law, have preference over investor-owned systems for purchase of power from Federal projects.

Profitability: Total revenue minus operating costs.

R

Ramp rate (ramping): The rate of change in instantaneous output from a powerplant. The ramp rate is managed to prevent undesirable effects due to rapid changes in loading or discharge. Changes in ramp rate often are implemented to protect habitat and the public from undesirable effects caused by large, sudden changes in riverflows.

Reasonable and prudent alternative (RPA): A recommended alternative action identified during formal consultation that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction, that is economically and technologically feasible, and that the U.S. Fish and Wildlife Service or NOAA Fisheries believes would not jeopardize the continued existence of listed species or the destruction or adverse modification of designated critical habitat.

Reasonable and prudent measure (RPM): An action that the U.S. Fish and Wildlife Service or NOAA Fisheries believes necessary or appropriate to minimize the impacts (the amount or extent) of incidental take caused by an action that was subject to consultation.

Recovery: The process by which the decline of an endangered or threatened species is stopped or reversed, or threats to its survival neutralized so that its long-term survival in the wild can be ensured, and it can be removed from the list of threatened and endangered species.

Recovery plan: A document drafted by the U.S. Fish and Wildlife Service, NOAA Fisheries, or other knowledgeable individual or group that serves as a guide for activities to be undertaken by Federal, State, or private entities in helping to recover and conserve endangered or threatened species.

Recreation value per visit: Recreator benefits or values per visit are represented by consumer surplus, measured by estimating recreator willingness-to-pay in excess of costs per visit.

Recreation valuation: Recreation valuation reflects the sum of individual recreator benefits or values aggregated across users of a site.

Recreation visit: A recreation visit reflects a round trip excursion from a recreator's primary residence for the main purpose of recreation.

Recreation visitation: Sum of recreation visits across users of a site.

Recruitment: Survival of young plants and animals from birth to a life stage less vulnerable to environmental change.

Redd: The nest that a spawning female salmon digs in gravel to deposit her eggs. Depression in riverbed or lakebed dug by fish to deposit eggs.

Regional economic impacts: Regional economic impacts attempt to measure changes in total economic activity within a specified geographic region, stemming from changes within region expenditures. Regional economic impacts are typically described using such general measures as total industry output, labor income, and employment.

Resource indicator: A quantification (measurement) of any environmental consequence arising from the implementation of flow and temperature recommendations that would indicate the presence of certain environmental conditions.

Resource issue: An effect or perceived effect, risk, or hazard on a physical, biological, social, or economic resource within the affected environment.

S

Sacred site: See Executive Order 13007. Any specific, discrete, narrowly delineated location on Federal land that is identified by an Indian tribe or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion, provided that the tribe or appropriately authoritative representative of an Indian religion has informed the agency of the existence of such a site.

Spot price: Market price of energy at a given moment at a point of exchange.

Sympatric: Occurring in the same area.

T

Tailwater: The water in the natural stream immediately downstream from a dam. The elevation of water varies with discharge from the reservoir. Applied irrigation water that runs off the lower end of a field.

Take: To harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct; may include significant habitat modification or degradation if it kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Terms and conditions: Required actions described in an Incidental Take Permit under section 10 or Incidental Take Statement intended to implement the reasonable and prudent measures under section 7.

Threatened species: An animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Total industry output: Dollar value of production (sales revenues and gross receipts) from all industries in the region. Total industry output includes the value of inter-industry trade of intermediate goods prior to final manufacture and sale.

Total labor income: Employment income derived at the workplace including wages and benefits (employee compensation) plus self-employed income (proprietary income).

Traditional cultural property (TCP): A site or resource that is eligible for inclusion in the NRHP because of its association with cultural practices of beliefs of a living community.

U

Unregulated inflow: Within the context of Flaming Gorge Reservoir, the naturally occurring inflows to Flaming Gorge Reservoir if Fontenelle Dam and other diversions did not exist upstream.

V

Vertebrate: Animal species with a spinal column.

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bonytail
Colorado
pikeminnow
humpback chub
razorback sucker

A

B

C

E

Operation of Flaming Gorge Dam
Final Environmental Impact Statement
Acronyms and Abbreviations

APE	area of potential effect
ATU	annual thermal units
BLM	Bureau of Land Management
CFR	Code of Federal Regulations
cfs	cubic feet per second
CRFSTC	Colorado River Forecasting Service Technical Committee
CRSP	Colorado River Storage Project
CUP	Central Utah Project
EIS	environmental impact statement
ESA	Endangered Species Act
FGNRA	Flaming Gorge National Recreation Area
2000 Flow and Temperature Recommendations	*Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam*
FR	*Federal Register*
GWh	gigawatthour
IMPLAN	IMpact analysis for PLANning
km	kilometer
kWh	kilowatthour
m^3/s	cubic meters per second
msl	mean sea level
MW	megawatt
NEPA	National Environmental Policy Act
NERC	North American Electrical Reliability Council
NPV	net present value
NRHP	*National Register of Historic Places*
P.L.	Public Law
PRS	Power Repayment Study
Reclamation	Bureau of Reclamation
Recovery Action Plan	*1993 Recovery Implementation Program Recovery Action Plan*
Recovery Program	Upper Colorado River Endangered Fish Recovery Program
RPA	Reasonable and Prudent Alternative
Secretary	Secretary of the Interior
SHPO	State Historic Preservation Office
SLCA/IP	Salt Lake City Area Integrated Projects
UDWR	Utah Division of Wildlife Resources
U.S.	United States
U.S.C.	United States Code
USDA Forest Service	United States Department of Agriculture Forest Service
USGS	United States Geological Survey
Western	Western Area Power Administration
YOY	young-of-the-year
§	section
°C	degrees Celsius
°F	degrees Fahrenheit
%	percent

RECLAMATION

Managing Water in the West

Operation of Flaming Gorge Dam Final Environmental Impact Statement Technical Appendices

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

September 2005

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

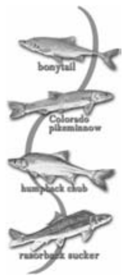
The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Front cover artwork courtesy of
Arizona Game and Fish Department

Operation of Flaming Gorge Dam
Final Environmental Impact Statement
Technical Appendices

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

September 2005



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FOREST SERVICE POSITION PAPER TECHNICAL APPENDIX

Page No.

Forest Service Position Paper Technical Appendix

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AUG 25 '00

United States Department of Agriculture	Forest Service	Ashley National Forest	355 North Vernal Ave Vernal, UT 84078

File Code: 1950

Date: August 23, 2000

Bruce C. Barrett, Area Manager
USDI – BOR Upper Colorado Region
302 East 1860 South
Provo, Utah 84606-7317

Subject: **Addendum** - Cooperating Agency Position for the Operation of Flaming Gorge Dam Environmental Impact Statement

Classification: ENV-6.00
Project: CS
Control No.: 3820
Folder I.D.: 38314
FGD EIS

Dear Mr. Barrett:

We have developed an addendum to the USDA Forest Service Position as a Cooperating Agency for the subject EIS. The addendum and the August 10 position paper are enclosed. All items in the addendum and position paper address policies and procedures that are in place for the Flaming Gorge National Recreation Area, including operation and management responsibilities for the Flaming Gorge Reservoir and Green River. The enclosed documents include information that is necessary to adequately address management concerns; and therefore, we request that these concerns guide data gathering, and analysis and evaluation steps in the EIS process.

Please provide us with a response to our requests and concerns, including how each will be displayed or otherwise used in the EIS process and EIS.

To date, we have coordinated closely with EIS team leaders and members and will continue to cooperate fully during the process.

Sincerely,

Bert Kulesza

BERT KULESZA
Forest Supervisor

Enclosures (2)

cc:
Eileen Richmond, Flaming Gorge District Ranger
Terry Clark, Public Service Group Leader
Garth Heaton, consultant

NOTICE: IF YOU DETACH ENCLOSURES, PLEASE INSERT CODE NO. ______

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OPERATION OF FLAMING GORGE DAM
ENVIRONMENTAL IMPACT STATEMENT

Addendum to
The revised (8/10/00) USDA Forest Service Position Paper

August 23, 2000

The Purpose and Need for Action for the Flaming Gorge Dam Operations EIS is: "…to protect and assist in the recovery of the population and designated critical habitat of the four endangered fishes, **while maintaining the other authorized purposes** of the Flaming Gorge Unit of the Colorado River Storage Project." (emphasis added). The "Authorizing Legislations" are described by BOR as; 1) The Colorado River Storage Project Act of 1956, and 2) the Colorado River Basin Project act of 1968.

The Forest Service believes that a third legislated Act needs to be added to the list of Authorizing Legislation **(PL 90-540, the Flaming Gorge National Recreation Area Act of 1968)**. The Forest Service requests that the following wording be added to all purpose and need narratives in the EIS, with such wording serving as the basis for analysis and evaluation of natural and socioeconomic resources:

> *PL 90-540 was enacted "... in furtherance of the purposes of the Colorado River Storage project." The purposes of the Flaming Gorge National Recreation Area are to provide "(1) Public Outdoor Recreation benefits; (2) Conservation of Scenic, Scientific, Historic, and other values contributing to public enjoyment; and (3) such management, utilization, and disposal of natural resources as in his (Secretary of Agriculture) judgment will promote, or are compatible with and do not* ***significantly impair*** *the purposes for which the recreation area is established." (emphasis added).*

The Forest Service proposes that the EIS identify and describe the…." **other authorized purposes** of the Flaming Gorge Unit of the Colorado River Storage Project" for each of the three acts cited above. Appropriate EIS sections should also define what would be entailed in maintaining these other purposes, display any and all deviations from the conditions that are to be maintained, and include specific mitigation measures for maintenance of the purposes.

In the case of PL 90-540 the purposes that should be specified and analyzed for effects are: 1) Recreation Benefits (i.e.: supply and economic contribution of land based, river based, and reservoir based recreation opportunities), 2) Scenic, 3) Scientific, and 4) Historic.

The Forest Service proposes to work with the socio-economic and/or other appropriate resource teams to describe the current or desired conditions to be maintained and to identify changes that would exceed the threshold of concern for each of the primary purposes identified in PL 90-540. We will work with the EIS team to define a level of "Significant Impairment" (sec 2, PL 90-540)

Addendum cont.

for each of the primary purposes, and to develop mitigation measures that could be employed if significant impairment results from implementing an alternative.

The Forest Service does not support the development of alternatives designed to emphasize one resource area, such as a recreation emphasis alternative. We prefer that all of the alternatives incorporate measures that lessen the effects on the authorized purposes of the Flaming Gorge National Recreation Area, while improving the recovery of the endangered fish species.

Operation of Flaming Gorge Dam Environmental Impact Statement

USDA Forest Service Position as a Cooperating Agency

Revised - August 10, 2000

Representatives of the USDA Forest Service (Forest Service) have responded to all invitations to participate as a cooperating agency in the preparation of the environmental impact statement for Operation of Flaming Gorge Dam. We have attending initial planning meetings, site visits, and public scoping meetings. We have also provided a Forest Service "fact sheet" to the Bureau of Reclamation NEPA managers for distribution during public scoping. We will continue to participate as a cooperating agency as defined in Council of Environmental Quality guidelines, and regulations for the National Environment al Policy Act of 1969.

The Forest Service has the following management concerns that need to be addressed in appropriate sections of the subject EIS. We will work with Bureau of Reclamation EIS team members to provide data, and corresponding analysis and evaluation that will be necessary to address and mitigate these concerns.

The EIS must adequately address the Forest Service role and responsibility to manage the Flaming Gorge National Recreation Area, including all infrastructure and uses associated with the management of this area. This includes: a) Flaming Gorge Reservoir from Green River, Wyoming to Flaming Gorge Dam; b) on-water and reservoir shoreline infrastructure and use; and c) Green River and river corridor use and infrastructure from Flaming Gorge Dam to a point 12 miles below the dam. The Forest Service places special emphasis on the need for the EIS to analyze economic affects (revenue, cash flow, etc.) to Forest Service operations, as well as to Forest Service concessionaire and permittee operations within the Flaming Gorge National Recreation area and the Green River Corridor. The EIS must also address the relationship and joint management role and responsibilities between the Forest Service and USDI Bureau of Land Management for managing facilities and use on the segment of the Green River from the boundary of the Ashley National Forest to the State of Utah Wildlife Refuge in Browns Park.

Therefore, the Flaming Gorge Dam EIS should include:

1. Analyses, evaluations and accompanying mitigation measures for all recreational, socioeconomic and natural resource values, benefits, and infrastructure associated with the Flaming Gorge National Recreation Area, including Flaming Gorge Reservoir, the Green River Corridor, and the Flaming Gorge-Uintas National Scenic Byway. *

2. Alternatives with flow regimes and draw downs that address and allow for adequate protection of existing facilities/infrastructure and uses on Flaming Gorge Reservoir and within the Green River Corridor, including maintaining the Little Hole National Recreation Trail in its present location; or if necessary due to unacceptable damage from flows, the relocation of the trail beyond high flow elevations. *

3. References to the role and responsibility of the Forest Service in regards to the Flaming Gorge National Recreation area. *

4. References to ongoing studies and considerations of Sections A and B as "Scenic" and Section C as "Wild "under the Wild and Scenic Rivers Act. *

> *
>
> In order to achieve accurate and complete data needed to address the above four points, the Forest Service asks that the Bureau of Reclamation EIS team prepare a technical report for socioeconomic values and benefits associated with the Flaming Gorge Reservoir and Green River.

The supporting rationale for the above management concerns and the need for a "socioeconomic technical report" is described in the following information on programs, actions, sites, and facilities that will be affected by the Proposed Action. We request that EIS team members gather site specific data associated with this information and address the above four points in appropriate sections of the EIS.

Flaming Gorge National Recreation Area Designation –

The Congressional Act establishing the Flaming Gorge National Recreation Area specified three broad missions and management goals. Specifically, the Secretary of Agriculture is directed *"to administer, protect, and develop the Flaming Gorge National Recreation Area in a manner to best provide for (1) public outdoor recreation benefits; (2) conservation of scenic, scientific, historic, and other values contributing to public enjoyment; and (3) such management, utilization, and disposal of natural resources as in his judgment will promote or are compatible with, and do not significantly impair the purpose for which the recreation area is established."*

As directed by the Congressional Act and the accompanying Administrative Directive, the Ashley National Forest administers and manages programs and activities associated with:

- ✓ Recreation Uses and Sites
- ✓ Scenic qualities
- ✓ Historic and Cultural values
- ✓ Special Uses, ex. Outfitters and Guides
- ✓ Transportation (roads and trails)
- ✓ Natural Resources, including grazing, wood products, and minerals

- ♦ The Flaming Gorge National Recreation Area is the flagship of the national recreation areas in the USDA Forest Service. It was the first national recreation area in the agency and remains a high priority in overall budgeting and planning actions.

- ♦ The Flaming Gorge National Recreation Area, including the Green River attracts 700 thousand to over 2 million visitors annually, depending on the year. The Green River corridor portion of the Flaming Gorge National Recreation Area has received annually between 100,000 and 150,000-user days over the past five years. The remaining use is spread out over the Flaming Gorge Reservoir and adjacent land areas. The Utah Travel Council and Utah Division of Wildlife Resources advertise the Green River as a blue ribbon fishery, and Flaming Gorge Reservoir as a major sport fishery and boating paradise. Direct and indirect annual expenditures connected with river experiences and uses are estimated to average $25 million ("Recreation Use Capacity of the Green River Corridor below Flaming Gorge Dam", dated April 1991), with close to $100 million expended on recreation pursuits for the Flaming Gorge National Recreation Area as a whole in both Wyoming and Utah (figures from Utah and Wyoming Travel Council Tourism Economic Studies).

Flaming Gorge Reservoir –

The 91-mile reservoir has approximately 360 miles of shoreline. A variety of infrastructure and uses occupy both the surface and shoreline of the reservoir.

- ♦ There are 29 developed sites immediately adjacent to the reservoir, consisting of:
  - 3 developed marinas
  - 9 concrete boat ramps with paved access roads
  - 4 boat-in campgrounds
  - 7 family or group campgrounds
  - 3 swim beaches
  - 3 undeveloped recreation sites

- In addition, there are numerous buoys, docks, signs, etc., associated with these sites.

- Both private business operations and Forest Service management activities are interconnected with each above sites. Mariana and campgrounds are operated and managed under special use permit by private companies.

- Concessionaires manage the campgrounds. Onsite management occurs 24 hours each day of the week. The majority of the campgrounds are on the National Campground Reservation System.

- Investments in recreation related infrastructure (both private and federal government) is estimated to near or slightly above 200 million dollars, with gross annual business income estimated between one and two million dollars. **

  **** These figures will be refined during the EIS Process.**

- Both investments and income can be adversely affected by unplanned, and severe changes in reservoir elevation levels. Damage to facilities can occur during severe drawdowns, causing increased business costs and loss of revenues to special use permittees and concessionaires.

Flaming Gorge-Uintas National Scenic Byway –

- Utah State Road 44 and US Highway 191 are components of the Flaming Gorge National Scenic Byway. This special designation recognizes historical, scenic, and recreational values associated with the Flaming Gorge National Recreation Area. The byway and its amenities are marketed and promoted nationally and internationally as a destination highway. The Flaming Gorge-Uintas Scenic Byway Corridor Management Plan directs programs and actions along the two routes, and includes actions and programs connected to Flaming Gorge Reservoir and Green River. The reservoir and river are major attractions and integral to successful marketing, promotion, and management of this National Scenic Byway.

Recreation and Administration of the Green River from Flaming Gorge Dam to Little Hole, including Little Hole National Recreation Trail, roads, boat ramps, parking areas, restroom facilities, day use areas, and concessionaire and outfitter/guide operations –

- Little Hole National Recreation Trail is advertised and displayed on State, Forest and other regional and national recreation maps. Primary use occurs between Flaming Gorge Dam and Little Hole Recreation Complex, with proposals to improve and extend the trail beyond the Little Hole area.

- The trail is needed to provide and manage access and use along the Green River. The trail is engineered to provide safe access. Relocation options are limited. Trail work and trail facilities have always been coordinated with the Bureau of Reclamation, Flaming Gorge Field Division.

- There is a 2.7 million dollar investment in facilities supporting the recreational fishery on National Forest System lands below Flaming Gorge Dam. Facilities considered in the investment are:

  -Spillway Recreation Complex (road, toilets, ramps, trail, etc.)
  -Trail along the river (engineered trail, including stabilizing structures)
  -Toilets in river corridor
  -Riverside campsites (13 sites)
  -Little Hole Road
  -Little Hole Overlook
  -Little Hole Recreation Complex (ramps, toilet, picnic area, jetties, etc.)
  -Dripping Spring Campground

- One million dollars of the 2.7 million dollars are invested in facilities directly within the Green River corridor on National Forest System lands.

- The Bureau of Land Management issues special use permits to outfitters/guides and concessionaires within the Green River corridor. The Forest Service administers these permits. This arrangement allows the return of up to 3 percent of special use permit revenues for the purpose of administering, improving, and maintaining river facilities. (The Forest Service does not have the authority that allows return of revenues collected within the Green River corridor.)

- Bureau of Land Management and Forest Service personnel jointly patrol the river, and manage and maintain river facilities in Sections A, B, and C, as defined in the Green River Management Plan", dated May 20, 1996. The Forest Service provides overall supervision.

- Concessionaires manage the Spillway Recreation Complex and Little Hole Recreation Complex in Section A. Onsite management occurs 14 hours each day of the week. These concessionaires also maintain the "river campgrounds" in Section B and collect a $10.00 per night fee. Several of these river campgrounds will soon be placed on the National Campground Reservation System.

- Thirteen Outfitter/Guide businesses use the Green River corridor, Sections A, B, and C as defined in the Green River Management Plan", dated May 20, 1996. Annual revenues for these businesses equal or exceed 1.3 million dollars. Each outfitter employs 7 to 9 people from early spring to late fall.

Business Ventures and Capital in the Flaming Gorge National Recreation Area–

- In addition to the developed marinas and outfitter/guide services mentioned above, several other businesses are directly related to both reservoir and river recreation activities. These businesses consist of stores, gas service stations, shuttle services, restaurants, and lodging facilities. Each business has substantial investments in infrastructure and employee many people, sometimes year round.

- Several of the businesses operate under special use permit issued by the Forest Service. We have the responsibility to provide a successful business environment and/or to inform them of pending changes that will adversely or otherwise affect their business income. The analysis and evaluation process for the EIS must address and quantify affects to these business ventures.

Dutch John Privatization –

- The town and town site of Dutch John, Utah has recently been privatized, with land and various facilities to be transferred to Daggett County. Success of this community will hinge on existing and new recreation businesses, and on regional and national recreation visits. Business success will be dependent on maintaining quality experiences for clients within the Green River corridor and on Flaming Gorge Reservoir.

Destination Resorts –

- Many visitors consider the Green River corridor and the Flaming Gorge National Recreation Area as a destination, rather than a "pass through" experience. Visitors are planning complete vacations around activities and accommodations associated with two areas. The Utah Travel Council advertises the Green River Corridor and Flaming Gorge National Recreation Area as destination resort areas. Annual recreation visits indicate that the area is within the top ten most visited sites in Utah.

Future Studies on Recreation Use –

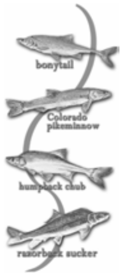
- A "Recreation Use Monitoring Contract" will be implemented October 1, 2000, and continue through September 2001. This contract will be designed to measure use, satisfaction, and expectations. Survey data will be gathered at many locations within the Flaming Gorge National Recreation Area and in the Green River corridor.

The Forest Service will provide technical representatives to assist EIS team members in gathering specific data for the above management concerns. We review all technical reports and the preliminary draft environmental impact statement, and provide substantive comments for change, modification, and clarification of issues, concerns, affects, alternatives, and mitigation measures.

-end-

Operation of
Flaming Gorge Dam
Final Environmental
Impact Statement

Hydrologic Modeling Technical Appendix



HYDROLOGIC MODELING TECHNICAL APPENDIX

Page No.

Hydrologic Modeling Technical Appendix

RESULTS OF ACTION AND NO ACTION ALTERNATIVE ANALYSIS

R. Clayton and A. Gilmore
October 1, 2001

INTRODUCTION

A model of the Green River Basin has been developed to simulate the operations of Flaming Gorge Dam under varying hydrologic conditions. The Green River model was developed for the purpose of characterizing the hydrologic effects to Flaming Gorge Reservoir and the Green River below Flaming Gorge Dam caused by the implementation of the proposed alternatives for the Flaming Gorge Dam Environmental Impact Statement (Flaming Gorge EIS).

Two alternatives have been proposed for the Flaming Gorge EIS. The Action Alternative requires Flaming Gorge Dam to be operated to achieve the flow recommendations described in the *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations). The No Action Alternative requires Flaming Gorge Dam to be operated to achieve the recommended flows described in the 1992 Biological Opinion on the Operation of Flaming Gorge Dam (1992 Biological Opinion). At the present time and since 1992, Flaming Gorge Dam has been operated to achieve the flow objectives of the 1992 Biological Opinion.

For each of these alternatives, the authorizing purposes of Flaming Gorge Reservoir are to be "maintained" in such a way that impacts to these resources are minimized. In the Green River model, rules to operate Flaming Gorge Dam to achieve the flow objectives described in the 2000 Flow and Temperature Recommendations and the 1992 Biological Opinion were developed. These rules were then modified to reduce the occurrences and magnitudes of bypass releases while still achieving the flow objectives of the alternative. Reducing the occurrences and frequencies of bypasses was the method used to "maintain" the purposes for which Flaming Gorge Dam was authorized.

The purpose of this report is to summarize the hydrologic effects observed in the model output as a result of achieving the flow objectives of each proposed alternative. The results in this report focus on the model output from Flaming Gorge Reservoir and the Green River below Flaming Gorge Dam.

MODELING SCOPE

The Green River model was created from an existing model called the Colorado River Simulation System (CRSS). The CRSS has been used for several years to identify impacts to reservoirs in the Colorado River Basin under different hydrologic scenarios. Most recently, CRSS was used to quantify the impacts of the proposed alternatives for the Colorado River Interim Surplus Criteria Environmental Impact Study (2000).

All major elements of the Green River System are represented in the Green River model, and some elements are more accurately represented than others. The Green River below Flaming Gorge Dam is divided into three sections, known as reaches, in the 2000 Flow and Temperature Recommendations. All three of these reaches are represented in the Green River model. Reach 1 extends from the tailrace of Flaming Gorge Dam to the confluence with the Yampa River. Reach 2 extends from the confluence of the Green River with the Yampa River to the confluence of the Green River with the White River. Reach 3 extends from the confluence of the Green River with the White River to where the Green River meets the Colorado River. The flows for Reaches 1 and 2 are more accurate in the model than those for Reach 3. This is because the effects of the White and Duchesne Rivers on the flows in the Green River are not fully understood. At this point, these river systems have not been adequately modeled to determine how they will be regulated and developed in the future. For this reason, results for Reach 3 have not been included in this report.

The Green River model routes natural flows (river flows that do not include human interferences such as depletion and regulation), referred to as input hydrology, through the reservoir system on the Green River (Fontenelle and Flaming Gorge Reservoirs). A monthly natural flow database was developed for the Upper Colorado River Basin for use as input hydrology for CRSS. The input hydrology for the Green River model was selected from this database. A period of record was selected that had the most complete natural flow dataset available for the upper Green River Basin. This period begins in January 1921 and ends in December 1985 (65 calendar years). The natural flow data is being extended to 1995; however, this work has not yet been completed. The Green River model will be re-evaluated with this additional data for the Final Flaming Gorge EIS.

The initial conditions of the Green River model were selected to be the state of the Green River system in January of 2002 as described in the 2000 Annual Operating Plan (AOP) for Colorado River System Reservoirs. The 2000 AOP was based on the August 2000 run of the 24-Month Study Operational Model of the Colorado River. The Green River model runs for 39 years to December 2040.

Beyond 2040, estimated depletion schedules for water users represented in the model were considered too speculative to be useful. Depletion schedules were updated to reflect water development forecasts produced by the Upper Colorado River Commission (1999). Given the uncertain nature of water development schedules far into the future and the fact that the model predicted reservoir elevations that appeared stabile in the distant future, ending the model run in 2040 was reasonable.

Different hydrologic scenarios, referred to as input traces, are routed through the Green River model. Each trace is one set of 39 years of natural flows. Because the input hydrology for the model is based on historic hydrology, all the input traces have a high probability of occurring in the future. No single input trace, or set of input traces, has a higher probability of occurring then any of the other input traces. The Index Sequential Method (ISM) was used to construct 65 input traces for the Green River model from the natural flow dataset selected. The ISM involves incrementing the beginning and ending years of the natural flows for the following input trace by 1 year. For example, the first trace of the model began with the natural flows for January 1921, and ended 39 years later with the natural flows for December 1959. The second trace began with natural flows for January 1922 and ended in December 1960. Subsequent traces were developed in this manner until the end of the period of record was reached (December 1985). Once the end of the period of record was reached, additional traces were created by incrementally appending the initial natural flows from the period of record to the end of the trace so that the length of the trace was 39 years long. For example, the 28^{th} trace contained the natural flows for January 1948 through December 1985, but this only equaled 38 years. To extend this trace to a length of 39 years, the natural flows for January 1921 through December 1921 were added to the end of the 28^{th} trace. The 29^{th} trace required that 2 years of natural flows (January 1921 through December 1922) be appended to the end of the trace to achieve a length of 39 years. This process was continued until all 65 traces were constructed. When the Green River model is run, the model run is complete when all 65 input traces have been successfully routed through the Green River system.

To evaluate how well each run of the model achieved the flow objectives of the proposed alternatives, it was necessary to generate output at a daily timestep for river flows in Reaches 1 and 2. A daily post processor model was constructed for this purpose. The daily post processor model generated the spring release hydrograph from the monthly model results and processed it into daily results. The daily release hydrograph was then routed through Reaches 1 and 2 of the Green River. The historic daily flows of the Yampa River for the period from January 1, 1921, to December 31, 1985, were taken from United States Geological Survey stream flow records and were used as the input hydrology by the daily post processor. There are no rules in the daily post processor that operate Flaming Gorge Dam that are unique to the daily postprocessor model. All of the rules necessary to operate Flaming Gorge Dam to achieve the proposed alternatives are present in the monthly model and the daily post processor model.

RULESET DEVELOPMENT

The rules that operate Flaming Gorge Dam to achieve the objectives of the proposed alternatives are referred to as rulesets. For each of the proposed alternatives, one ruleset has been developed. The paragraphs below describe the specific objectives that each ruleset was designed to achieve.

During the spring (April through July), the objectives of the Action Alternative require a peak release magnitude of sufficient duration to achieve flow targets in Reaches 1 and 2. These objectives change depending on the hydrologic condition of the upper Green River Basin. Except for cases when the minimum release rate of 800 cubic feet per second (cfs) is prescribed, the objectives for Reach 2 appear to achieve the objectives for Reach 1 as well. The spring objectives of the Action Alternative for Reach 2 that are achieved by the Action ruleset are described below.

1. Achieve peak of 26,400 cfs for at least 1 day in 10 percent (%) of all years
2. Sustain peak of 22,700 cfs for at least 2 weeks in 10% of all years
3. Sustain peak of 18,600 cfs for at least 4 weeks in 10% of all years
4. Achieve peak of 20,300 cfs for at least 1 day in 30% of all years
5. Sustain peak of 18,600 cfs for at least 2 weeks in 40% of all years
6. Achieve peak of 18,600 cfs for at least 1 day in 50% of all years
7. Sustain peak of 8,300 cfs for at least 1 week in 90% of all years
8. Sustain peak of 8,300 cfs for at least 2 days in 98% of all years
9. Achieve peak of 8,300 cfs for at least 1 day in 100% of all years

These requirements were derived from table 5.5 in the 2000 Flow and Temperature Recommendations. The 2000 Flow and Temperature Recommendations are divided into five separate categories depending on the type of hydrologic conditions experienced in the upper Green River Basin. The objectives described above aggregate all of the flow objectives in the separate categories of the 2000 Flow and Temperature Recommendations into one group.

The Action Alternative also has flow objectives for the summer, autumn and winter. During this period (August through February), the Action ruleset controls the releases from Flaming Gorge Dam to achieve flow objectives for Reach 1 and 2 while attempting to lower the reservoir water surface elevation to a target of 6027 feet above sea level by the beginning of March. The Action ruleset maintains releases to achieve the flow objectives during the base flow period unless the reservoir elevation rises to 6040 feet above sea level or greater. When this occurs, releases are controlled by a maximum storage rule that prevents uncontrolled spills. When the inflow into Flaming Gorge during the base flow period is greater than anticipated and the elevation is below 6040, the flow objectives are maintained; and the target elevation will not be achieved. Releases during March and April attempt to reset the elevation of the reservoir to 6027 feet above sea level by the beginning of May by making releases in the range from 800 to 4,600 cfs.

The No Action Alternative has spring flow objectives that are less specific than the Action Alternative. Instead, the flow objectives of the No Action Alternative focus more on flows during the summer and autumn period. The flow objectives of the No Action Alternative during the spring require a peak release with a magnitude of at least 4,600 cfs (powerplant capacity) and a duration from 1 to 6 weeks in all years. In wet years, the No Action ruleset makes the duration of the peak release approach 6 weeks in length. In dry years, the duration is set to at least 1 week in length. The No Action ruleset determines a spring release volume by attempting to control the reservoir elevation to achieve a fill target for the end of July. This volume is then shaped into a spring peak hydrograph that achieves the spring objectives described above.

During the summer and autumn (before October), releases from Flaming Gorge Dam are managed by the No Action ruleset so that flows in Reach 2 are between 1,100 and 1,800 cfs. In October, releases are managed so that flows in Reach 2 are between 1,100 and 2,400 cfs. From November through February, there are no restrictions placed on flows during the base flow period. The model restricts these flows to the range from 800 to 4,600 cfs to lower the reservoir elevation to a target of 2027 feet above sea level by the beginning of March. These constraints are violated only when the reservoir elevation gets too high for safe operation of , Flaming Gorge Dam (6040 feet above sea level). In March and April, releases are controlled between 800 and 4,600 cfs to achieve a reservoir elevation target of 6027 feet above sea level by May. The rule, which operates Flaming Gorge Dam during March and April, is identical in both the Action and No Action rulesets.

MODELING ASSUMPTIONS

Because of the limitations of the modeling environment, many assumptions were made in the development of the Green River model and the Action and No Action rulesets. The assumptions that are specific to this model are described below:

1. Actual historic forecasting of the spring (April through July) unregulated inflow volume for Flaming Gorge is assumed to represent the current and future level of forecast accuracy. Forecasted spring unregulated inflow volumes into Flaming Gorge have been issued by the National Weather Service since 1963. The Green River model generates spring unregulated inflow forecasts with an error distribution that is similar to the historical error distribution.

2. It is assumed that the timing and magnitude of the peak flow of the Yampa River can be predicted accurately at least 10 days prior to its occurrence. To achieve the spring flow objectives of the Action Alternative, while efficiently managing the resources of Flaming Gorge, the peak release from Flaming Gorge Dam must be optimally timed with the peak flows of the Yampa River. The magnitude of the peak release from Flaming Gorge Dam must also be optimally chosen to efficiently supplement flows on the Yampa River.

3. It is assumed that decisions regarding the operation of Flaming Gorge will be made at the beginning of each month. Even when conditions change mid-month, decisions to react to the changing conditions must wait until the beginning of the following month. In reality, operational decisions at Flaming Gorge Dam are made on a daily basis, but the Green River model is limited by the monthly timestep process.

4. It is assumed that the natural hydrology of the Green River Basin (from 2002 to 2040) will be similar in the future to the natural hydrology that occurred during the period from 1921 to 1985.

5. Whenever flow objectives for Reach 2 are achieved, it is assumed that the flow objectives for Reach 3 are also achieved.

6. River flows in Reach 1 and Reach 2 are assumed to have the same magnitude at all points along the reach. Gains and losses as a result of infiltration, precipitation, or evaporation along the reach are not accounted for in the model.

7. All hourly flow objectives for each of the proposed alternatives are assumed to be achieved and are not directly considered within the Green River model.

8. Flaming Gorge Powerplant is assumed to have a capacity of 4,600 cfs. The bypass tubes are assumed to have a total capacity of 4,000 cfs. The spillway is assumed to have a capacity of approximately 28,000 cfs.

MODEL RESULTS

Analysis of the output for the Action Alternative model run indicated that the magnitude and duration of the peak releases increased significantly as a result of achieving all of the flow objectives of the Action Alternative. Magnitudes and durations of the peak releases in the No Action results were noticeably smaller and shorter. An investigation of the individual flow objectives for the Action Alternative discovered that one flow objective was responsible for most of these increases. The Reach 2 objective requiring a sustained flow on the Green River of 18,600 cfs for at least 2 weeks in 40% of all years required peak releases of at least 8,600 cfs in 40% of all years and at least 10,600 cfs in 20% of all years to achieve this objective.

To help understand the impacts associated with achieving this one objective, two versions of the Action ruleset were constructed. The first version, which is described as the Action (ALL) model run, achieved all flow objectives for the Action Alternative including the 18,600-cfs objective. The second version of the Action ruleset, described as the Action (ALL-1) model run, did not focus on achieving the 18,600-cfs objective. Instead this ruleset focused on achieving all other flow objectives of the Action Alternative and ignored the 18,600-cfs objective. Table 1 summarizes the Action (ALL), Action (ALL-1) and No Action model results in terms of how well the spring flow objectives of the Action Alternative were achieved under each ruleset. It is important to note that even when this objective was ignored by the Action (ALL-1) ruleset, it was still achieved 18.2% of the time as a result of achieving the other flow objectives. Analysis of the Action (ALL-1) results show that 18,600 cfs was achieved 40% of the time in Reach 2 for a duration of 6 days.

Table 1—Controlling Criteria Analysis of Action and No Action Model Results

Spring Peak Flow Recommendations for Reach 2	Target %	Model Results (%)		
		Action (ALL-1)	Action (ALL)	No Action
Achieve Peak at Jensen >= 26,400 cfs	10	11.4	16.4	5.0
Sustained Peak at Jensen >= 22,700 cfs for at least 2 weeks	10	10.8	12.3	4.1
Sustained Peak at Jensen >=18,600 cfs for at least 4 weeks	10	9.5	18.1	5.0
Achieve Peak at Jensen >= 20,300 cfs	30	44.7	57.7	40.4
Sustain Peak at Jensen >= 18,600 cfs for at least 2 weeks	**40**	**18.2**	**43.1**	**14.0**
Achieve Peak at Jensen >= 18,600 cfs	50	60.2	66.0	58.9
Achieve Peak at Jensen >= 8,300 cfs	100	99.7	99.7	98.5
Sustain Peak at Jensen >= 8,300 cfs at least 1 week	90	96.9	96.9	96.9
Sustain Peak at Jensen >= 8,300 cfs at least 2 days except in extreme dry years	98	97.3	97.3	97.3

RESERVOIR WATER SURFACE ELEVATION RESULTS

For each month of the model run, from January 2002 to December 2040, there are 65 elevations that could potentially occur in any given month (one elevation for each trace). These monthly data sets have been sorted from lowest to highest. The 10th, 50th, and 90th percentile values have been selected from each set. Figure 1 shows the 90th percentile elevations that occurred for all three runs of the model for the first 10 years of the model run. The results in figure 1 do not represent any one particular elevation trace. Rather, these curves can best be thought of as a boundary elevation that will be exceeded 10% of the time. To illustrate how individual traces fluctuate through time, trace 54, which achieved the 90% boundary elevation in July, 10 years into the model run, is included in the figure. The amplitude of the curves from year to year indicated how much water was being stored during the spring for release later in the year. The smaller the amplitude, the less storage that took place throughout the year and the less change in elevation that occurred from year to year. Both the Action (ALL) and the Action (ALL-1) model runs have smaller amplitudes than the No Action Alternative, indicating less active storage and less elevation change during the year.

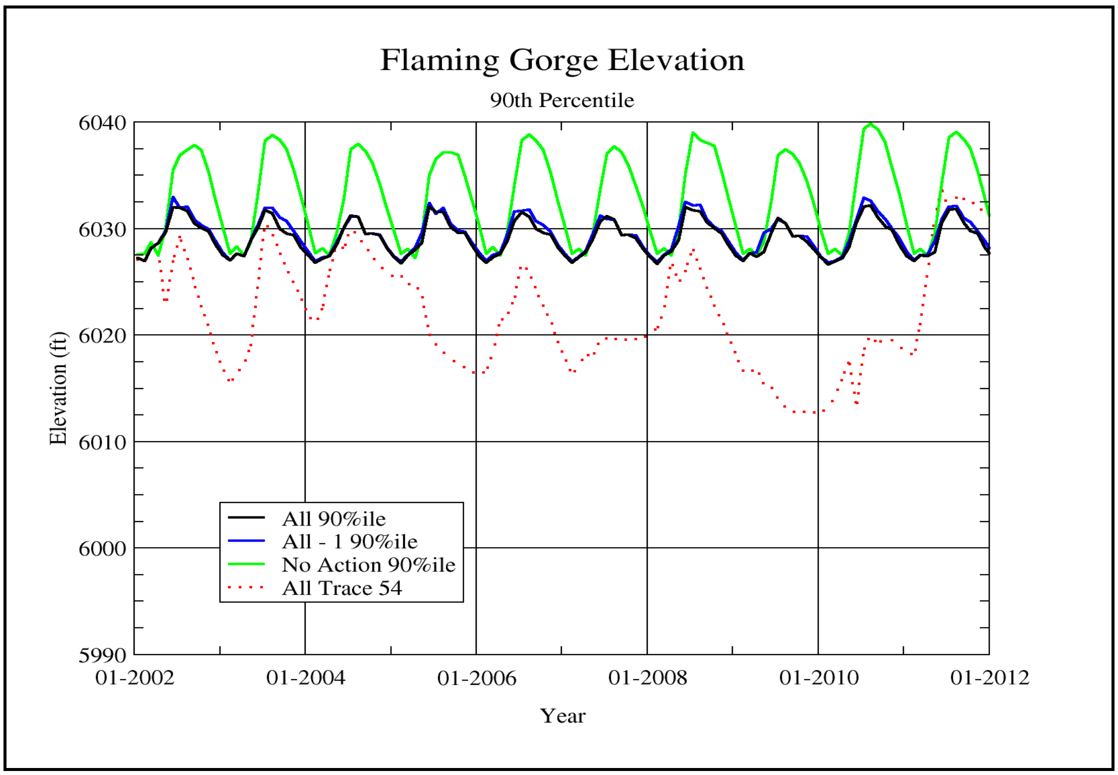


Figure 1.—90th Percentile Elevations from January 2002 to December 2011.

To illustrate an example of the impacts that achieving the 18,600-cfs objective had on the reservoir elevation, figure 2 shows trace 54 results for all three model runs during the first 10 years. Five of the ten years shown in the figure triggered the Action (ALL) ruleset to achieve 18,600-cfs objective because of high flows experienced on the Yampa River. The years when Action (ALL) ruleset was triggered were 2002, 2006, 2008, 2010, and 2011. In these years, the

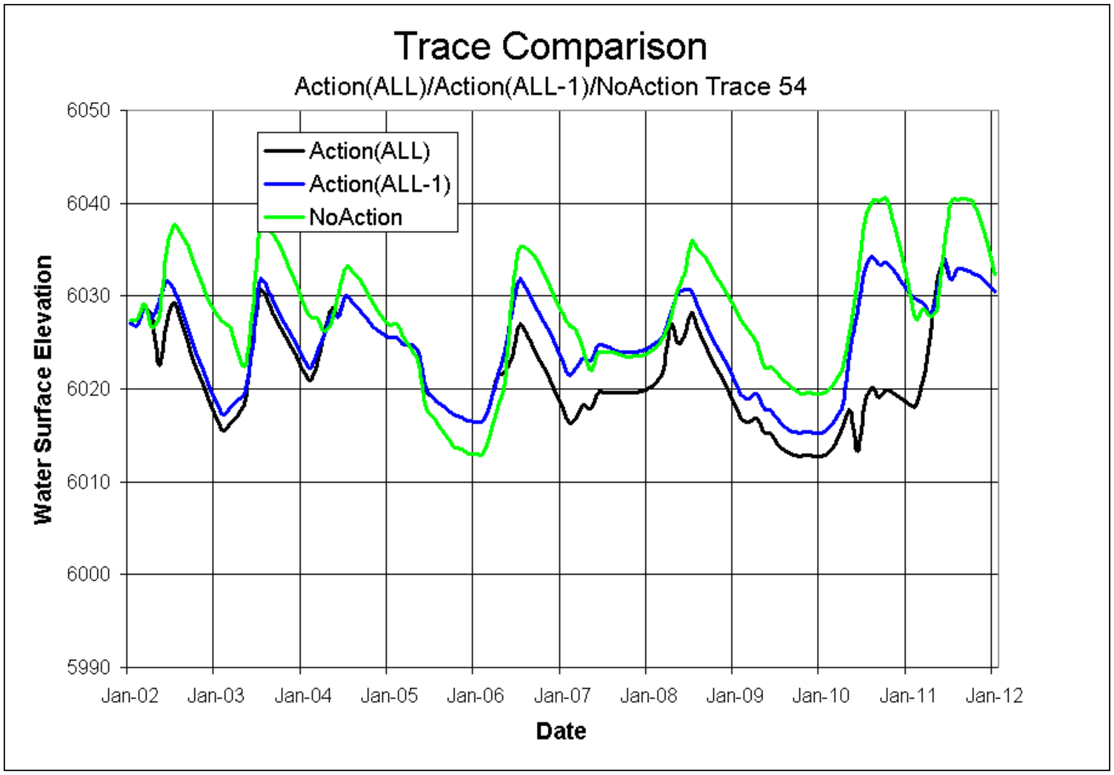


Figure 2.—Trace 54 Elevation Comparison.

peak release from Flaming Gorge Dam was increased (if necessary) to the threshold level necessary to achieve 18,600 cfs in similar years (in some years, this meant increasing to 8,600 cfs and other years to 10,600 cfs). In all years except 2011, the peak release was increased by the Action (ALL) ruleset above the peak release that was calculated for the Action (ALL-1) ruleset. In 2011, the release rate estimated in both the Action (ALL) and the Action (ALL-1) rulesets was high enough to achieve the 18,600-cfs objective. The hydrology for the upper Green River Basin during the spring of 2011 was very wet, and releases during that year were hydrologically driven to control the reservoir elevation and not by the flow objectives of the proposed alternative. The increased releases are evident by the sharp drops in elevation that occurred in the spring of each of the years mentioned above.

The 50th percentile ("most probable") elevations over the first 10 years of the model runs are shown in figure 3. As compared to the two Action Alternatives, the No Action Alternative provided significantly higher reservoir elevations in the summer months. The Action (ALL) results indicated lower elevations than the Action (ALL-1) results. During the winter, elevations were very similar for all three model runs since the draw down target is the same in all three rulesets. As in figure 1, a single trace has been included in figure 3. This trace (trace 16) achieved the 50% exceedance level for the Action (ALL) results in July, 10 years into the trace.

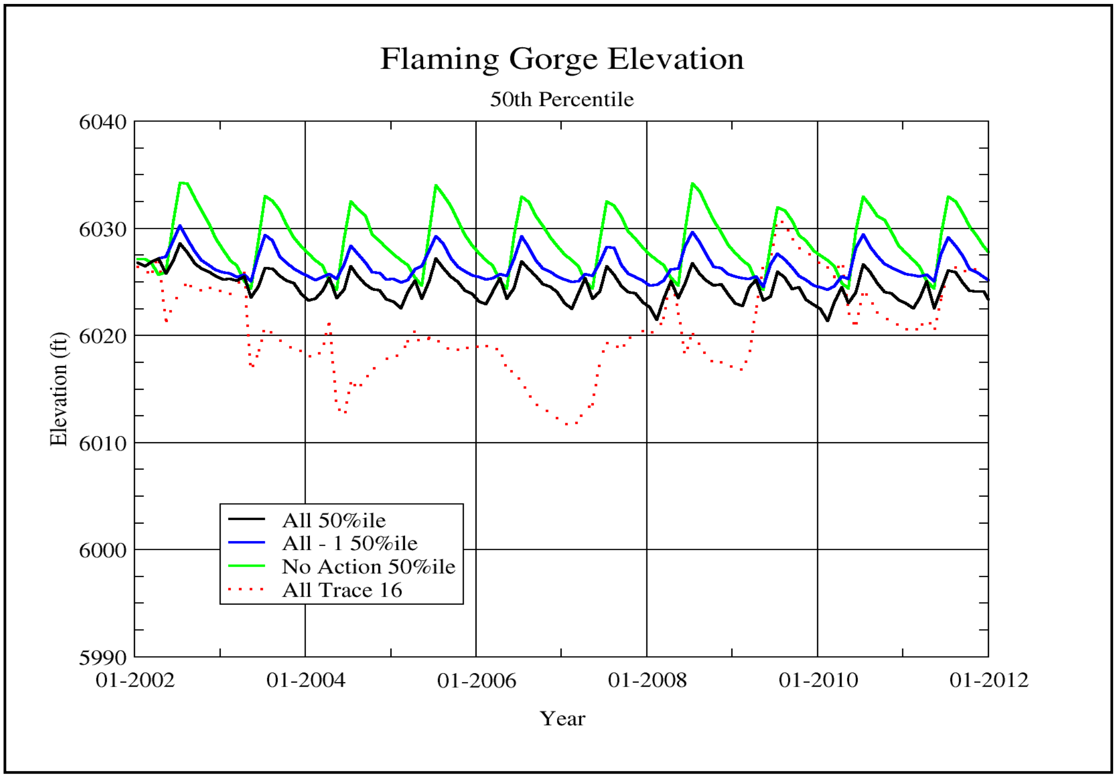


Figure 3.—50th Percentile Elevations from January 2002 to December 2011.

Figure 4 shows another example of how achieving the 18,600-cfs objective had a significant impact to the reservoir elevation of the Action (ALL) results. In this trace (trace 16), there are 5 years where the Yampa River flows during the spring were high and triggered the Action (ALL) ruleset to attempt to achieve the 18,600-cfs objective. These years were 2002, 2003, 2004, 2008, and 2010. Because of the increased peak releases that occurred in these years for the Action (ALL) model run, the reservoir elevation remained substantially lower than the Action (ALL-1) model run for most of the 10-year period shown in the figure. The elevation, fully recovered in 2009, was then depressed in 2010 when the Action (ALL) ruleset was again triggered to achieve the 18,600-cfs objective.

Figure 5 shows the 10th percentile reservoir elevations for the first 10 years of each model run. These elevations were exceeded 90% of the time but were equal or lower than these levels 10% of the time. The Action (ALL) results show a significant impact to the reservoir elevation as a result of the 18,600-cfs objective. Reservoir elevations for the Action (ALL) results decreased substantially over the first 10 years, then stabilized below 6000 feet above sea level for the remainder of the model run. The results for the Action (ALL-1) model run indicated that meeting all flow objectives except for the 18,600-cfs objective did not significantly impact the reservoir elevation through time. An example trace (trace 5) has been included in figure 5 which shows how the reservoir elevation tracked for the Action (ALL) model run. The elevation for this trace of the Action(ALL) model run achieved the 10th percentile value in July, 10 years into the trace.

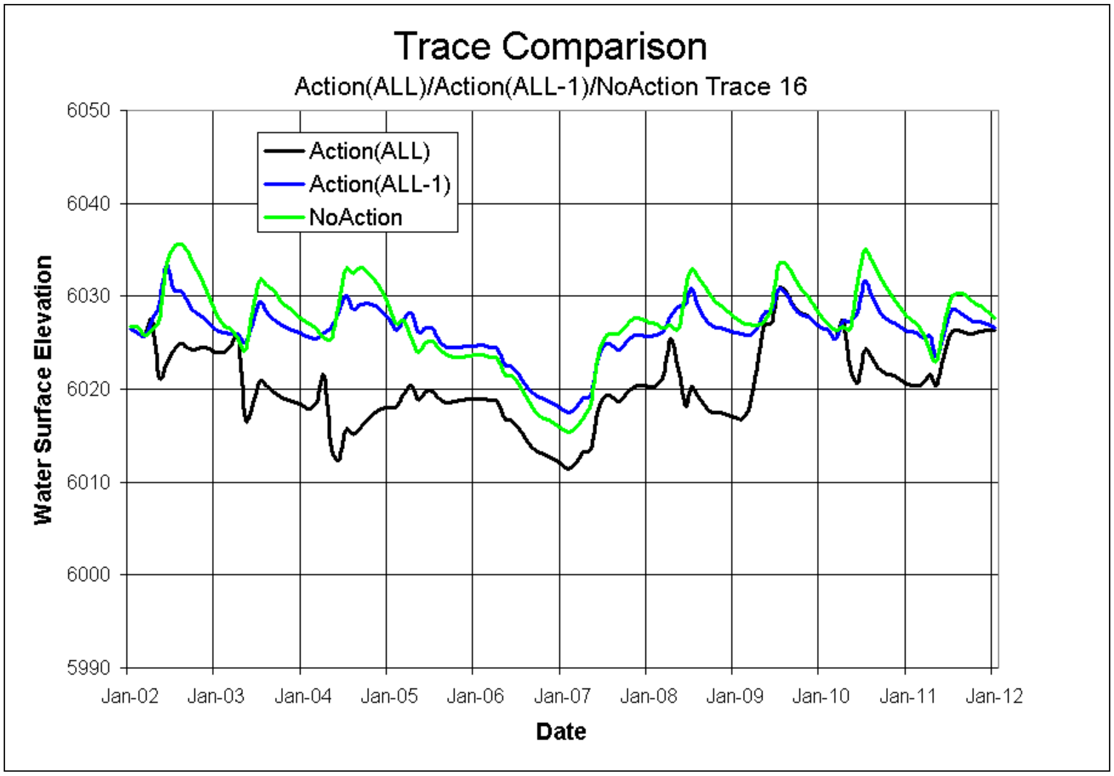


Figure 4.—Trace 16 Elevation Comparison.

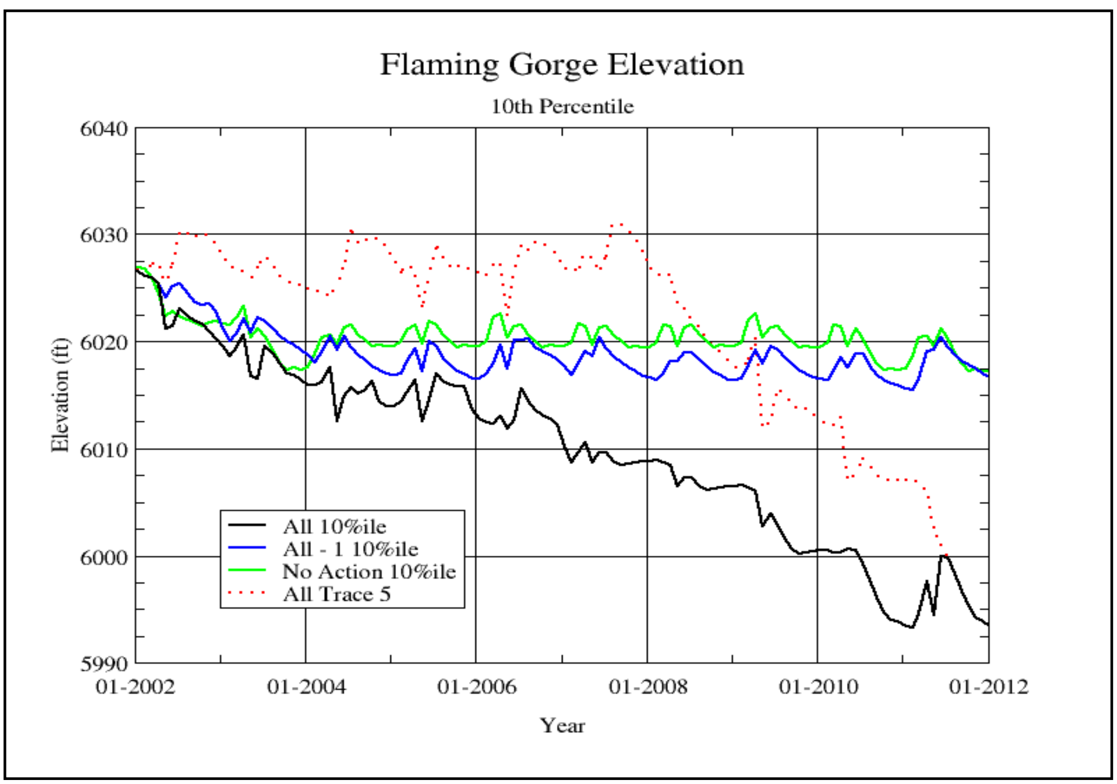


Figure 5.—10th Percentile Elevations from January 2002 to December 2001.

Figure 6 shows another example of how the Action (ALL) and Action (ALL-1) rulesets behave under identical hydrologic conditions. In the first 8 years of trace 5, the Action (ALL) reservoir elevations were the same as the Action (ALL-1) reservoir elevations. This indicated that the releases made by the two rulesets were identical for the first 8 years. However, conditions on the Yampa River in 2005, 2006, and 2007 triggered the Action (ALL) ruleset to attempt to achieve the 18,600-cfs objective. Because conditions were very wet in the upper Green River Basin in those years, the peak release established by the Action (ALL-1) ruleset was equal to or greater than the threshold peak release that the Action (ALL) ruleset would have reset the peak release to. For this reason, the Action (ALL) reservoir elevations did not deviate from the Action (ALL-1) reservoir elevations during the first 8 years of the trace. In 2010, this was not the case. The Action (ALL) ruleset reset the peak release to achieve the 18,600-cfs objective, resulting in the reservoir elevation dropping about 8 feet below the Action (ALL-1) elevation.

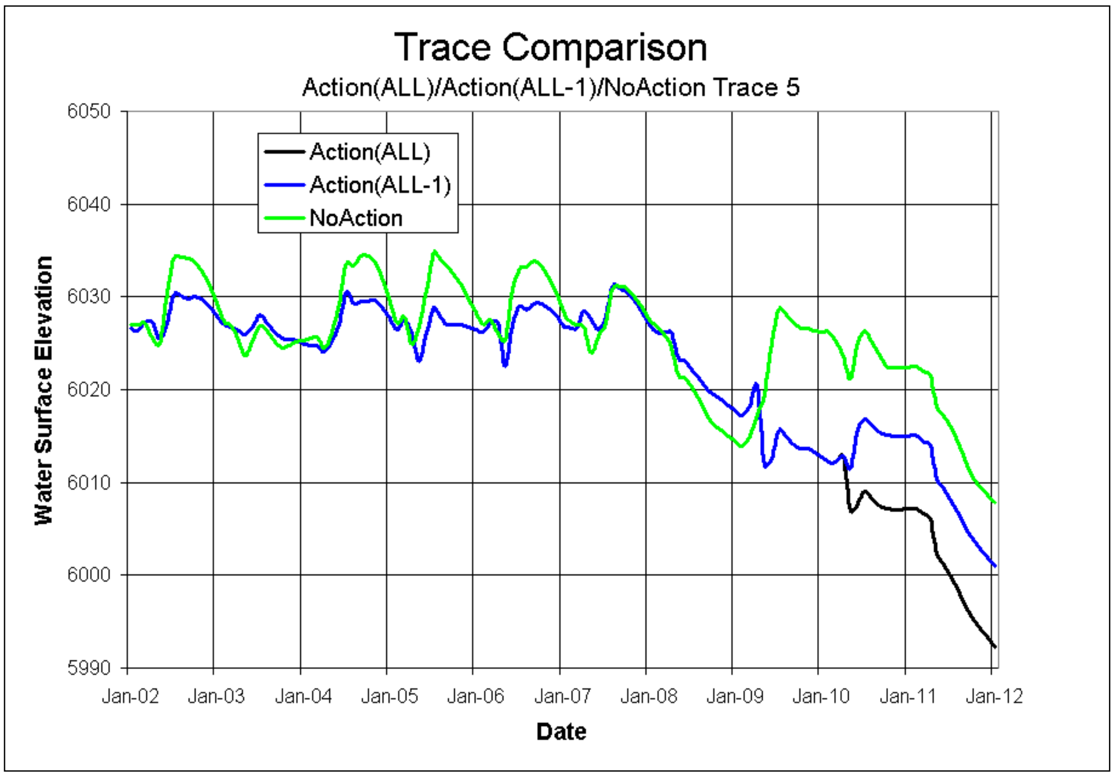


Figure 6.—Trace 5 Elevation Comparison.

During the early spring, the elevation of Flaming Gorge Reservoir is normally at its lowest level of the year. Figures 7 and 8 show the number of occurrences when the elevations at the end of April are within particular ranges. Figure 7 shows a comparison between the Action (ALL-1) and the No Action model output. Figure 8 shows a comparison between the Action (ALL) and the No Action model output. Comparison between figure 7 and figure 8 shows that achieving the 18,600-cfs objective had the effect of increasing the occurrences of lower elevations in the spring. The number of occurrences when elevations at the end of April were below 6000 feet above sea level increased from less than 50 (2% of the time) in the Action (ALL-1) model run to nearly 300 (12% of the time) in the Action (ALL) model run. There were no occurrences in the No Action results where the elevations at the end of April fell below 6000 feet.

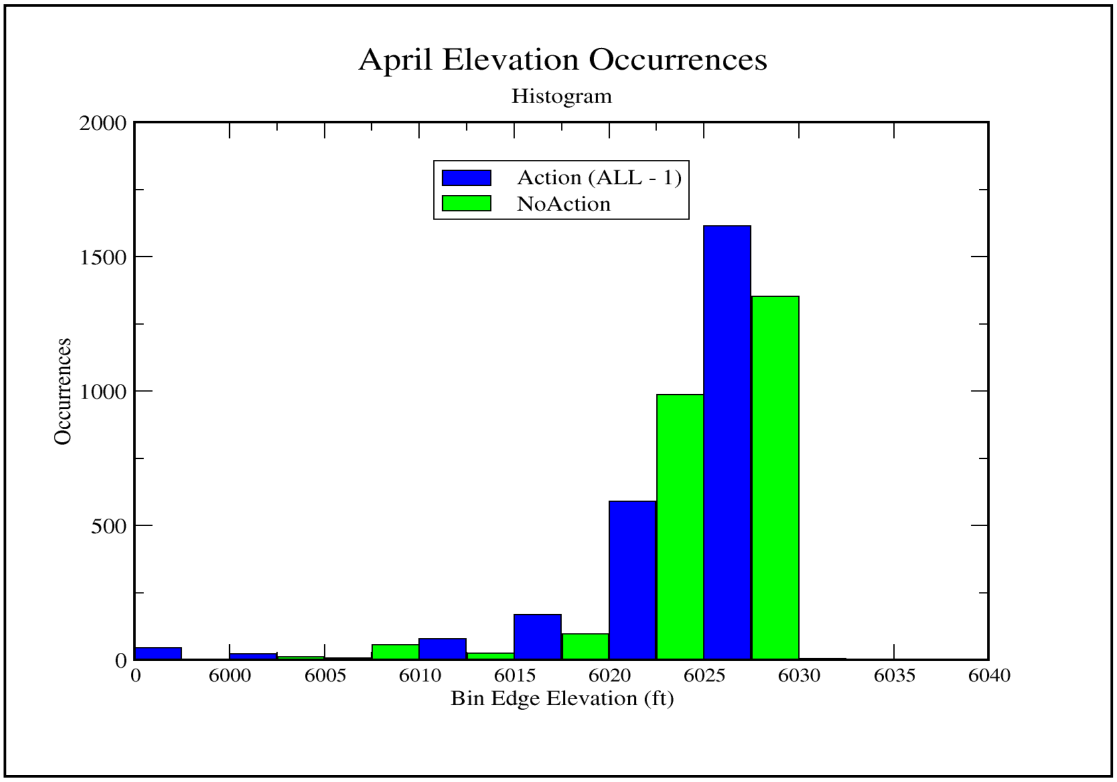


Figure 7.—Histogram of Action (ALL-1) and No Action April Elevations.

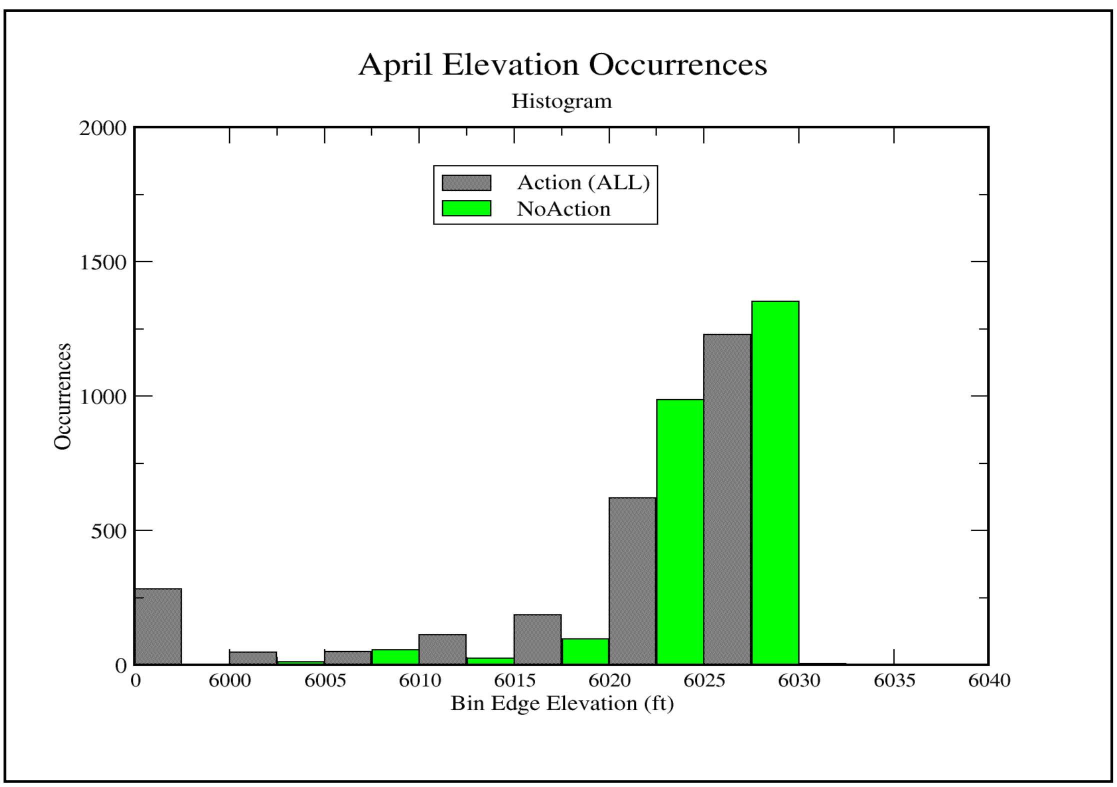


Figure 8.—Histogram of Action (ALL) and No Action April Elevations.

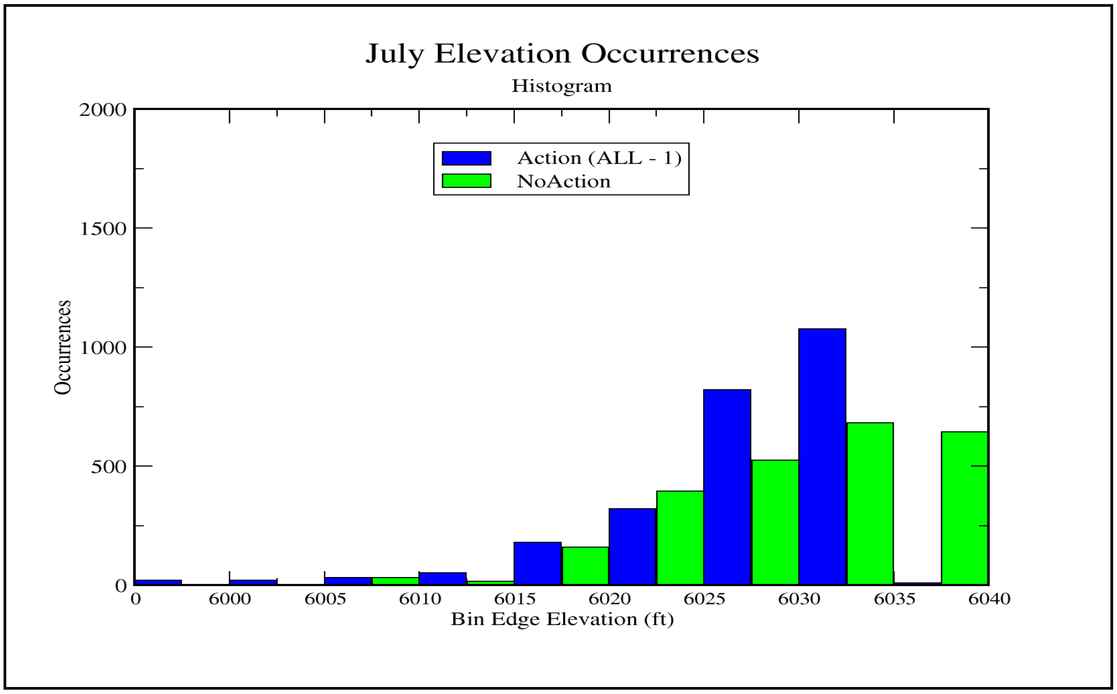


Figure 9.—Histogram of Action (ALL-1) and No Action July Elevations.

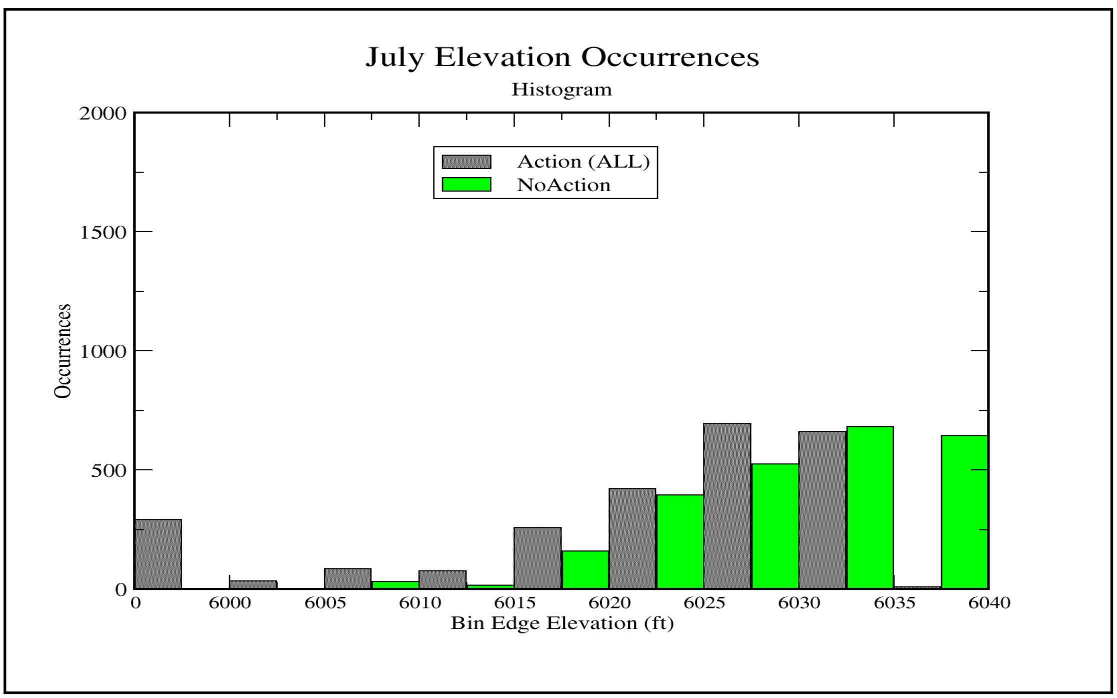


Figure 10.—Histogram of Action (ALL) and No Action July Elevations.

Typically, by the end of July, the reservoir is approaching its highest level of the year. Figures 9 and 10 show the same relationships as figures 7 and 8, only for reservoir elevations at the end of July. Inspection of these figures shows again that the occurrences of elevations at the end of July that were below 6000 feet above sea level increased significantly when the model achieved the 18,600-cfs objective. The Action(ALL-1) occurrences when elevations at the end of July were below 6000 were about 20 (>1% of the time). The Action(ALL) occurrences for this same classification were nearly 300 (12% of the time). The No Action model run had no occurrences where elevations at the end of July were below 6000.

Table 2 shows the exceedance percentage values for all February and July elevations for the Action (ALL and ALL-1) and No Action results. The results in table 2 indicate that the "most likely" (50% exceedance) reservoir elevations at the end of February for the Action (ALL-1) model run were about 2 feet lower than the No Action model run. The "most likely" end-of-July elevations had a difference of nearly 4 feet for the Action (ALL-1) and No Action rulesets. Similar comparison between the Action (ALL) ruleset and the No Action rulesets shows that the "most likely" end-of-February elevations were about 5 feet lower for the Action (ALL) then the No Action ruleset. The July elevation difference was about 7 feet.

Table 2.—Percentage Exceedance February/July Elevations

Percentage Exceedance	Action (ALL-1) (Feet above Sea Level)	Action (ALL) (Feet above Sea Level)	No Action (Feet above Sea Level)
90%	6016.4/6019.2	5992.9/5997.2	6020.1/6021.4
80%	6020.1/6023.6	6013.7/6015.7	6024.7/6024.1
70%	6022.5/6026.4	6017.7/6020.3	6026.3/6026.7
60%	6024.0/6028.0	6020.0/6023.5	6026.9/6028.7
50%	6025.1/6029.1	6022.0/6026.0	6027.0/6032.8
40%	6025.9/6030.3	6024.2/6027.9	6027.2/6033.9
30%	6026.3/6030.7	6025.5/6029.3	6027.3/6034.9
20%	6026.6/6031.2	6026.2/6030.8	6027.5/6036.1
10%	6027.0/6032.1	6026.8/6031.8	6027.7/6038.0

Figures 11 and 12 show the complete distribution of the February and July elevations that were predicted for the three model runs. For reference, historic elevations for the period from 1971 through 1991 have been included on the figures.

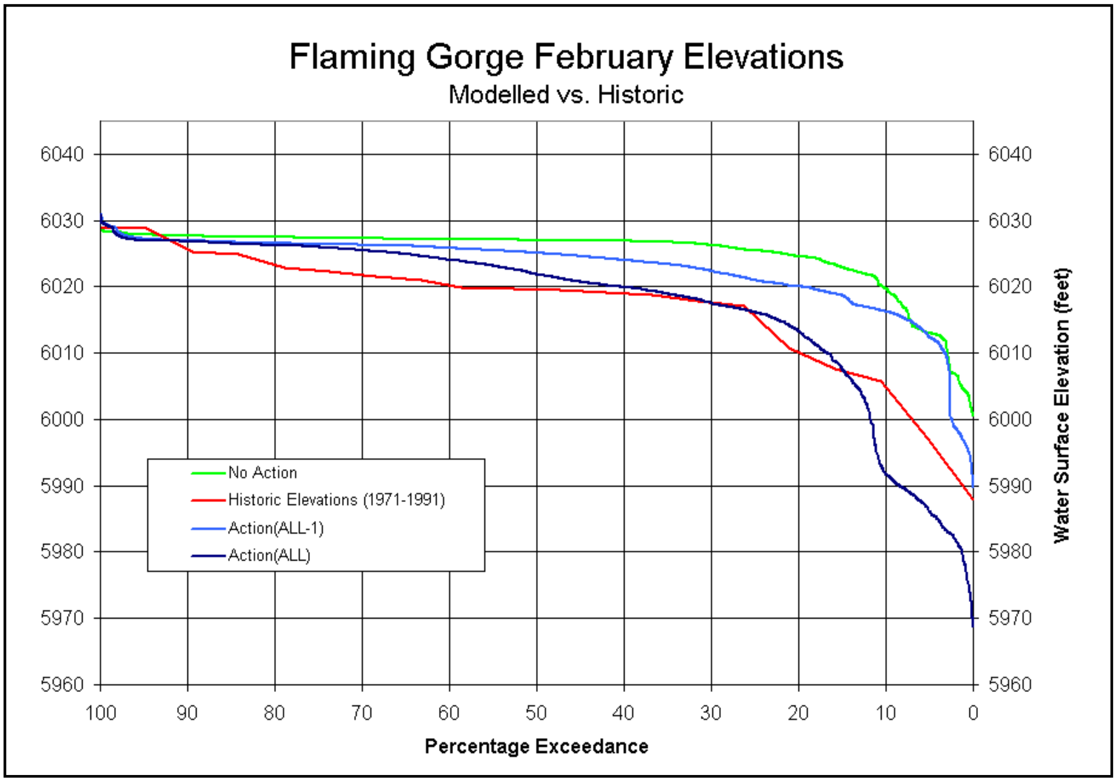


Figure 11.—Distribution of February Water Surface Elevations.

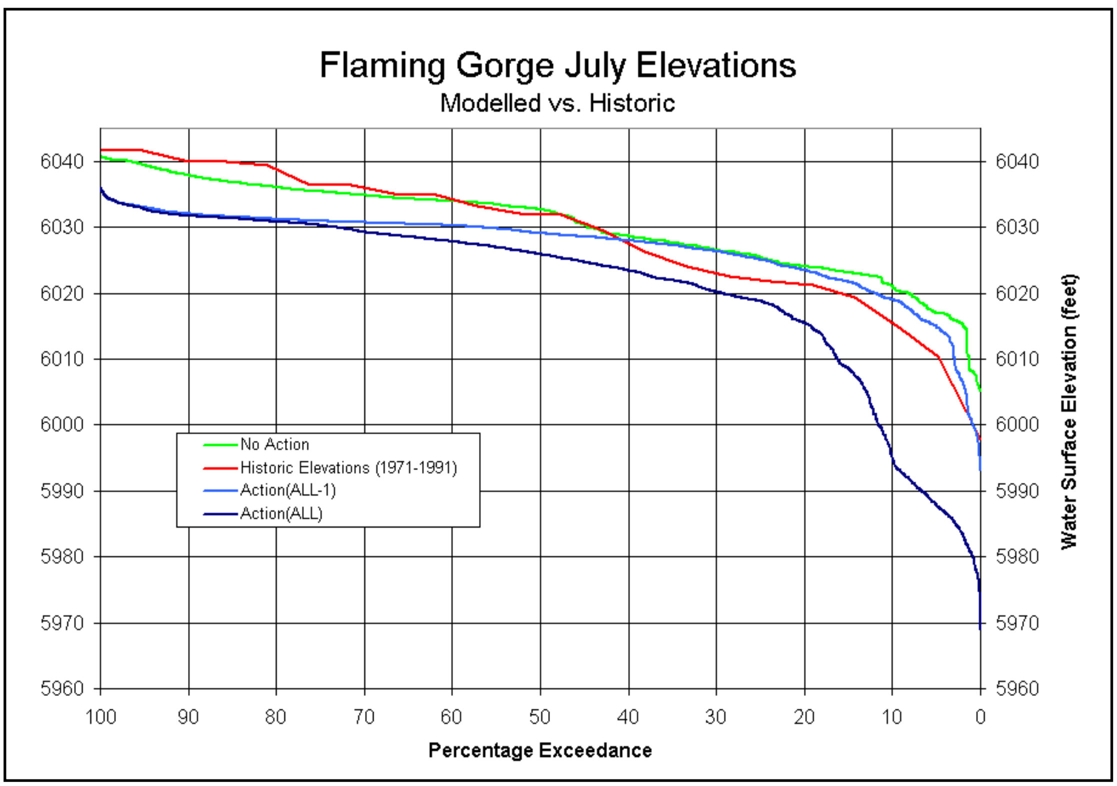


Figure 12.—Distribution of July Water Surface Elevations.

REACH 1 SPRING PEAK RELEASE RESULTS

The estimated flows at all points along Reach 1 were assumed in the model results to be the same as the release rate from Flaming Gorge Dam. During the spring, the model released the volume of water necessary to safely operate the reservoir while also achieving the objectives of the Action (ALL and ALL-1) and No Action Alternatives. Figure 13 shows the distribution of the peak flows (greatest magnitude single day average flow) that occurred in Reach 1 for all three model runs. The capacity of the powerplant at Flaming Gorge is assumed to be 4,600 cfs. Releases greater than 4,600 cfs are considered bypass releases. Figure 13 shows that water was bypassed by the No Action model run in about 18% of all years. The Action (ALL-1) model run bypassed water in about 37% of all years while the Action (ALL) model run bypassed water in about 53% of all years. It is also noted that bypasses from the Action (ALL and ALL-1) model runs had significantly higher magnitudes than those for the No Action model run. For reference, historic peak flows for the period from 1971 to 1991 are included in figure 13. This historic data includes years 1983, 1984, and 1986, which were abnormally wet years in the upper Green River Basin. Statistically, it is very unlikely that 3 years of such high magnitude would occur within 20 years of record. The historic record presented in figure 13 is, therefore, statistically skewed toward wet conditions. Figure 13 also shows that the differences in peak releases between the Action (ALL) and the Action (ALL-1) model runs were significantly larger than the differences between the Action (ALL-1) and No Action model runs.

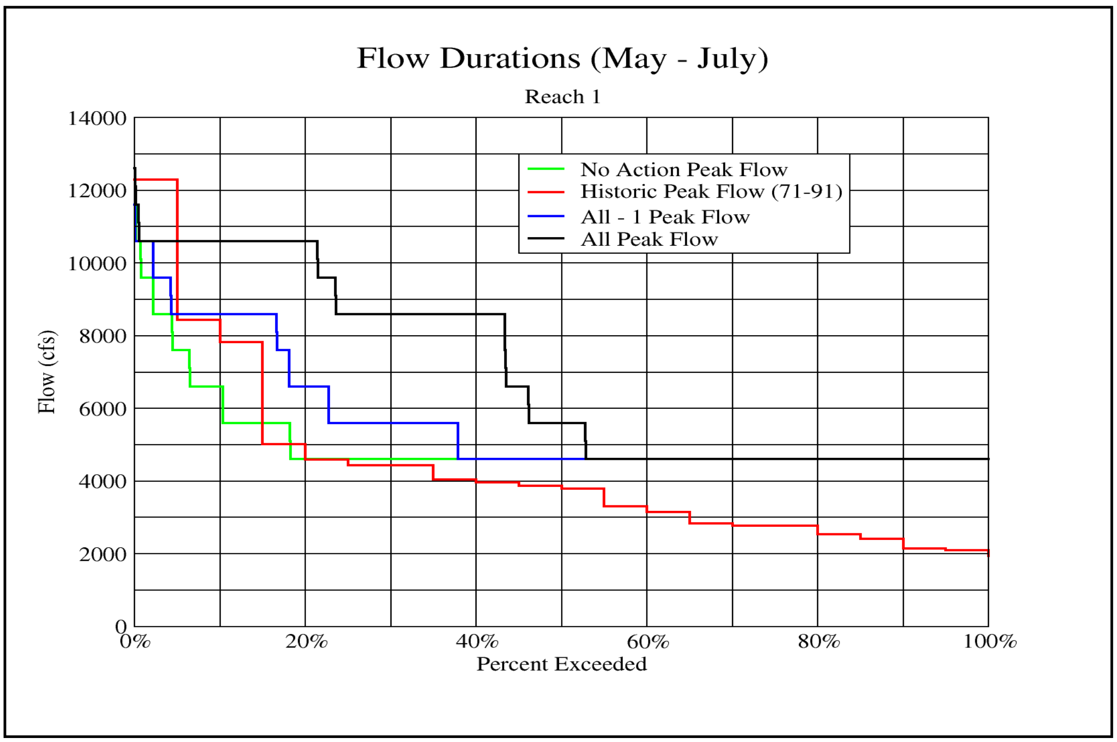


Figure 13.—Distribution of Peak Flows in Reach 1.

To illustrate the impacts to Reach 1 when the Action (ALL) ruleset was triggered to achieve the 18,600-cfs objective, figure 14 shows a sample spring hydrograph in Reach 1 for all three model runs. The data in this figure is from trace 37 in year 2015 from May through July. The peak release that achieved all flow objectives except the 18,600-cfs objective had a magnitude of 4,600 cfs and a duration of about 16 days. Because the Yampa River triggered the Action (ALL) ruleset to attempt to achieve the 18,600-cfs objective, the peak release magnitude was reset by the Action (ALL) ruleset from 4,600 cfs to 8,600 cfs; and the duration was decreased to 14 days. This caused a significant bypass to occur in a year when achieving all other flow objectives would not have required a bypass release. The historic year of this hydrology was 1970. For reference, the No Action model results and the historic spring releases that actually occurred at Flaming Gorge Dam in 1970 are included on the figure.

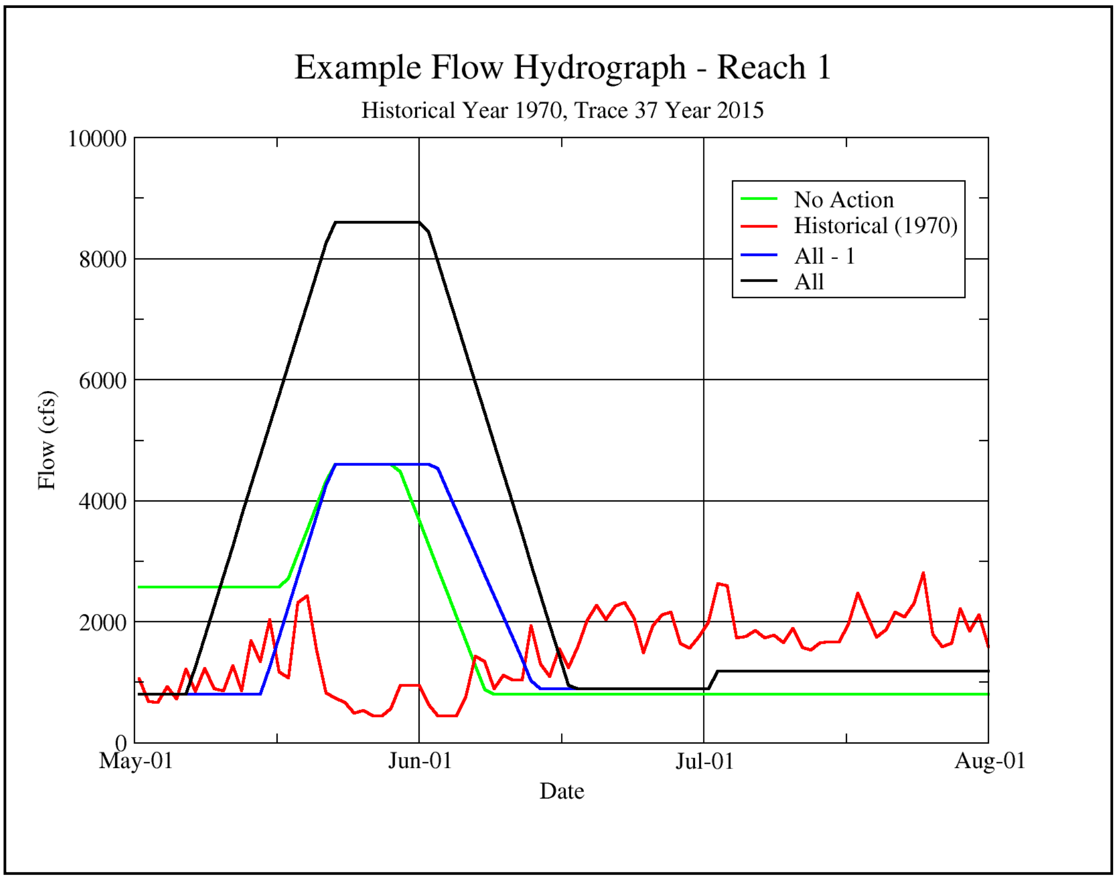


Figure 14.—Sample Hydrograph Comparison of Action (ALL and ALL-1) Reach 1.

Figure 15 shows the corresponding flows that occurred in Reach 2 as a result of the release hydrographs illustrated in figure 14. Figure 15 shows that although the Action(ALL-1) model run did not achieve the 18,600-cfs objective, that 18,600 cfs was sustained for 11 days in Reach 2 during this year. The Yampa River flows decrease very rapidly from the peak. Extending the duration of the 4,600-cfs peak release would not have sustained flows in Reach 2 above 18,600 cfs for 3 additional days.

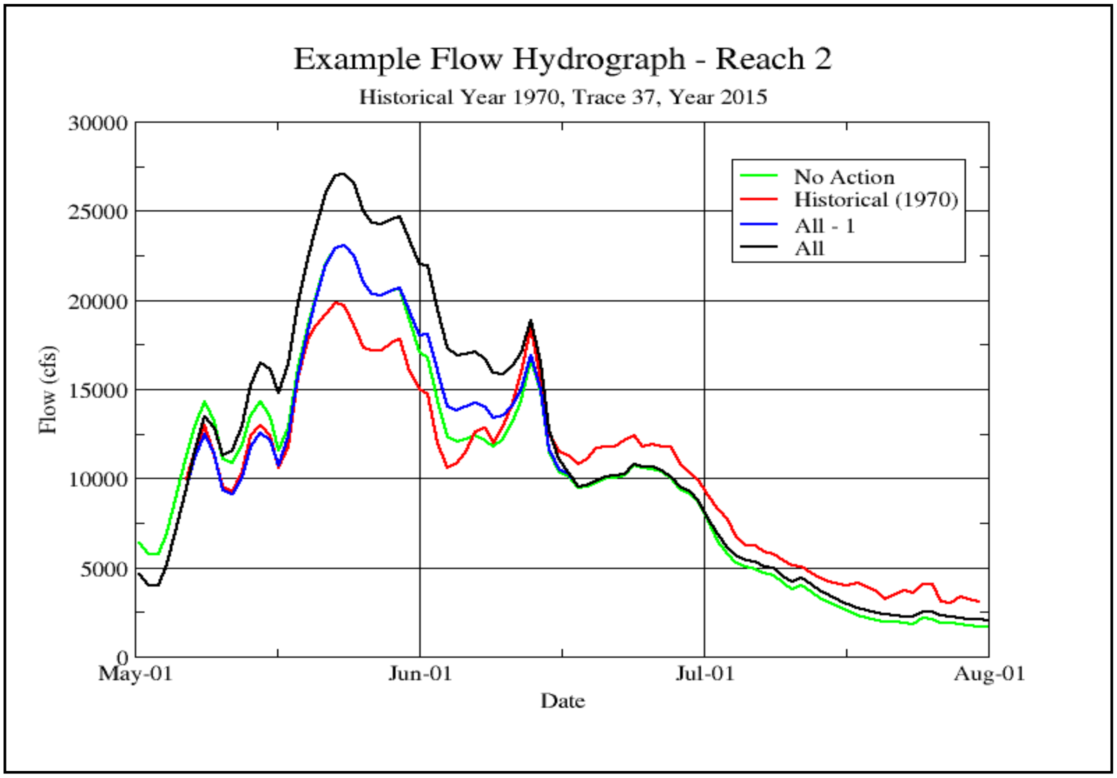


Figure 15.—Sample Hydrograph Comparison of Action (ALL and ALL-1) Reach 2.

Figures 16 and 17 show how the duration of the release peak was affected by the Action (ALL and ALL-1) and No Action rulesets. The distribution of Reach 1 flows that were exceeded for a duration of 2 weeks is presented in figure 16, while figure 17 shows the distribution of Reach 1 flows that were exceeded for 4 weeks. Distributions for all three model runs are presented, while the historic values that occurred during the period from 1971 to 1991 are also presented in these figures.

Flaming Gorge Spring Bypass Results

Figure 18, like figure 13, shows the frequency of bypass releases that occurred during the spring for all three model runs. Figure 18 shows this information in terms of the annual volume of water that was bypassed under the control of the three rulesets. The difference between each of these curves can be related to the power generation that was lost as a result of achieving the objectives of each of the proposed alternatives.

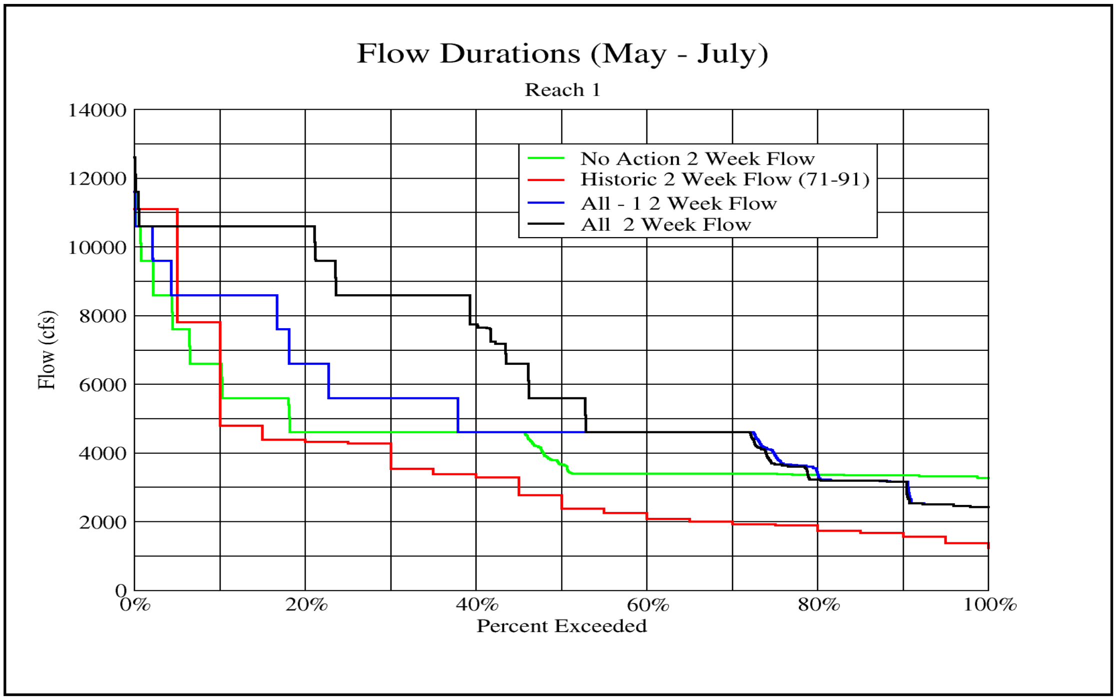


Figure 16.—Distribution of 2-Week Duration Flows in Reach 1.

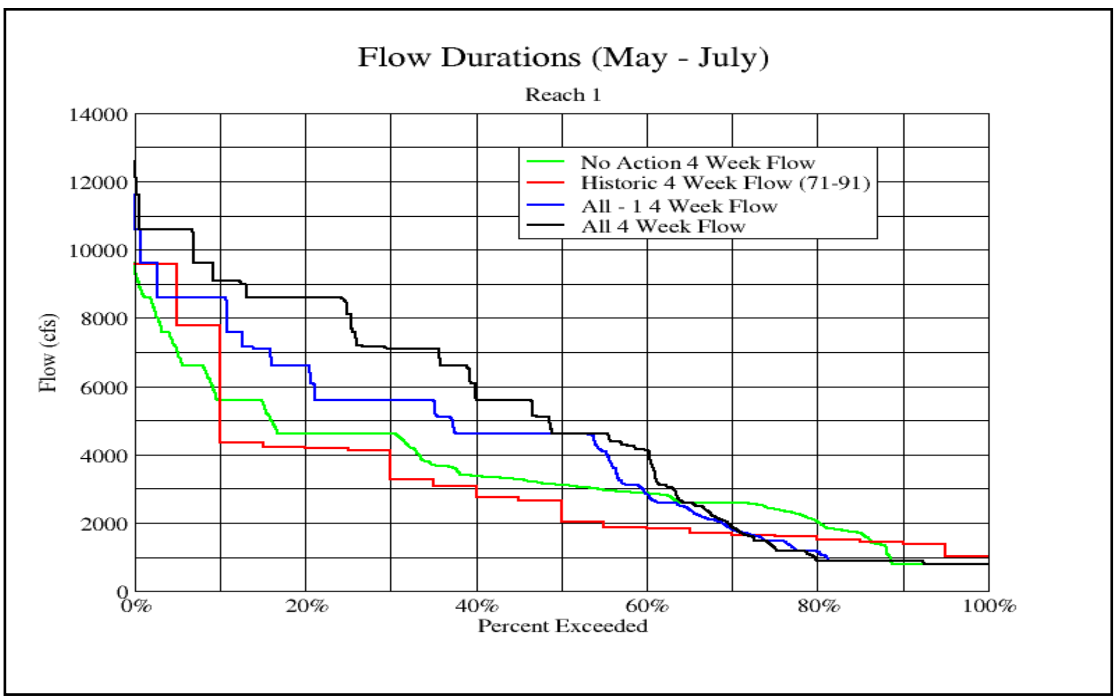


Figure 17.—Distribution of 4-Week Duration Flows in Reach 1.

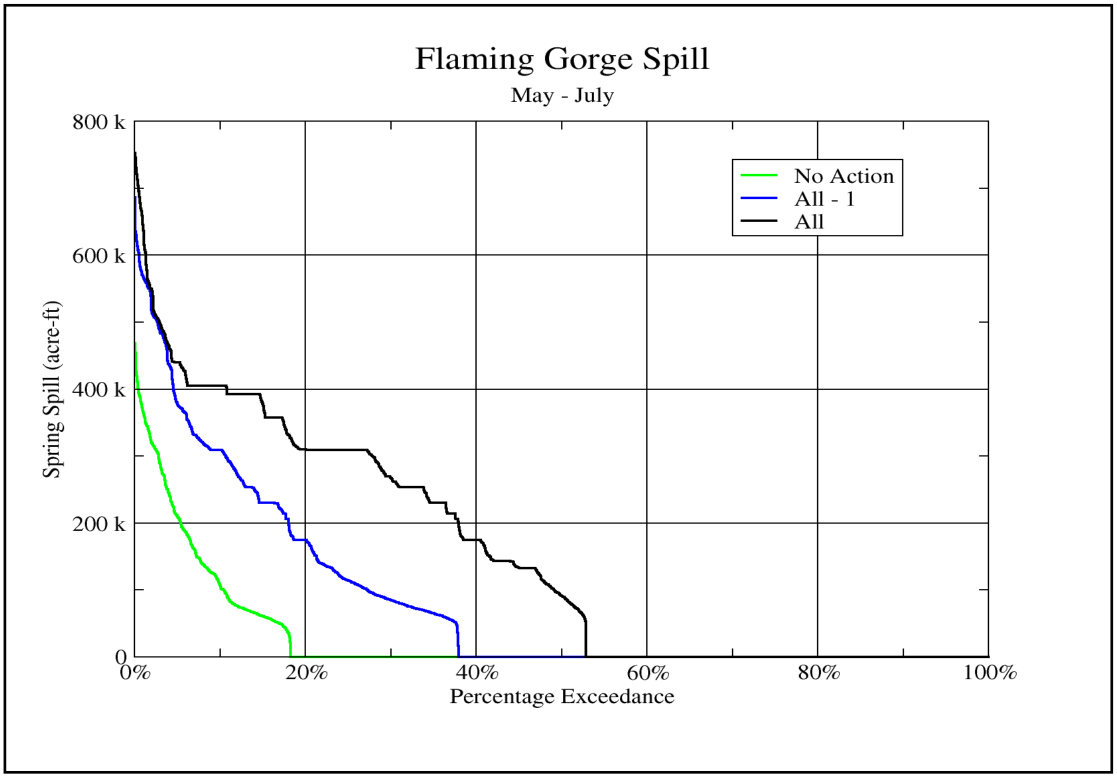


Figure 18.—Exceedance Percentage Bypasses During April Through July.

REACH 1 AUGUST THROUGH FEBRUARY BASE FLOW RELEASE RESULTS

Figure 19 shows the distributions of Reach 1 flows that occurred during the base flow period (August though February), when Reach 1 flows are typically at their lowest. This analysis shows the frequency and magnitude of the Reach 1 flows that occurred during the base flow period under the Action (ALL and ALL-1) and No Action model runs. The most notable difference between the Action and No Action flows during the base flow period was for the 0-20% exceedance flow. The No Action ruleset was more flexible during the base flow period and allowed releases to increase when conditions became wetter in the upper Green River Basin. To give some perspective to the results of the three model runs, historic Reach 1 base flows from 1971 to 1991 and historic Reach 1 unregulated base flows from 1971 to 1991 are included in the figure. The historic flows show how Flaming Gorge Dam operations, prior to the 1992 Biological Opinion, effected the distribution of flows in Reach 1 during the base flow period. Releases prior to 1992 were elevated above natural levels to produce power. The historic unregulated flows for the same period indicate how the distribution of flows in Reach 1 might have been if Flaming Gorge Dam did not regulate the flow of the river.

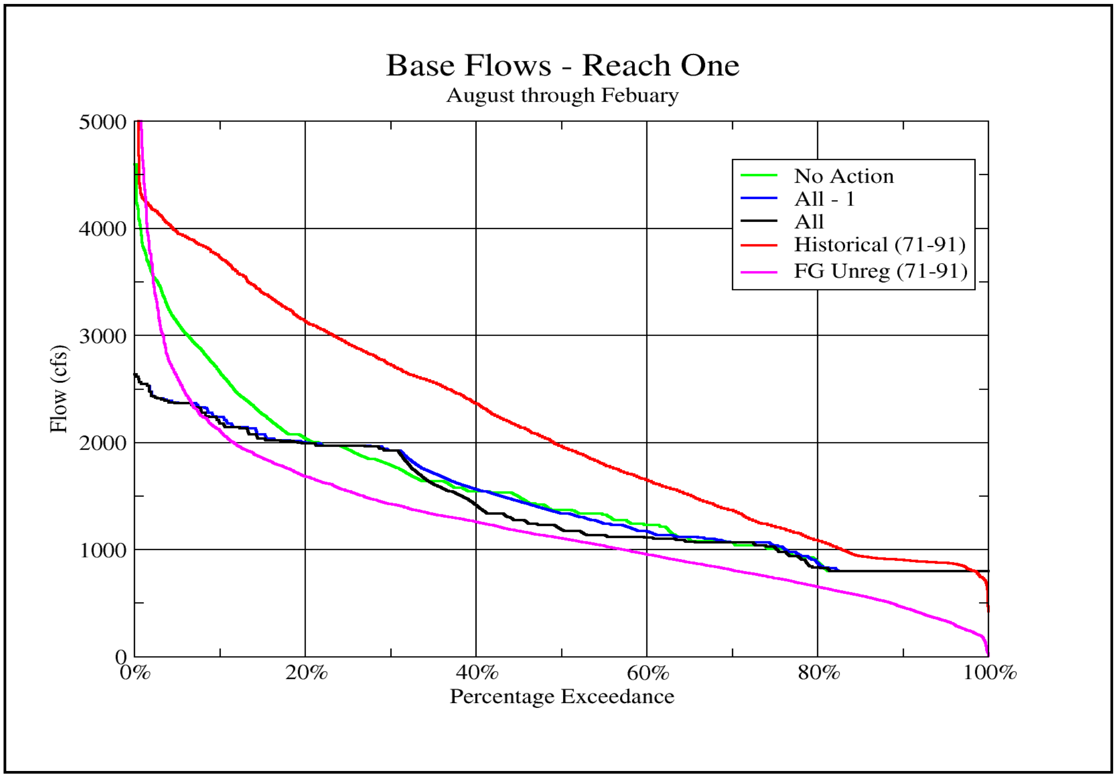


Figure 19.—Exceedance Percentage Flows for Reach 1 Flows During Base Flow Period.

REACH 2 SPRING PEAK RELEASE RESULTS

The model accounts for flows in Reach 2 by adding the flows from the Yampa River to the flows from Reach 1. The estimated flows at all points along Reach 2 were assumed to be equal to the release rate from Flaming Gorge Dam plus the flows on the Yampa River. The Green River model lagged Flaming Gorge Dam releases by 1 day to account for travel time through Reach 1.

Figure 20 shows the distributions of peak flows that occurred in Reach 2 during the spring. Figures 21 and 22 show distributions for flows in Reach 2 that had a duration of 2 and 4 weeks, respectively. Figure 21 shows a noticeable increase in the Action (ALL) results at about 40% exceedance. This was a result of the Action(ALL) ruleset attempting to achieve the 18,600-cfs objective.

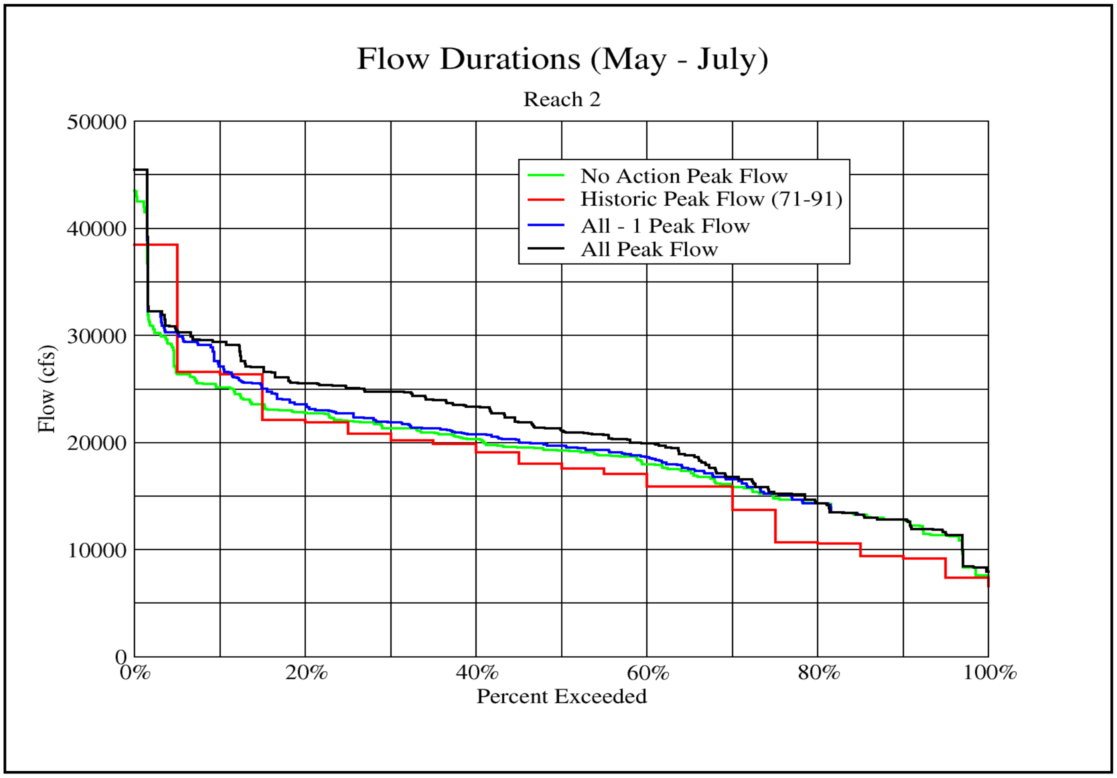


Figure 20.— Distribution of Peak Flows in Reach 2.

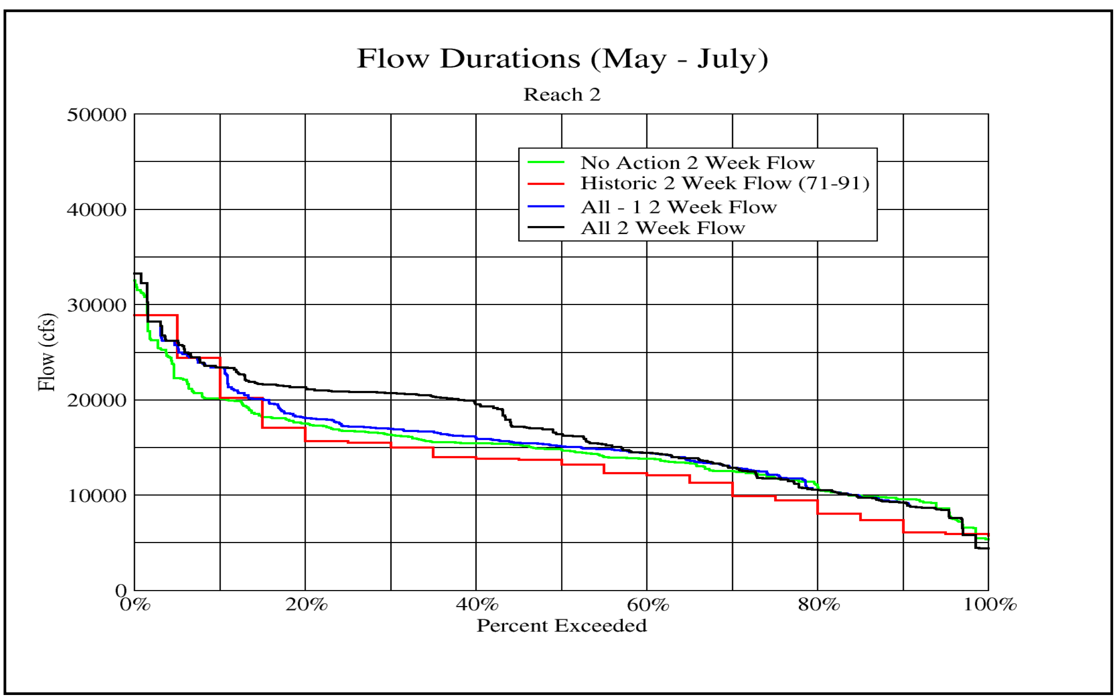


Figure 21.—Distribution of 2-Week Duration Flows in Reach 2.

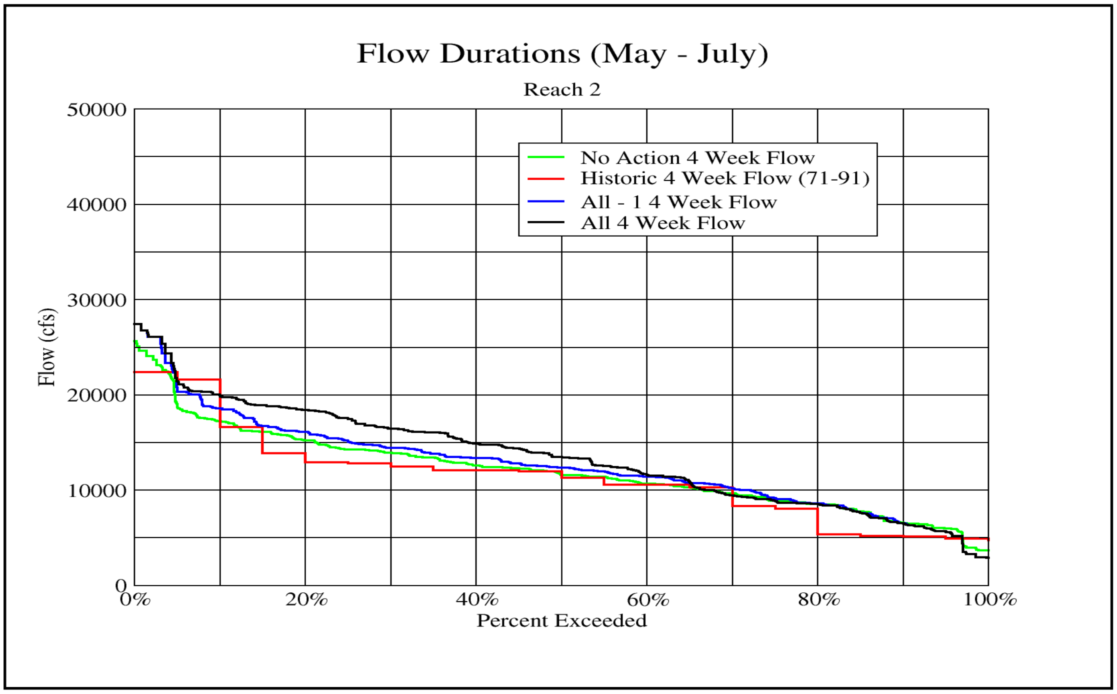


Figure 22.—Distribution of 4-Week Duration Flows in Reach 2.

REACH 2 BASE FLOW RELEASE RESULTS

Figure 23 shows the distribution of Reach 2 flows during the base flow period that occurred in the three model runs. Jensen gauge predam historic flows (1950-1961) during the base flow period and Jensen gauge post-dam historic flows (1971-1991) are also shown in the figure. The historic flows prior to 1961 show the distribution of flows in Reach 2 during the base flow period prior to the construction of Flaming Gorge Dam. Historic flows during the period from 1971 through 1991 show the distribution of Reach 2 flows after the construction of Flaming Gorge Dam but prior to the 1992 Biological Opinion. The most significant change that has occurred in Reach 2 in terms of river regulation occurred during the period from the end of the construction of Flaming Gorge Dam to 1991. Reach 2 flows during the base flow period were elevated substantially as a result of power production at Flaming Gorge Dam. The No Action curve shows the distribution of Reach 2 flows during the base flow period that as a result of operating Flaming Gorge Dam to achieve the flow objectives of the 1992 Biological Opinion. The Action (ALL and ALL-1) curves show how the Action Alternative would adjust the current distribution. Most notably, the Action Alternative operational regime depressed the flows during the base flow period in Reach 2 when conditions are wetter than average in the upper Green River Basin.

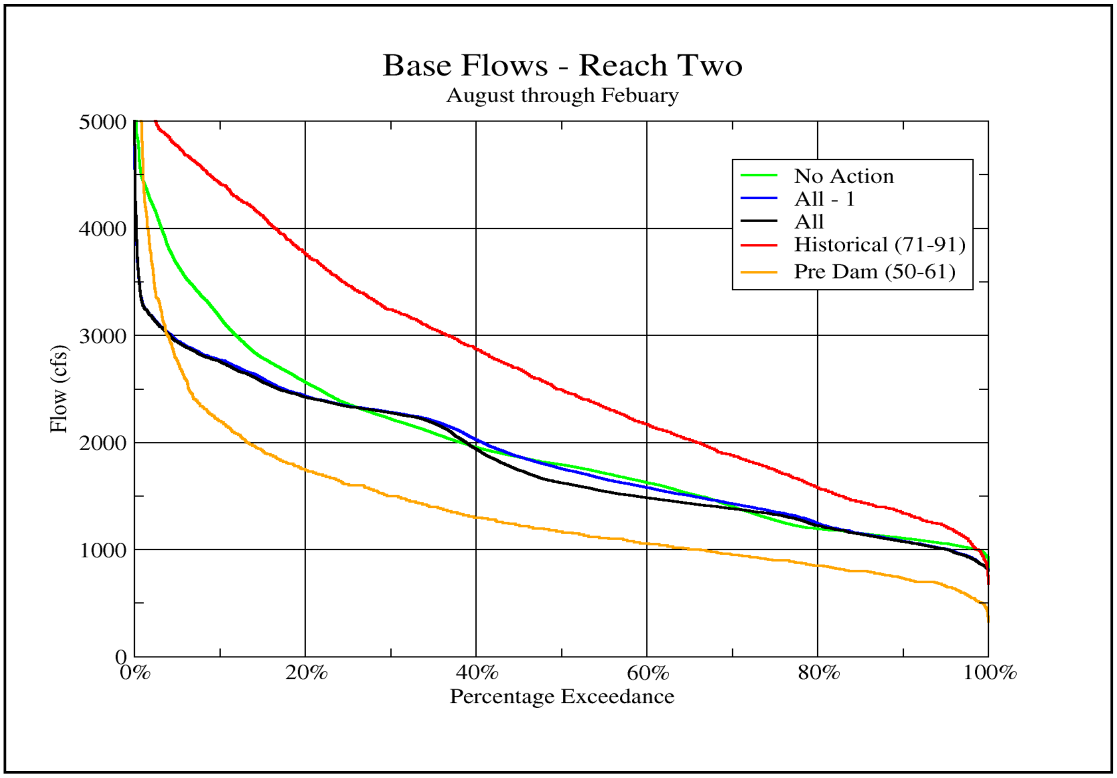


Figure 23.—Exceedance Percentage Flows for Reach 2 Flows During Base Flow Period.

SUMMARY

The results presented in this report describe three separate runs of the Green River model. Two of these runs were controlled by rulesets that achieved the objectives of the Action Alternative while the other run was controlled by a ruleset that achieved the objectives of the No Action Alternative. The Action Alternative is an operational regime for Flaming Gorge Dam that achieves the flow objectives of the 2000 Flow and Temperature Recommendations while "maintaining" the resources for which Flaming Gorge Dam was authorized. The No Action Alternative is an operational regime that achieves the flow objectives of the 1992 Biological Opinion while also "maintaining" the resources associated with the authorization of Flaming Gorge Dam. The rulesets "maintain" the resources associated with the authorizing purposes of Flaming Gorge Dam by minimizing bypass releases as much as possible while achieving the flow objectives for each of the proposed alternatives.

The difference between the two rulesets of the Action Alternative is the degree to which the flow objectives of the Action Alternative are achieved. The first version, referred to as the Action (ALL) ruleset, achieved all of the flow objectives of the Action Alternative. Results from this model run showed that the frequency and magnitude of bypass releases were much greater than in the No Action model run. Bypasses in the Action (ALL) model run were 53%, while the No Action model run had a bypass frequency of 18%. The frequency and magnitude of the bypasses in the Action (ALL) model run had a dramatic effect on the reservoir elevation when compared to the No Action model results. The occurrences of the reservoir elevations below 6000 feet above sea level were significant for the Action (ALL) model run while there were no occurrences of elevations below 6000 feet in the No Action model run. In general, the reservoir elevations during the summer months, on average, were about 7 feet lower in the Action (ALL) model run than they were in the No Action model run.

It was discovered that one flow objective for the Action Alternative caused most of the increase in the frequency and magnitude of the spring bypass releases. The Action Alternative flow objective that requires flows in Reach 2 in excess of 18,600 cfs for 2 weeks in 40% of all years caused most of the increase in the frequency and magnitude of the bypasses that occurred in the Action(ALL) results. To achieve this objective, 40% of all years were required to have peak releases with magnitudes of 8,600 cfs and durations of at least 2 weeks while 20% of all years were required to have magnitudes of 10,600 cfs and durations of at least 2 weeks. Achieving the other objectives of the Action Alternative did not require peak release magnitudes, durations, and frequencies at these levels.

The second version of the Action Alternative model run, referred to as the Action(ALL-1) model run, achieved all the flow objectives of the Action Alternative but did not specifically make any attempt to achieve the 18,600-cfs objective. While achieving all other flow objectives, the Action (ALL-1) model run was able to achieve 18,600 cfs for 2 weeks or greater in 18.2% of all years. Reach 2 flows did achieve 18,600 cfs in 40% of all years, but the duration was 6 days compared to the flow objective duration of 14 days. The results from the Action(ALL-1) model run showed a significant improvement to the impacts that were observed in the reservoir elevations of the Action (ALL) model run. Reservoir elevations for the Action (ALL-1) model run, on average, were 3 to 4 feet lower than the No Action model run results during the summer month as compared to 7 feet lower for the Action (ALL) results. Bypass releases were significantly reduced from the Action (ALL) model results. The frequency of bypass releases in the Action (ALL-1) model results was 38%; while in the Action (ALL) model results, this frequency was 53%. The Action(ALL-1) model run achieved nearly all of the objectives of the Action Alternative while dramatically reducing the impacts to the resource associated with the authorization Flaming Gorge Reservoir.

The intent of this study has been to evaluate the relative differences between the Action and No Action Alternatives proposed for the Flaming Gorge EIS. The modeling of the Green River system and these alternatives is now at a point where these differences are evident. This report provides hydrologic information for the purpose of determining the impacts to the resources associated with Flaming Gorge Reservoir. If additional information is needed for this purpose, it will be provided as needed.

HYDROLOGIC MODELING

R. Clayton and A. Gilmore
February 26, 2002 (Modified August 15, 2003)

INTRODUCTION

In October of 2001, a report titled "Flaming Gorge Environmental Impact Statement Hydrologic Modeling Study Report" was distributed to all Cooperating Agencies and Interdisciplinary (ID) Teams working on the Flaming Gorge Environmental Impact Statement (EIS). The report described the hydrologic impacts observed in the modeled implementation of the 1992 Biological Opinion (No Action Alternative) and the *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations) (Action Alternative) for the period from 2002 through 2040. Based on comments received from the Cooperating Agencies, ID Teams, as well as the authors of the 2000 Flow and Temperature Recommendations, the Flaming Gorge Model has been modified to more accurately reflect the intentions of the 2000 Flow and Temperature Recommendations and the 1992 Biological Opinion. The purpose of this report is to detail these modifications and update the model results so the Cooperating Agencies and ID Teams can conduct their impact analyses.

DESCRIPTION OF MODIFICATIONS

The Flaming Gorge Model was populated with natural inflow data generated from historic riverflow and consumptive use records. For the upper Green River and Yampa River Basins, the only records available for consumptive use were recorded as monthly volumes. For this reason, the natural inflow data used to populate the Flaming Gorge Model, as well as the model itself, were developed at a monthly timestep. The monthly timestep framework of the Flaming Gorge Model limited when operational decisions could be made to the beginning of every month. It became apparent very early in the development of this model that limiting the timing of these operational decisions, which was only an artifact of the model framework, made it more difficult for the model to achieve the target flows and durations specified in the 2000 Flow and Temperature Recommendations than would be the case in reality.

In reality, Flaming Gorge Dam is operated to adjust to changing hydrologic conditions the moment these conditions change. The Flaming Gorge Model, however, must wait until the beginning of each month to make these adjustments. Sometimes, this caused the daily average releases determined by the model under the Action Alternative to be set much higher than necessary to achieve specific targets established for Reach 2. After receiving comments from the authors of the 2000 Flow and Temperature Recommendations regarding the report issued in October, it became clear that this artifact of the model did not satisfactorily reflect the intended implementation of the 2000 Flow and Temperature Recommendations.

To get the model to operate Flaming Gorge Dam more realistically while maintaining the monthly timestep framework, a daily model was developed to take monthly results from the Flaming Gorge Model and operate Flaming Gorge Dam to react to daily hydrologic conditions.

This daily model operated Flaming Gorge Dam during the spring (May, June, and July) to match estimated Yampa River flows to achieve target flows for Reach 2. While this caused the release results of the daily model to differ from the release results of the monthly model, it did provide a more reactive approach for achieving the recommended flow targets. To maintain some integrity between the daily and monthly models, the only restriction placed upon the daily model was to match the total volume released during the spring to the total volume released during the spring by the monthly model. After a targeted duration was achieved, the daily model released the necessary volume for the remainder of the spring to match the monthly model while minimizing additional bypass releases. This enhancement of the Flaming Gorge Model greatly reduced the bypass releases that were reported in the October report.

Base flows, under the Action Alternative, are dependent upon the classification of the hydrologic conditions in the upper Green River Basin. In October (2001), the model based this classification on the volume of unregulated inflow into Flaming Gorge that occurred during the preceding spring. Once this classification was set on August 1, it could not change during the base flow period. The 2000 Flow and Temperature Recommendations, however, stated that this classification was flexible and could change if hydrologic conditions changed during the base flow period. The authors, however, did not describe how this determination was to be made. Comments received from the authors gave guidance for how this determination could be made in the model, and the model has now been modified to adjust the hydrologic classification during the base flow period when conditions warrant a change.

Under the Action and No Action Alternatives, a volume of water to be released during the spring is calculated based on forecasted inflows and reservoir conditions. From this volume of water, a peak release hydrograph is developed to achieve the specific parameters of the operational alternative. In the model presented in the October report, both the Action and No Action Alternatives extended the peak release hydrograph to the end of July, when possible, depending on the calculated volume to be released during the spring. The 1992 Biological Opinion, however, states that base flow levels are to be established by July 20 at the latest. For this reason, the No Action Alternative was modified so that July 20 is now the maximum date that the spring release hydrograph can be extended to. This modification increases the peak magnitude and the potential for bypasses in the No Action Alternative as compared to the No Action results presented in the October report.

In October, the Flaming Gorge Model, for both alternatives, had a static drawdown target established for the end of April. During the base flow and transition periods, releases from Flaming Gorge were determined in an attempt to achieve this drawdown target. For both the Action and No Action Alternatives, the drawdown target was set to 6027 feet above sea level independent of the developing hydrology in the upper Green River Basin. In years where the early indications of the developing hydrology are for wet or dry conditions, this target would, in reality, be reset to a more appropriate level. For example, when the early indications are that the spring is going to be wet, Flaming Gorge will typically be drawn down to a target somewhat lower than 6027 feet above sea level to provide space in the reservoir to absorb the above average inflow. Conversely, in years where the early indications are that the spring is going to be dry, the reservoir is typically drawn down to a target higher than 6027 so the reservoir has a better chance of filling despite the dry conditions. This flexibility has now been incorporated into the Flaming Gorge Model. In anticipated wet years, the drawdown target is now set to 6025 feet above sea level and in anticipated dry years, the drawdown target is set to 6029 feet above sea level.

MODEL RESULTS

Flow Recommendations

Table 1 shows the current state of the Action and No Action Alternatives in terms of how well each alternative achieves the specific recommendations of the 2000 Flow and Temperature Recommendations during the spring in Reaches 1 and 2. While the No Action Alternative does not attempt to meet any of these targets, a comparison between the Action and No Action results does indicate some of the key differences between the operational regimes.

Table 1—2000 Flow and Temperature Recommendations Target Flows, Durations, and Frequencies

Spring Peak Flow Recommendations	Reach	Target %	Action Ruleset	No Action Ruleset
Peak >= 26,400 cfs for at least 1 day	2	10%	11.3%	7.1%
Peak >= 22,700 cfs for at least 2 weeks	2	10%	10.7%	4.6%
Peak >= 18,600 cfs for at least 4 weeks	2	10%	11.1%	6.0%
Peak >= 20,300 cfs for at least 1 day	2	30%	46.3%	42.3%
Peak >= 18,600 cfs for at least 2 weeks	2	40%	41.1%	15.6%
Peak >= 18,600 cfs for at least 1 day	2	50%	60.3%	59.1%
Peak >= 8,300 cfs for at least 1 day	2	100%	100%	98.5%
Peak >= 8,300 cfs for at least 1 week	2	90%	96.8%	96.9%
Peak >= 8,300 cfs for at least 2 days except in extreme dry years	2	98%	99.6%	98.4%
Peak >= 8,600 cfs for at least 1 day	1	10%	30.2%	6.5%
Peak >= 4,600 cfs for at least 1 day	1	100%	100%	100%

RESERVOIR WET AND DRY CYCLE RESULTS

In the 65 traces of inflow hydrology used to populate the model, a variety of wet and dry cycles occurred. These cycles were routed through the Flaming Gorge Model with the reservoir elevation set at various levels to show the full range of potential impacts that could realistically occur. The cycles having the driest and wettest intensities with durations of 2, 3, 5, and 7 years were found in the model results. The traces where these cycles occurred at the beginning of the trace were identified so that the differences between the Action and No Action Alternatives could be directly compared. This is because the water surface elevation of the Action and No Action Alternatives were the same in these traces prior to these cycles routing through Flaming Gorge Reservoir. The difference in reservoir elevation at the end of the cycle then could be attributed solely to the operational regime. The reservoir elevations and release hydrographs generated under the Action and No Action Alternatives were plotted to show the differences between these regimes. Figure 1 shows the reservoir elevations resulting from the most intense 3-year dry cycle found in the input hydrology. The plot extends 1 year beyond the end of the dry cycle to show the rate at which the reservoir was able to recover under the two alternatives.

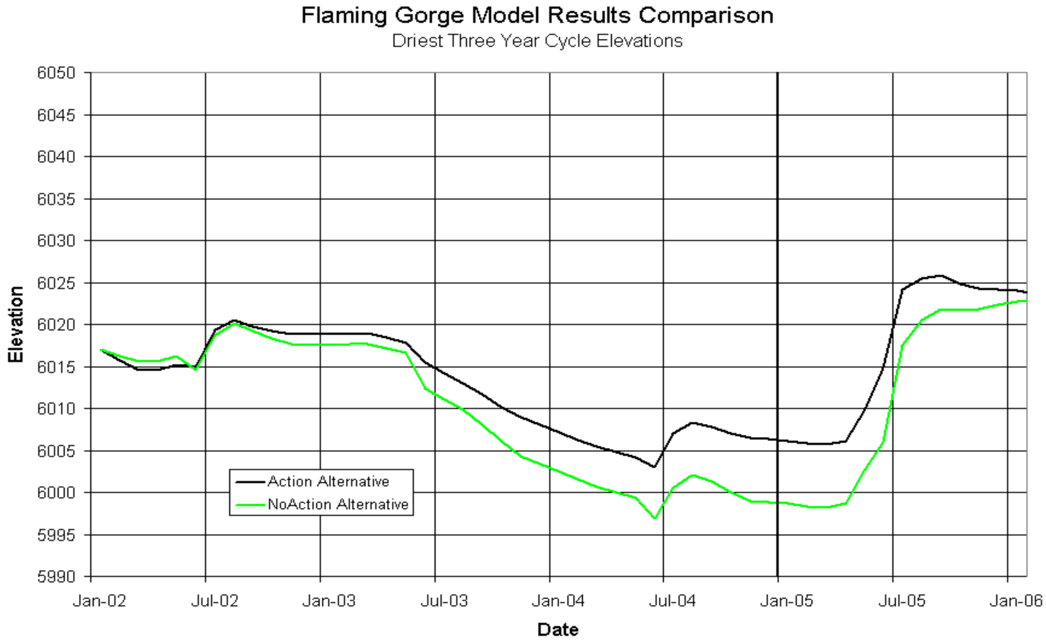


Figure 1.—Reservoir Elevations Under the Most Intense 3-Year Dry Cycle.

By the end of this 3-year cycle, operating under the No Action Alternative caused the reservoir elevation to be about 8 feet lower than operating under the Action Alternative. This can be mostly attributed to the fact that the No Action Alternative requires a spring peak each year with a minimum duration of 7 days while the Action Alternative allows the spring peak with a duration as short as 2 days. The corresponding release hydrographs produced for this 3-year cycle are shown in figure 2. While the peaks, under both alternatives, have a magnitude of 4,600 cfs (powerplant capacity), the No Action Alternative maintains 4,600 cfs for 7 days before declining back to base flow levels where as the Action Alternative peaks for only 2 days. In years classified as dry or moderately dry, the difference between the Action and No Action Alternatives, in terms of minimum duration, can have a significant impact on the reservoir elevation. When dry years occur in series, which is often the case, the year-to-year differences in reservoir elevation caused by the operational regime can compound upon each other as shown in this case.

When conditions are wet, the Action and No Action Alternatives operate Flaming Gorge Dam very differently from when conditions are dry. Spring releases for the Action Alternative in wet years are typically larger than those generated for the No Action Alternative as a result of attempting to achieve specific targets established for Reach 2. This is evident in figure 3, which shows the reservoir elevations that occurred during the most intense 3-year wet cycle found in the inflow hydrology. The higher releases that occur each spring under the Action Alternative cause the reservoir to fill less in the spring as compared to the No Action Alternative. As a result, the releases under the Action Alternative during the base flow period are not as high as those that occur under the No Action Alternative. The No Action Alternative is forced to release greater volumes during the base flow period to achieve the drawdown target established for the following year. This can be seen in figure 4, which shows the daily release hydrographs that occurred during this 3-year wet cycle. In November, the release constraints of the No Action Alternative are relaxed so that releases can increase to powerplant capacity if they are necessary to control the reservoir elevation. Figures showing the reservoir elevations and release hydrographs for 2-, 3-, 5-, and 7-year duration wet and dry cycles are located in the appendix.

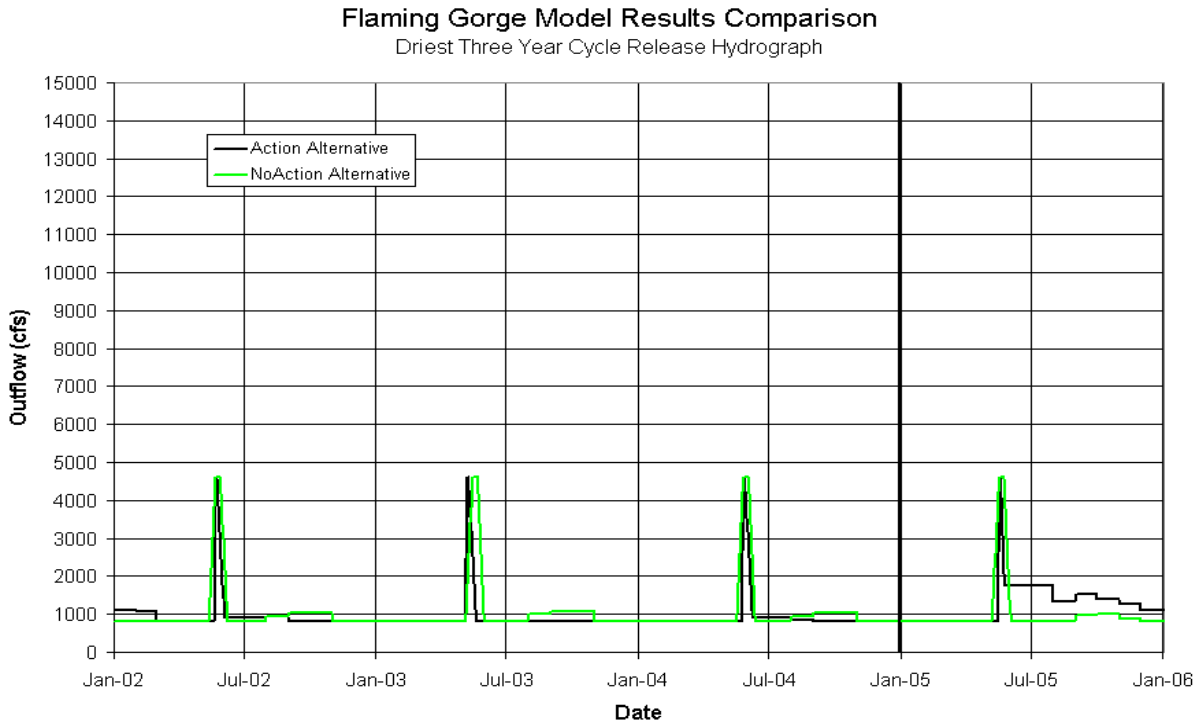


Figure 2.—Reservoir Releases Under the Most Intense 3-Year Dry Cycle.

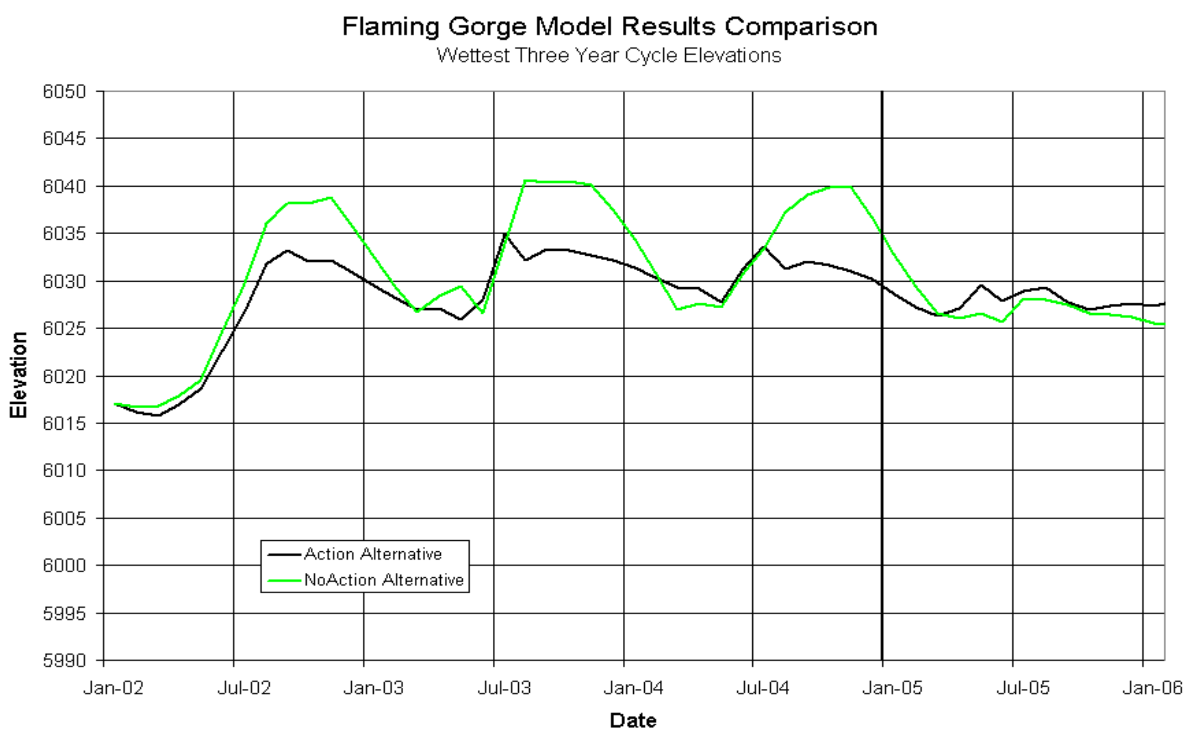


Figure 3.—Reservoir Elevations Under the Most Intense 3-Year Wet Cycle.

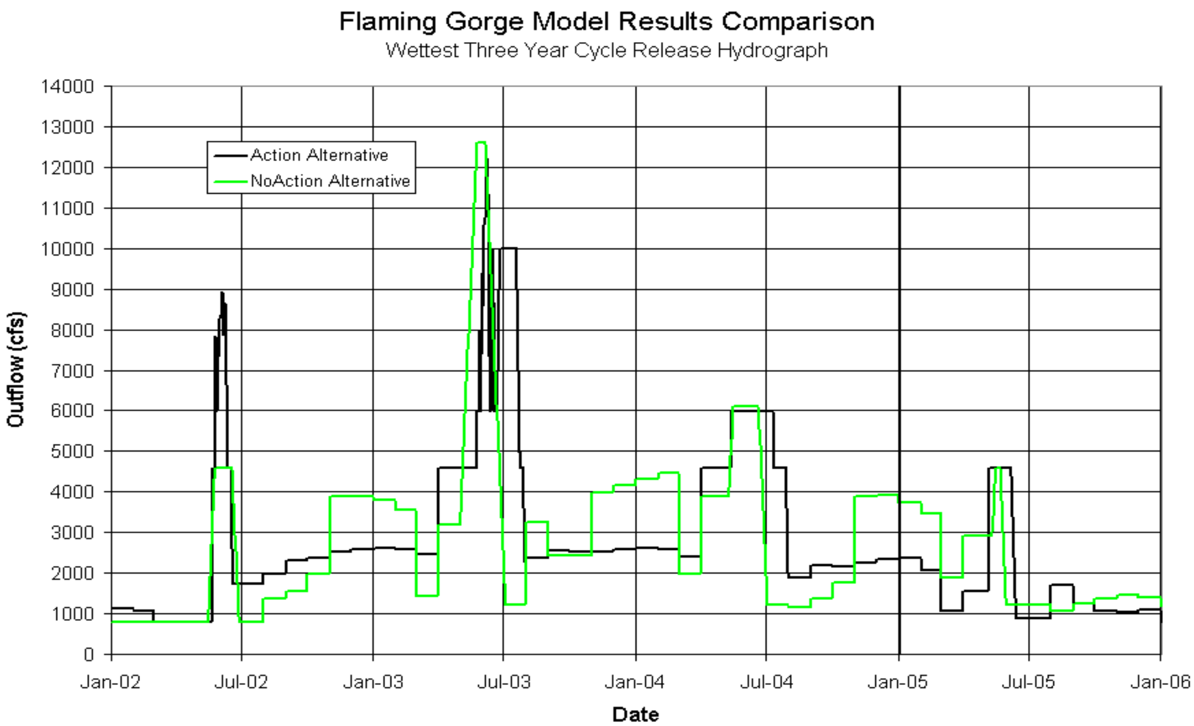


Figure 4.—Reservoir Releases Under the Most Intense 3-Year Wet Cycle.

RESERVOIR WATER SURFACE ELEVATION PERCENTILE RESULTS

For each month of the model run, from January 2002 through December 2040, there are 65 potential reservoir elevations that make up the model results for reservoir elevation for that particular month. Each set of potential elevations was ranked from lowest to highest to determine the probabilities associated with specific reservoir elevations. Figures 5, 6, and 7 show the potential reservoir elevations associated with three levels of probability. Figure 5 shows the 90^{th} percentile reservoir elevations during the first 10 years of the model run. These reservoir elevations were exceeded by only 10% of the 65 potential elevations that occurred in the model results for that month and that year. Reservoir elevations are typically at their lowest level in early spring when the Action and No Action Alternatives attempt to achieve a drawdown target. During the late summer, reservoir elevations are typically at their highest level of the year as a result of storing a portion of the spring runoff. The No Action Alternative typically allows the reservoir elevation to rise significantly higher in the spring than the Action Alternative, as evident in figure 5. Summer reservoir elevations are typically 5 to 7 feet higher for the No Action Alternative than those for the Action Alternative.

Reservoir elevations that occur under more typical (average) hydrologic conditions are shown in figure 6. These reservoir elevations are those that were exceeded by 50% of the 65 potential reservoir elevations that occurred for each month. In the dryer scenarios, reservoir elevations are typically much lower than in the average or wet scenarios. Figure 7 shows reservoir elevations that were exceeded by 90% of the potential reservoir elevations that occurred for each month.

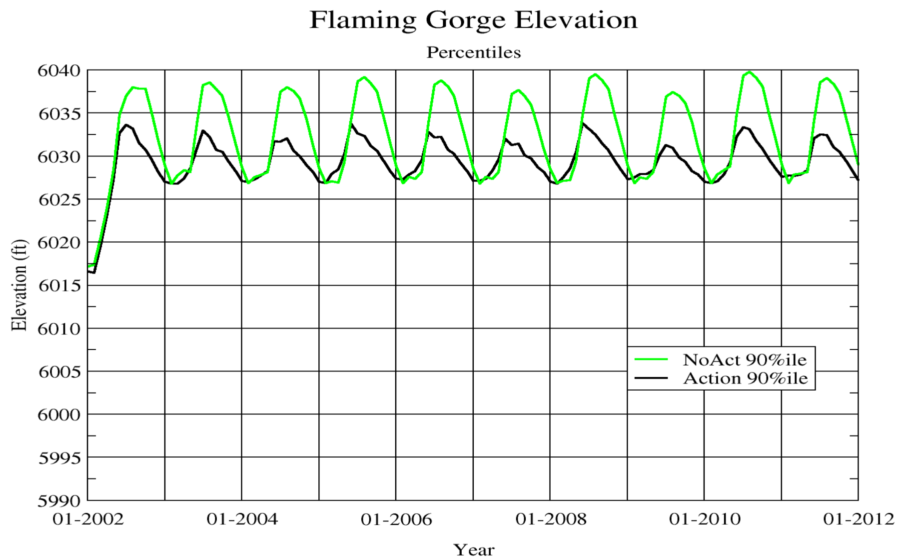


Figure 5.—90th Percentile Reservoir Elevations from January 2002 to December 2012.

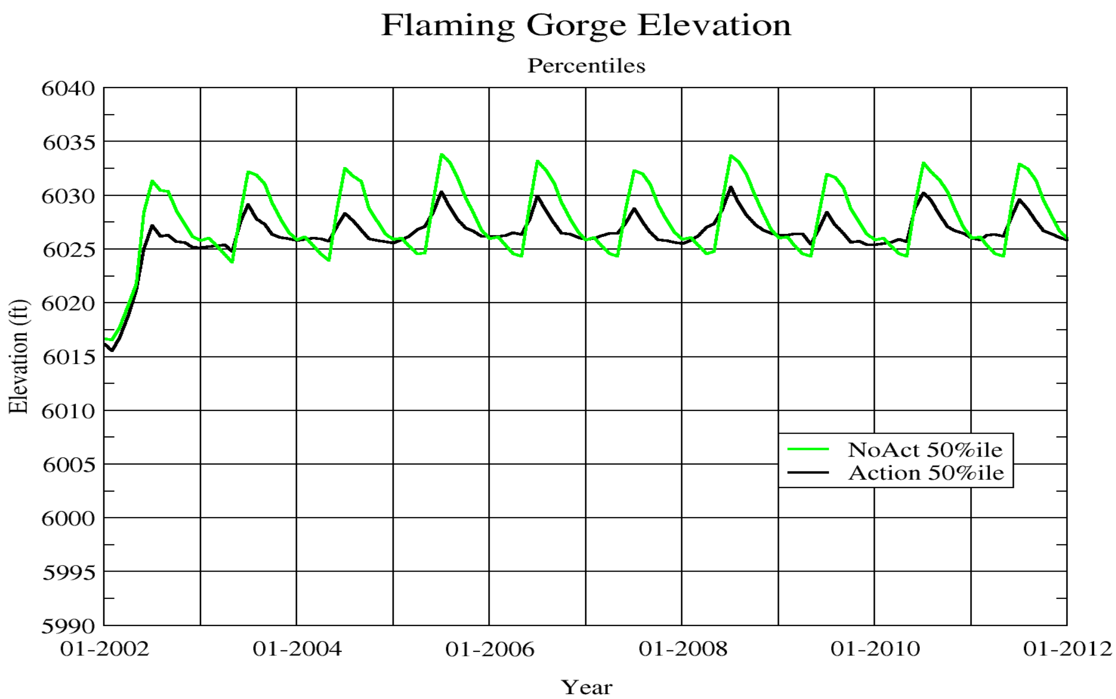


Figure 6.—50th Percentile Reservoir Elevations from January 2002 to December 2012.

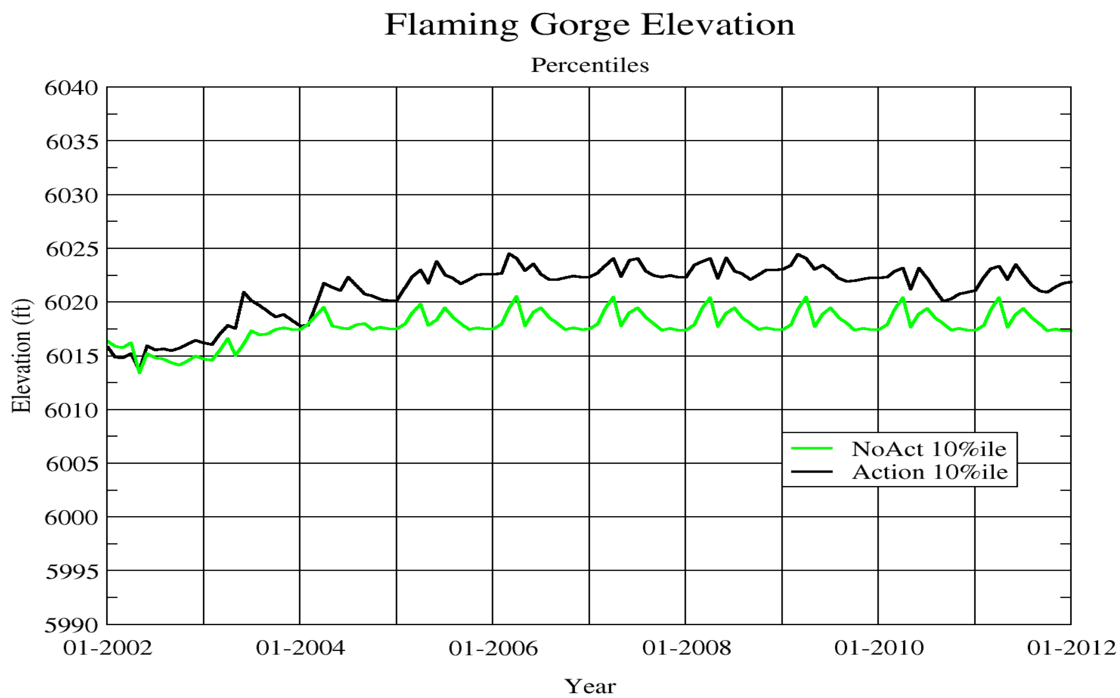


Figure 7.—10th Percentile Reservoir Elevations from January 2002 to December 2012.

Figure 7 is significant because it shows a tremendous improvement for Action Alternative in comparison to what was reported in the October report. Now, the Action Alternative yields reservoir elevations that are even higher than those yielded by the No Action Alternative. The October report showed a large disparity between the Action and No Action Alternatives with the Action Alternative much lower than the No Action Alternative.

The model results indicate that reservoir elevations are basically stable throughout the model run under both alternatives. That is to say the reservoir elevation did not gradually increase or decrease under the Action and No Action Alternatives in the later years of the run. For this reason, it was valid to combine all of the reservoir elevations into a single dataset, grouped by month and then ranked from lowest to highest into monthly distributions. Figures 8 and 9 show these distributions for the months of February and June. These months are shown because reservoir elevations are typically near their lowest level of the year by the end of February and near their highest level by the end of June. Both figures show that the distributions of reservoir elevations for the Action Alternative are now actually higher than the distributions for the No Action Alternative. These results are substantially different from those presented in October and indicate the impact of the modifications made to the model over the past 3 months. Similar plots for all months of the year are located in the appendix.

Figure 10 shows the Action and No Action Alternative reservoir elevations for all months at the 5% probability level grouped by month. The 5% probability level marks the reservoir elevations that were exceeded by 95% of all potential reservoir elevations on average. In other words, for each month of the year there were 5% of all potential reservoir elevations that were below those indicated in the figure. Figure 10 shows that at the 5% probability level, there was a 7- to 8-foot difference between the Action and No Action Alternatives. Similar plots showing the reservoir elevations for the 10%, 25%, 50%, and 75% probability levels are located in the appendix.

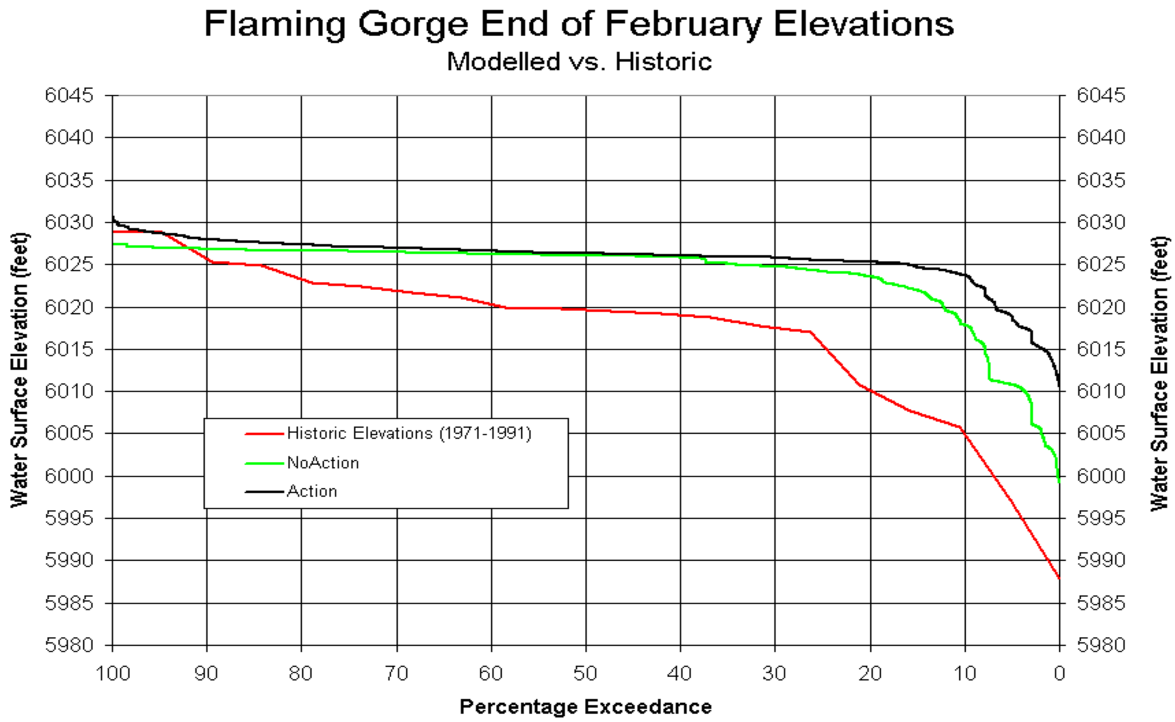


Figure 8.—February Reservoir Elevation Distribution Plot.

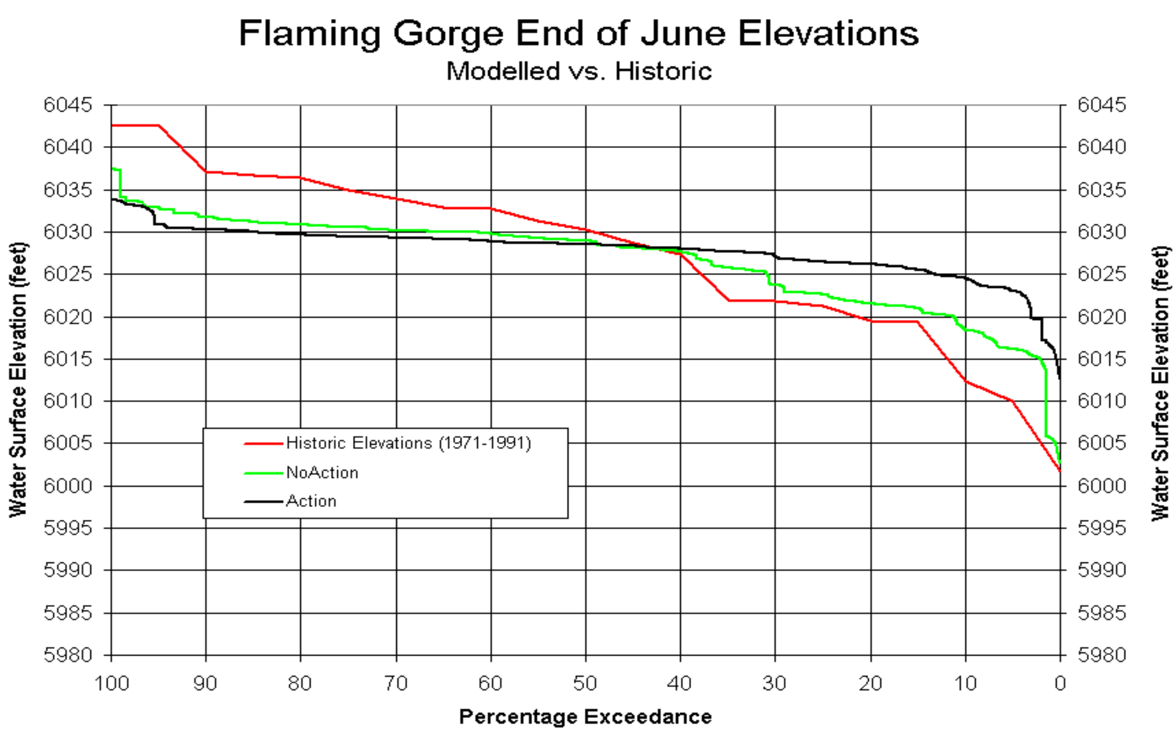


Figure 9.—June Reservoir Elevation Distribution Plot.

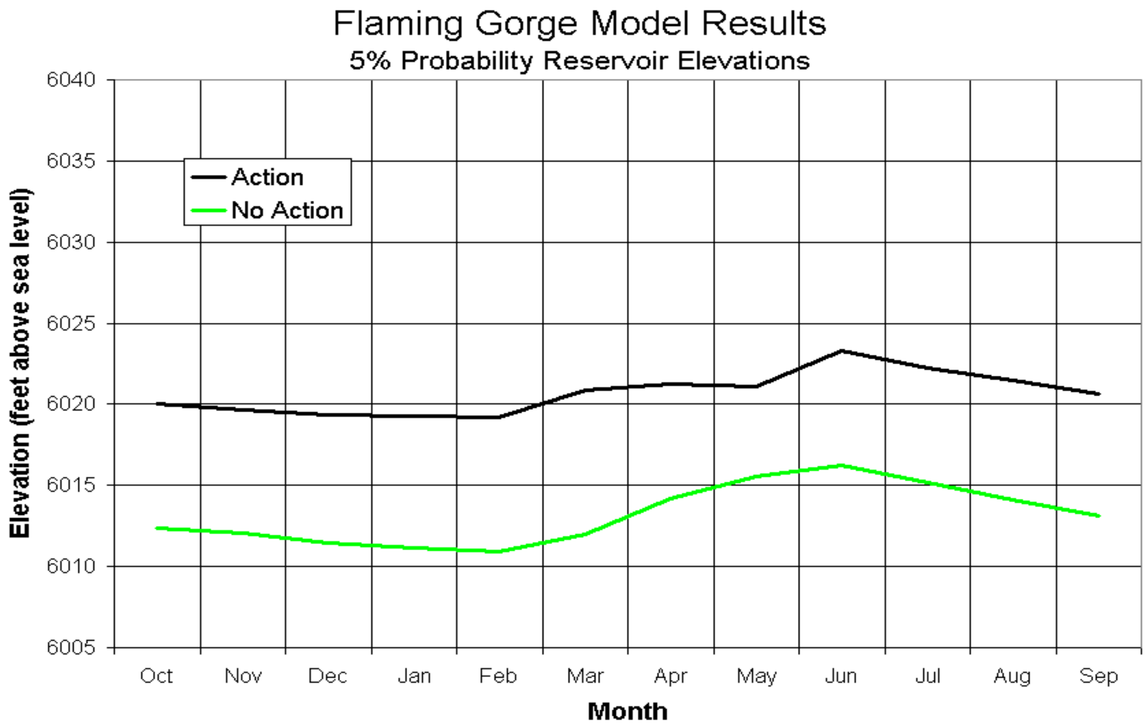


Figure 10.—5% Probability Level Reservoir Elevations (All Months).

REACH 1 SPRING PEAK FLOW RESULTS

The Flaming Gorge Model does not account for side inflows that occur along Reach 1 of the Green River. Historically, the volumes of flow contributed by tributaries to the Green River in Reach 1 have been relatively insignificant except during large thunderstorm events. Reach 1 flows that appear in this report are actually the average daily releases made from Flaming Gorge Dam. Figure 11 shows the distribution of peak flows having a duration of 1 day that occurred in the model results. It is also assumed that peak flows always occur during the spring period. Thus the distributions that appear in figure 11 can also be used to represent the distribution of annual peaks as well. For reference to how the reservoir was operated prior to the 1992 Biological Opinion, the distribution of historic peak flows in Reach 1 having a duration of 1 day for the period from 1971 to 1991 are included in the figure. Figures 12 and 13 show the distributions of peak flows in Reach 1 having durations of 2 and 4 weeks, respectively.

FLAMING GORGE ANNUAL BYPASS RELEASE RESULTS

Water released through the bypass tubes and the spillway (bypasses) can have a direct impact on the amount of power produced at Flaming Gorge Dam. For the purpose of comparing the Action and No Action Alternatives in terms of impact to power production, the distributions of annual bypass volumes are shown in figure 14. The figure shows the percentage of occurrences associated with the total volume bypassed each year. The model results indicate that the Action

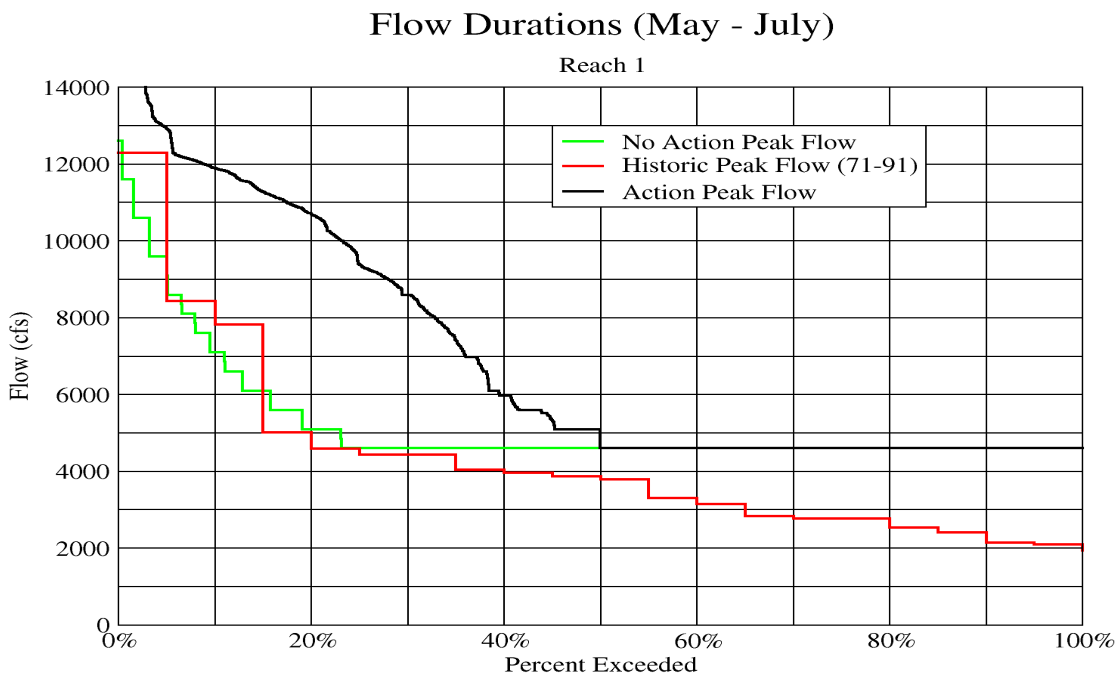


Figure 11.—5% Distribution of Peak (1-Day Duration) Releases.

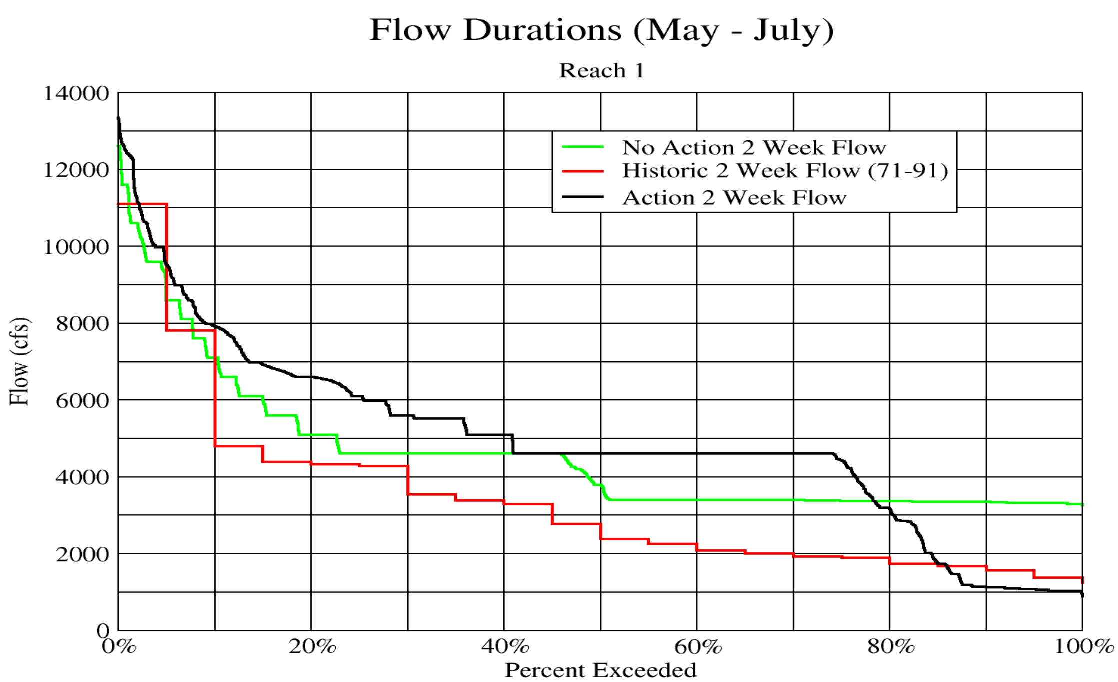


Figure 12.—Distribution of Peak (2-Week Duration) Releases.

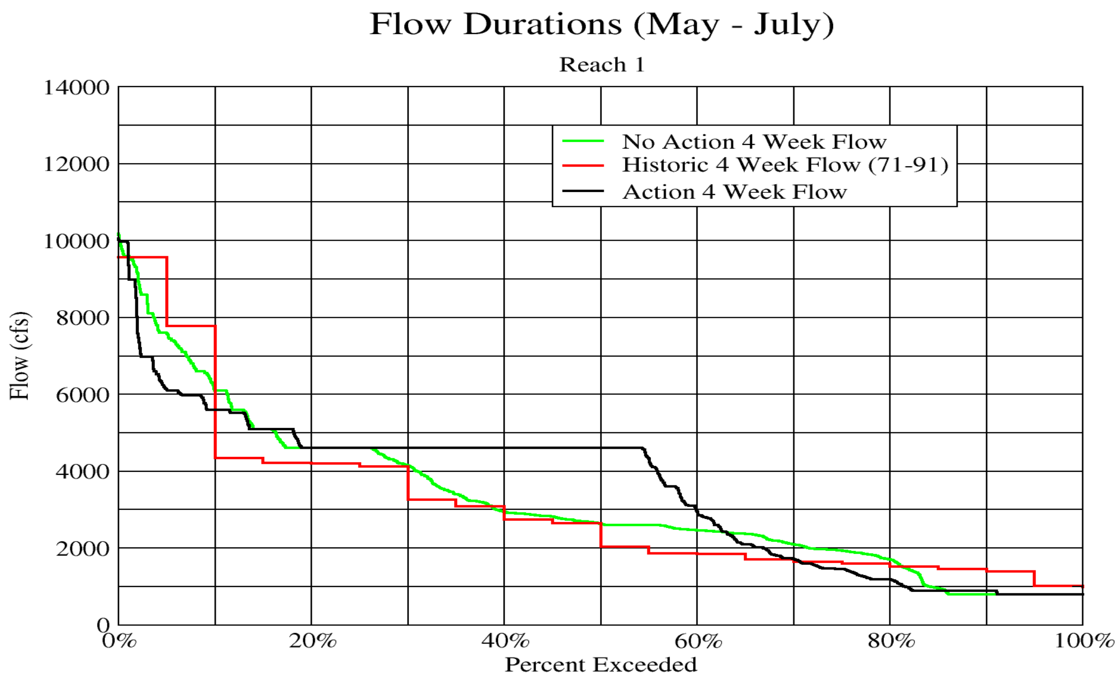


Figure 13.—Distribution of Peak (4-Week Duration) Releases.

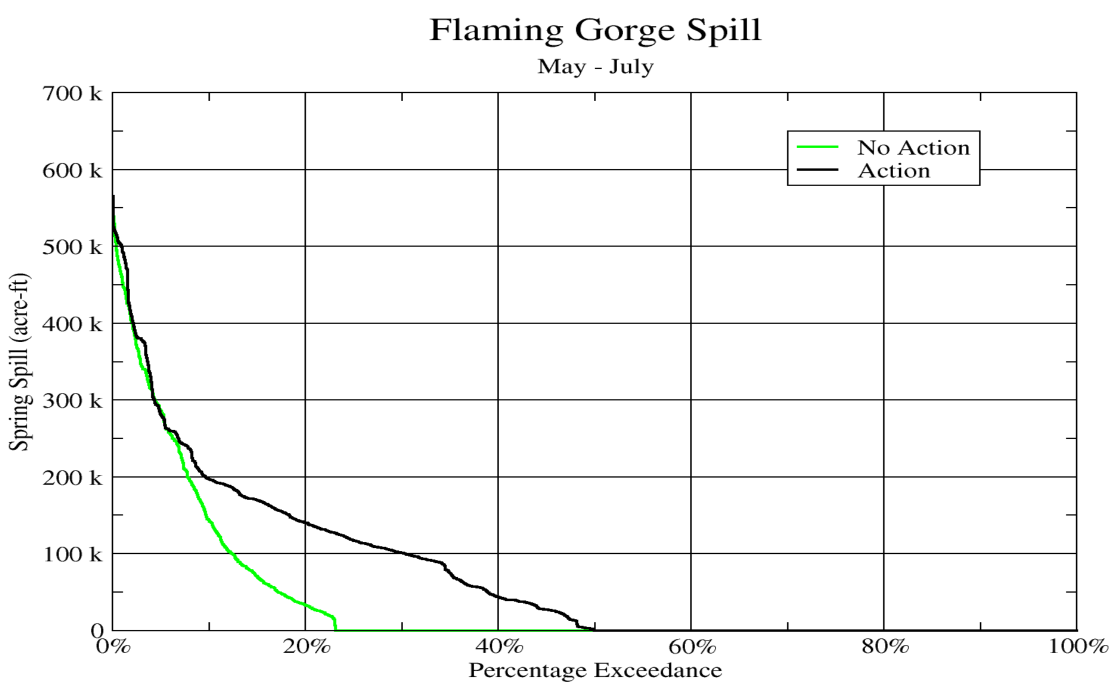


Figure 14.—Annual Bypass Volume Distribution.

Alternative will likely have about a 1 in 2 chance of requiring a bypass (about 50% of the time) in any given year while the No Action Alternative will likely have about a 1 in 5 chance of requiring a bypass (about 22% of the time) in any given year. These frequencies have not changed much from those reported in the October report, however the magnitude (volume) of these bypasses has diminished substantially.

REACH 1 AUGUST THROUGH FEBRUARY BASE FLOW RELEASE RESULTS

Releases made from August 1 through the end of February are referred to as the base flows in Reach 1. Figure 15 shows the distributions of base flows that occurred for Reach 1 in the model as a result of operating under the Action and No Action Alternatives. For reference to how Flaming Gorge Dam was operated prior to 1992, the distribution of actual base flows in Reach 1 that occurred from 1971 though 1991 are included in the figure. The distribution of unregulated inflows to Flaming Gorge Dam during this same period is also included. The unregulated inflows, in comparison to the actual base flows, indicate the effects of reservoir regulation at both Fontenelle Dam and Flaming Gorge Dam on Reach 1 flows during this period. Under the No Action Alternative, releases during the months of November through February are only restricted to be less than powerplant capacity and greater than 800 cfs. The Action Alternative maintains much stricter control of the releases during this period. This difference is evident in figure 15 between 0 and 20% exceedance. In many cases, the No Action Alternative strictly controls releases from August through October only to have releases increase dramatically in November

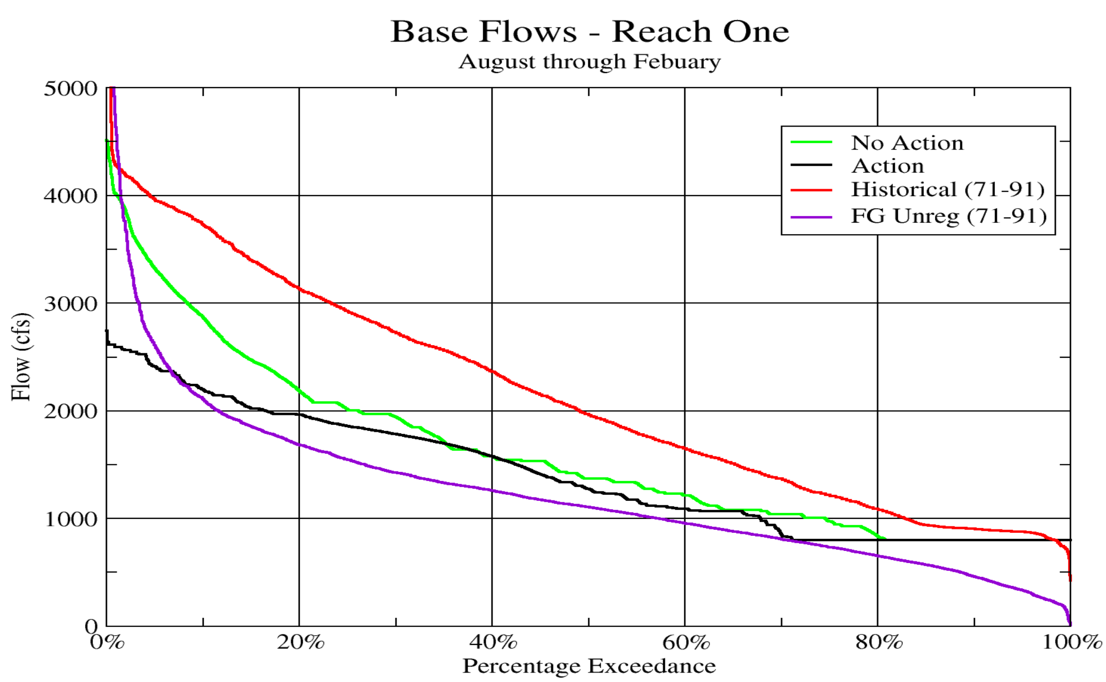


Figure 15.—Exceedance Percentage Flows for Reach 1 Flows During Base Flow Period.

when these controls are no longer valid. A good example of this situation is shown in figure 4. Releases during November for all three of these wet years were nearly double the releases that occurred during the preceding October.

The No Action Alternative restricts flows in Reach 2 from the end of the spring peak until September 15 to the range from 1,100 cfs to 1,800 cfs. In many cases, the Yampa River hydrograph is receding during this period and flows are above base flow levels. In order for the No Action Alternative to meet the base flow recommendation, releases are often times limited to 800 cfs (the minimum objective release). After September 15, the No Action Alternative expands the range of acceptable base flows to 1,100 to 2,400 cfs. In November these restrictions are no longer valid and releases are set within the range from 800 cfs to 4,600 cfs to achieve the drawdown target for the following year. To show the effect of these restrictions, the distribution of flows during the months of September and December were isolated. Graphs showing the distribution of flows for the Action and No Action Alternatives are included in the appendix of this report. There is a significant difference between the two months with respect to the flows generated by the Action and No Action rulesets. In September, flows in Reach 1 are typically less under the No Action Alternative than the flows of the Action Alternative. But in December, this relationship is reversed with flows of the No Action Alternative being much greater than those of the Action Alternative. This relationship translates to the other downstream reaches to a lesser degree. Flow distribution graphs for Reach 2 for the months of September and December are also included in the appendix.

REACH 2 SPRING PEAK FLOW RESULTS

Figures 16, 17, and 18 show the distributions of modeled spring peak flows that occurred in Reach 2. Figure 16 shows the distribution of peak flows having a duration of 1-day while figure 17 and 18 show distributions for peak flows having durations of 2 and 4 weeks, respectively. For perspective, the historic peak flows during the period from 1971 though 1991 are included on each of these figures. While the distributions of the Action and No Action peak flows are similar, there are notable differences at specific percentage exceedances. This is evident in figure 16 where the distribution for the Action Alternative noticeably deviates from the No Action Alternative at about 13% exceedance. Similar deviations occur in the Action Alternative at 10% and 40% exceedance levels for the 2-week duration peak flows. In the 4-week duration peak flows, a deviation in the Action distribution occurs at about 10% exceedance. All of these deviations indicate where peak flows were increased by the Action Alternative in order to achieve the specific targets of the 2000 Flow and Temperature Recommendations.

REACH 2 BASE FLOW RELEASE RESULTS

Figure 19 shows the distribution of base flows that occurred in Reach 2 under the Action and No Action Alternatives. Base flows are noticeably decreased under the Action Alternative especially in wetter years. For reference, the distribution of pre-dam (1946 to 1961) base flows and the distribution of base flows during the period from 1971 through 1991 are included in the figure.

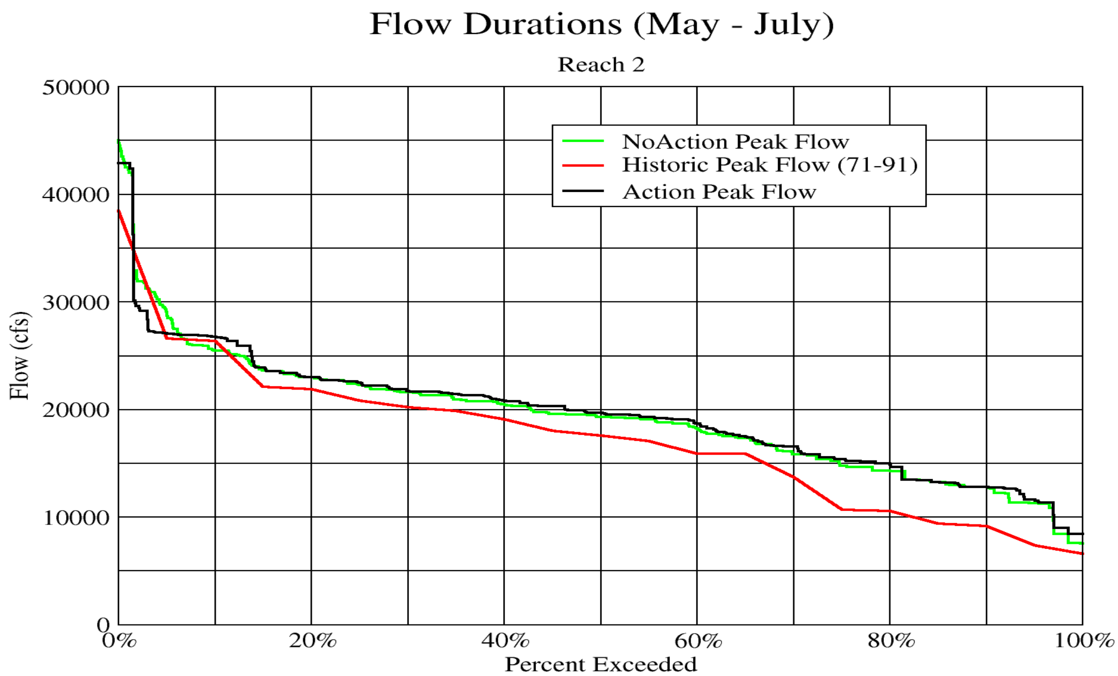


Figure 16.—Distribution of Peak Flows (1-Day Duration) in Reach 2.

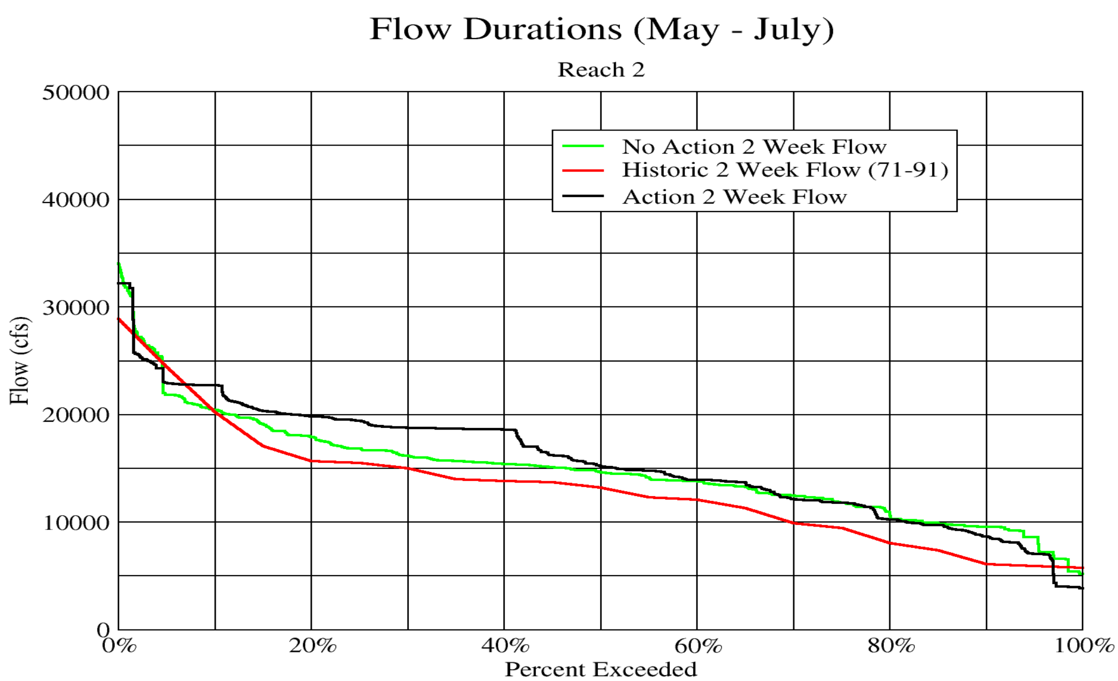


Figure 17.—Distribution of Peak Flows (2-Week Durations) in Reach 2.

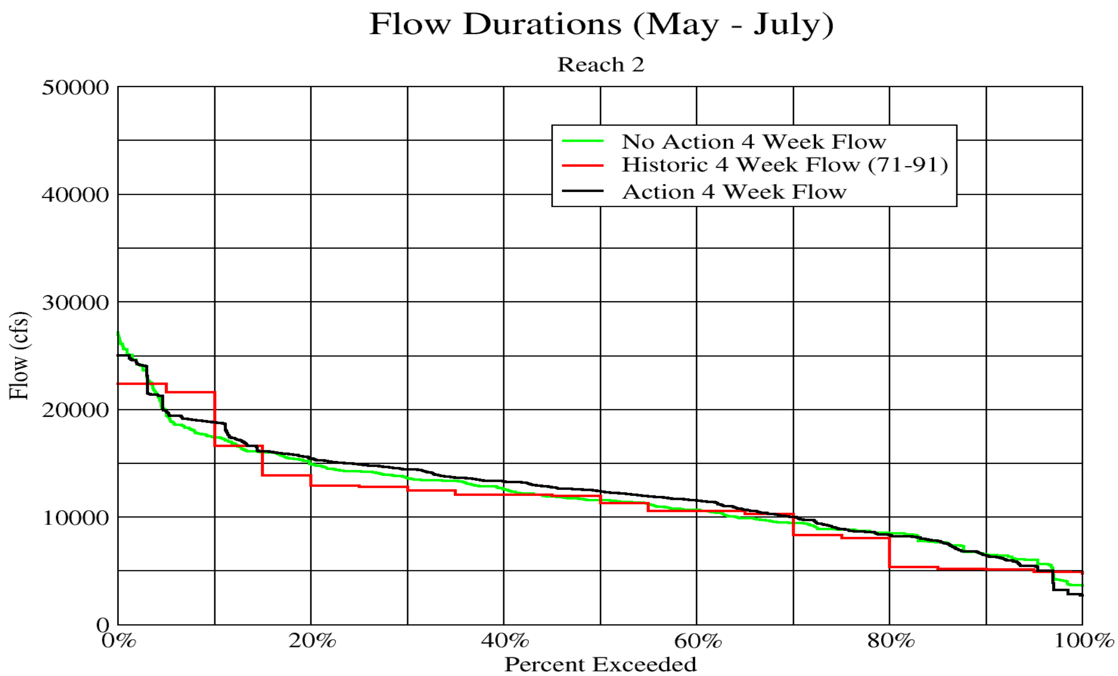


Figure 18.—Distribution of Peak Flows (4-Week Durations) in Reach 2.

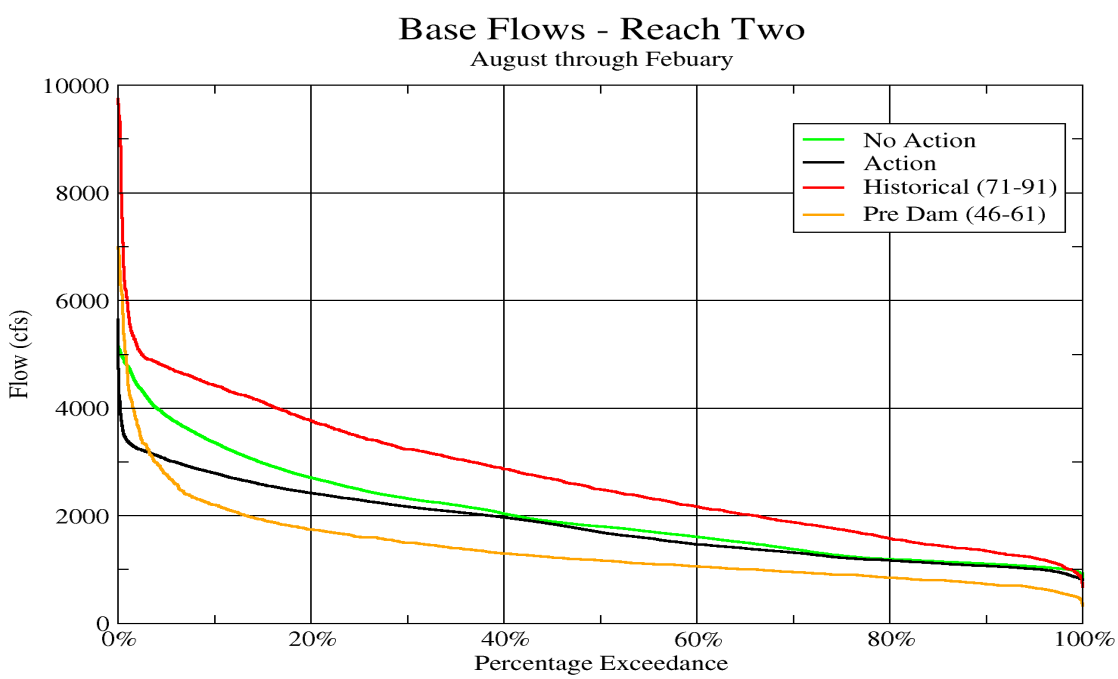


Figure 19.—Exceedance Percentage Flows for Reach 2 Flows During Base Flow Period.

The period from 1946 through 1961 does include a significant dry cycle for the Upper Green River Basin but these two distributions of historic Reach 2 flows give some perspective to the difference between the Action and No Action Alternative base flows.

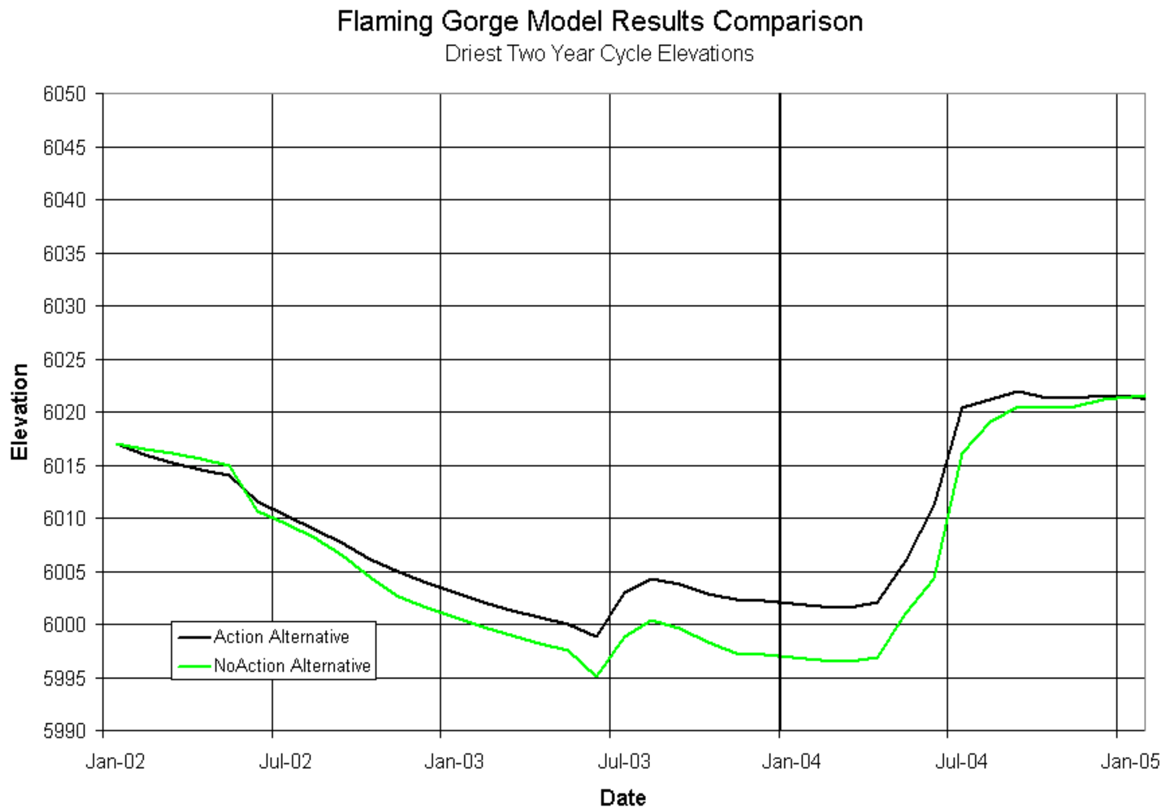
Reach 2 is also impacted by the No Action flow restrictions during the summer months. Flow distribution graphs for the months of September and December characterize how base flows in Reach 2 will transition from low to high during the fall months (October and November). These graphs are located in the appendix of this report.

SUMMARY

The results described in this report show significantly reduced impacts to reservoir related resources. Of all of the modifications made since October, the most significant was the implementation of the daily model to react to estimated Yampa River flows. This modification substantially reduced the volume of the spring releases made by the Action Alternative, which in turn, decreased the drawdown effects associated with the spring release. The Action Alternative now yields reservoir elevations that are significantly higher than those presented in the October report. While the frequency of bypasses in the Action Alternative has not changed very much from those reported in October, the bypass volumes have been significantly reduced. In October, there was about a 20% chance that any given year would have a bypass in excess of 300,000 acre-feet. With the modifications made since October, there is now a 20% chance in any given year of a bypass in excess of 150,000 acre-feet.

This report is not comprehensive in terms of the model results analysis presented. It is an attempt to provide some useful analysis for the purposes of determining other resource impacts. Statistical analysis of data depends largely on the question that must be answered. While the results presented in this report do answer many questions about impacts that may occur as a result of implementing the Action or No Action Alternatives, the results will not answer all questions. If additional analysis is required to answer your particular resource questions, it is suggested that you present your questions to the hydrologic modeling team.

APPENDIX



Flaming Gorge Model Results Comparison
Driest Two Year Cycle Elevations
Elevation
6050
6045
6040
6035
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6020
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Action Alternative
NoAction Alternative
Jan-02
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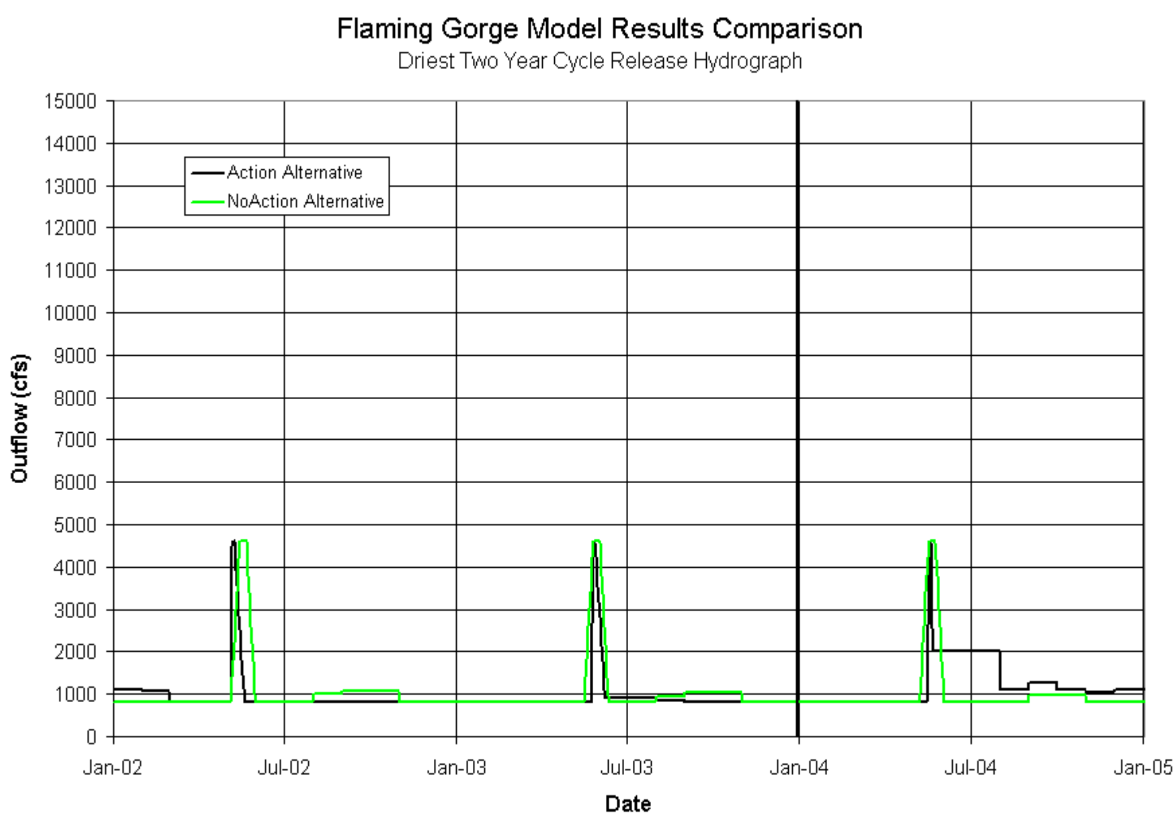
Date



Flaming Gorge Model Results Comparison
Driest Two Year Cycle Release Hydrograph
Outflow (cfs)
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
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Action Alternative
NoAction Alternative
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Jul-04
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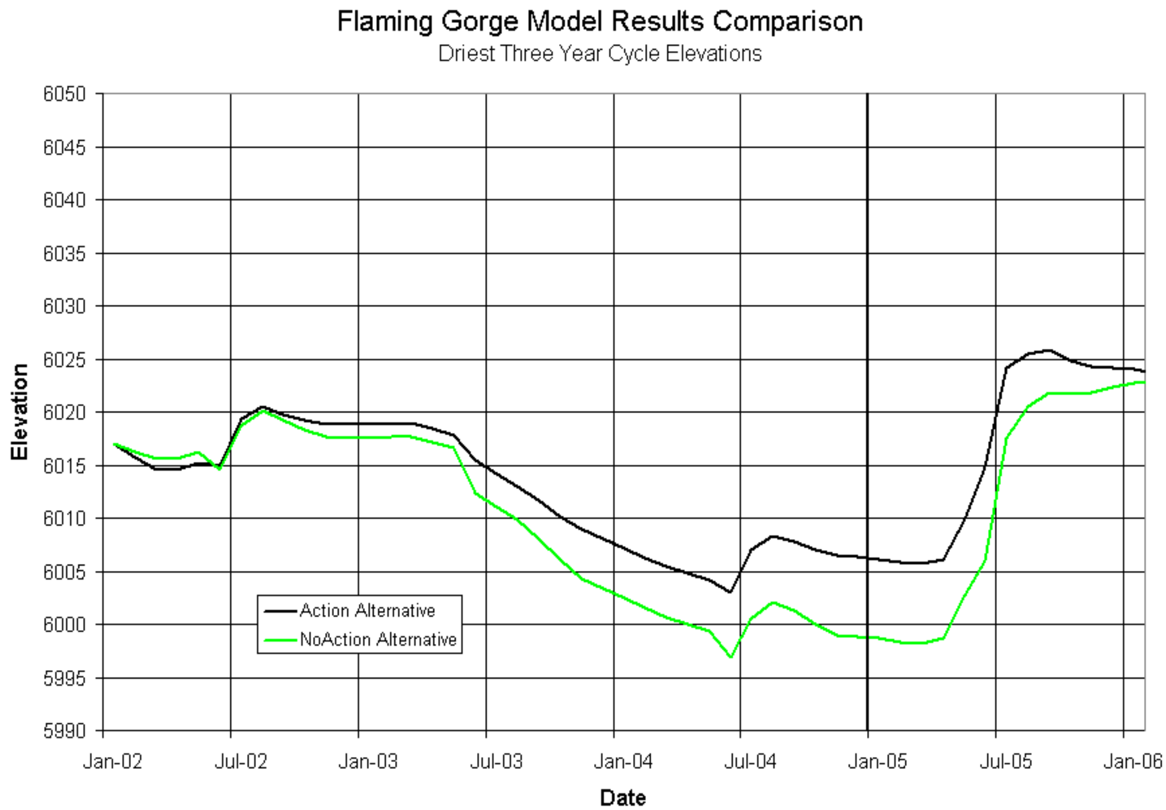
Date


Flaming Gorge Model Results Comparison
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Elevation
6050
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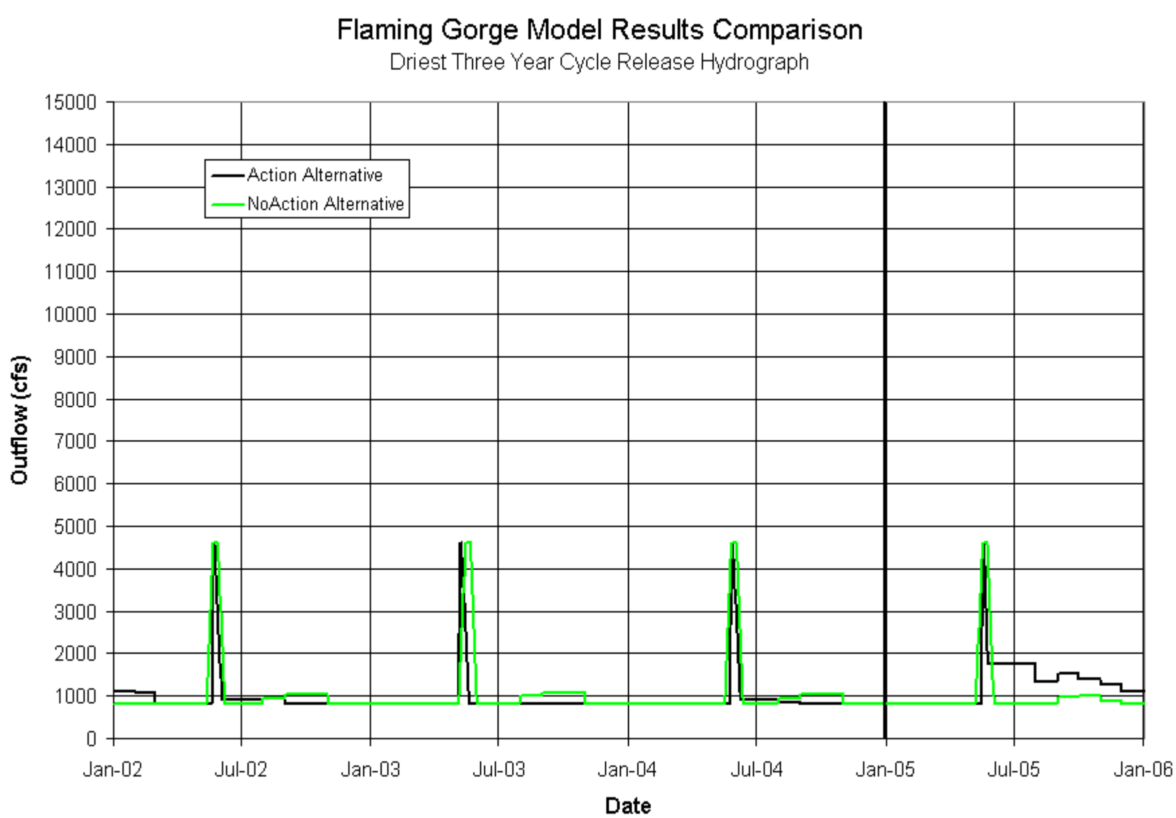
Date
Action Alternative
NoAction Alternative


Flaming Gorge Model Results Comparison
Driest Three Year Cycle Release Hydrograph
Outflow (cfs)
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Date
Action Alternative
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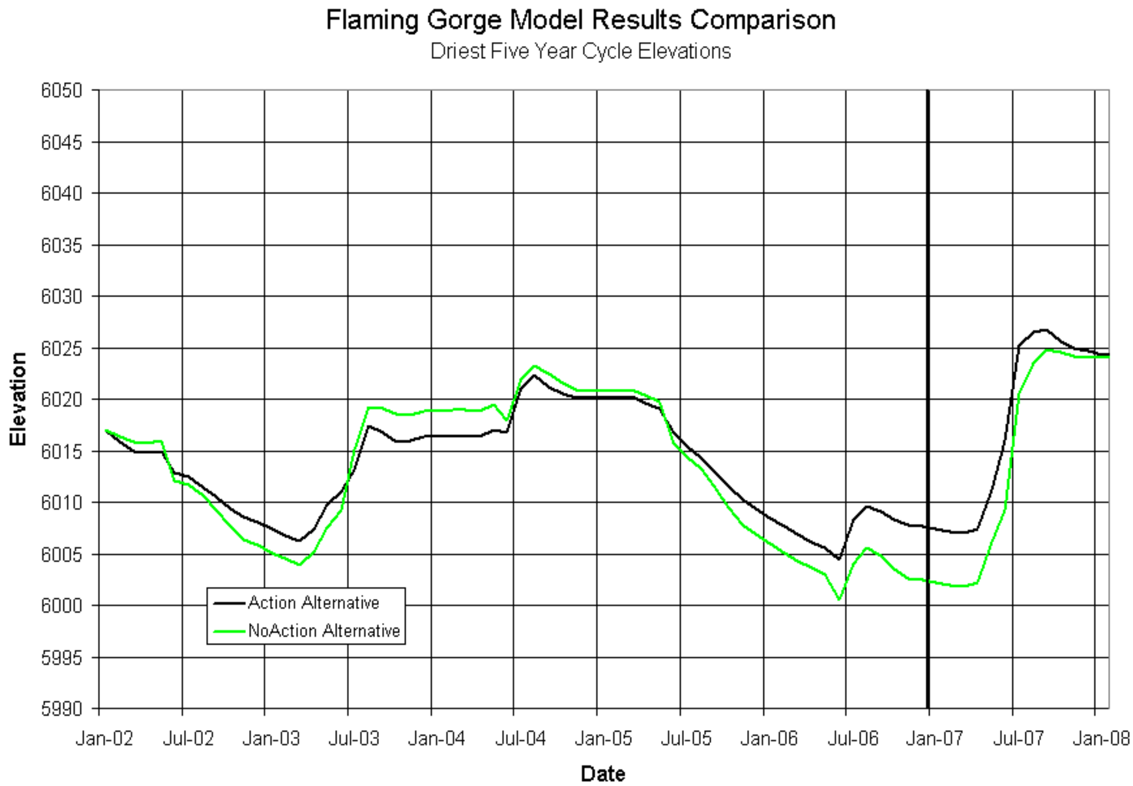
Flaming Gorge Model Results Comparison
Driest Five Year Cycle Elevations
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5995
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Action Alternative
NoAction Alternative
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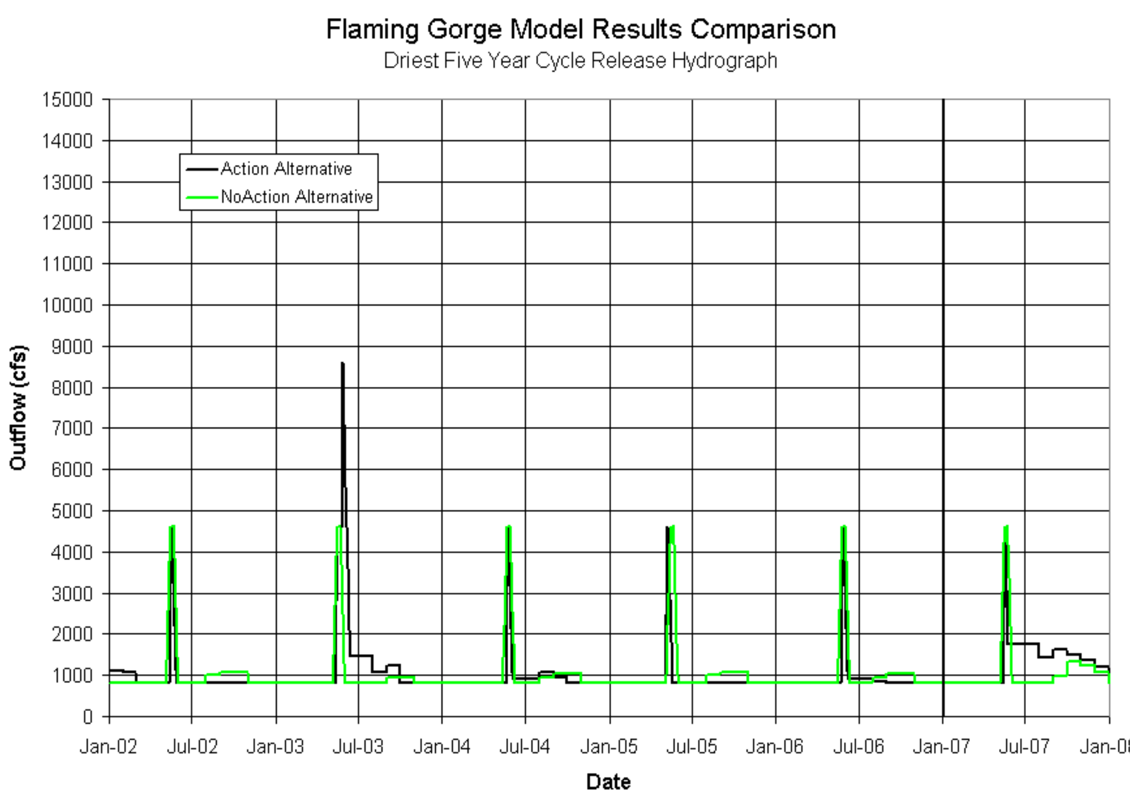
Date


Flaming Gorge Model Results Comparison
Driest Five Year Cycle Release Hydrograph
Outflow (cfs)
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Action Alternative
NoAction Alternative
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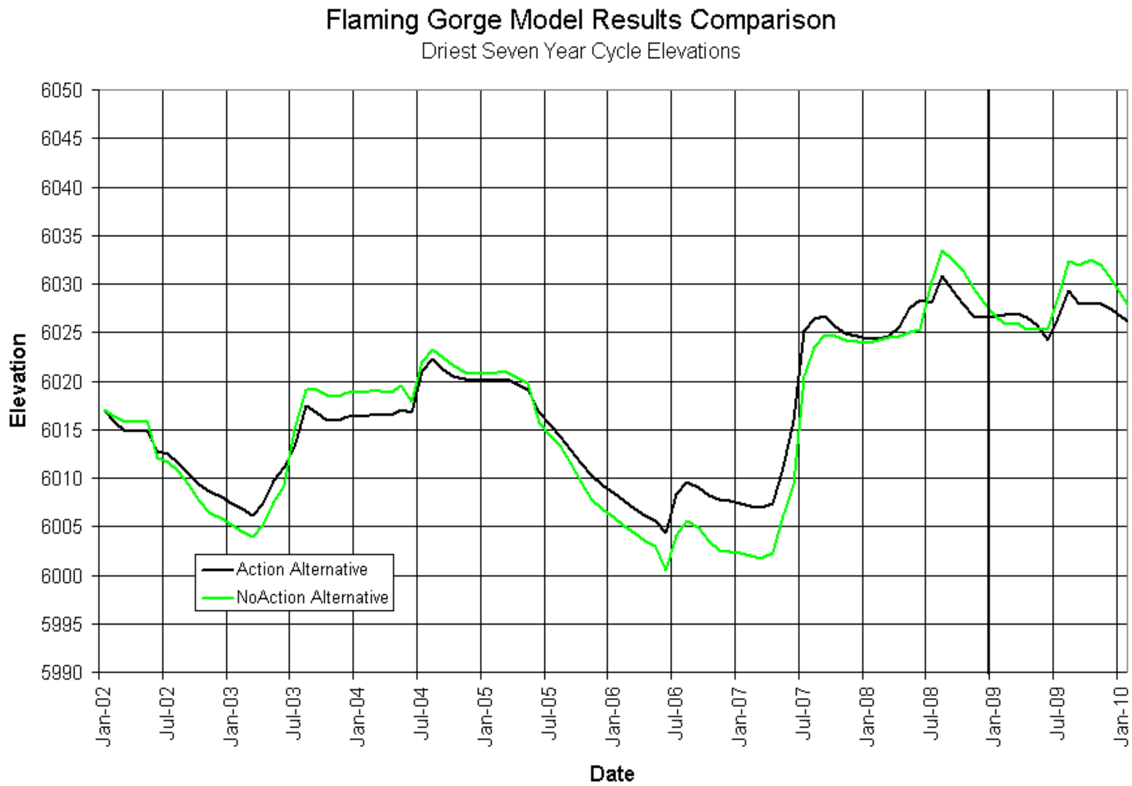

Flaming Gorge Model Results Comparison
Driest Seven Year Cycle Elevations
Elevation
Date
Action Alternative
NoAction Alternative
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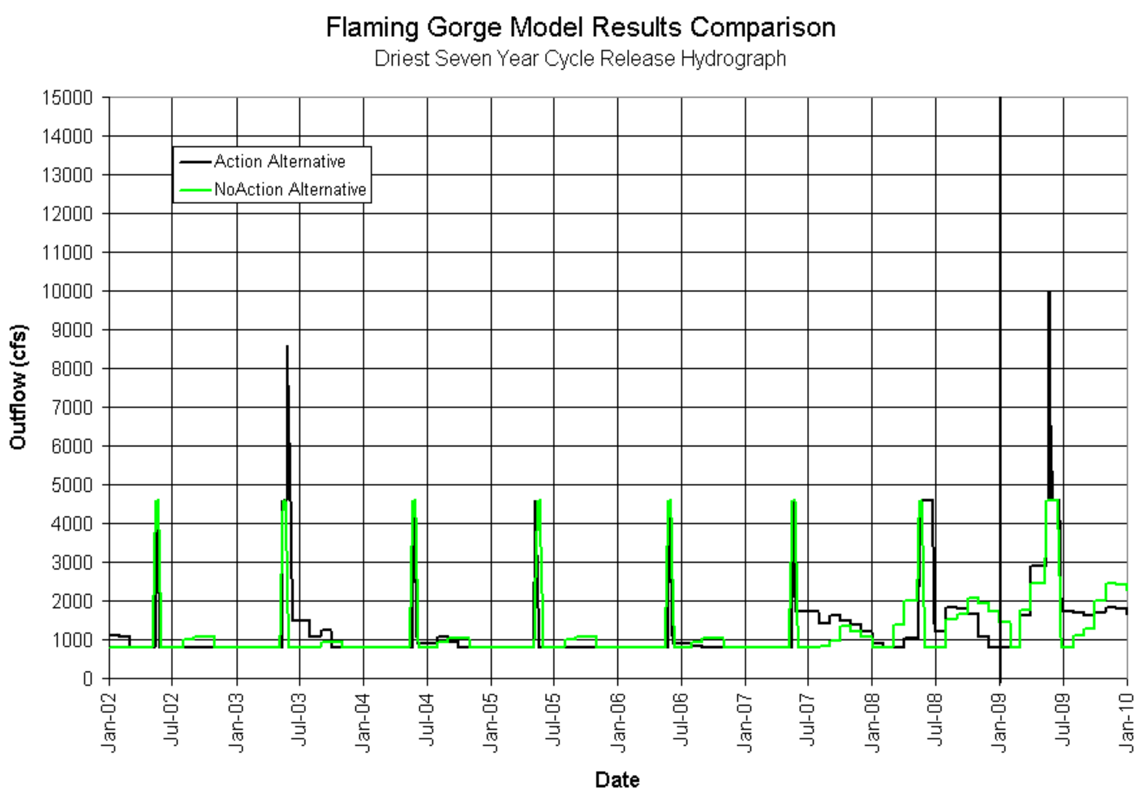

Flaming Gorge Model Results Comparison
Driest Seven Year Cycle Release Hydrograph
Outflow (cfs)
Date
Action Alternative
NoAction Alternative
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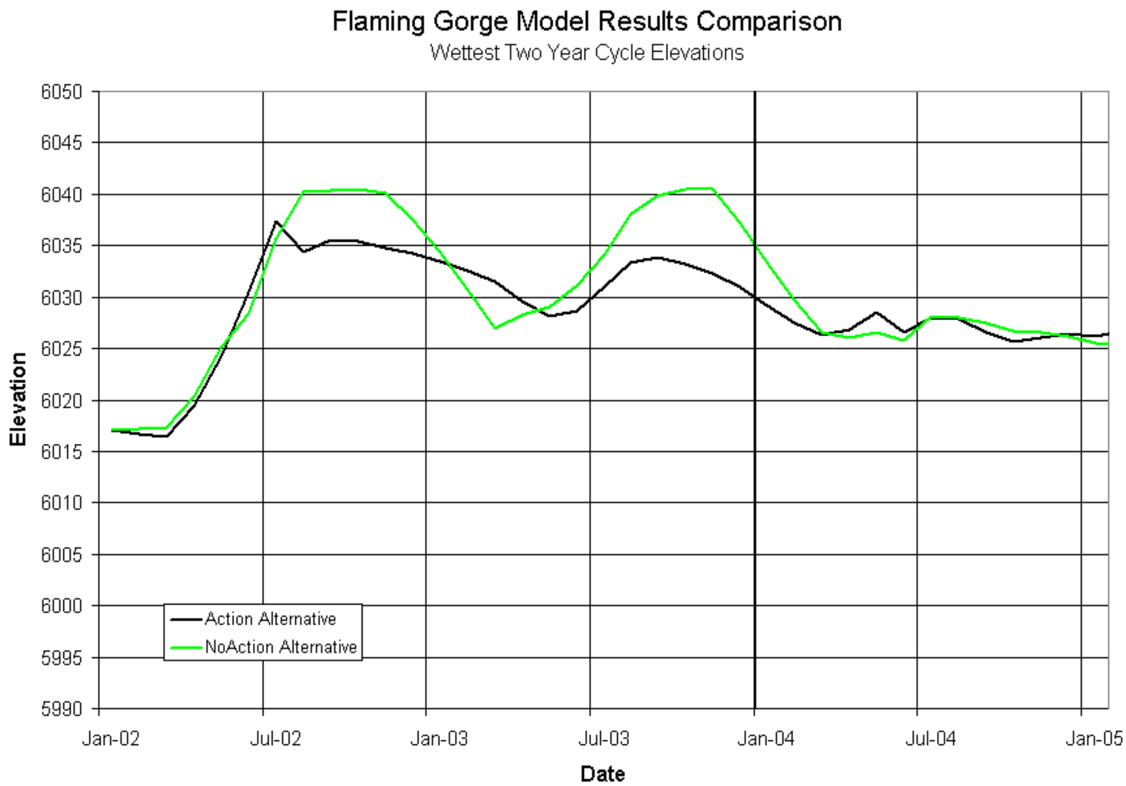
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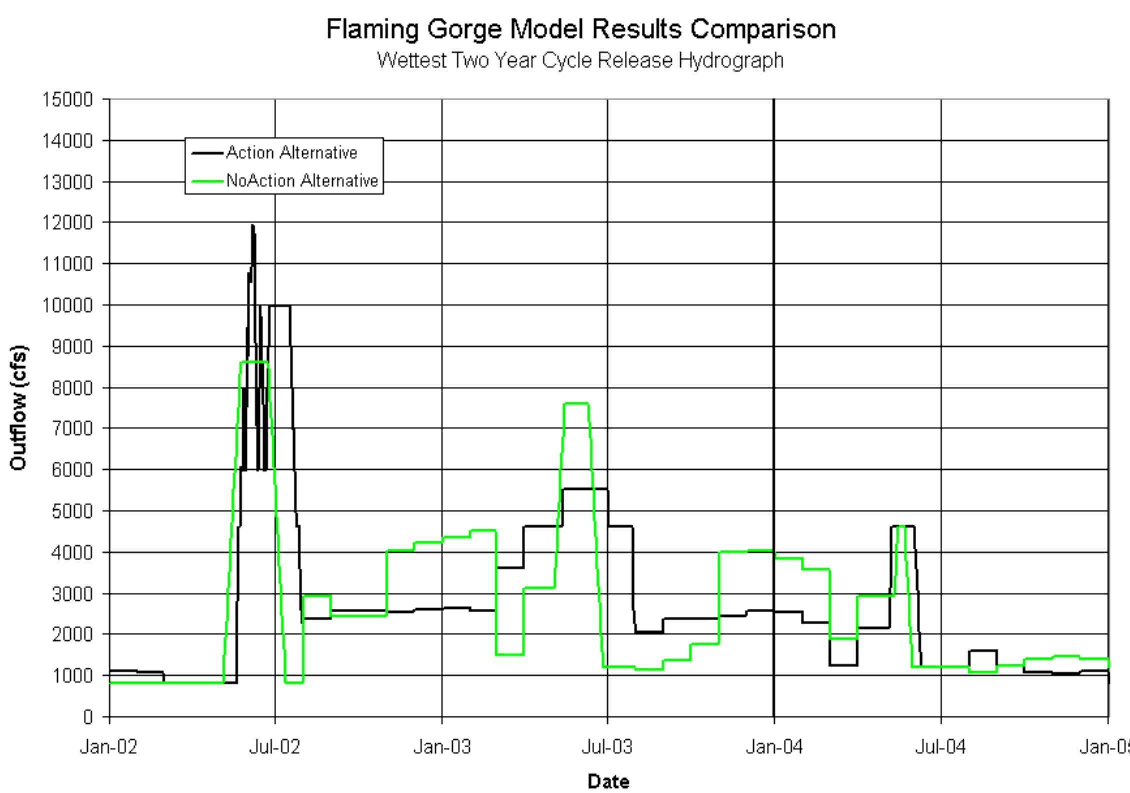
Flaming Gorge Model Results Comparison
Wettest Two Year Cycle Release Hydrograph
Outflow (cfs)
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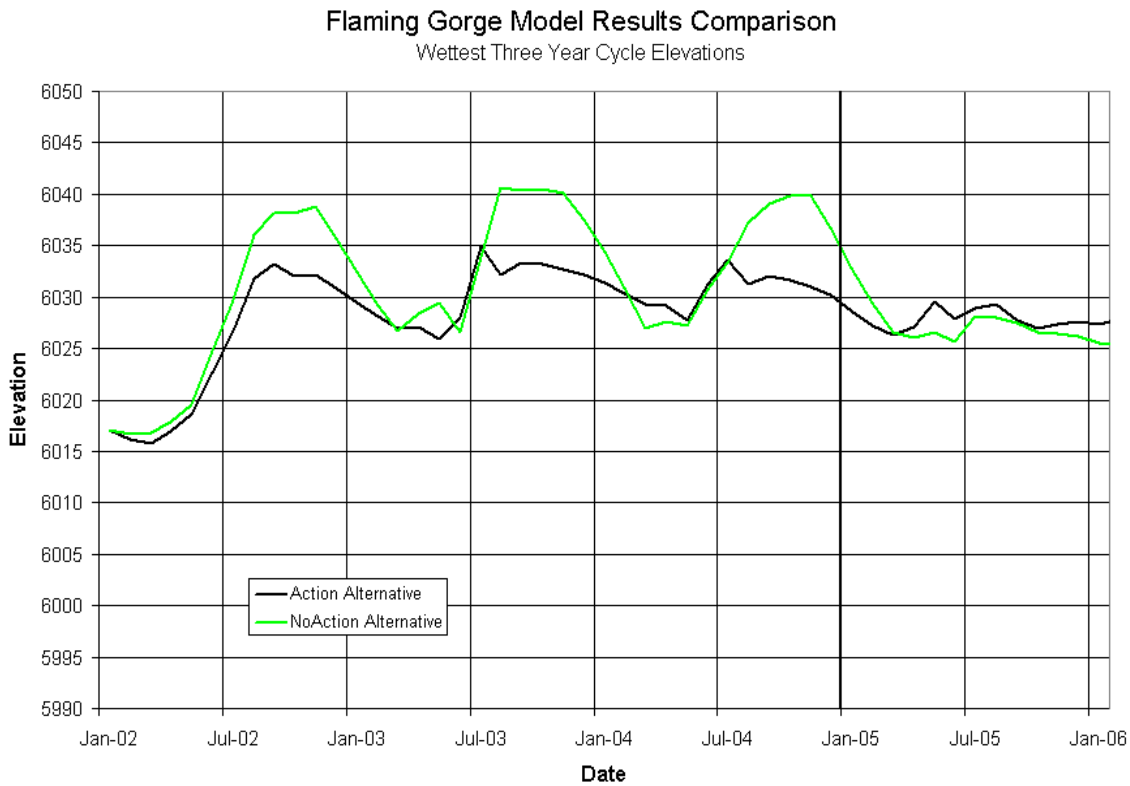
Flaming Gorge Model Results Comparison
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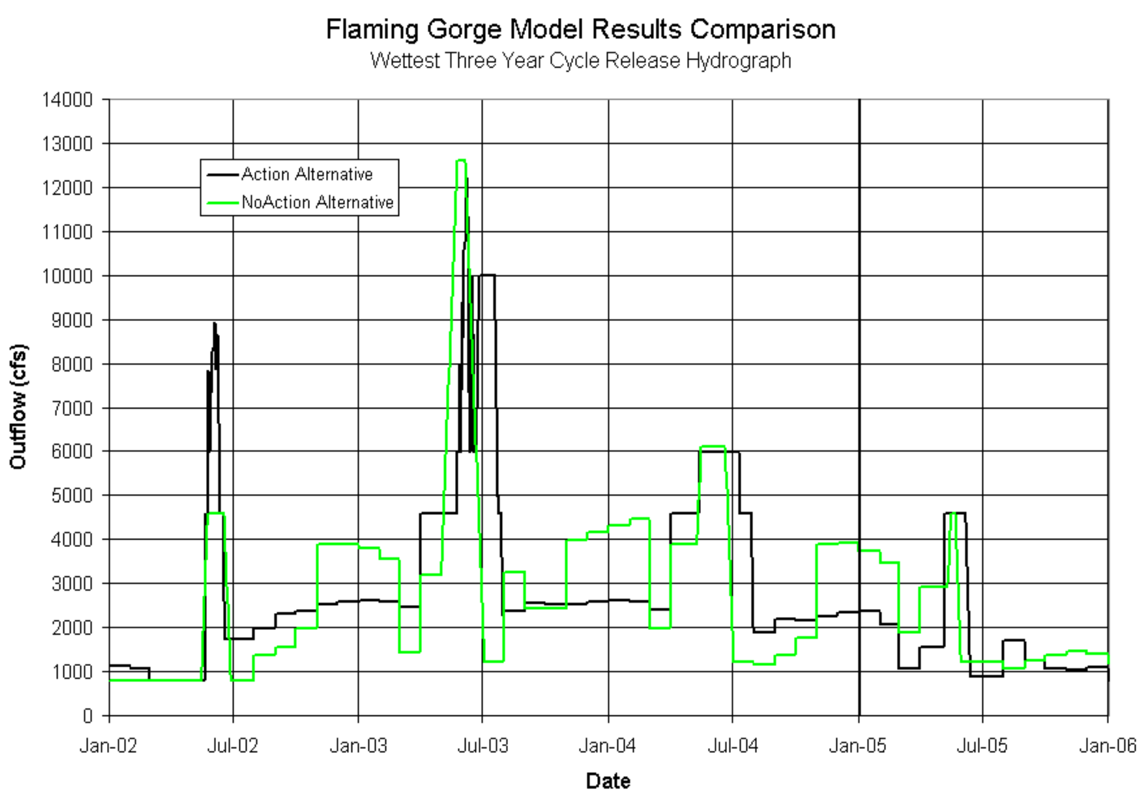
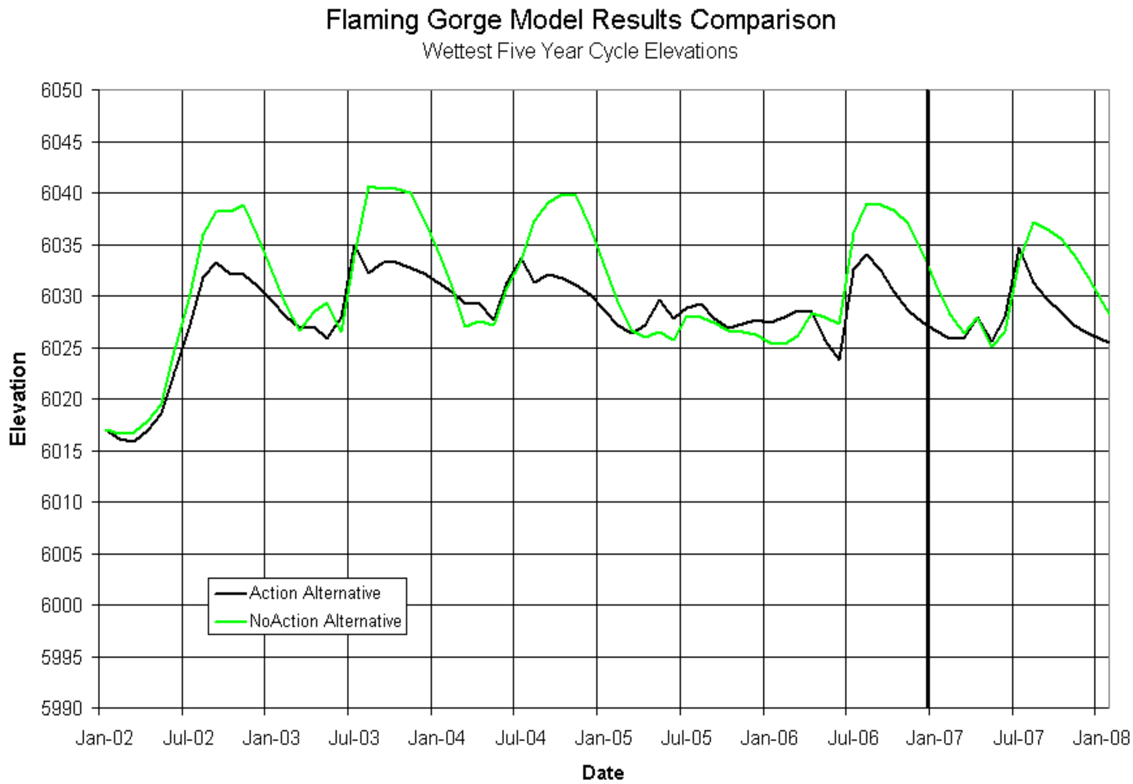
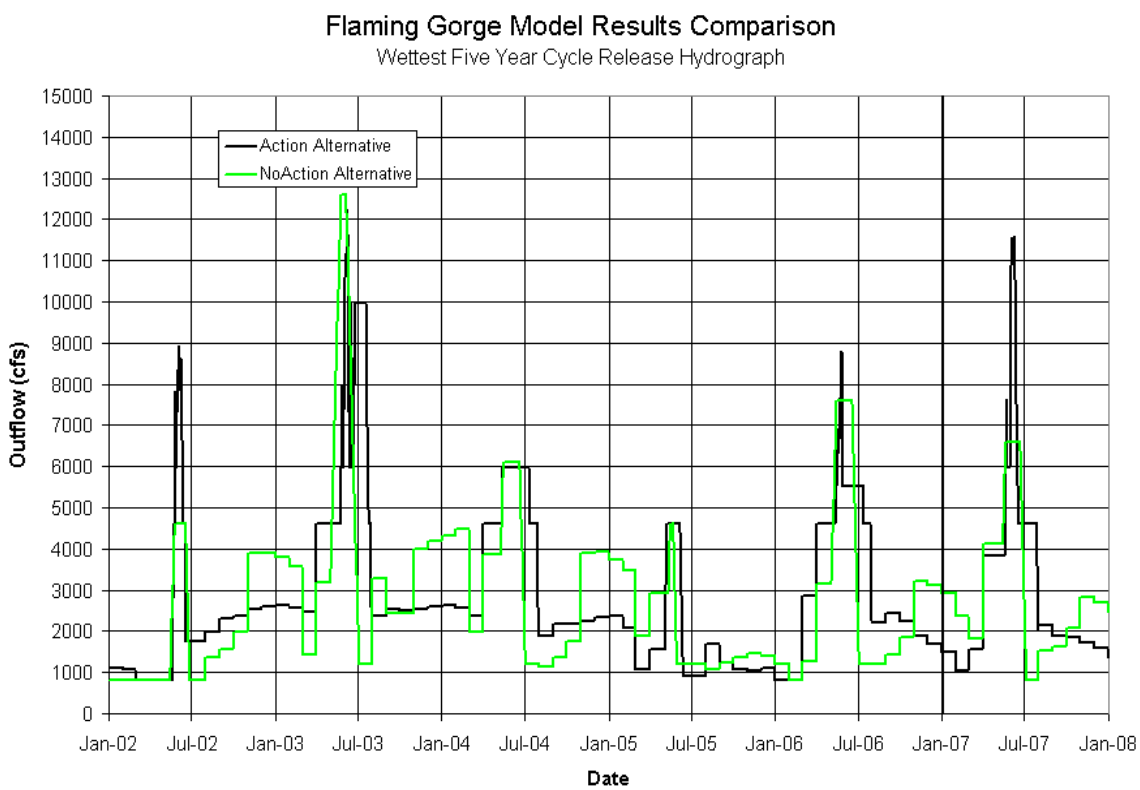
Jul-05
Jan-06

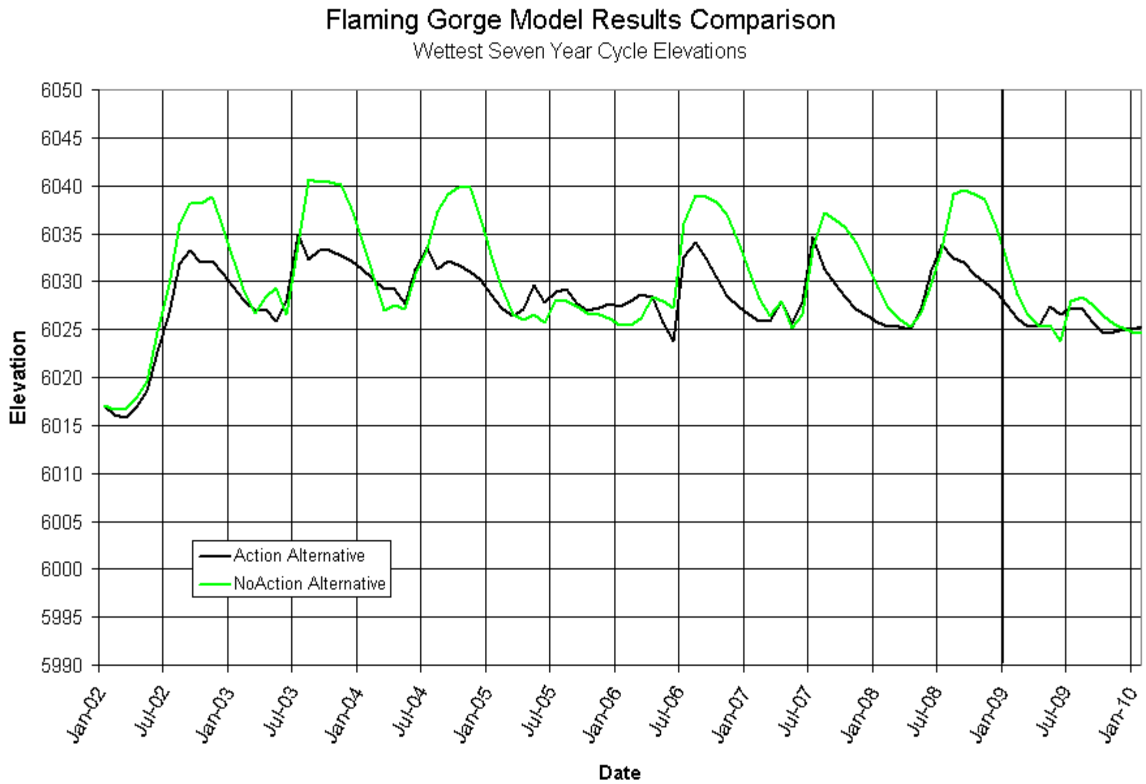

Flaming Gorge Model Results Comparison
Wettest Three Year Cycle Release Hydrograph
Outflow (cfs)
Date
Action Alternative
NoAction Alternative
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06

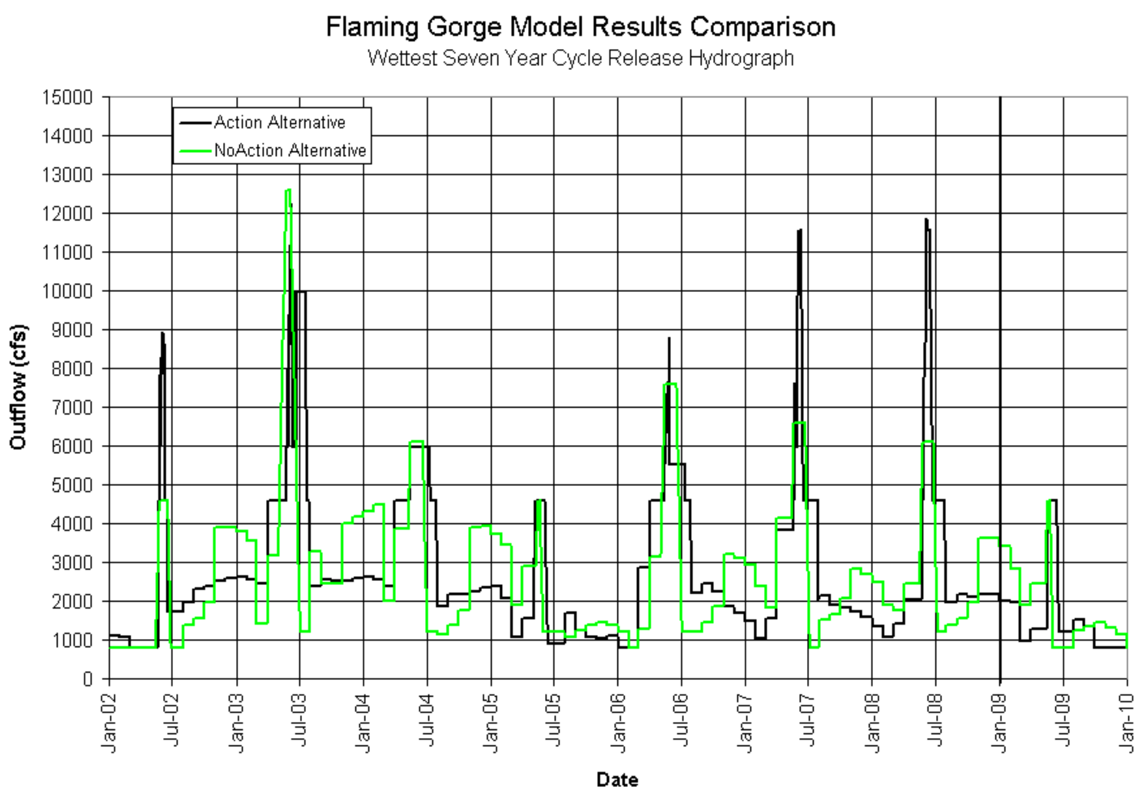


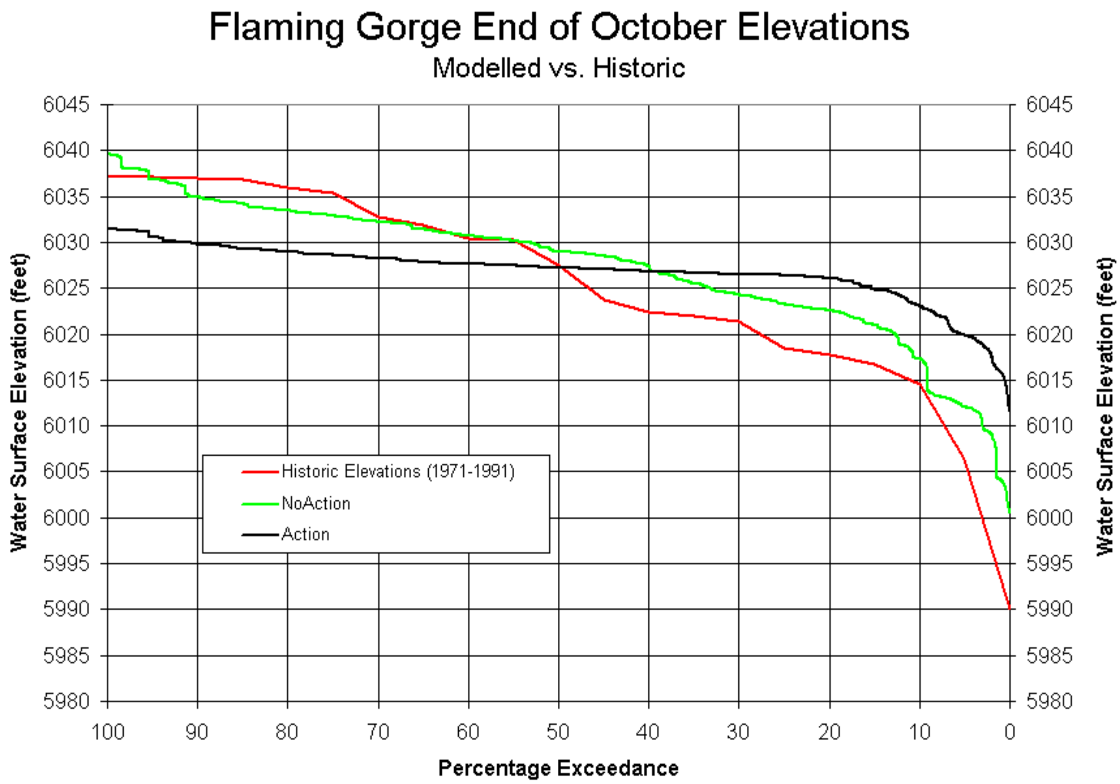
Flaming Gorge Model Results Comparison
Wettest Five Year Cycle Elevations
Elevation
6050
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
Action Alternative
NoAction Alternative
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Date

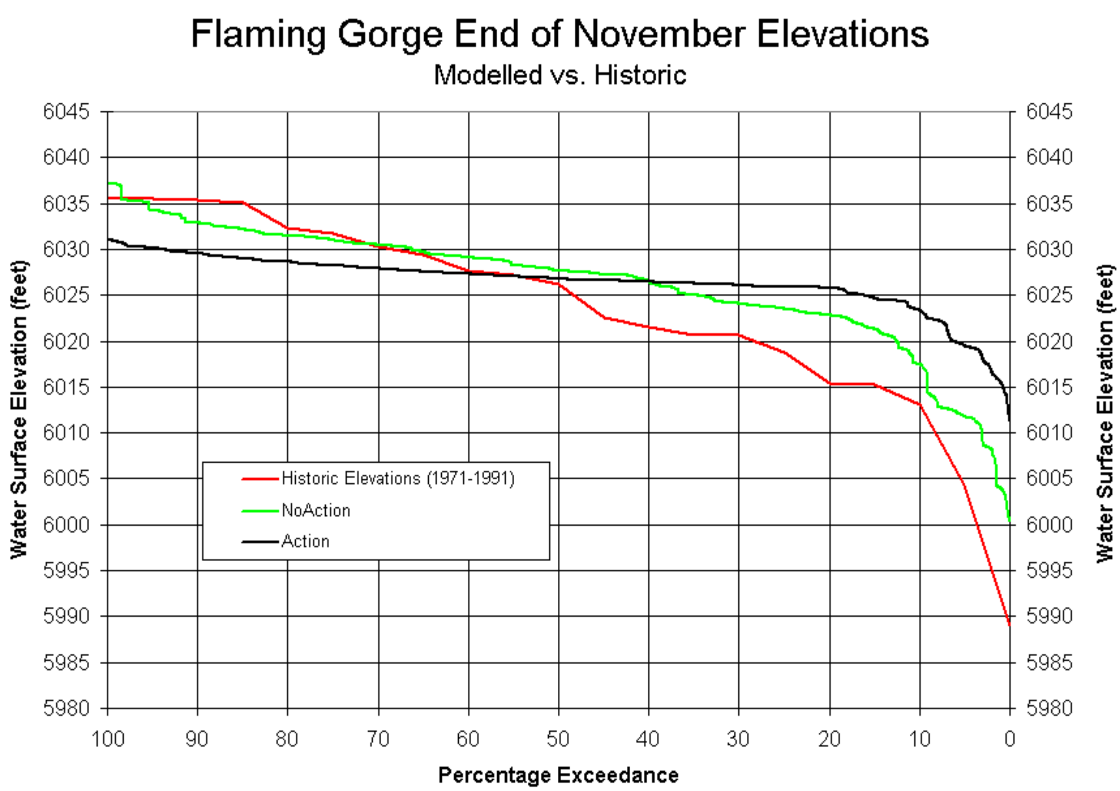


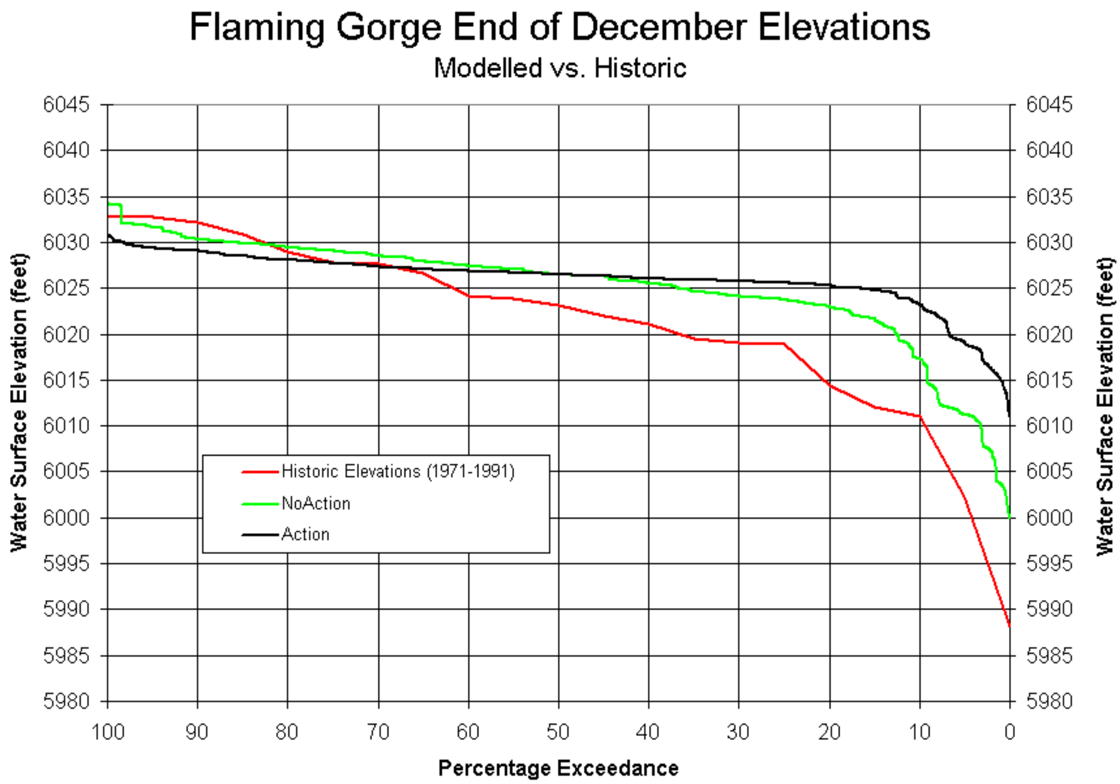
Flaming Gorge Model Results Comparison
Wettest Five Year Cycle Release Hydrograph
Outflow (cfs)
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Action Alternative
NoAction Alternative
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Date


Flaming Gorge Model Results Comparison
Wettest Seven Year Cycle Elevations
Elevation
Date
Action Alternative
NoAction Alternative
6050
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10

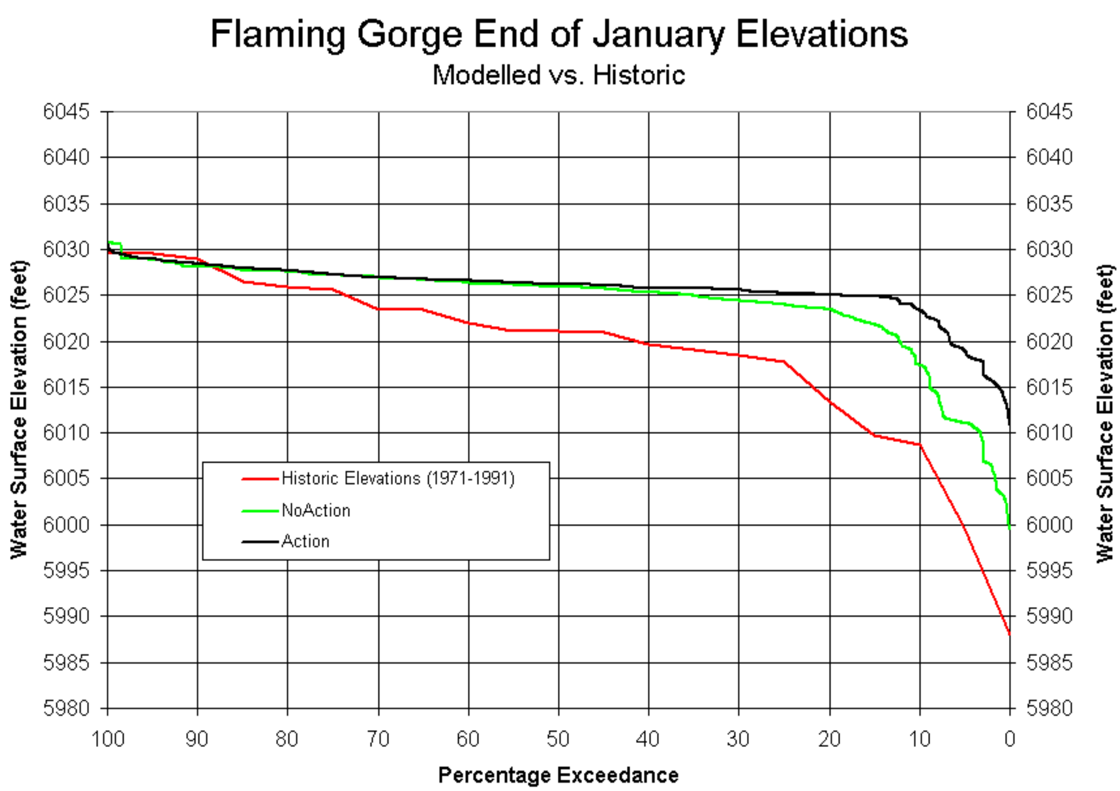

Flaming Gorge Model Results Comparison
Wettest Seven Year Cycle Release Hydrograph
Outflow (cfs)
Date
Action Alternative
NoAction Alternative
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
Jan-02
Jul-02
Jan-03
Jul-03
Jan-04
Jul-04
Jan-05
Jul-05
Jan-06
Jul-06
Jan-07
Jul-07
Jan-08
Jul-08
Jan-09
Jul-09
Jan-10


Flaming Gorge End of October Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0

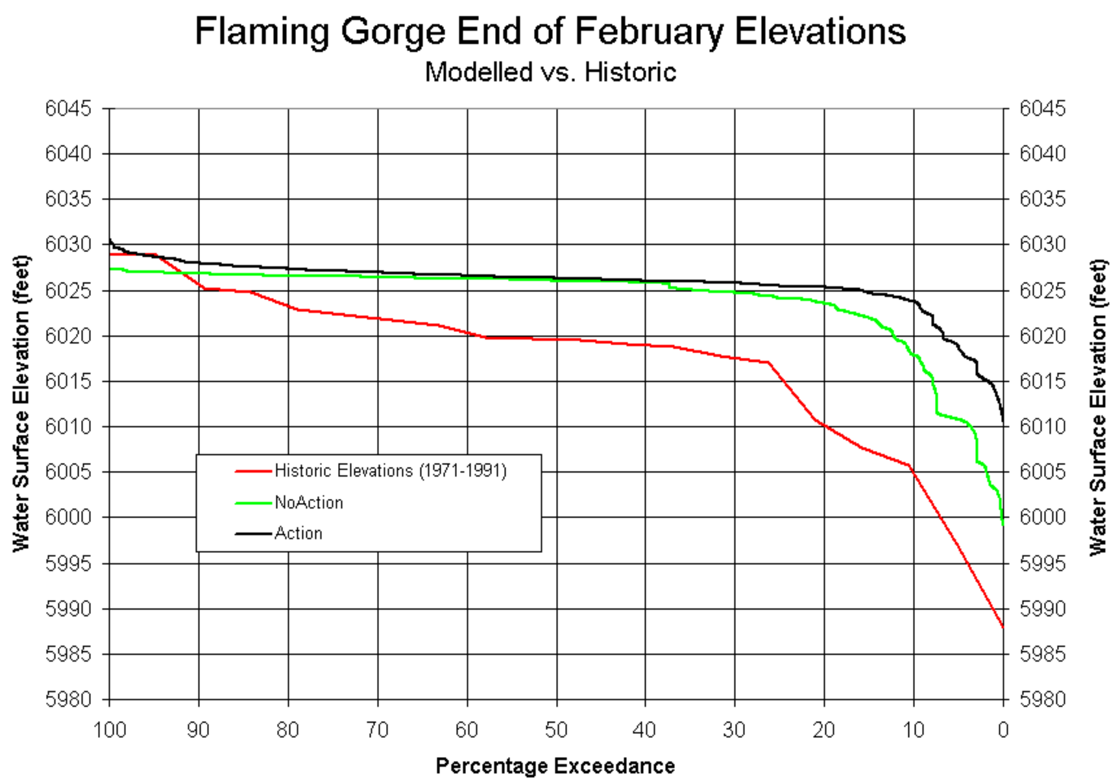

Flaming Gorge End of November Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0



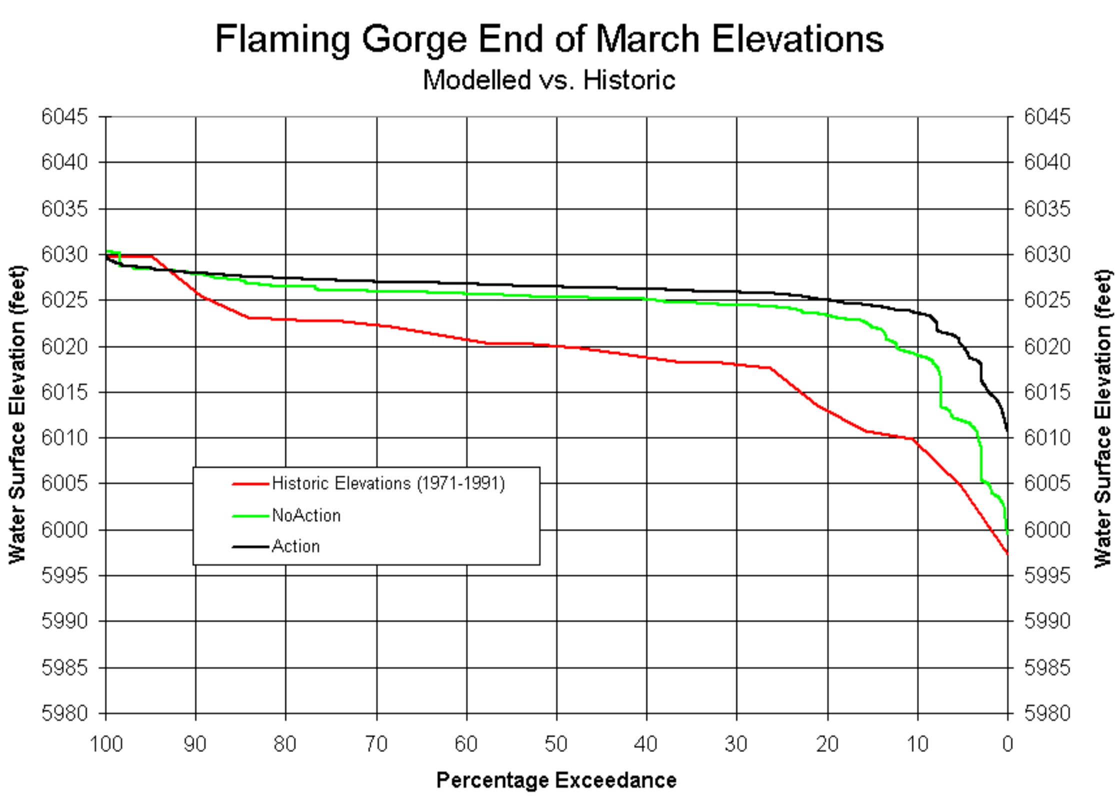
Flaming Gorge End of December Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0



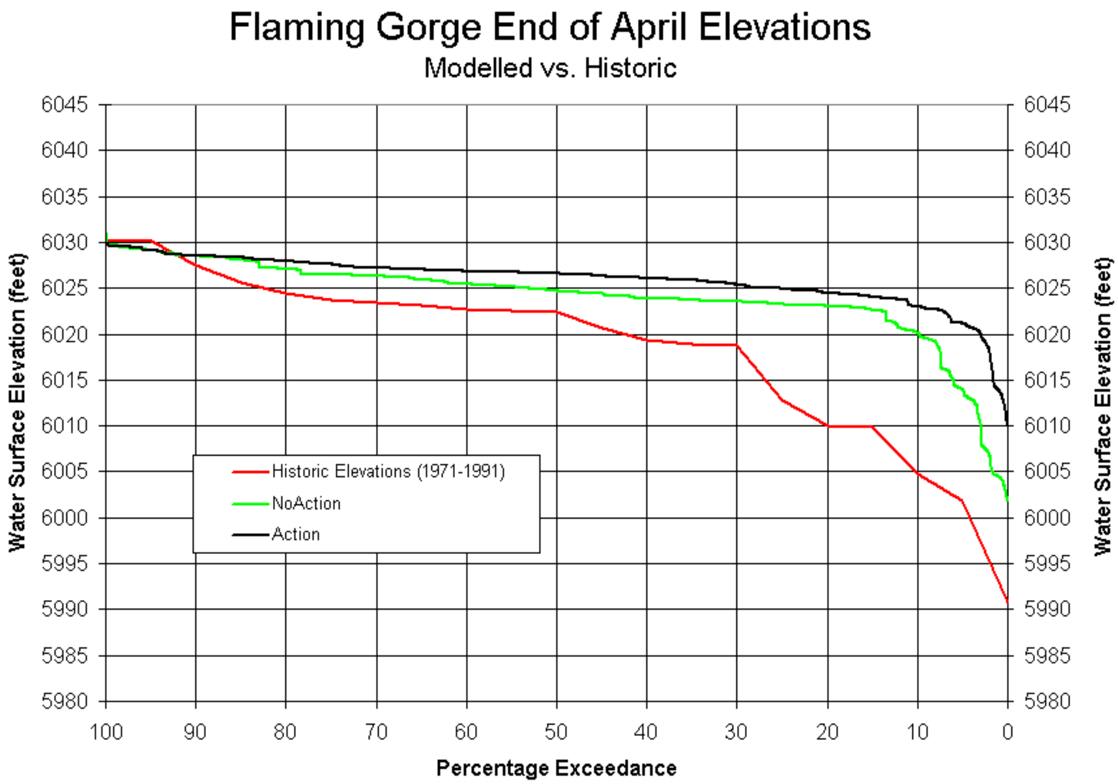
Flaming Gorge End of January Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0

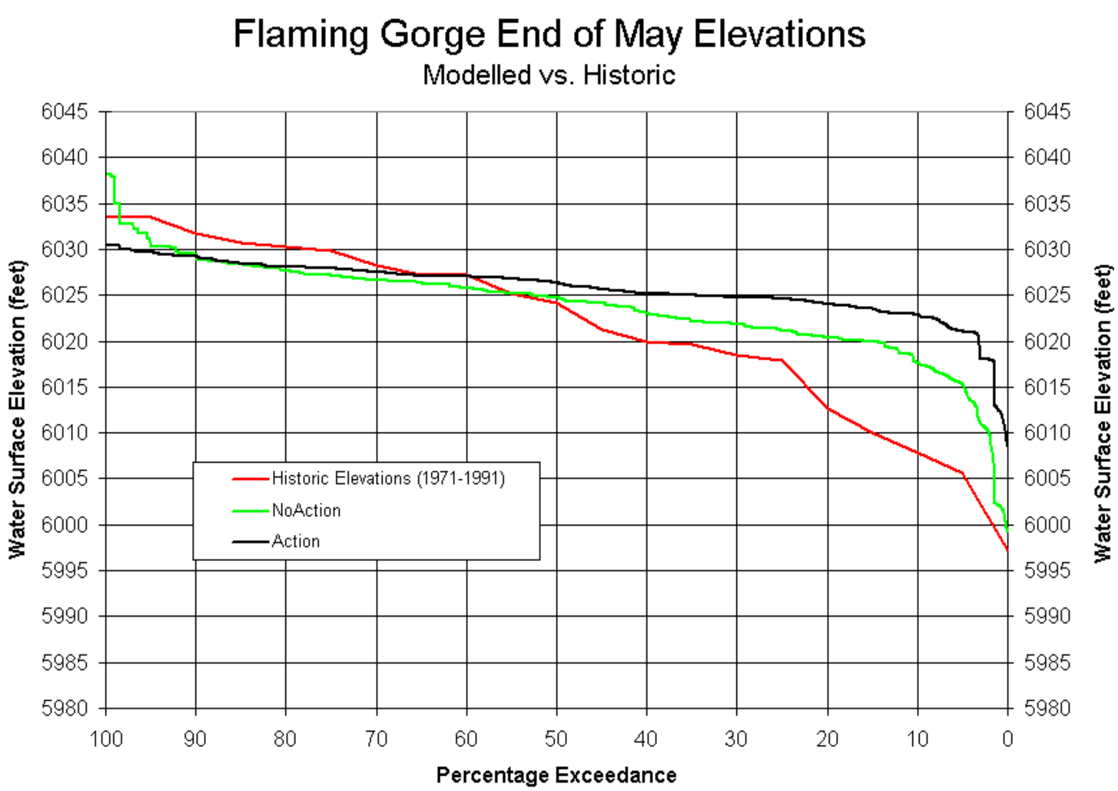


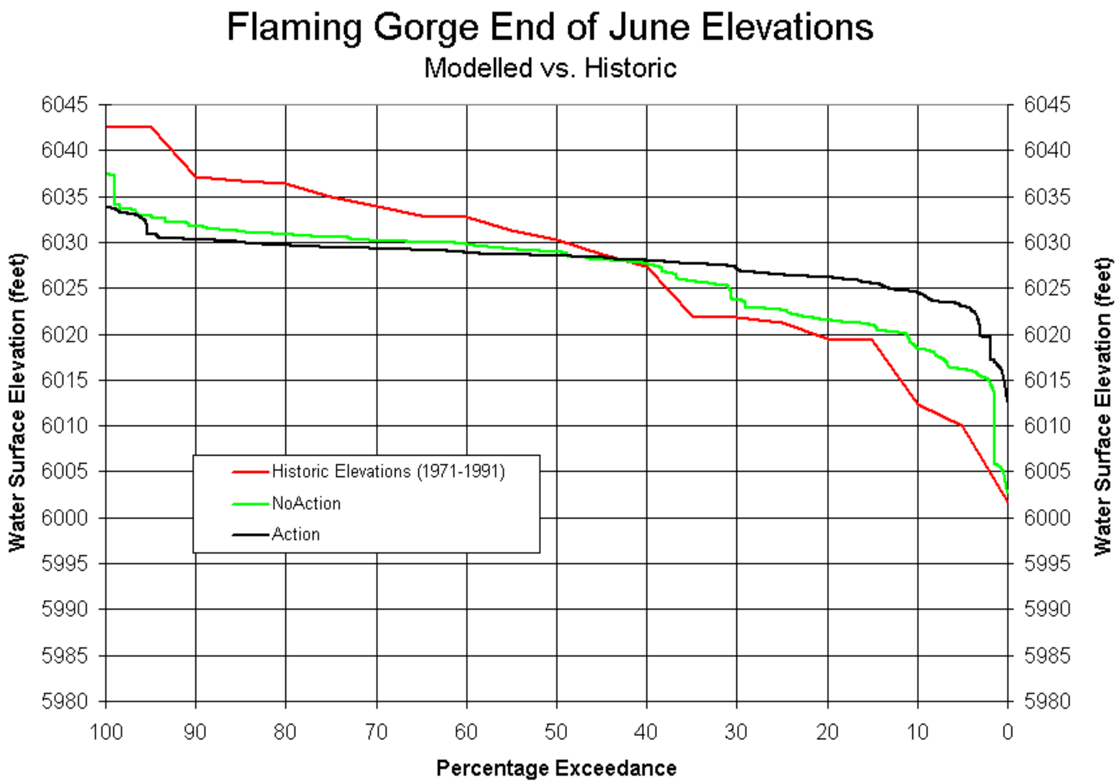
Flaming Gorge End of February Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0



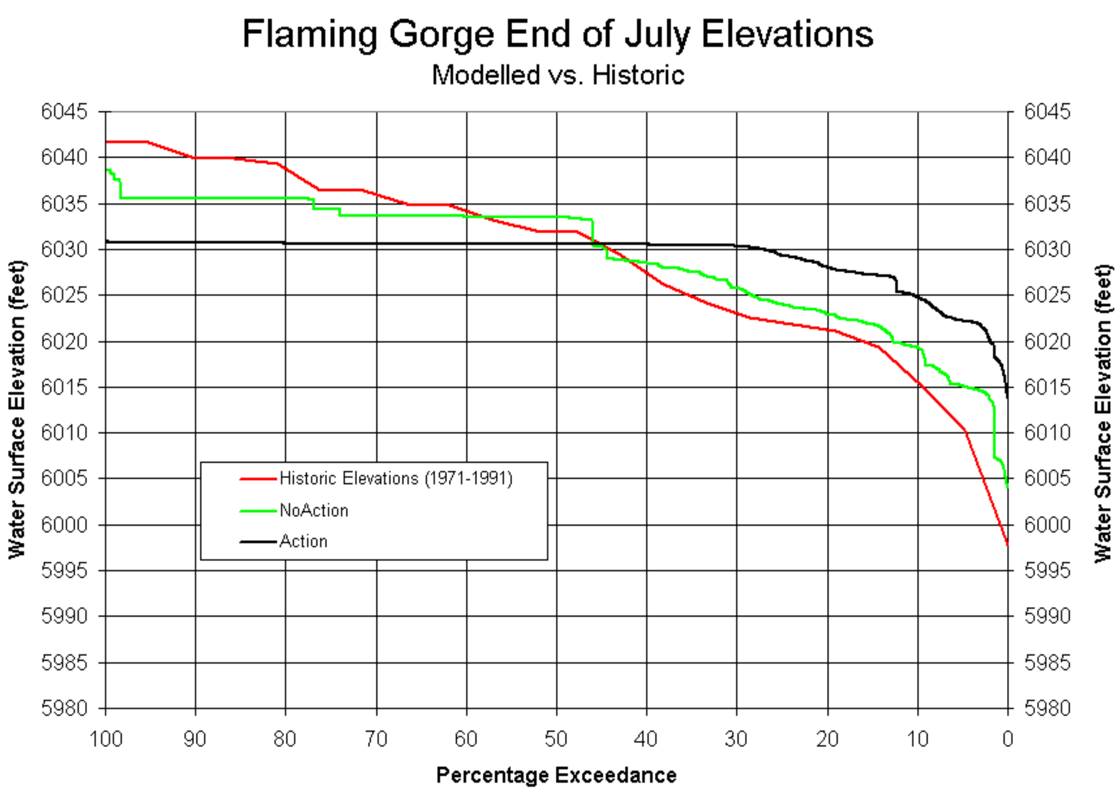
Flaming Gorge End of March Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0


Flaming Gorge End of April Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action

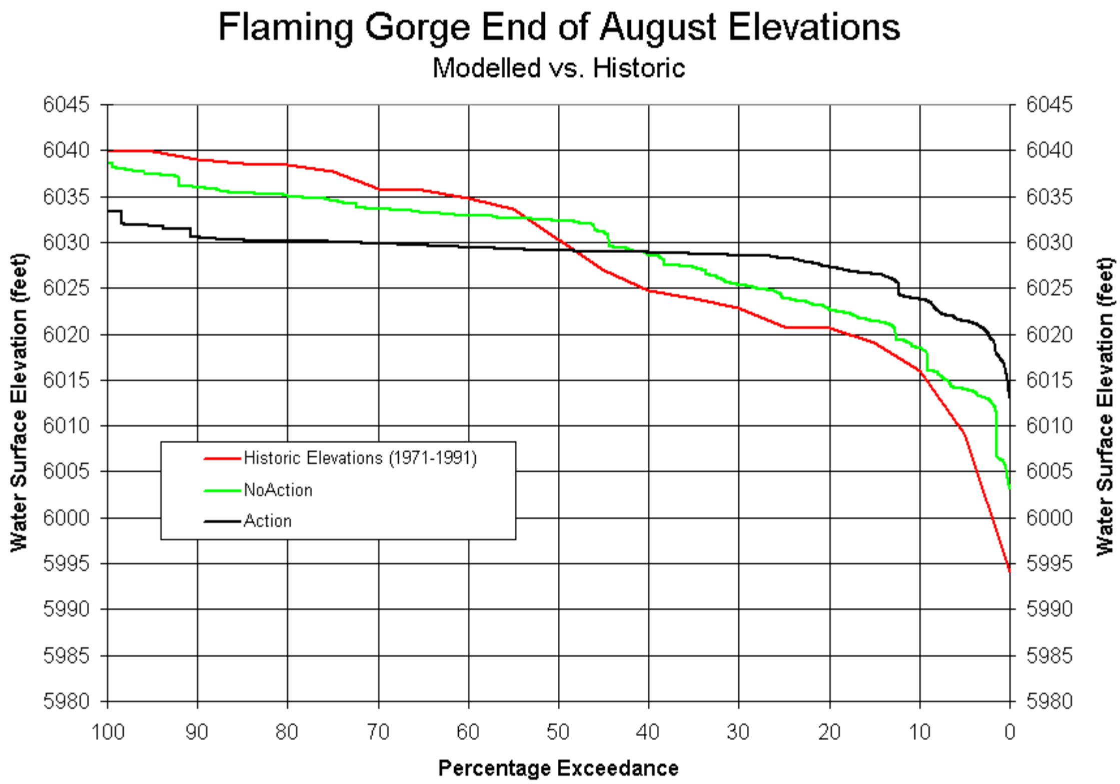

Flaming Gorge End of May Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action

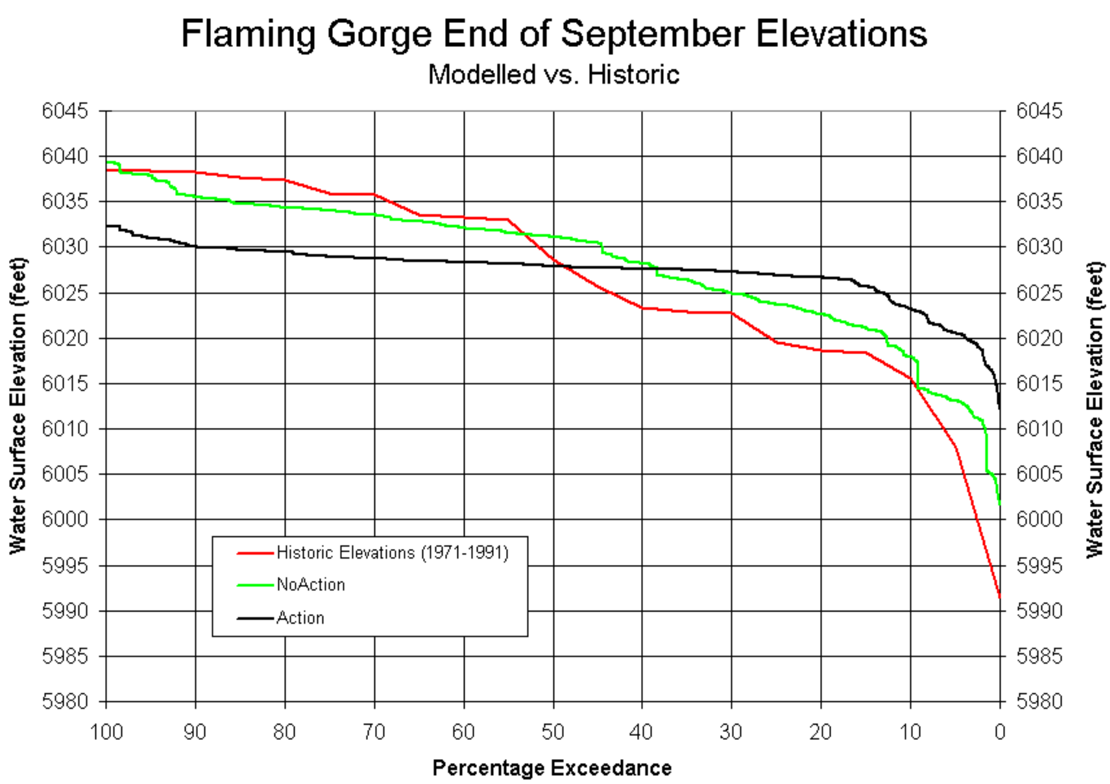


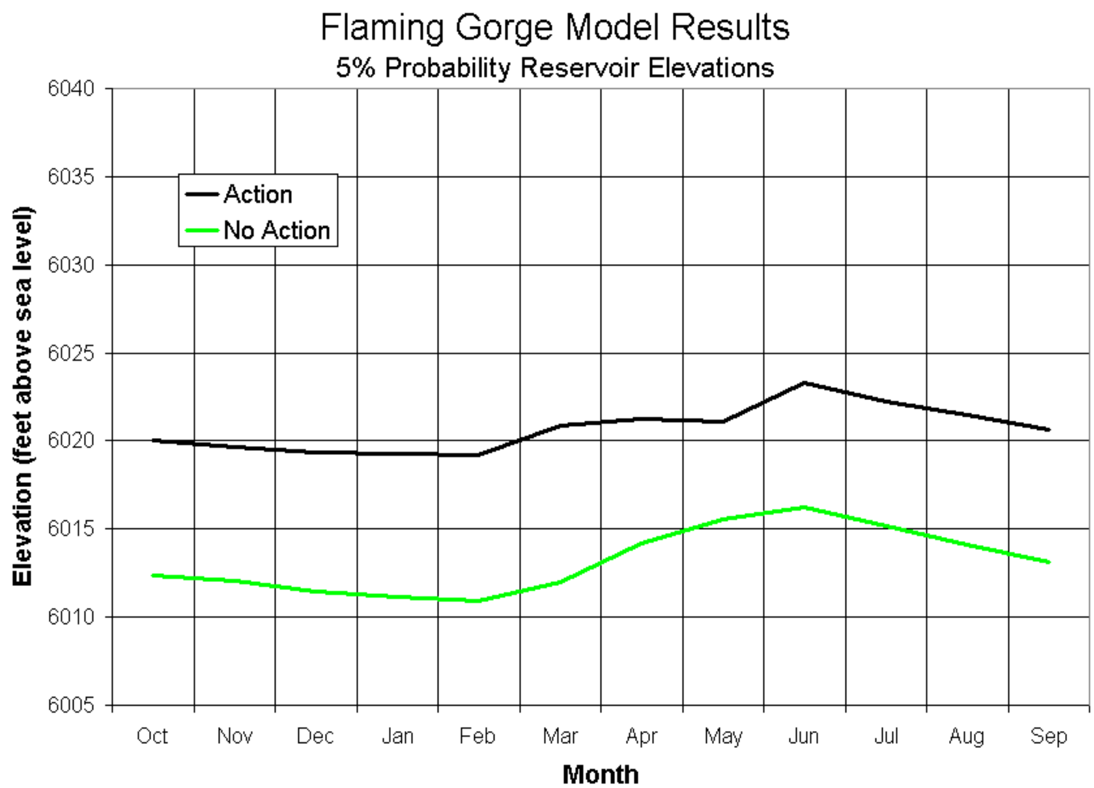
Flaming Gorge End of June Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0

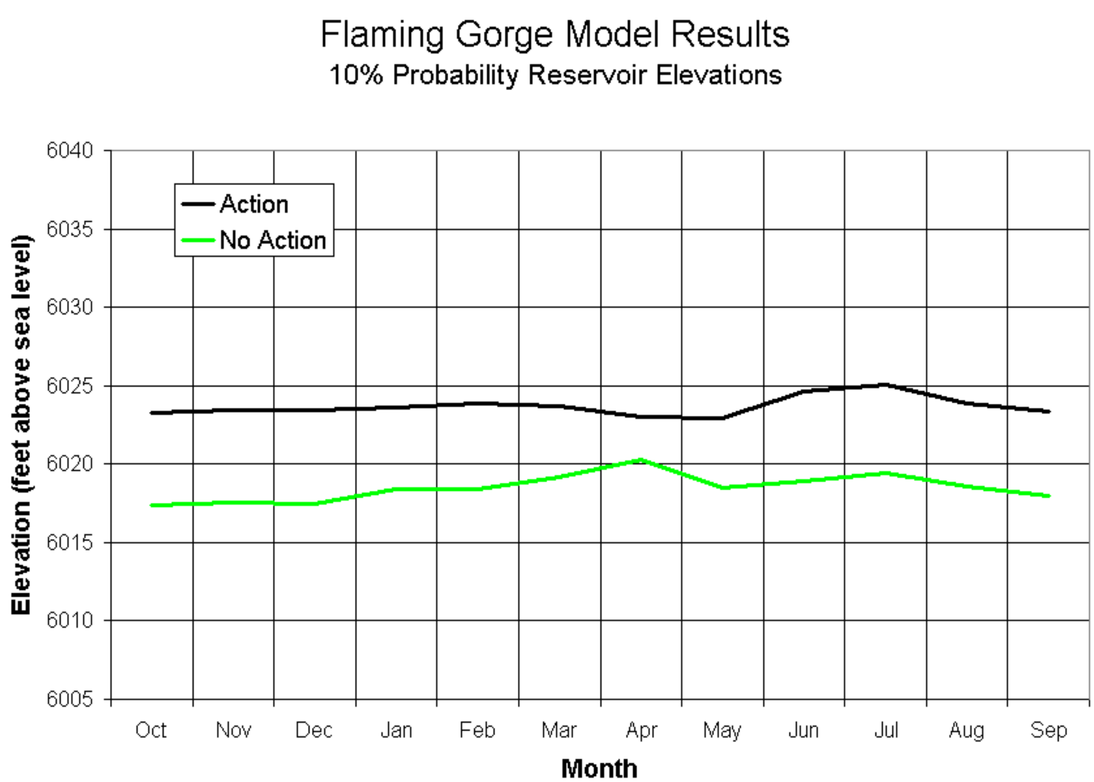


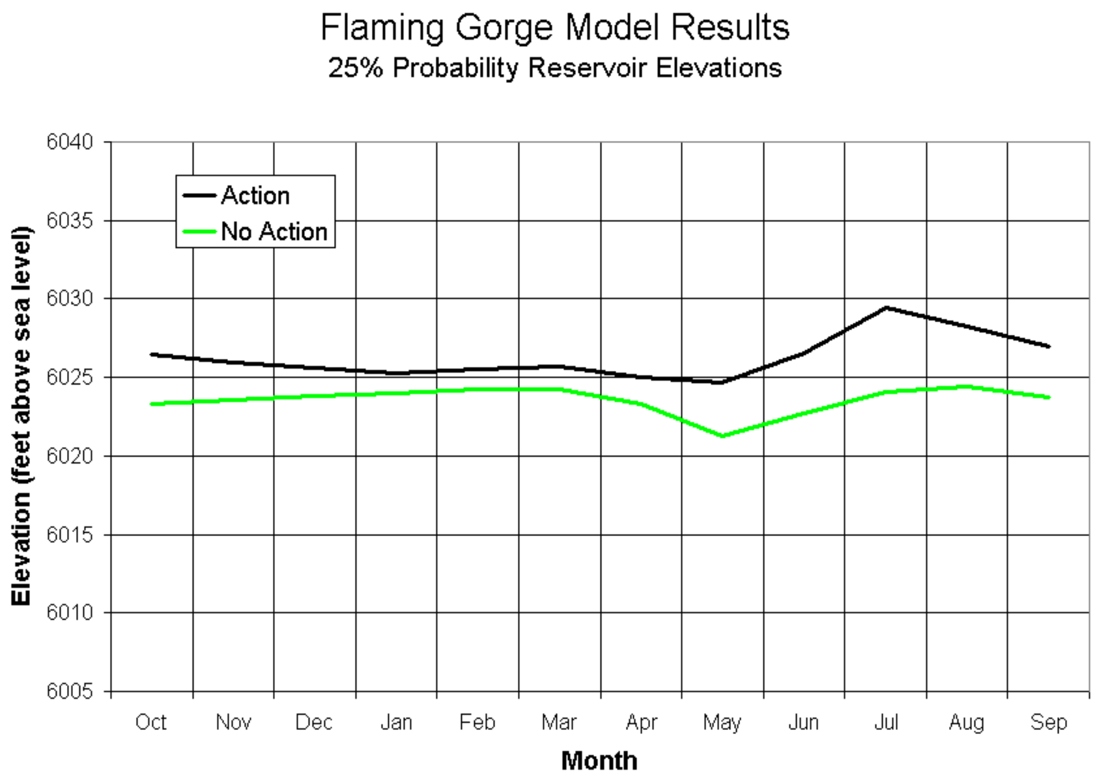
Flaming Gorge End of July Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0

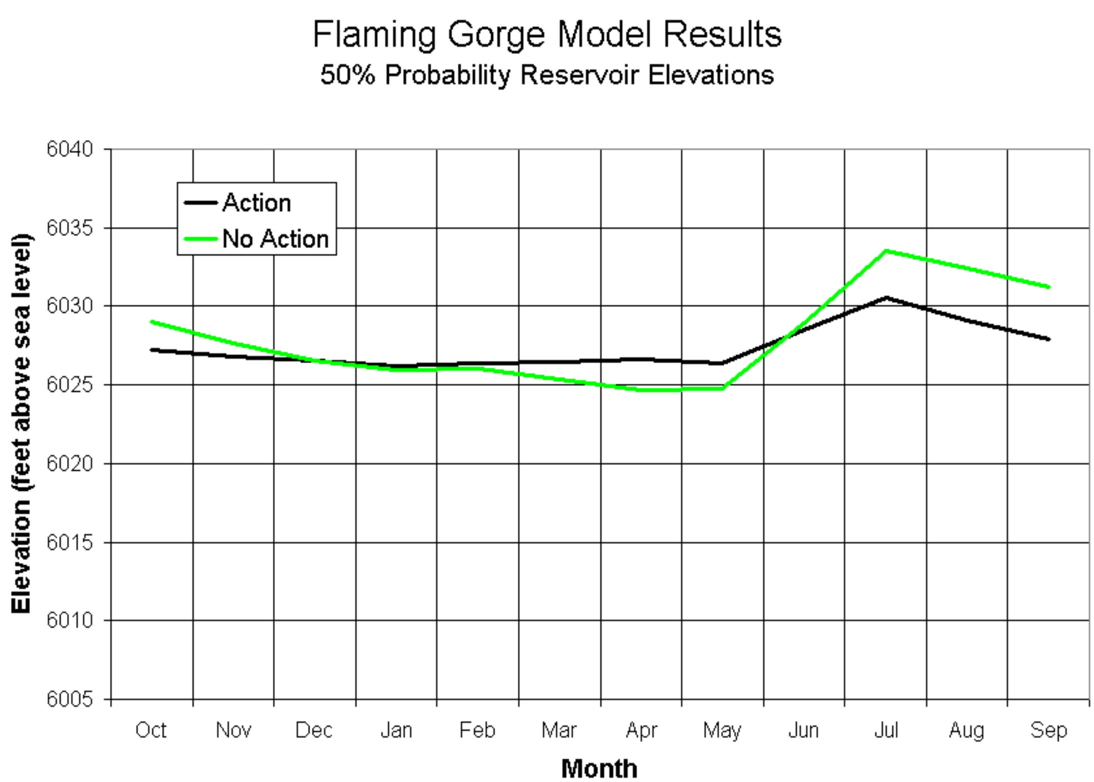

Flaming Gorge End of August Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0

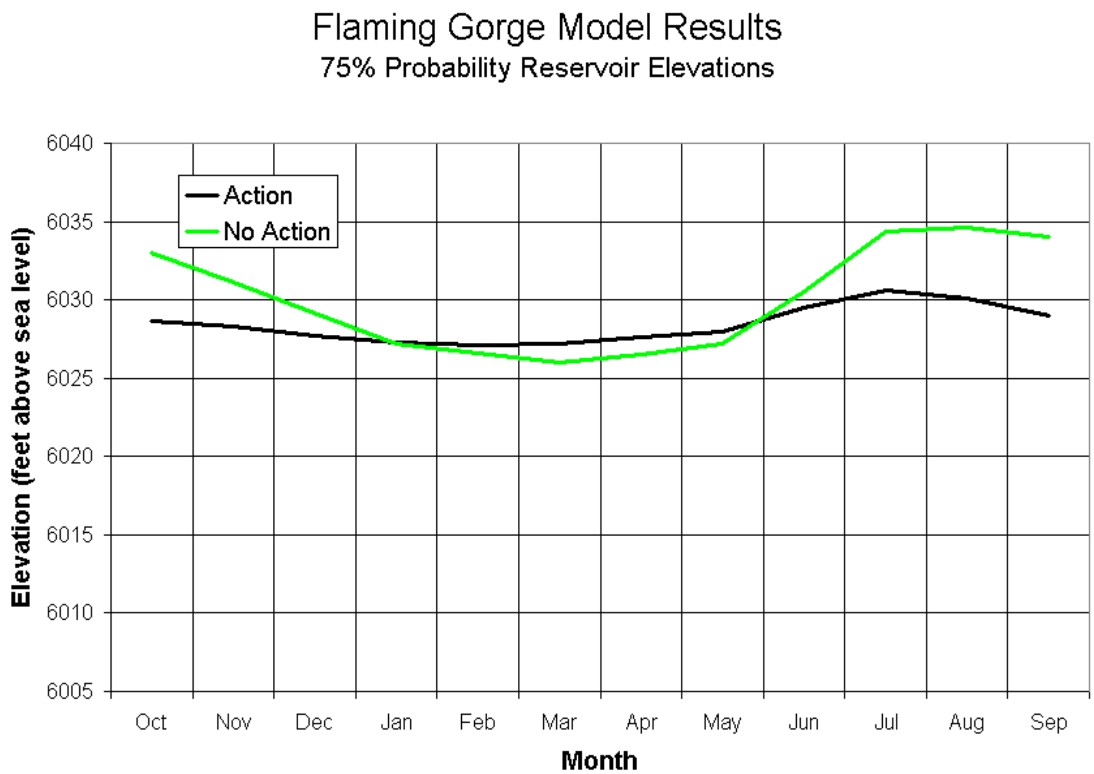

Flaming Gorge End of September Elevations
Modelled vs. Historic
Water Surface Elevation (feet)
Percentage Exceedance
Historic Elevations (1971-1991)
NoAction
Action
6045
6040
6035
6030
6025
6020
6015
6010
6005
6000
5995
5990
5985
5980
100
90
80
70
60
50
40
30
20
10
0

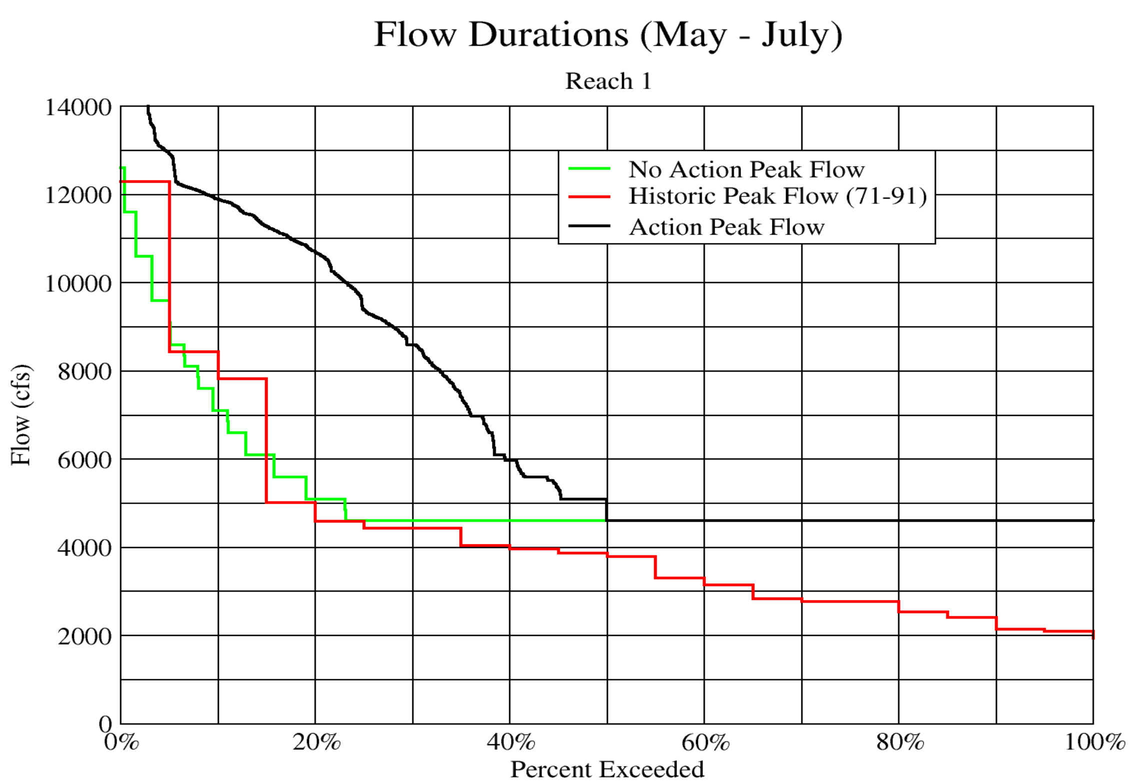

Flaming Gorge Model Results
5% Probability Reservoir Elevations
Elevation (feet above sea level)
6040
6035
6030
6025
6020
6015
6010
6005
Action
No Action
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

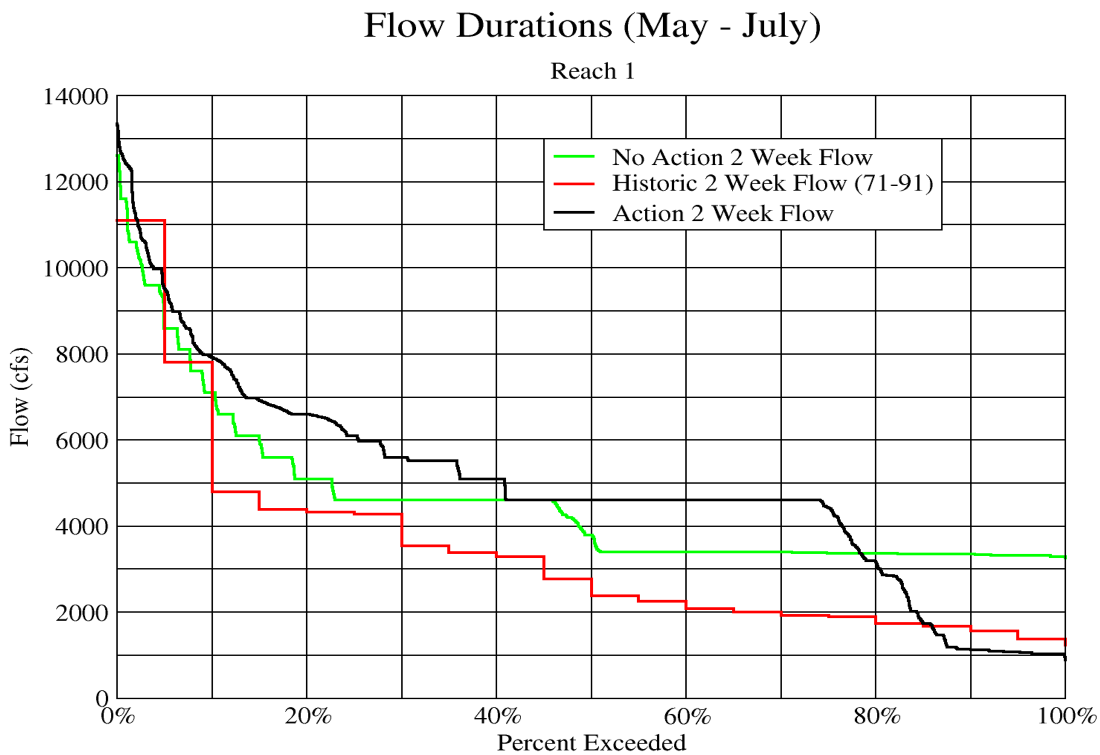

Flaming Gorge Model Results
10% Probability Reservoir Elevations
Elevation (feet above sea level)
6040
6035
6030
6025
6020
6015
6010
6005
Action
No Action
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

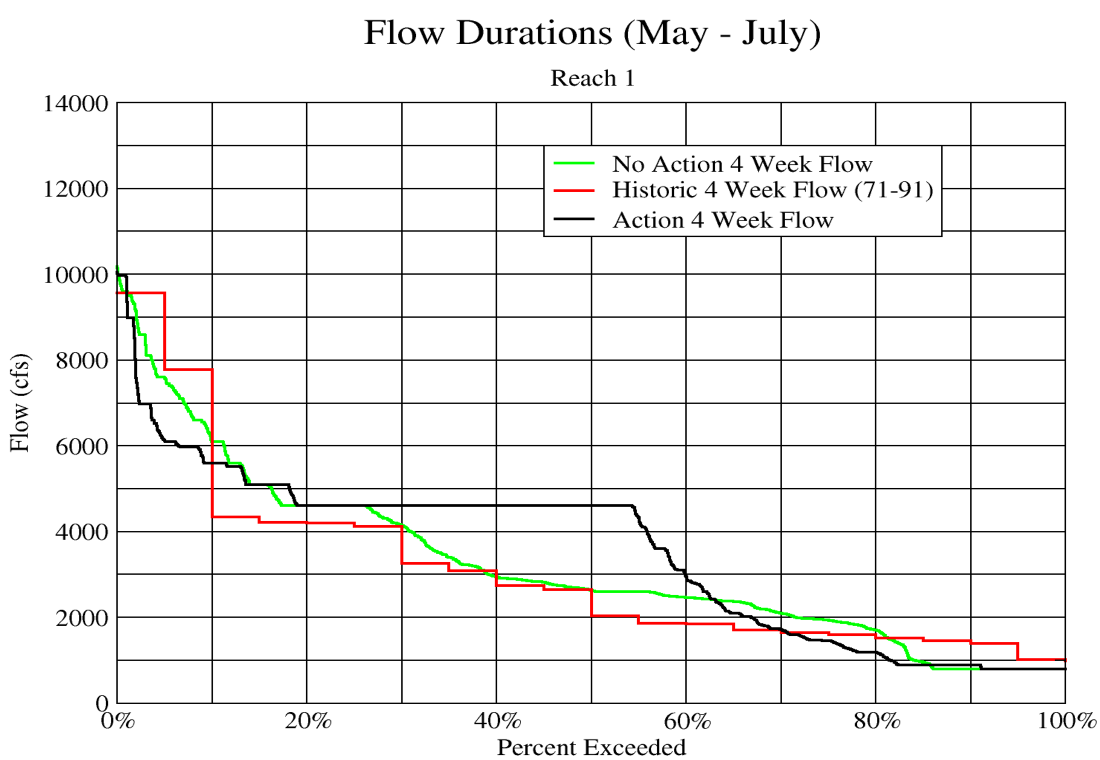

Flaming Gorge Model Results
25% Probability Reservoir Elevations
Action
No Action
Elevation (feet above sea level)
6040
6035
6030
6025
6020
6015
6010
6005
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

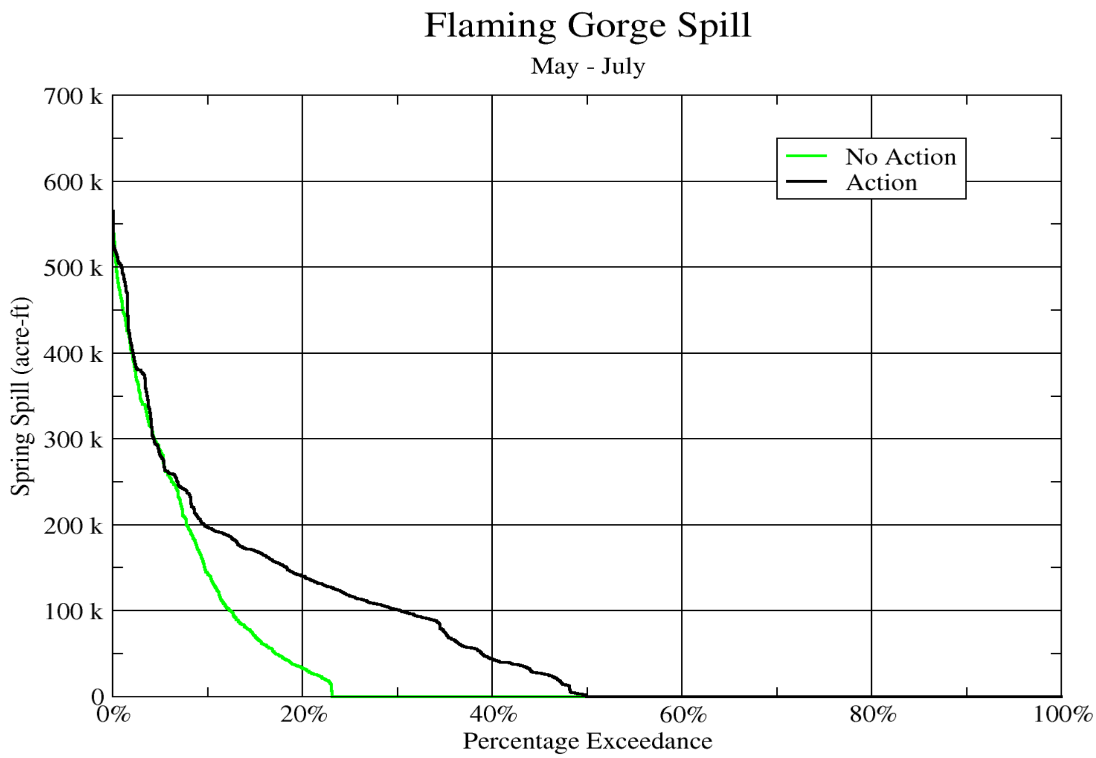

Flaming Gorge Model Results
50% Probability Reservoir Elevations
Action
No Action
Elevation (feet above sea level)
6040
6035
6030
6025
6020
6015
6010
6005
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

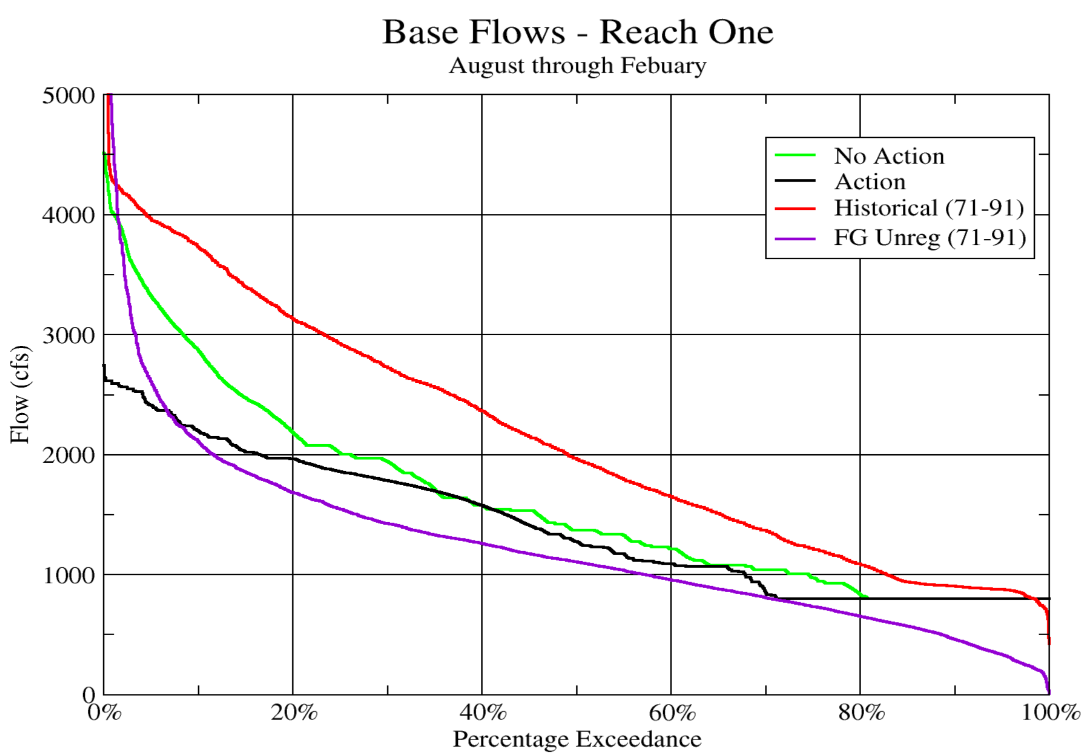

Flaming Gorge Model Results
75% Probability Reservoir Elevations
Elevation (feet above sea level)
6040
6035
6030
6025
6020
6015
6010
6005
Action
No Action
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Month

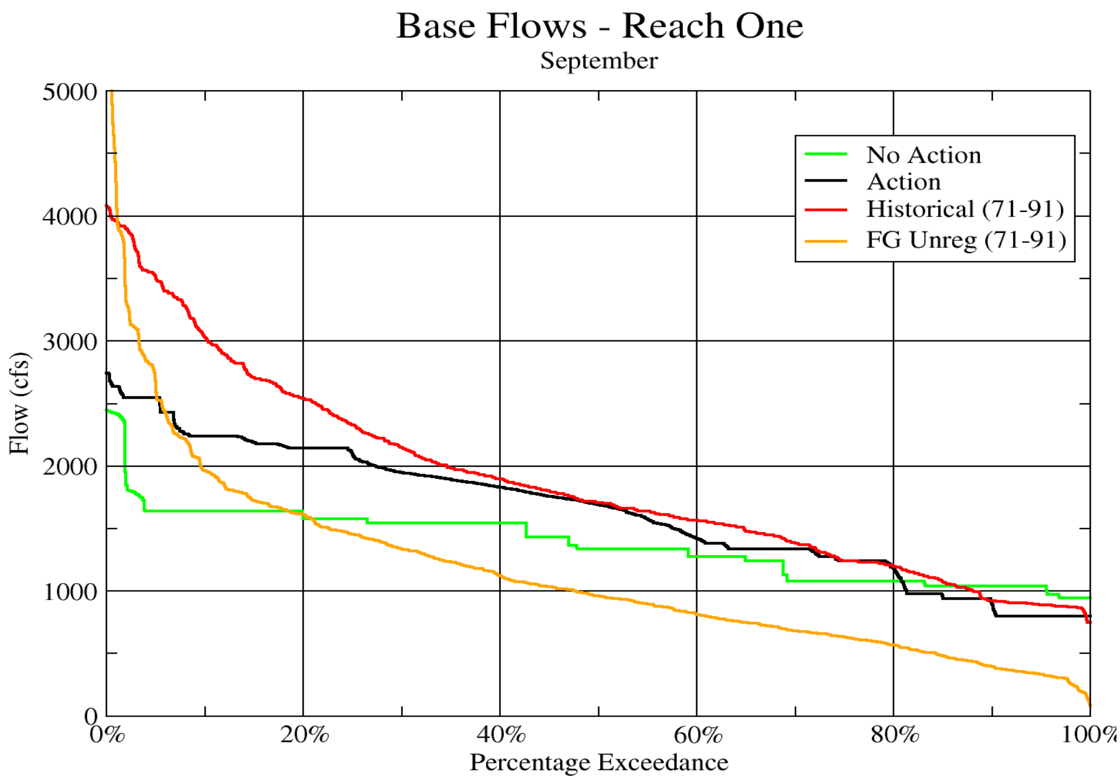

Flow Durations (May - July)
Reach 1
Flow (cfs)
14000
12000
10000
8000
6000
4000
2000
0
No Action Peak Flow
Historic Peak Flow (71-91)
Action Peak Flow
0%
20%
40%
60%
80%
100%
Percent Exceeded

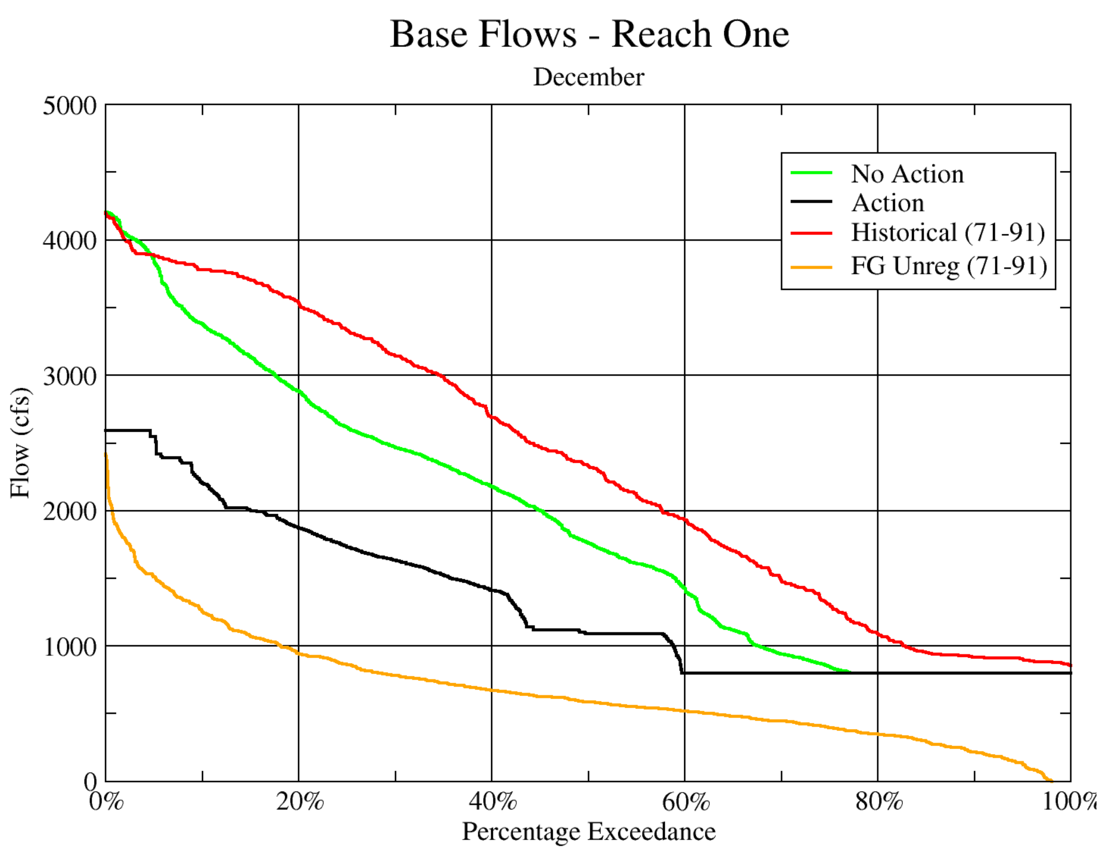

Flow Durations (May - July)
Reach 1
No Action 2 Week Flow
Historic 2 Week Flow (71-91)
Action 2 Week Flow
Flow (cfs)
Percent Exceeded
14000
12000
10000
8000
6000
4000
2000
0
0%
20%
40%
60%
80%
100%

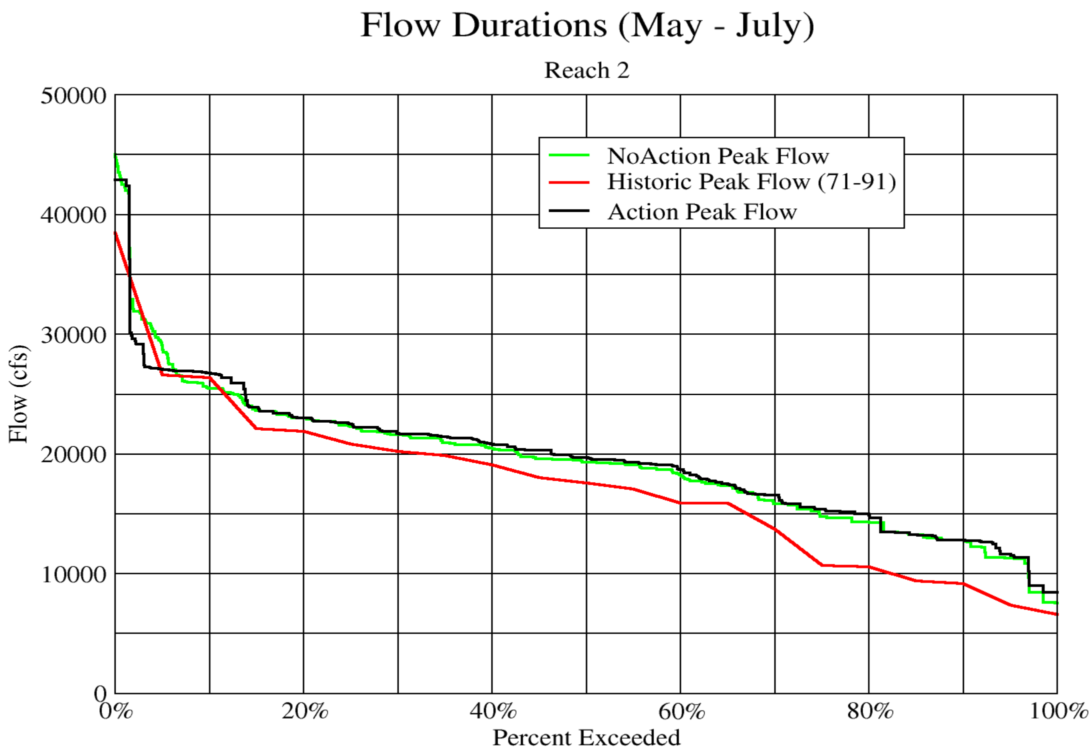

Flow Durations (May - July)
Reach 1
No Action 4 Week Flow
Historic 4 Week Flow (71-91)
Action 4 Week Flow
Flow (cfs)
Percent Exceeded
14000
12000
10000
8000
6000
4000
2000
0
0%
20%
40%
60%
80%
100%

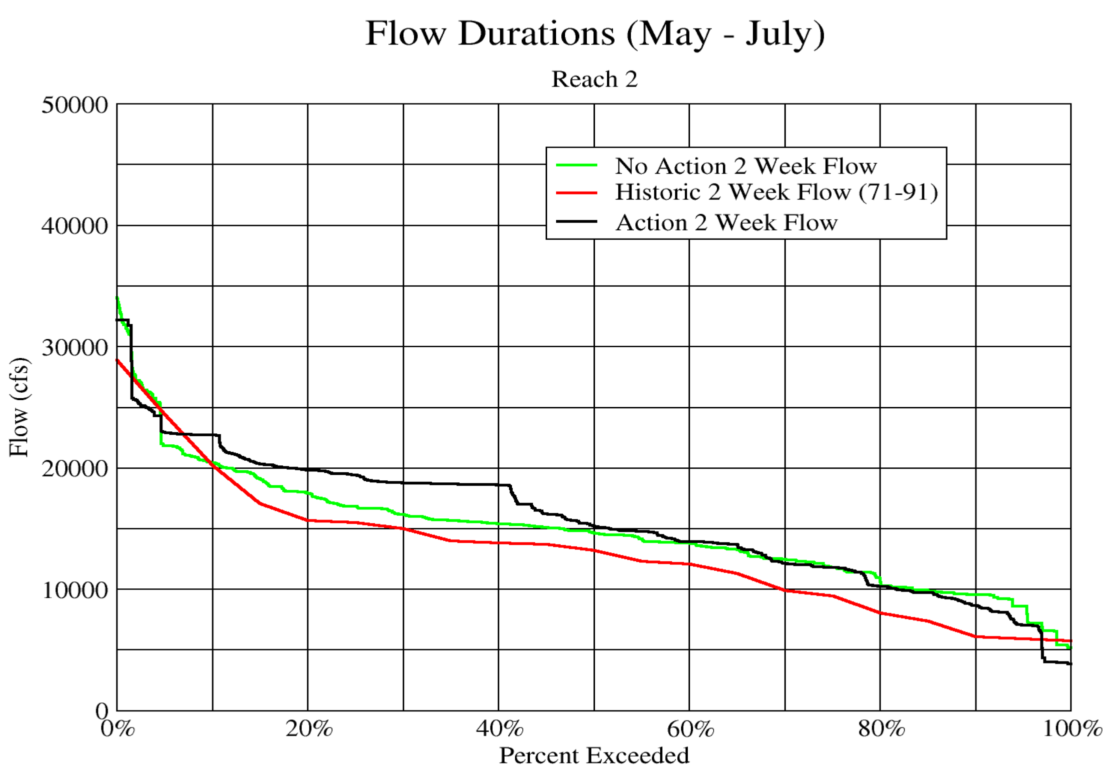

Flaming Gorge Spill
May - July
700 k
600 k
500 k
400 k
300 k
200 k
100 k
0
Spring Spill (acre-ft)
0%
20%
40%
60%
80%
100%
Percentage Exceedance
No Action
Action

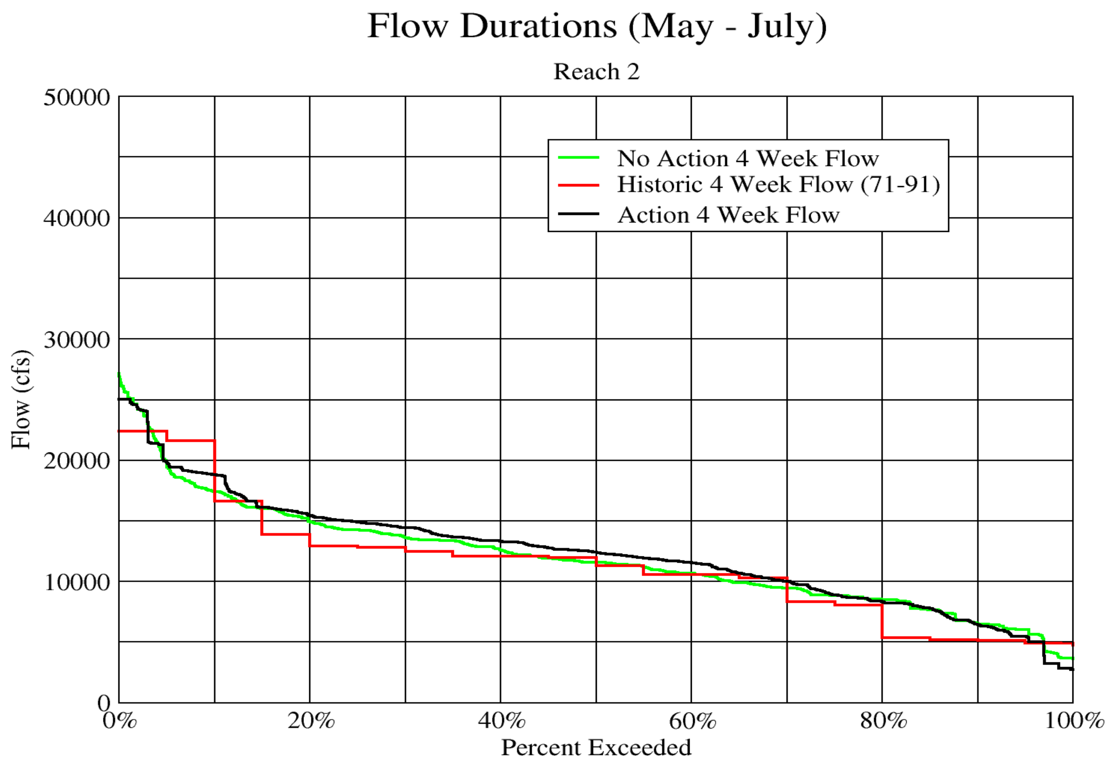

Base Flows - Reach One
August through Febuary
5000
4000
3000
2000
1000
0
Flow (cfs)
0%
20%
40%
60%
80%
100%
Percentage Exceedance
No Action
Action
Historical (71-91)
FG Unreg (71-91)


Base Flows - Reach One
September
No Action
Action
Historical (71-91)
FG Unreg (71-91)
Flow (cfs)
Percentage Exceedance
5000
4000
3000
2000
1000
0
0%
20%
40%
60%
80%
100%

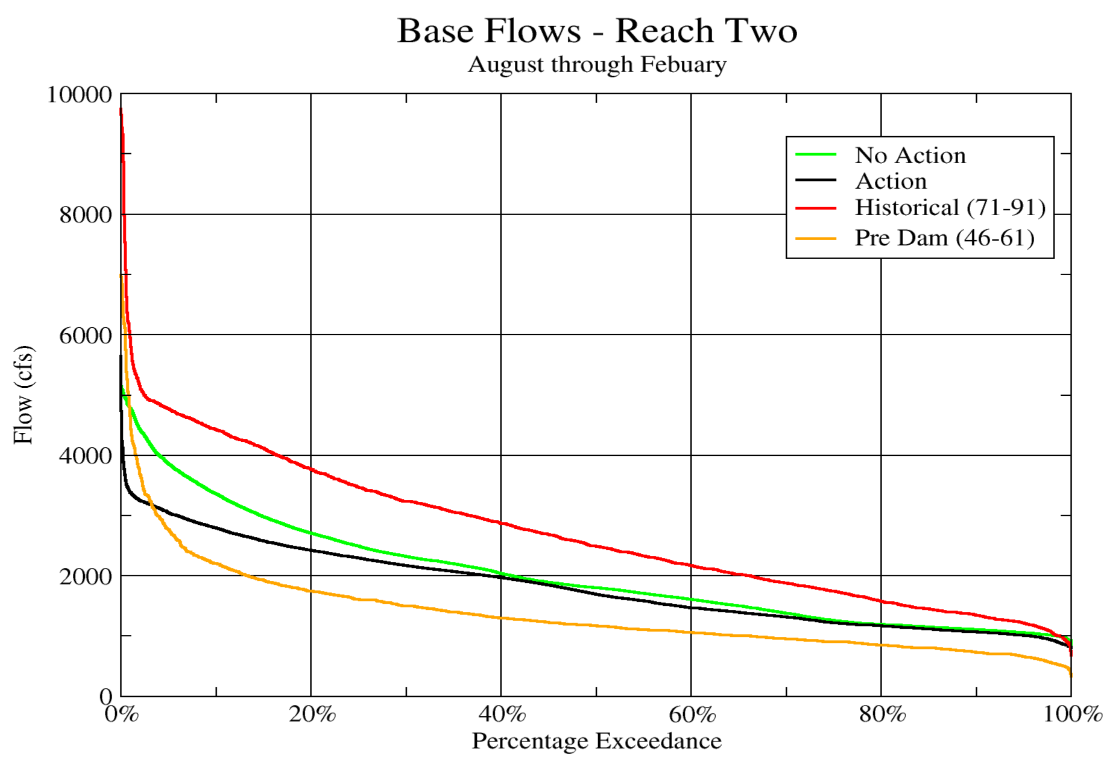

Base Flows - Reach One
December
No Action
Action
Historical (71-91)
FG Unreg (71-91)
Flow (cfs)
Percentage Exceedance
5000
4000
3000
2000
1000
0
0%
20%
40%
60%
80%
100%


Flow Durations (May - July)
Reach 2
NoAction Peak Flow
Historic Peak Flow (71-91)
Action Peak Flow
Flow (cfs)
50000
40000
30000
20000
10000
0
0%
20%
40%
60%
80%
100%
Percent Exceeded

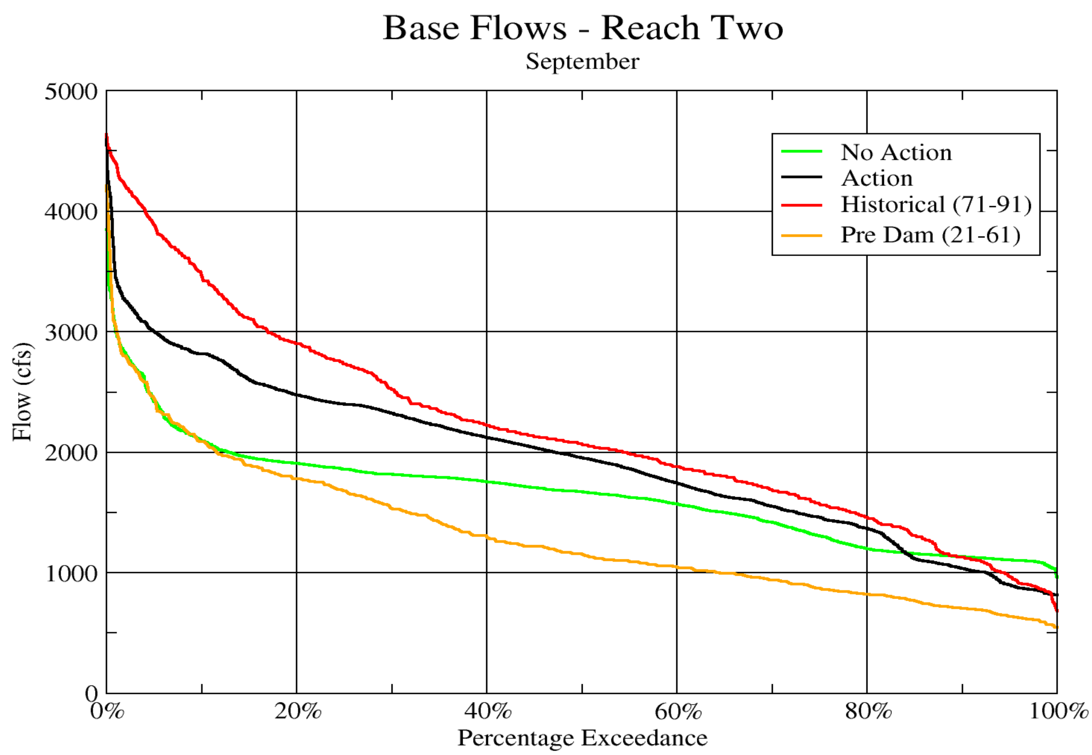

Flow Durations (May - July)
Reach 2
No Action 2 Week Flow
Historic 2 Week Flow (71-91)
Action 2 Week Flow
Flow (cfs)
50000
40000
30000
20000
10000
0
0%
20%
40%
60%
80%
100%
Percent Exceeded

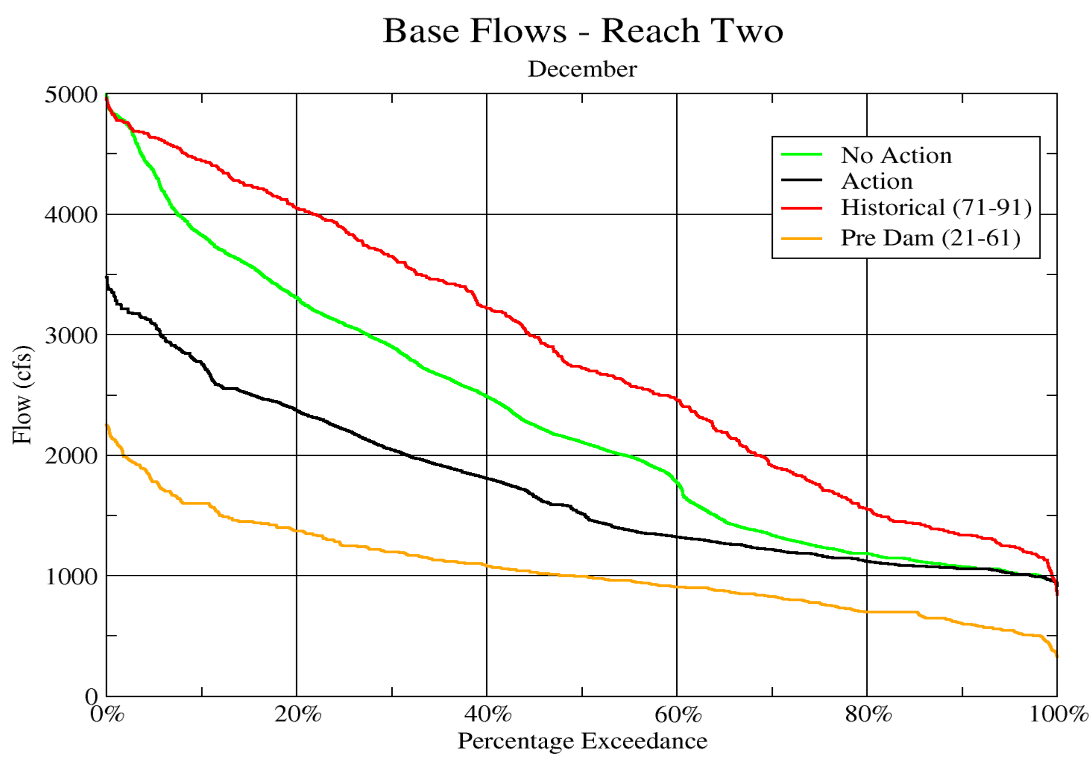


Flow Durations (May - July)
Reach 2
No Action 4 Week Flow
Historic 4 Week Flow (71-91)
Action 4 Week Flow
Flow (cfs)
50000
40000
30000
20000
10000
0
0%
20%
40%
60%
80%
100%
Percent Exceeded



Base Flows - Reach Two
August through Febuary
No Action
Action
Historical (71-91)
Pre Dam (46-61)
Flow (cfs)
10000
8000
6000
4000
2000
0
0%
20%
40%
60%
80%
100%
Percentage Exceedance


Base Flows - Reach Two
September
5000
4000
3000
2000
1000
0
Flow (cfs)
0%
20%
40%
60%
80%
100%
Percentage Exceedance
No Action
Action
Historical (71-91)
Pre Dam (21-61)


Base Flows - Reach Two
December
5000
4000
3000
2000
1000
0
Flow (cfs)
0%
20%
40%
60%
80%
100%
Percentage Exceedance
No Action
Action
Historical (71-91)
Pre Dam (21-61)

FLAMING GORGE FINAL
ENVIRONMENTAL IMPACT STATEMENT
AMENDMENT TO
HYDROLOGIC MODELING REPORT

R. Clayton and A. Gilmore
August 5, 2003

INTRODUCTION

During the development of the Flaming Gorge Model, it was decided that the model would be developed to use the longest reasonable historic hydrologic record available. While records for the Green River and Yampa River extended back to 1921, historic records for the tributary rivers in Reach 3 only extended back to the mid 1940's. Because of the uncertainties associated with modeling Reach 3, it was decided that the Flaming Gorge Model would focus on Reaches 1 and 2 using the extended hydrologic record from 1921 to 1985 rather than including details for Reach 3 and having a much shorter hydrologic record.

For these reasons, the Hydrologic Modeling Report issued in February of 2002 did not include analysis of the predicted future flows in Reach 3. Since that time, a concern for the lack of Reach 3 information within the draft EIS has developed, prompting several requests for a hydrologic analysis of the Reach 3 predicted future flows for the Action and No Action alternatives. To help satisfy this request, this report provides hydrologic analysis of the estimated future flows of the Green River in Reach 3.

DATA DESCRIPTION AND ASSUMPTIONS

The Flaming Gorge Model produced the predicted future flows of the Green River in Reach 2 for the period beginning in January 2002 and extending to December of 2040. Sixty-five traces, or sequences of historic flows, were routed through the Flaming Gorge Model to generate 65 potential future operations for this future time period. The historic hydrologic record from January 1921 to December 1985 formed the basis for these inflow traces. For each inflow trace that was routed through the model there is a sequence of historic hydrology that the trace was constructed from.

In order to generate an estimate of the potential future flows in Reach 3 that would result from operating Flaming Gorge Dam under the Action and No Action Alternatives, an estimate of tributary contribution to the flows in Reach 3 is required. Without the historic records of the tributaries extended back to 1921, it was not possible to determine what each individual tributary contributed to the Green River for the historic period that the model was run. However it was possible to estimate the approximate contribution to the Green River of all tributaries located in Reaches 2 and 3 because complete historic records were available for the Green River located near Flaming Gorge Dam and Green River, Utah. The difference between the historic daily average flow for the Greendale and Green River, Utah gauges was used to estimate of historic daily contribution of all tributaries along the Green River including channel losses. This estimate included the historic flow of the Yampa River in addition to all of the other tributaries in Reach 3. The estimated future flow in Reach 3 described in this report was generated by adding the Flaming Gorge release data predicted by the Flaming Gorge Model to the corresponding historic tributary input with an estimated lag period of 5 days.

REACH 3 ANALYSIS

Flow Recommendations

Table 1 shows the Action and No Action alternatives (as modeled) in terms of how well each alternative achieves the specific recommendations of the 2000 Flow and Temperature Recommendations during the spring in Reach 3. While the No Action alternative does not attempt to meet any of these targets, a comparison between the Action and No Action results does indicate some of the key differences between the operational regimes. The Action alternative has been modeled to achieve all of the targeted flows and durations for Reach 2 and it was assumed that if the Reach 2 flow recommendations were achieved that Reach 3 flow recommendations would also be achieved. The results show that, except for the single day peak flow of 39,000 cfs in Reach 3, all other recommended flows, durations and frequencies are achieved by the Action Alternative as currently modeled.

Table 1—Reach 3 Recommendations Targets and Predicted Results

Spring Peak Flow Recommendations	Reach	Target %	Action Ruleset	No Action Ruleset
Peak >= 39,000 cfs for at least 1 day	3	10%	4.6%	5.9%
Peak >= 24,000 cfs for at least 2 weeks	3	10%	22.0%	14.4%
Peak >= 22,000 cfs for at least 4 weeks	3	10%	12.0%	8.4%
Peak >= 24,000 cfs for at least 1 day	3	30%	65.2%	59.4%
Peak >= 22,000 cfs for at least 2 weeks	3	40%	40.2%	33.8%
Peak >= 22,000 cfs for at least 1 day	3	50%	70.3%	69.4%
Peak >= 8,300 cfs for at least 1 day	3	100%	100%	98.5%
Peak >= 8,300 cfs for at least 1 week	3	90%	96.9%	96.9%
Peak >= 8,300 cfs for at least 2 days except in extreme dry years	3	98%	100%	98.5%

Peak Flows in Reach 3

Figures 1, 2, and 3 show the distribution of single day peak, 14-day duration peak, and 28-day duration peak flows that will likely occur if Flaming Gorge Dam is operated under the Action or No Action Alternative during the period from January 2002 to December 2040. Peak flows in Reach 3 are only subtly different under the two alternatives. The most notable difference between the two alternatives is that flow durations under the Action Alternative appear to be longer than those of the No Action Alternative.

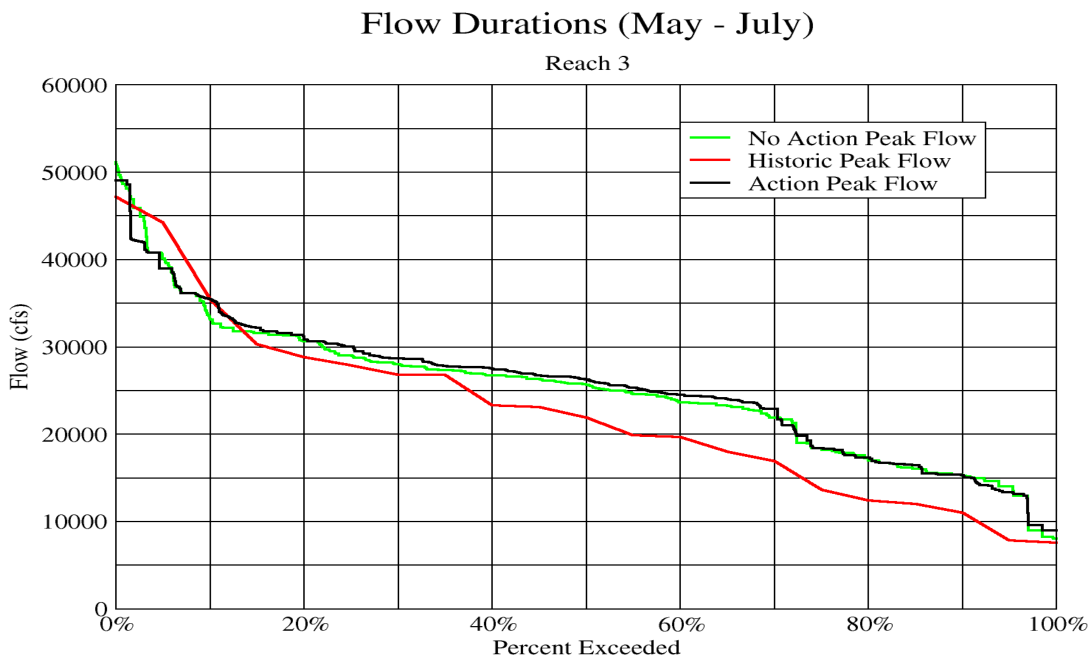


Figure 1.—Reach 3 Distribution of 1-Day Peak Flows.

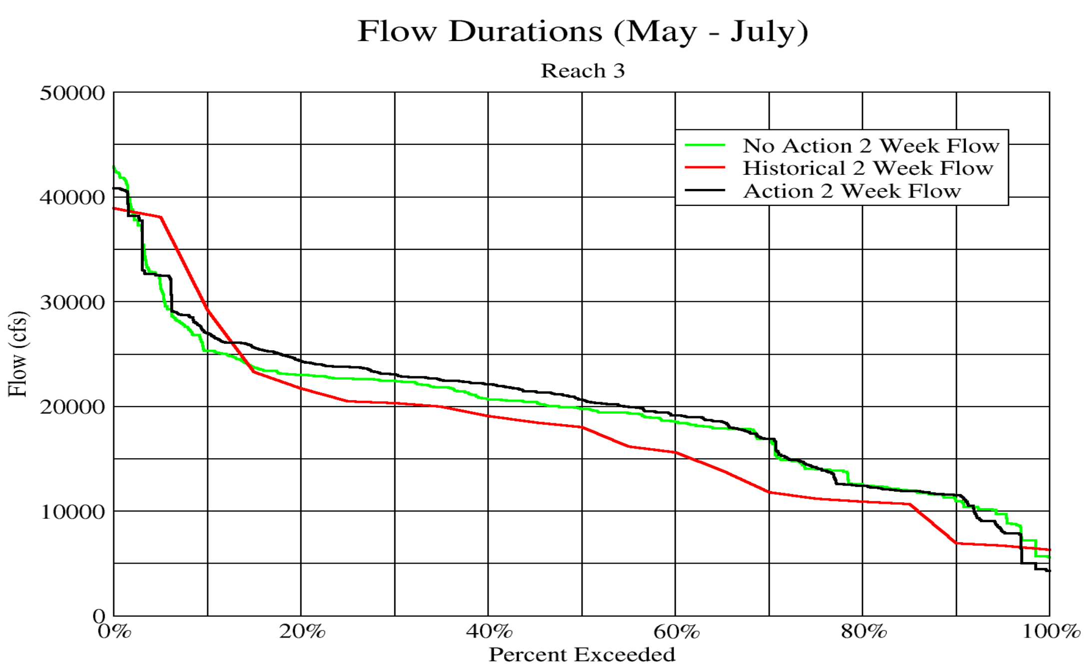


Figure 2.—Reach 3 Distribution of 2-Week Duration Peak Flows.

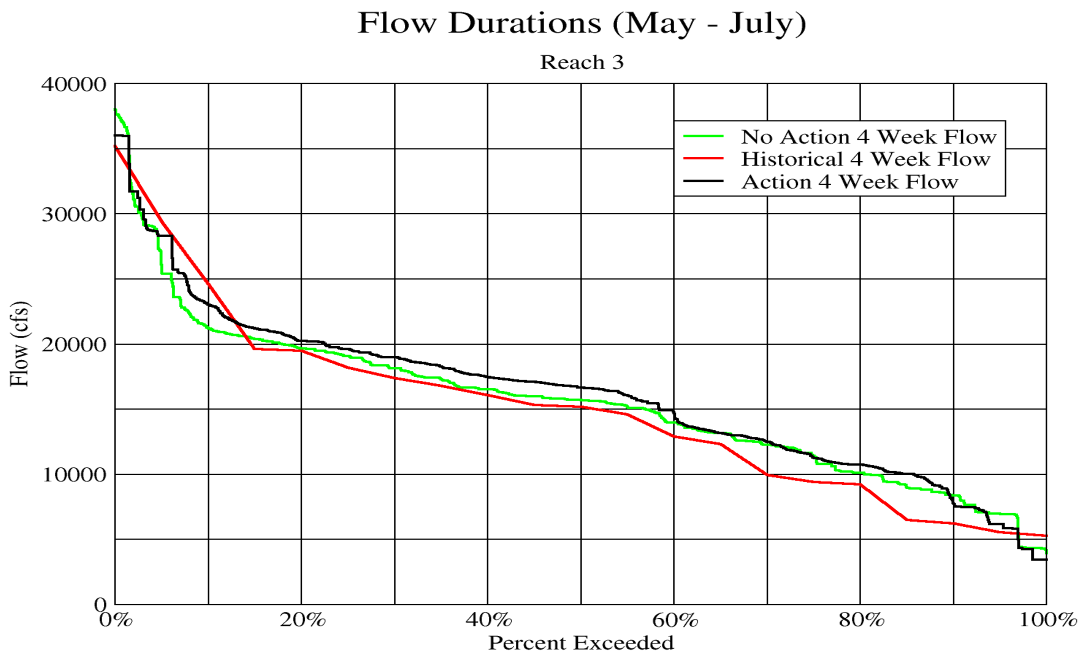


Figure 3.—Reach Distribution of 4-Week Duration Peak Flows.

Base Flows in Reach 3

Overall, the base flows in Reach 3 that will occur if Flaming Gorge Dam is operated under the Action and No Action Alternatives will be similar. In general, the base flows under the Action Alternative will be slightly lower than those of the No Action Alternative as shown in figure 4.

As with Reaches 1 and 2 the relationship between the flows of the Action and No Action Alternatives is dependant on the time of year. During the summer months, when the No Action Alternative restricts the flows in Reach 2, the base flows in Reach 2 will likely be less than those of the Action Alternative. When these restrictions are lifted in November, base flows in Reach 3 under the No Action Alternative will likely be higher than those of the Action Alternative. This can clearly be seen in figures 5 and 6 that show the distribution of flows in Reach 3 that occur under each alternative during the months of September and December. Reach 3 flows during the period from November through February will most likely be 500 to 1000 cfs greater than those of the Action Alternative. This is especially true in wet years. Reach 3 flows during the summer months including late July, August and September will most likely see flows under the No Action Alternative that are lower than those of the Action Alternative by 300 to 700 cfs.

SUMMARY

The data provided in this report has been generated to match the data that was provided for Reaches 1 and 2 in the Hydrologic Modeling Report issued in February of 2002. Although the data for this report was not a product of the model output, as was the data for Reaches 1 and 2,

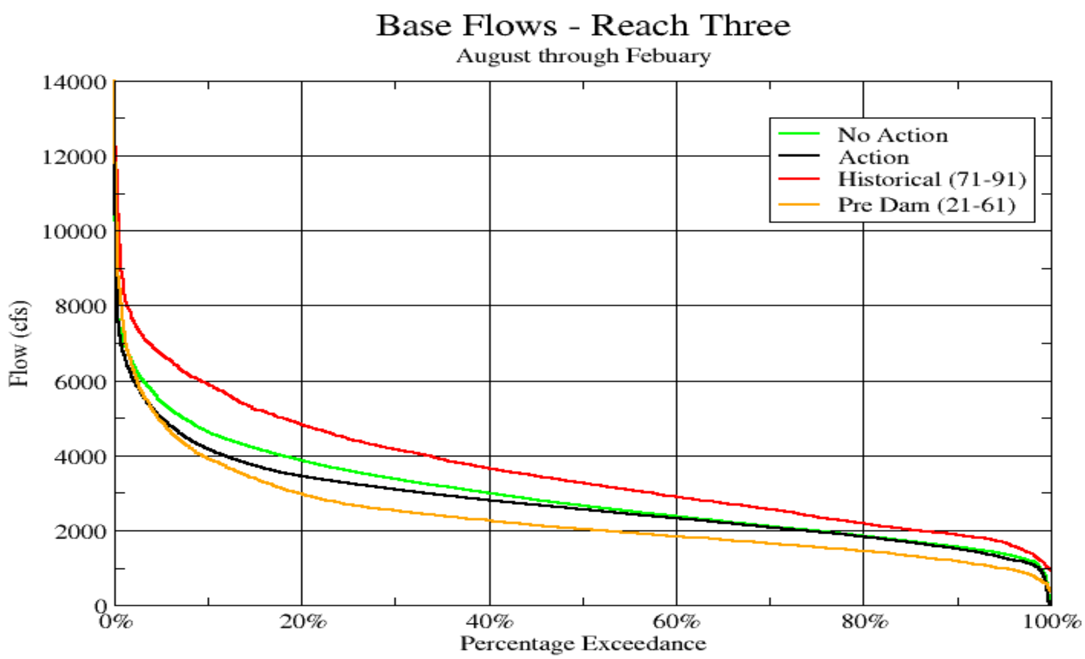


Figure 4—Reach 3 Distribution of Flows (August through February.

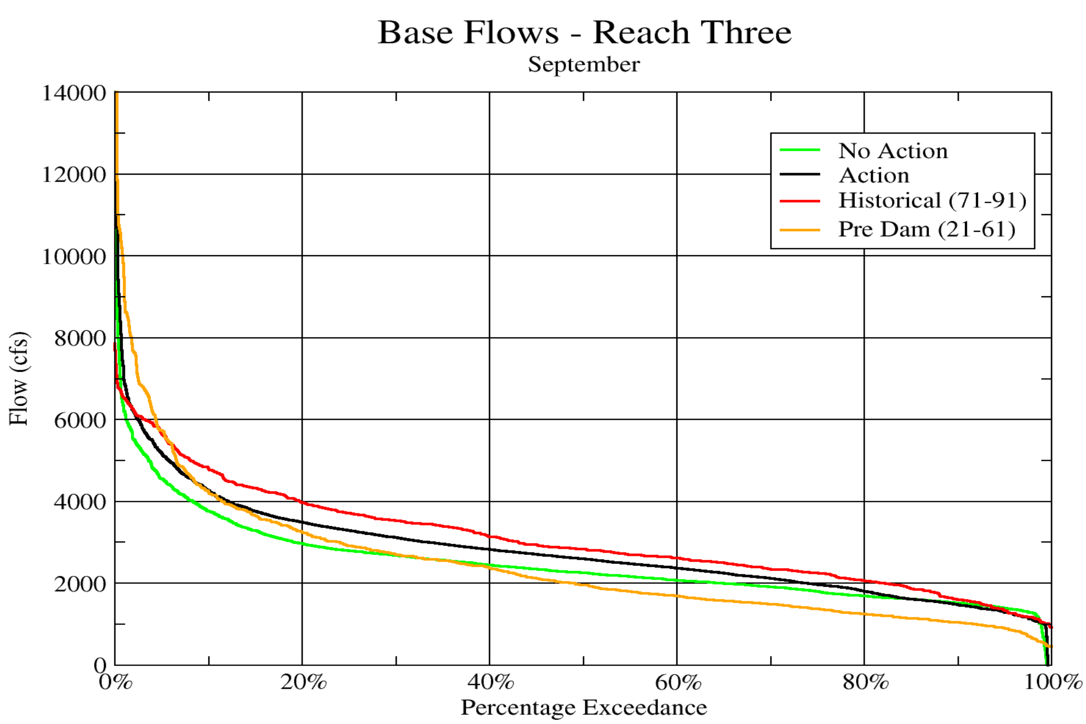


Figure 5.—Reach 3 Distribution of Flows (September).

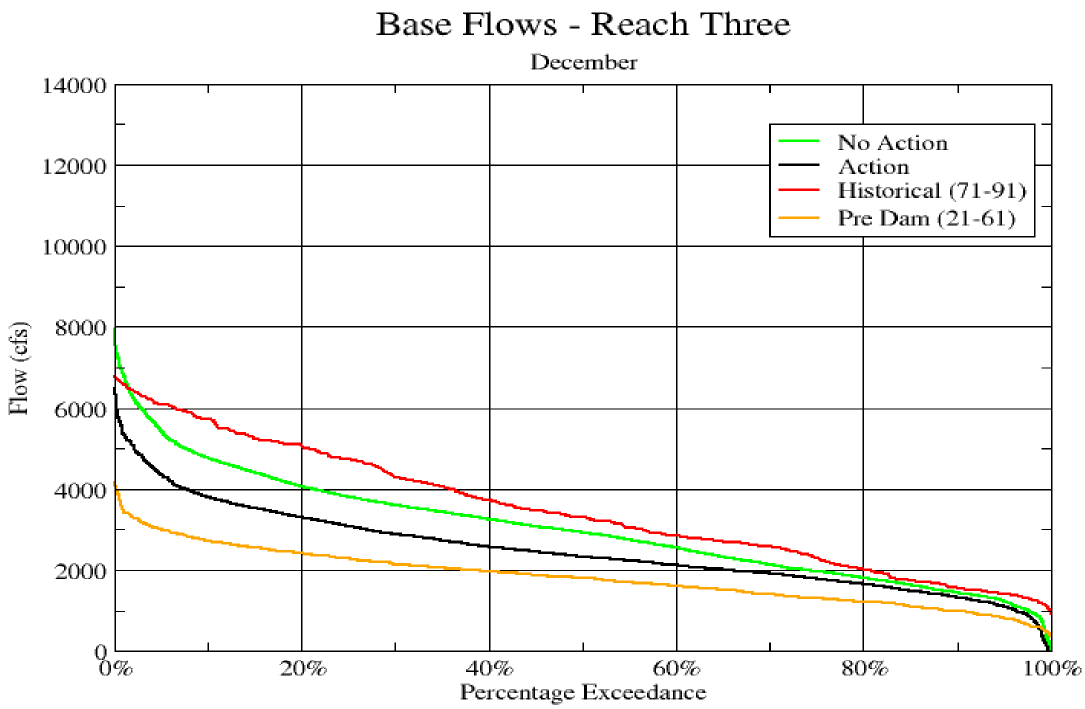


Figure 6.—Reach 3 Distribution of Flows (December).

it does represent the best possible estimate of the predicted future flows in Reach 3 that would result from operating Flaming Gorge Dam under the Action and No Action Alternatives.

It is important to note that the consumptive uses and losses implicitly included in the Reach 3 flows are historical and do not represent consumptive uses and losses that will occur in the future. The trend of water consumption in the Green River Basin is increasing so it would be safe to assume that the Reach 3 flows that would actually occur if Flaming Gorge was operated under the Action and No Action Alternatives would be marginally less than those reported here in. Future consumptive uses and losses are speculative and hard to accurately quantify and therefore no attempt has been made to characterize how these future consumptive uses and losses would affect the flows of Reach 3. However, the incremental differences between the Reach 3 flows under the two alternatives should be relatively accurate.

September 8, 2003

TO: Peter Crookston, Flaming Gorge EIS Manager

FROM: Tom Ryan[1], Kirk LaGory[2], and John Hayse[3]

SUBJECT: Review of the Green River Model Developed for the Flaming Gorge Dam EIS[4]

Background

A river simulation model was developed for the Green River system to assess impacts of Flaming Gorge Dam operations in the Operation of Flaming Gorge Dam Environmental Impact Statement (Flaming Gorge EIS). The model was developed using the RiverWare simulation modeling software package. The Green River Model evaluates two alternative operations: the no-action alternative (operation of Flaming Gorge Dam as prescribed by the 1992 Biological Opinion; FWS 1992) and the action alternative (operation of Flaming Gorge Dam to meet the flow recommendations developed by Muth et al. 2000). Input to the model includes the inflows to Flaming Gorge Reservoir and inflow to the Green River from the Yampa River, and predicts flow at the USGS streamflow gage on the Green River at Jensen, Utah approximately 93 miles downstream from Flaming Gorge Dam.

For the action alternative, the Green River Model predicts significant use of the bypass tubes and spillway at Flaming Gorge Dam when compared to the no-action alternative. Under the action alternative, the Green River Model predicts that the bypass tubes would be used in 49.9% of years and the spillway would be used in 29.4% of years. These relatively high frequencies have caused concern among those involved in the management of Flaming Gorge Dam. Our review of the Green River Model was performed to evaluate whether the degree of bypass and spill predicted by the Green River Model would be necessary to meet the requirements of the flow recommendations. Our review did not include an evaluation of the no-action alternative. While the main focus of our model review was the frequency of bypass and spillway use, we also examined the model's behavior in its entirety, and evaluated how the model simulated the year-round operation of Flaming Gorge Dam to meet the flow recommendations.

Review Approach

The Green River Model uses the indexed sequential method where multi-trace output is created. The model simulates the Green River system including the operation of Fontenelle and Flaming Gorge Dams for the years 2002 through 2040 (39 years). For the EIS, the model was used to simulate these 39 years 65 separate times using hydrology from 1921 through 1985 (rotating among these 65 years to create 65 distinct traces). Thus, the model simulates the operation of the Green River system for 2,535 different years (39 times 65). For our review, a sample of these 2,535 years was taken. The sample size was 65 years, and included one representation from each year of hydrology used in the model. Specifically, we reviewed simulations of Trace 0 from 2002 until 2040 (using the hydrology from 1921 through 1959), and Trace 39 from 2002 until 2025 (using the hydrology from 1960 through 1985). To determine if the sample was a good

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[4] Green River Model is Flaming Gorge Model as referenced throughout the EIS and the hydrology modeling reports.

representation of all years, model statistics for meeting flow recommendations in Reach 2 were compiled for the sample and compared to results for all years. The following table shows this comparison. It can be seen that the difference between the sample (65 years) and all years (2,535) is very small.

Flow Recommendations for Reach 2 and Predicted Occurrence of Target Achievement in All Years of Analysis and in the Sample Review Period Under the Action Alternative

Spring Peak Flow Recommendations	Recommended	Sample Period (Trace 0 and 39)	All Years	Difference
Peak >= 26,400 cfs for at least 1 day	10	12.3	11.3	1.0
Peak >= 22,700 cfs for at least 2 weeks	10	10.7	10.7	0.0
Peak >= 18,600 cfs for at least 4 weeks	10	10.7	11.1	0.4
Peak >= 20,300 cfs for at least 1 day	30	47.7	46.3	1.4
Peak >= 18,600 cfs for at least 2 weeks	40	40.0	41.1	1.1
Peak >= 18,600 cfs for at least 1 day	50	60.0	60.3	0.3
Peak >= 8,300 cfs for at least 1 day	100	100	100	0.0
Peak >= 8,300 cfs for at least 1 week	90	96.9	96.8	0.1
Peak >= 8,300 cfs for at least 2 days except in extreme dry years	98	98.5	99.6	0.9
Frequency of bypass (> 4,600 cfs)	NA	50.7	49.9	0.8
Frequency of spills (>8,600 cfs)	NA	27.7	29.4	1.7

We evaluated performance of the Green River Model in each of the 65 years in the sample (1921 through 1985). We considered the May 1 forecasted inflow and actual inflow to Flaming Gorge Reservoir, reservoir storage and flow regimes on the Yampa River in evaluating how well the Green River Model simulated the operation of Flaming Gorge Dam to meet flow recommendations in Reach 2, and to manage Flaming Gorge Reservoir under existing authorities. We also evaluated how well the model met recommended base-flow targets.

We tried to be conservative in our evaluation. In some years, the Green River Model predicted bypasses or spills, and very precise adjustment of releases could eliminate these above-powerplant-capacity releases. We chose not to include these borderline years among those where spills or bypasses could more clearly be eliminated using realistic operational decisions.

Findings

In most situations, the Green River Model appears to properly simulate the operation of Flaming Gorge Dam to meet flow recommendations in Reach 2, while minimizing the effects on authorized purposes of the dam. Modeling of the action alternative is complicated by the intricacies of the flow recommendations, hydrologic variability and the degree of hydrologic difference between the Green and Yampa Rivers. Within the RiverWare modeling package a complex "rule set" has been developed for the action alternative that controls the behavior of the model and thus the simulated operation of Flaming Gorge Dam. Much of the logic of the rule set is presented in this review.

A few specific issues were identified in our review of the Green River Model in the action alternative. These issues are related to how the model moves water in wetter than average years. We found that, in some years, predicted bypass releases might not be necessary for either hydrologic reasons or to meet downstream targets. Additionally, there are some years where the model predicts spills that produce flows that are greater than recommended Reach 2 targets. The following text discusses these issues as they relate to the predicted frequency of bypasses and spills from Flaming Gorge Dam.

1. Mass balance rules result in higher bypass frequency than is needed to meet recommended flow targets

The Green River Model uses a March 1 drawdown target for the reservoir of 6,027 feet (13 feet from full pool). This drawdown target is a dam safety constraint, where the 13 feet of vacant space assures a safe spring operation even under very wet hydrology. The model balances water to achieve this March 1 drawdown target throughout the year, but it is important to understand how the model performs this balance in the spring period.

In May, the model generates an inflow forecast (which includes a forecast error term), and places the year in one of 7 hydrologic classifications (wet, moderately wet, average wet, average, average dry, moderately dry, or dry). The model determines the Flaming Gorge Dam release that would be needed to meet the base-flow recommendations in Reach 1 for the year's hydrologic classification. The model then performs a mass balance to calculate how much water should be released in the months of May, June, and July, in combination with the August through March base flows, to result in a reservoir elevation of 6,027 feet (or below in drought years) on March 1 of the following year. The model then shapes releases from May through July to meet Reach 2 peak flow and duration targets.

Generally, the Green River Model shapes this May through July release volume appropriately, matching the Yampa River peak flows and meeting recommended Reach 2 targets. However, in 6 of the 65 years evaluated in our review (1943, 1944, 1950, 1951, 1956, and 1967), the model bypassed water to meet the mass balance requirements, but these bypasses did not result in meeting any Reach 2 targets. In these years, the reservoir remained 8 to 11 feet below the full-pool elevation in July, and therefore bypass was not required for safety considerations. All of these years were either classified as moderately wet or average wet. Evaluation of the model determined that these bypasses were not necessary for safe operation of the dam or to meet base flow requirements after the runoff season. Other operating options would be available, but the model does not have the capability to evaluate all these other options, and the multiple combinations in which they might be implemented.

One option available to move additional water during the May through July time period is to extend the peak flow duration. The flow recommendations allow for peak flows to extend to July 15 in average years, August 1 in moderately wet years, and August 15 in wet years. In most of the 6 years discussed above, releases were ramped down to base flows before these specified dates.

Another option is the ability to increase releases from Flaming Gorge Dam in April and May. The Green River Model generally does not increase releases from Flaming Gorge Dam to the maximum powerplant capacity of 4,600 cfs (unless reservoir storage is above a set threshold) until the Yampa River is about to reach its peak (usually in late May). The model delays increasing releases even in wetter than average years. Unless the model is constrained by meeting a drawdown target in the months of April and May (which it generally is not), simulated increases in releases from Flaming Gorge do not generally begin until the middle of May. In wetter than average years, the model frequently misses an opportunity to move water in these months. In the all of the 6 years mentioned above, additional water could be moved in April and May. In wet, moderately wet, and average wet years, it is appropriate to increase releases in this period to release water and avoid a bypass later without compromising the recommended flow targets (releases could be increased to a level intermediate between the base flow and 4,600 cfs or in very wet years, all the way to 4,600 cfs).

In making mass balance adjustments, the Green River Model first assures that the base flow is consistent with the flow recommendations by targeting the mean base flow for the hydrologic category. However, the flow recommendations provide a range for target flows rather than a single flow and also allow for adjustment of flows during the base-flow period. For the period reviewed, there were several years in which Reach 2 peak flow targets could not be reasonably met, and in which more runoff could be put into storage and base flows raised to meet the March 1 drawdown target. Some bypasses predicted by the Green River Model are being driven by the need to meet the base flow targets, even though the flow recommendations allow for a range of base flows.

The option of increasing releases from Flaming Gorge Dam in April or May in wetter years has an additional benefit as well. There are some years (e.g., 1962 and 1974) where the Yampa River has an early 'first' peak in late April or early May that sometimes exceed 14,000 cfs. The model has been developed to match the later more significant peak, but in wetter years additional days at 18,600 cfs (a significant duration target in the flow recommendations) in Reach 2 could be achieved by appropriately increasing releases in April or May in wetter years, and, on occasion, eliminate the need for bypass releases to reach downstream targets.

The year 1962 was also identified as one in which bypass releases would not be required. It is an 'early' runoff year with two large peaks on the Yampa River, one in late-April and one in mid-May. It was a moderately wet year in the upper Green River Basin (upstream of Flaming Gorge Dam) with the need to release a significant amount of water from the reservoir for hydrologic reasons. The modeled operation shows a large bypass and spill (with a peak release of 12,200 cfs) in late May to achieve the 18,600 cfs, 2-week, Reach 2 target. This large release is made as the Yampa River flow declines from its second peak. This same target could be met, and the same volume of water released from the reservoir, by eliminating the bypass and spill entirely, and releasing 4,600 cfs from late April through mid July.

There were 3 years identified as borderline years in terms of the use of the bypass tubes in the Green River Model. These were 1932, 1970, and 1974. In each of these years, bypass releases were used to meet the 18,600-cfs, 2-week, Reach 2 target. In these 3 years, a steady release of 4,600 cfs would achieve the same Reach 2 target without bypass. Because of the difficulty in precisely predicting the behavior of the Yampa River, however, our review concludes that the use of the bypass to meet downstream targets may have been warranted in these years.

2. Spillway releases frequently occur when Reach 2 targets are being exceeded.

In some years, the Green River Model predicts releases from Flaming Gorge Dam that are higher than those needed to achieve recommended Reach 2 peak flow targets. In the rule set for the model, bypass and spill releases are increased by a factor of 1.2 when the mass balance calculation indicates that additional water needs to be bypassed after the Yampa River has finished peaking. The 1.2 rule in the model may be causing releases from Flaming Gorge Dam to exceed 8,600 cfs, the threshold where spillway use is required in wet and moderately wet years.

There are 10 years (1922, 1923, 1927, 1947, 1971, 1973, 1975, 1978, 1980, and 1982) where releases exceed 8,600 cfs, where flows in Reach 2 are greater than target levels. In each of these years, all of the same Reach 2 targets could be met using bypass releases. With the exception of 1973, these years are all moderately wet or wet years. The spillway was not required for dam safety considerations in these years because in each one, there is at least 6 feet of vacant space at the end of the runoff period. Other operating options would be available to meet the downstream targets and evacuate the appropriate amount of water from the reservoir. In most cases the volume released through the spillway could be shifted to an extended use of the bypass tubes to meet the downstream target. In other years, the spill could be eliminated and the additional water evacuated by extending the period of powerplant capacity flows to the end of July (in moderately wet years) or to August 15 (in wet years), by releasing additional water in April or May, or by storing some additional water and making minor adjustments to base flows.

In our review, we classified 2 of these 10 years as borderline years (1927 and 1947). Given the hydrologic uncertainty in these 2 years, and the fact that the Reach 2 targets would just barely be reached without releases greater than 8,600 cfs, our review concludes the use of the spillway in these 2 years to be reasonable.

There are 2 years where the Green River Model predicts releases from Flaming Gorge Dam that are just above 8,600 cfs. This occurs in 1938 when releases of about 9,000 cfs are made for 3 days, and in 1942, when releases for 2 days are about 8,800 cfs. In each of these 2 years, releases could be limited to 8,600 cfs to achieve the same Reach 2 targets. There is no sensitivity to 8,600 cfs as a threshold in the Green River Model. The 2 years mentioned show up as “spill” years in the Flaming Gorge Model, even though the volume released through the spillway is negligible. In actual practice, the spillway would not likely be used for such a small amount of release (200 to 400 cfs).

The following table displays those years in which the Green River Model predicted bypass or spill, but we concluded that such use may not be necessary.

Years In Which Bypass or Spill Was Predicted by the Green River Model, but May Not Be Necessary

Unnecessary Bypass Release Years	Unnecessary Spillway Release Years
1943	1922
1944	1923
1950	1938
1951	1942
1956	1962
1962	1971
1967	1973
	1975
	1978
	1980
	1982

3. Other Findings

There is considerable variability between the hydrology of the Green River and Yampa River basins on a year-to-year basis. There are numerous wetter years in the Yampa River Basin where hydrologic conditions are average in the upper Green River Basin. The reverse is also true. The Green River Model's approach is to capitalize on Yampa River Basin hydrology so to limit the volume of spills and bypasses from Flaming Gorge Dam while achieving the flow recommendations. The model attempts to achieve Reach 2 targets by considering Yampa River Basin hydrology in combinations with hydrologic conditions in upper Green River Basin. There are numerous years where moderately wet or wet Reach 2 targets are met with a limited amount of bypass (with 1929, 1957, 1958, 1970, and 1984 as example years). We believe the approach used in the Green River Model is appropriate, and that if the model were configured to try and 'force' the achievement of the flow recommendations based solely on hydrologic classifications in the upper Green River, that significantly larger volumes of water would have to be bypassed or spilled at Flaming Gorge Dam.

Down-ramp rates when the bypass tubes or the spillway are used in the Green River Model vary. In moderately wet and wet years the down-ramp rate is 1,000 cfs per day. Occasionally the model bypasses some water in average or average wet years to take advantage of opportunities on the Yampa River. In these years, the down ramp rate is only 500 cfs per day. Consideration should perhaps be given to increasing this down ramp to 1,000 cfs per day to reduce the volume of water bypassed.

Conclusions

The Green River Model predicts the use of the bypass or spillway at Flaming Gorge in 33 of 65 years. Our review concludes that in 26 of these 65 years this use is appropriate for hydrologic reasons or to meet targets in Reach 2. In 11 of these 26 years (1921, 1922, 1923, 1927, 1928, 1929, 1947, 1952, 1972, 1978, and 1980), it appears that the volume of bypass produced by the Green River Model was higher than necessary, and could be reduced while still meeting the same objectives in Reach 2. The same strategies discussed previously to reduce bypass and spills are relevant, i.e., extend the duration of the peak flow to August 1 in moderately wet years and August 15 in wet years, increase releases from Flaming Gorge Dam in April or early May in wetter years, and take advantage of flexibility in the base-flow period when needed.

The Green River Model performs well in dry, moderately dry, average dry, and average years. In many of the wetter years the model also performs well (1957 and 1984 are examples of excellent wet year operations). The model appears to bypass or spill more water than may necessary in average wet, moderately wet, and wet years, however. The Green River Model operates Flaming Gorge Dam to assure that frequencies of peak flow targets and duration targets as specified in the flow recommendations are met. The model also meets base flow targets as specified in the flow recommendations.

A key issue with river simulation modeling is lack of flexibility. Rules must be 'hard coded'. While rules allow for decision trees, a model such as the Green River Model will not be able to adjust to all situations and be able to consider the balance of all available operating options. The inability to program extensive flexibility into the model's rules makes precise modeling of the effects of flow recommendations, which are inherently flexible, more difficult.

Three key findings were made in reviewing the model:

- ❖ The model does not take advantage of the ability to move water in April and early May in wetter than average years. By not increasing releases during this period the frequency of spills and bypass releases in the Green River Model is increased, and some opportunities to more easily achieve targets in Reach 2 are missed.
- ❖ Modeled releases frequently exceed 8,600 cfs (requiring spillway use) even when such spillway releases are not needed to meet downstream targets or for hydrologic reasons. The 1.2 rule may be contributing to this phenomenon.
- ❖ The Green River Model mass balance procedure in the spring 'locks' in base flows for the following August through February time frame and also locks in the amount of water to be released in the May through July time period. The model is not able to capitalize on the flexibility allowed by the flow recommendations for base flows as it moves through the operation in the May through July time period.

Each of these factors contributes to the Green River Model bypassing and spilling more water than may be necessary. Based on the evaluation of the Green River Model, the frequency of use of the spillway and bypass predicted by the model in the action alternative is probably higher than necessary to achieve the flow recommendations. We found 7 years out of 65 when bypasses occurred, but were not required. We believe that operations at Flaming Gorge Dam could meet the flow recommendations by using the bypass tubes about 40.0% of the time, a reduction of 9.9% from that predicted by the Green River Model. The frequency of spillway use appears to be overstated by the model as well. We found 11 years in which the model predicted spills (releases greater than 8,600 cfs), but those spills did not result in meeting downstream targets nor were they needed for hydrologic reasons. We believe that the use of the spillway may be needed about 10.8% of the time to meet the flow recommendation, a reduction of 18.6% percent from that predicted by the Green River Model. The total volume of water released above powerplant capacity (as bypasses or spills) as predicted by the Green River Model may also be greater than necessary.

Operation of
Flaming Gorge Dam
Final Environmental
Impact Statement

Modified Run of the River Modeling Report Technical Appendix

MODIFIED RUN OF THE RIVER MODELING REPORT TECHNICAL APPENDIX

Page No.

Modified Run of the River Modeling Report Technical Appendix

R. Clayton and A. Gilmore
July 17, 2002

INTRODUCTION

At the request of the National Park Service, a "Run of River" approach for operating Flaming Gorge Dam was modeled by the hydrologic modeling team to see if this type of approach could achieve the *2000 Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations). The Action and No Action Alternatives of the Flaming Gorge Environmental Impact Statement (Flaming Gorge EIS) are the only two alternatives that have been fully modeled. This study was done to potentially create a third alternative for the Flaming Gorge EIS.

A "Run of River" operational approach provides a more natural hydrograph to river reaches downstream of a reservoir because releases from the reservoir are patterned to mimic the reservoir inflow pattern. The "Run of River" approach modeled for this study followed a simple rule where the daily release volume was set equal to a percentage of the previous day's unregulated inflow volume. There were two main goals this study attempted to achieve. The first goal was to determine what percentage of the previous day's unregulated inflow volume to release so that the flow objectives of the 2000 Flow and Temperature Recommendations would be achieved. This percentage had to meet these flow objectives while also minimizing impacts to other resources associated with the Flaming Gorge facility. The second goal was to compare and quantify the hydrologic effects of this operational approach to the approaches used for the Action and No Action Alternatives.

MODEL METHODOLOGY

The basic methodology of the “Run of River” approach used for this study was to release a percentage of the previous day’s unregulated inflow during the period from March through July. During other months of the year, the “Run of River” approach determined releases in the same way that the Action Alternative determined releases.

Unregulated inflow is a measure of what volume of water would have flowed into the reservoir over a period of time assuming no upstream regulation occurred. In the case of Flaming Gorge Reservoir, the unregulated inflow is the actual inflow, over a period of time, adjusted for any change in storage or evaporation in Fontenelle Reservoir located upstream from Flaming Gorge Reservoir.

The main difference between the “Run of River” approach and the approach taken by the Action Alternative was the method by which releases from Flaming Gorge Dam were determined during the March through July period. The Action Alternative divided this period into a transitional operations period (March and April) and a spring period (May, June, and July). During the transitional period, the Action Alternative operated Flaming Gorge Dam to achieve a drawdown target by a deadline date of May 1st each year. During this period, a minimum release rate of 800 cubic feet per second (cfs) and a powerplant capacity release rate of 4,600 cfs were the only limits placed upon releases. During the spring period, the Action Alternative classified the anticipated spring hydrology into one of five classifications (dry to wet). From this classification the Action Alternative developed a spring release pattern that would most likely meet the flow objectives defined for that particular classification. It was assumed that future flows of the Yampa River could be predicted within a reasonable degree of accuracy.

The “Run of River” approach, on the other hand, was more indirect in terms of how it attempted to achieve the flow objectives of the 2000 Flow and Temperature Recommendations. Under the “Run of River” approach during the period from March through July, each day Flaming Gorge releases were controlled so that a percentage of the unregulated inflow for the previous day was released. During this period, the “Run of River” approach did not make any direct attempt to achieve the flow objectives of the 2000 Flow and Temperature Recommendation. It was assumed that by releasing a particular percentage of the unregulated inflow, that these flow objectives could be achieved coincidentally. Preliminary analysis of the historic inflows into Flaming Gorge indicated that releasing 87 percent (%) of the unregulated inflow would most likely provide enough storage during the spring to achieve the base flow targets. This percentage was applied to the rule that governed releases under the “Run of River” approach during the period from March through July.

The 2000 Flow and Temperature Recommendations call for riverflows during the base flow period (August through February) that are higher than flows that would have occurred naturally. To achieve these flows, water is released from storage during the base flow period. This draws the water surface elevation of Flaming Gorge down during the base flow period. The challenge of this “Run of River” approach was to find a percentage of the spring unregulated inflow that would provide enough storage to achieve the flow objectives during the base flow period while also setting releases high enough during the spring to achieve the flow objectives for the spring. This proved to be very challenging and was not fully accomplished in this study.

MODEL RESULTS

Table 1 shows the results of how the "Run of River" approach compared to the Action and No Action Alternatives for the spring flow and duration objectives described in the 2000 Flow and Temperature Recommendations. For many of the spring flow objectives, the "Run of River" approach achieved or exceeded the recommended flows and durations for the recommended frequencies. But for flow objectives with extended durations, the "Run of River" approach did not successfully achieve these flow and duration combinations as frequently as recommended. For example, one flow objective of the 2000 Flow and Temperature Recommendations calls for flows in Reach 2 to meet or exceed 18,600 cfs for at least 2 weeks in 40% of all years. The "Run of River" approach, with a release percentage of 87%, accomplished these flows only about 21% of the time. Even when the release percentage was increased to 100%, which would cause the reservoir to store no water during the spring, this flow objective was achieved only 30% of the time. This was a strong indication that the "Run of River" approach implemented for this study could not achieve the 2000 Flow and Temperature Recommendations without having significant impacts on other resources associated with Flaming Gorge. Without achieving all of the flow objectives of the 2000 Flow and Temperature Recommendations, the "Run of River" approach could not meet the purpose and need for the Flaming Gorge EIS and thus was not considered as a viable alternative. Despite these findings, a study of the hydrologic impacts of this "Run of River" approach was done and the results of which are presented in the remainder of this report.

Table 1.—Spring Flow Objectives of the 2000 Flow and Temperature Recommendations with Model Results

Spring Peak Flow Recommendations	Reach	Target %	Action Ruleset	No Action Ruleset	Run of the River Action Ruleset
Peak >= 26,400 cfs For at least 1 day	2	10%	11.3%	7.1%	13.8%
Peak >= 22,700 cfs For at least 2 weeks.	2	10%	10.7%	4.6%	6.2%
Peak >= 18,600 cfs For at least 4 weeks.	2	10%	11.1%	6.0%	7.9%
Peak >= 20,300 cfs For at least 1 day.	2	30%	46.3%	42.3%	47.2%
Peak >= 18,600 cfs For at least 2 weeks.	2	40%	41.1%	15.6%	21.5%
Peak >= 18,600 cfs for at least 1 day.	2	50%	60.3%	59.1%	58.5%
Peak >= 8,300 cfs for at least 1 day.	2	100%	100%	98.5%	96.9%
Peak >= 8,300 cfs for at least 1 week.	2	90%	96.8%	96.9%	89.2%
Peak >= 8,300 cfs for at least 2 days except in extreme dry years.	2	98%	99.6%	98.4%	96.9%

RESERVOIR WET AND DRY CYCLE RESULTS

To capture the uncertainty of future hydrologic events, 65 sets of historic inflows for the years 1921 through 1985 were routed through the Flaming Gorge model. Each set was systematically varied from the others to provide a range of reasonable inflow patterns that could potentially happen in the future. Because the inflow sets were constructed from historic hydrology over the period from 1921 though 1985, the extreme wet and dry cycles that occurred in these inflow sets were assumed to be the most reasonable extreme events that could likely occur in the future. An example of how the "Run of River" approach, and the Action and No Action Alternatives, operated Flaming Gorge Dam differently under the most extreme wet and dry events that occurred in the model results are shown in figures 1 through 4. Figures 1 and 2 show a comparison of how the three rulesets operated Flaming Gorge Dam through the most extreme 3-year dry cycle. These historic years are 1939, 1940, and 1941. Figure 1 shows what happened to the reservoir elevation while figure 2 shows the release patterns generated by the three rulesets. For consistency of comparison, the initial elevations were all normalized to the actual water surface elevation that occurred on January 2002. Figures 3 and 4 show a comparison of how the rulesets operated Flaming Gorge Dam through the most extreme 3-year wet cycle. These historic years are 1982, 1983, and 1984. Figure 3 tracks the reservoir elevation for each ruleset through this cycle, while figure 4 shows the release patterns generated by the three rulesets.

RESERVOIR WATER SURFACE ELEVATION PERCENTILE RESULTS

For each of the 65 sets of inflows that were routed through the model, a potential reservoir elevation was calculated for each month. The potential reservoir elevations for each month were ranked from lowest to highest. Figures 5, 6, and 7 show the reservoir elevations for various probabilities of exceedance. Figure 5, for example, shows the reservoir elevations that the model predicted would have a 10-percent chance of being exceeded over the next 10 years with Flaming Gorge operated under the three rulesets. Figure 6 shows reservoir elevations that would have a 50-percent chance of being exceeded, and figure 7 shows reservoir elevations that would have a 90-percent chance of being exceeded. It is important to note that figures 5, 6 and 7 do not represent the reservoir elevations for any single set of inflows but are rather a composite of all of the results from all 65 sets of inflows that were routed through the model.

Typically, Flaming Gorge Reservoir reaches the lowest elevation of the year in late winter. This is because the reservoir is intentionally drawn down to an water surface elevation that provides enough storage space to safely route the anticipated snowmelt runoff during the spring. For this reason, the distribution of February reservoir elevations is shown in figure 8. Figure 8 shows that reservoir elevations for February, under the "Run of River" approach, are the lowest of the three rulesets studied. Similar results are shown in figure 9, which shows the distributions of June reservoir elevations. At the end of June, the reservoir elevation of is typically nearing the highest level of the year. These figures characterize the general trend of how each of the operational regimes will likely affect the reservoir elevation at the high and low points of the year.

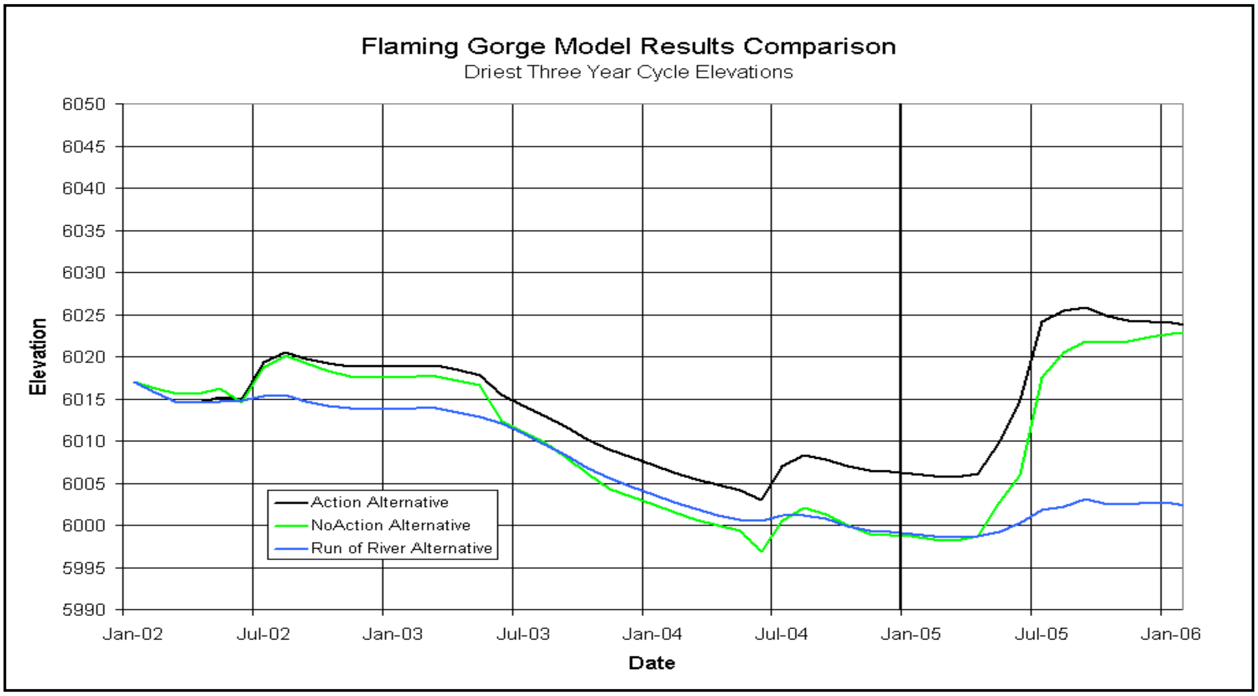

Figure 1.—Reservoir Elevations Under the Most Extreme 3-Year Dry Cycle.

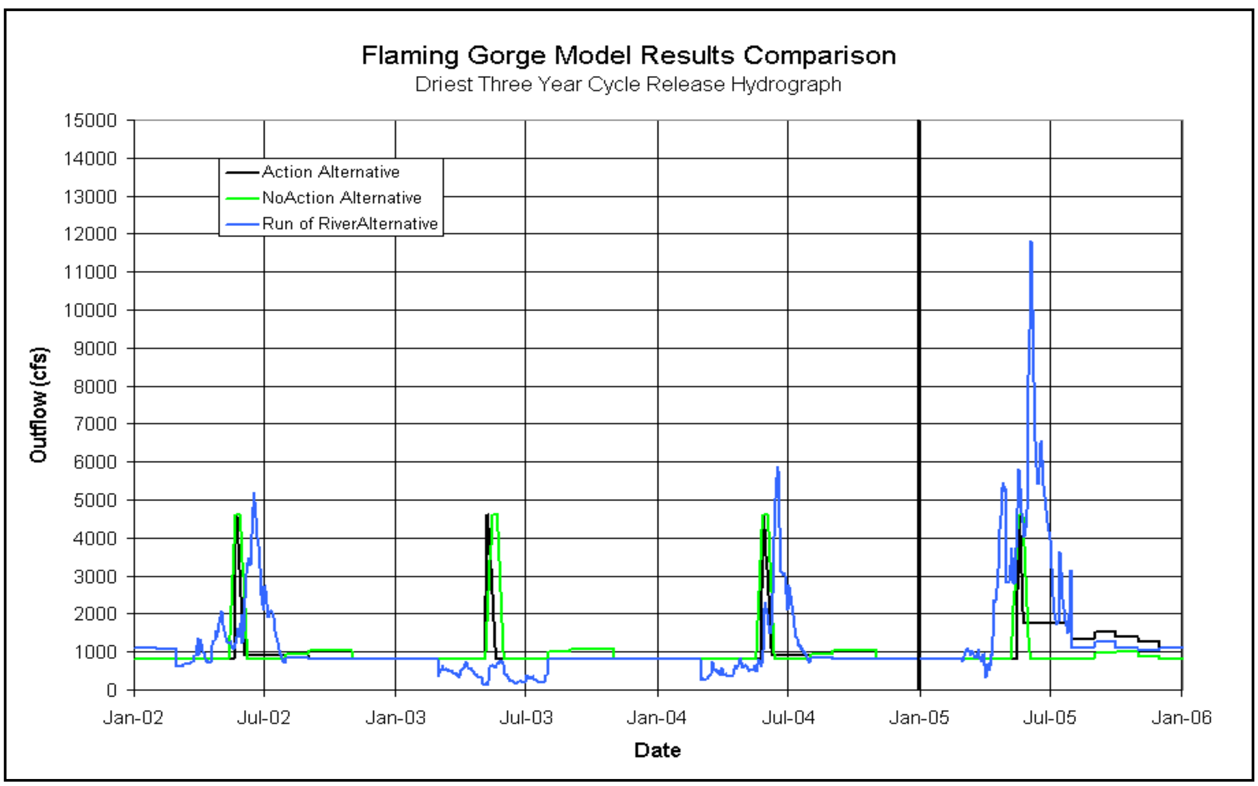

Figure 2.—Reservoir Releases Under the Most Extreme 3-Year Dry Cycle.

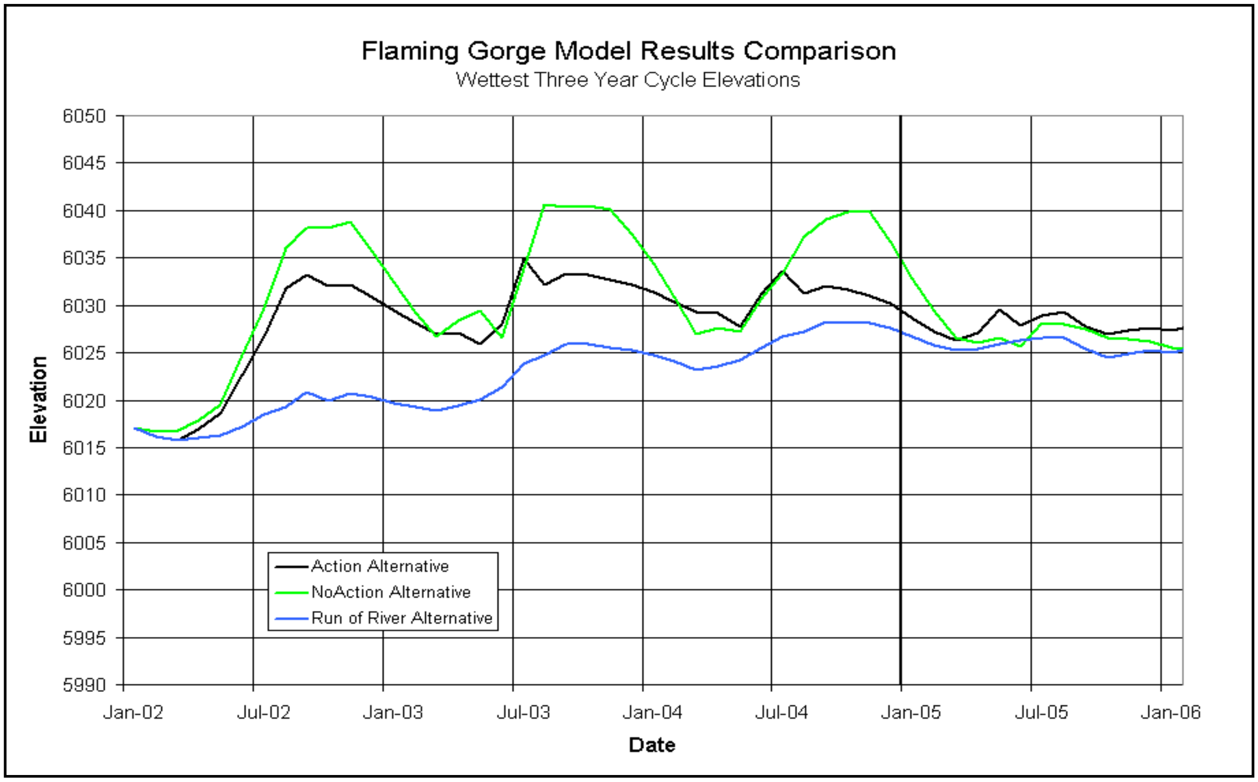

Figure 3.—Reservoir Elevations Under the Most Extreme 3-Year Wet Cycle.

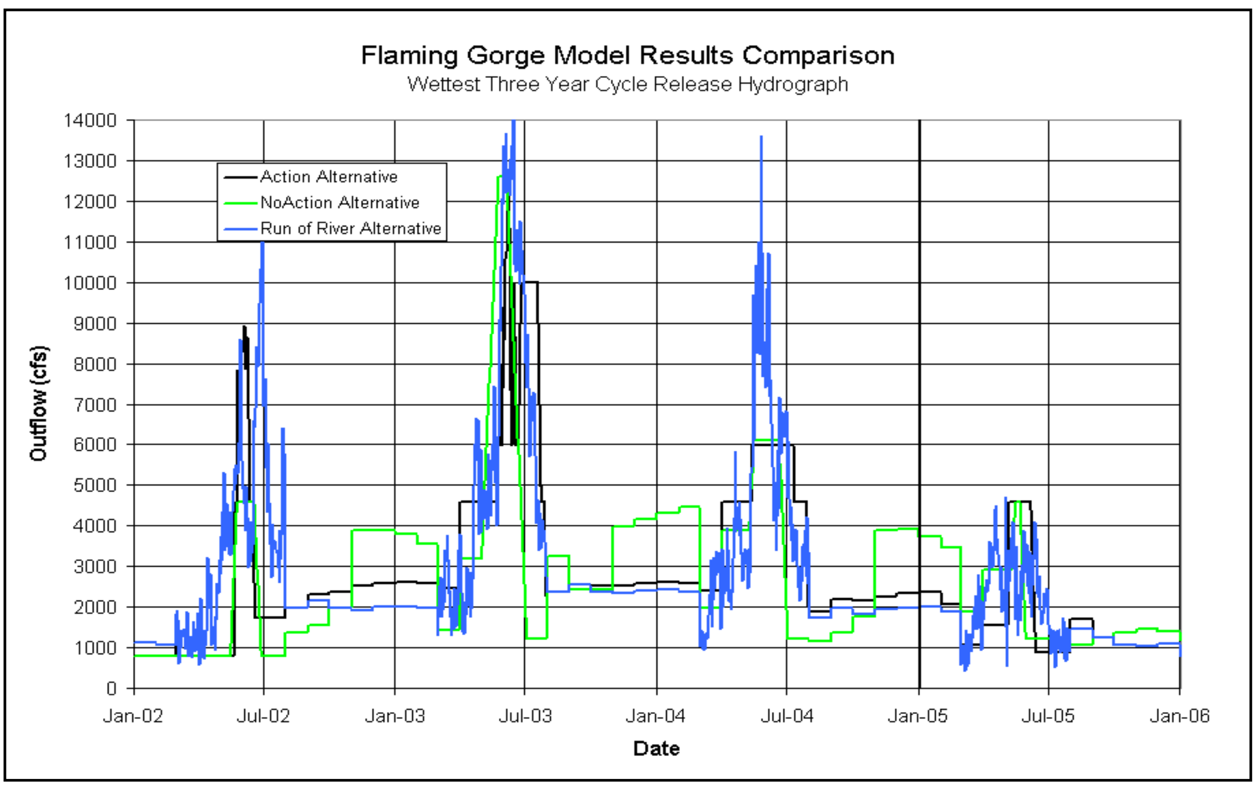

Figure 4.—Reservoir Releases Under the Most Extreme 3-Year Wet Cycle.

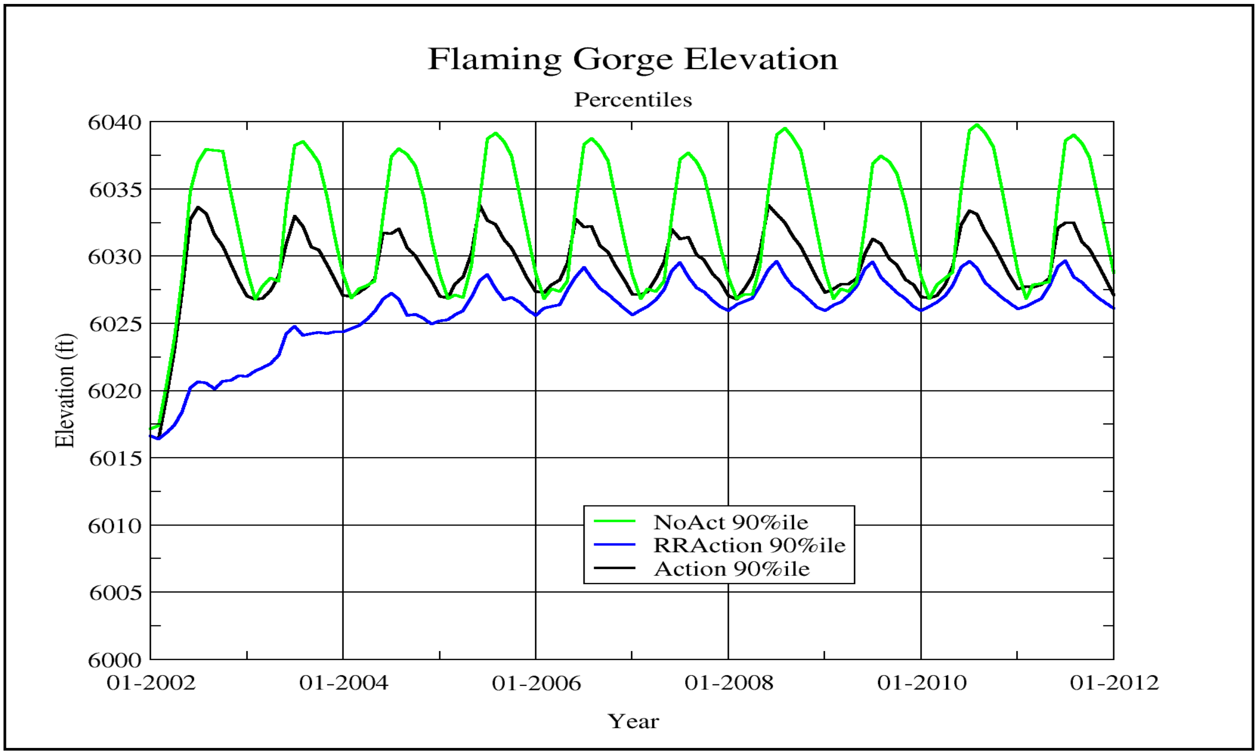

Figure 5.—10% Exceedance Reservoir Elevations From January 2002 to December 2012.

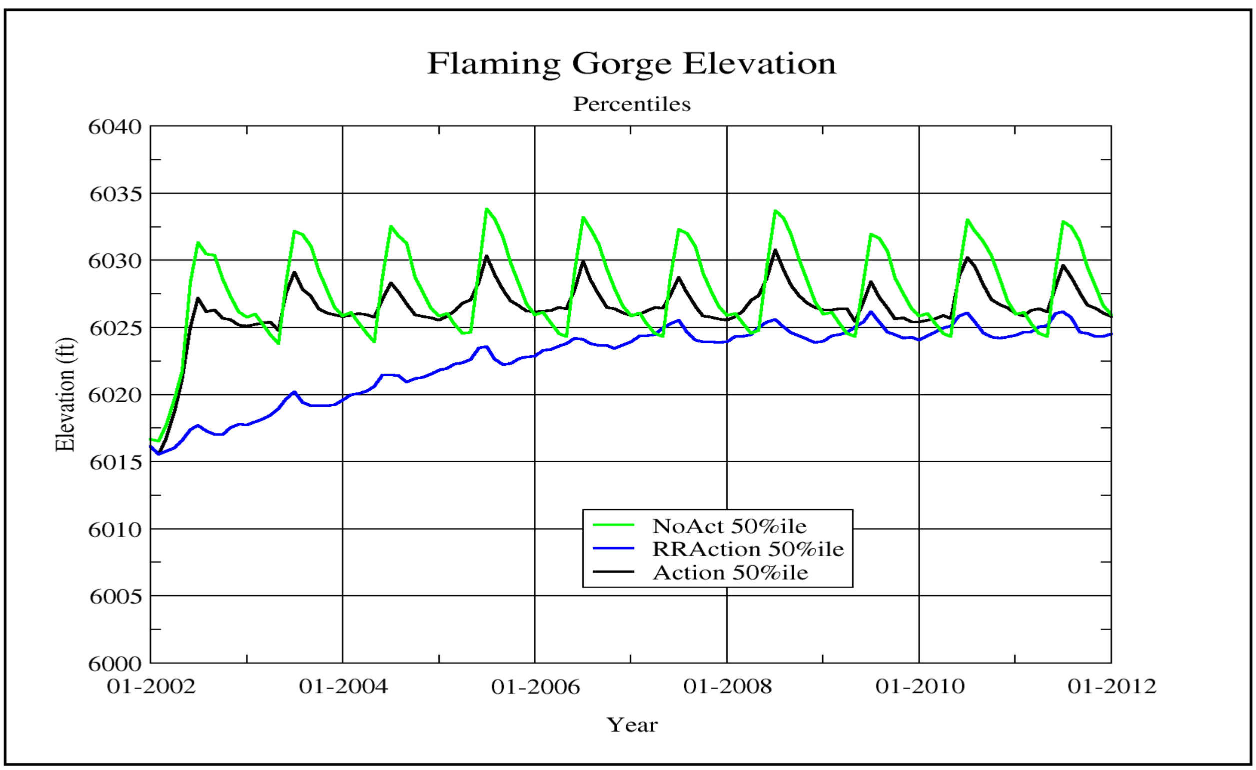

Figure 6.—50% Exceedance Reservoir Elevations From January 2002 to December 2012.

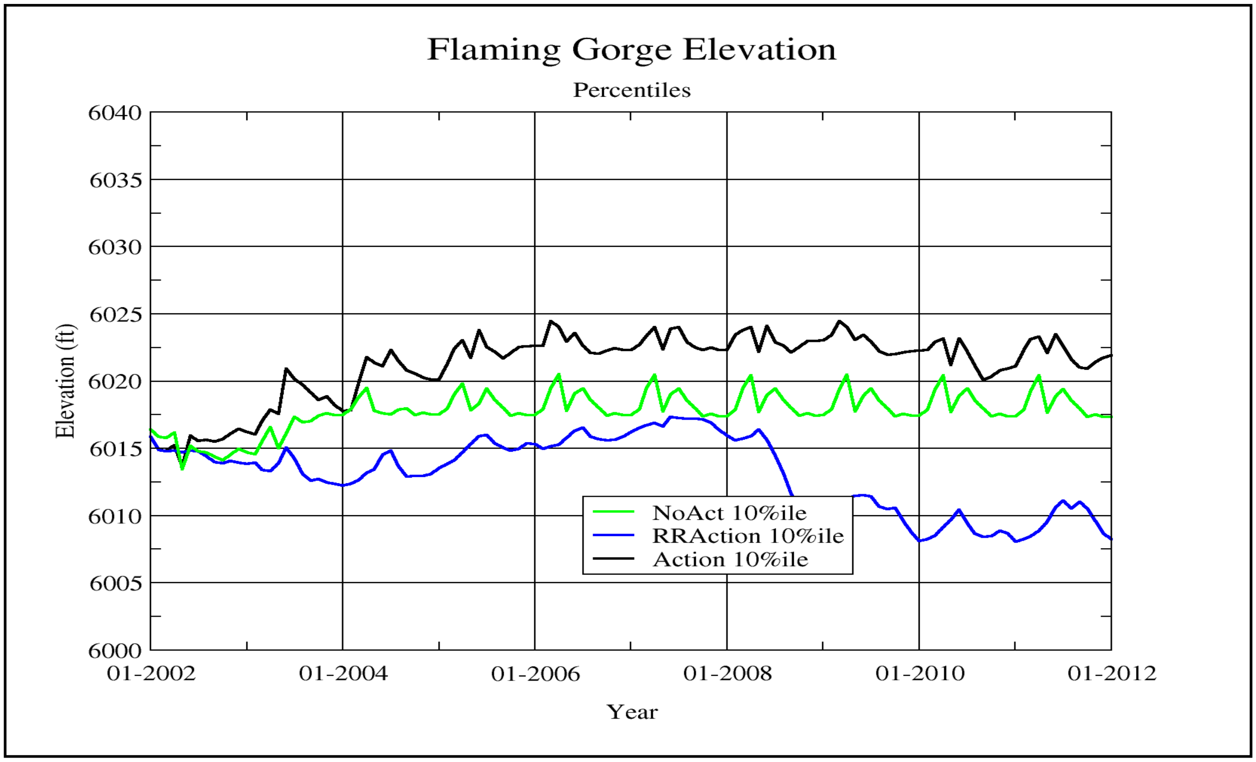

Figure 7.—90% Exceedance Reservoir Elevations From January 2002 to December 2012.

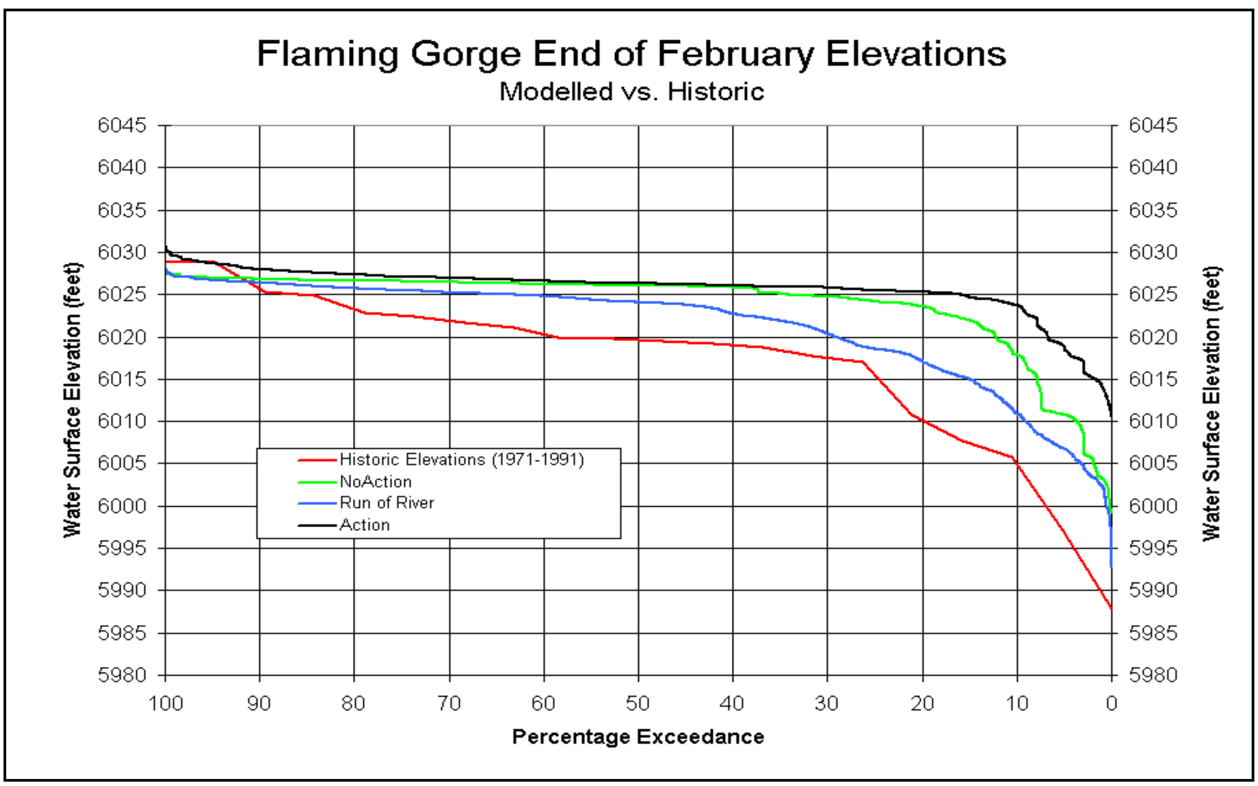

Figure 8.—February Reservoir Elevation Distribution Plot.

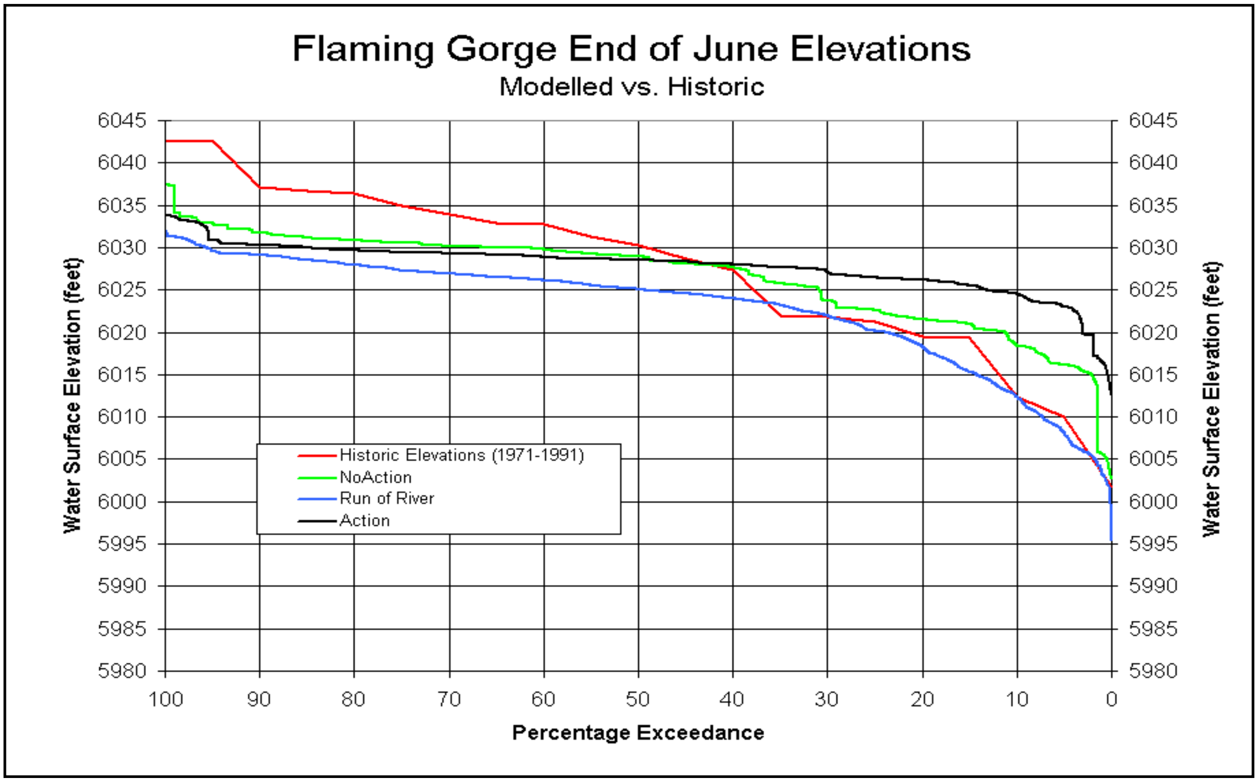

Figure 9.—June Reservoir Elevation Distribution Plot.

REACH 1 SPRING PEAK FLOW RESULTS

The Flaming Gorge model does not account for side inflows that occur along Reach 1 of the Green River. Historically, the volumes of flow contributed by tributaries to the Green River in Reach 1 have been relatively insignificant except during large thunderstorm events. Reach 1 flows that appear in this report are actually the average daily releases made from Flaming Gorge Dam. Figure 10 shows the distribution of peak flows that occurred in the model results having durations of one day for the Action, No Action and "Run of River" approach. Originally, it was assumed that the peak flows would be limited to the months of May, June and July. For the "Run of River" approach, however, it was possible for peak flows to occur in the months of March and April. For this report, however, the peak flows were only analyzed for the May through July period. This is because the flow objectives of the 2000 Flow and Temperature Recommendations during the spring were expected to occur during May-July timeframe and not for the months of March and April. Figures 11 and 12 show the distributions of flows in Reach 1 having durations of two and four weeks respectively. These durations were chosen because the 2000 Flow and Temperature Recommendations specified them as minimum durations for target flows in Reach 2.

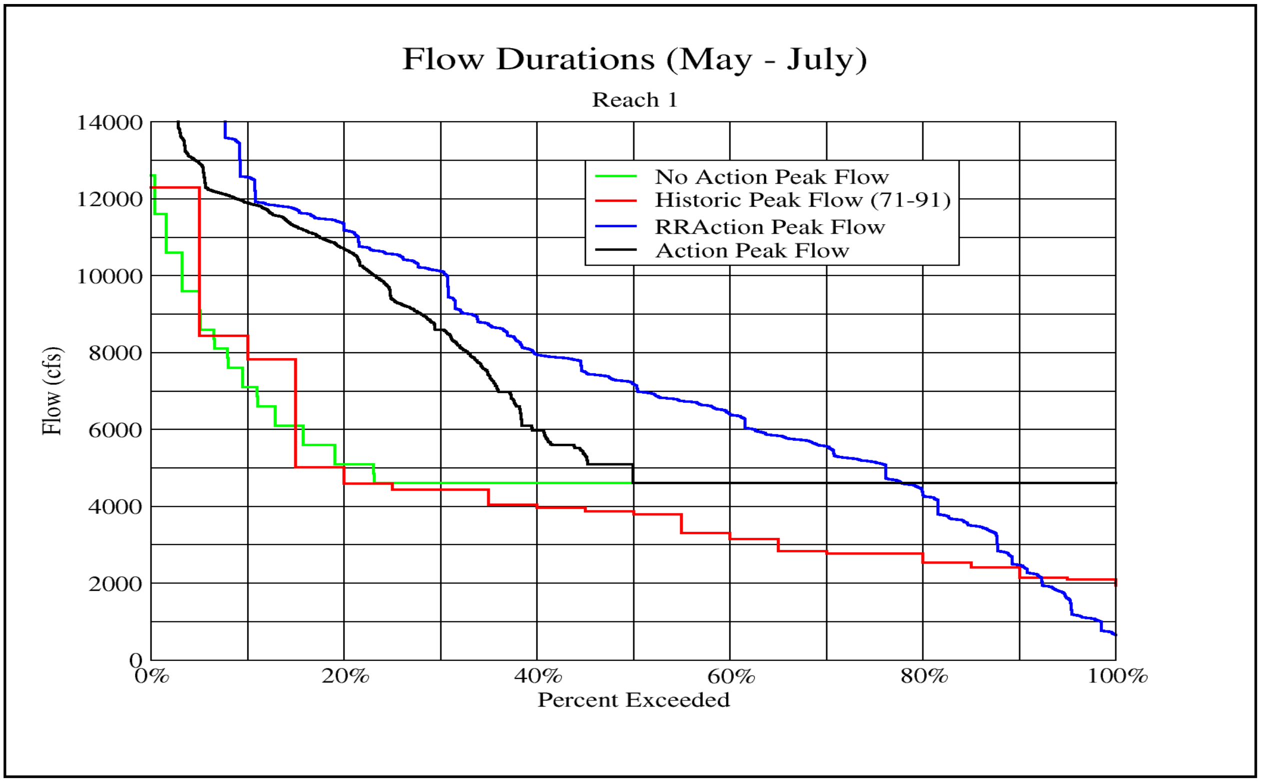

Figure 10.—Distributions of Peak (1-Day Duration) Releases During May-June.

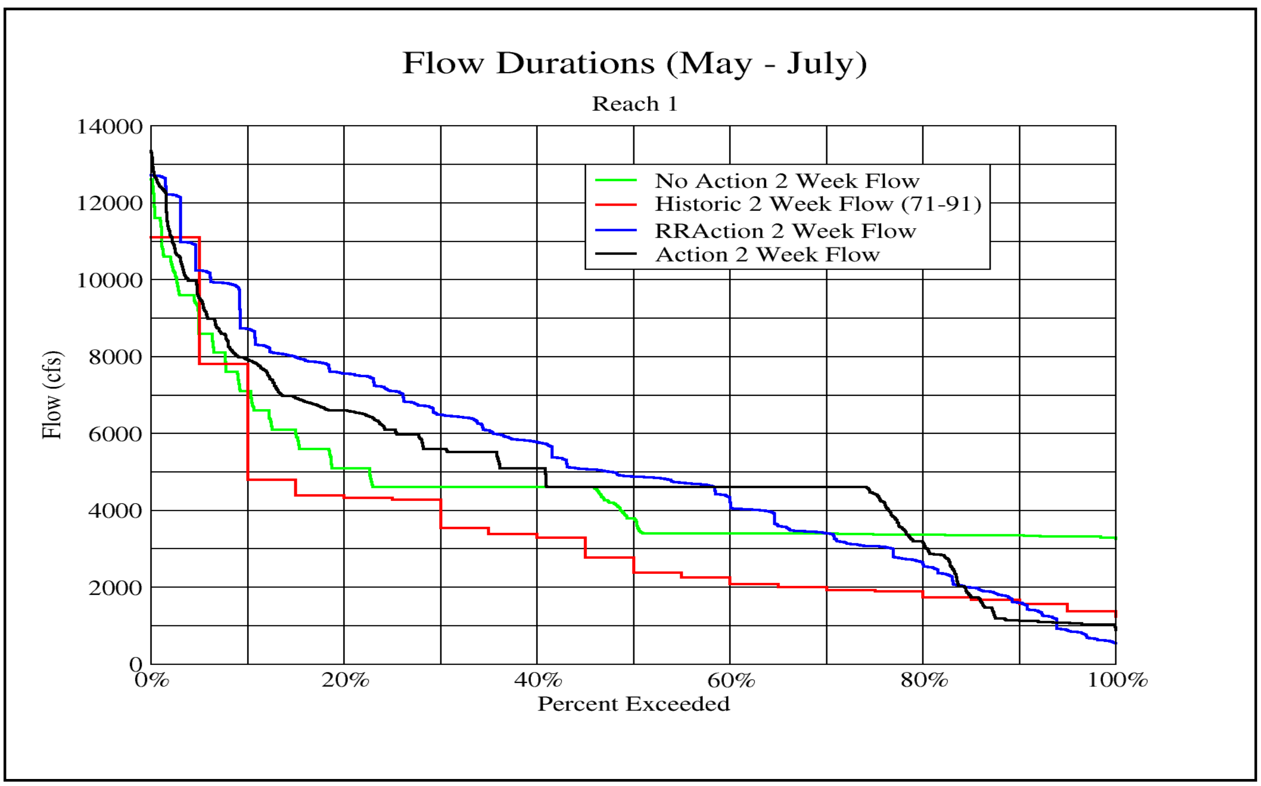

Figure 11.—Distribution of Peak (2-Week Duration) Releases.

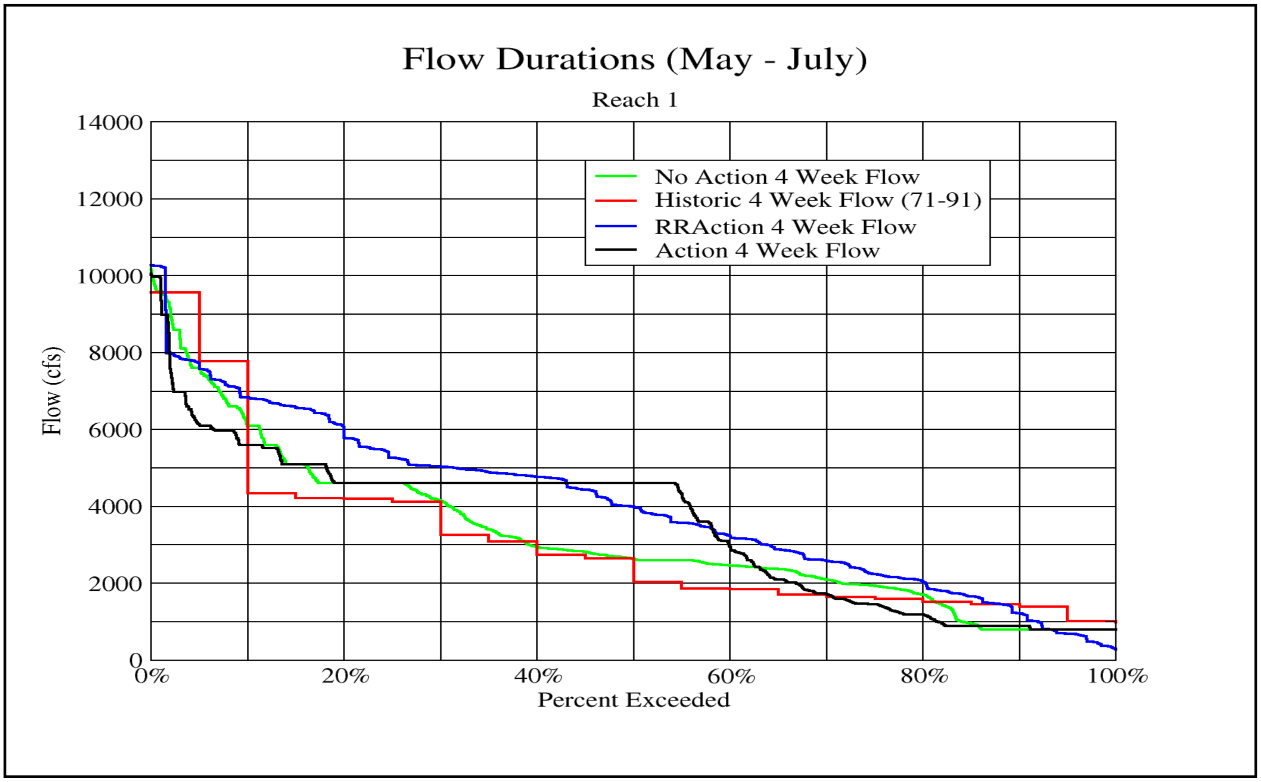

Figure 12.—Distribution of Peak (4-Week Duration) Releases.

FLAMING GORGE ANNUAL BYPASS RELEASE RESULTS

Releases made through the bypass tubes or the spillway that might otherwise have been made through the powerplant have a direct impact on power produced at Flaming Gorge Dam. As a rough method of comparing the Action and No Action Alternatives to the "Run of River" approach in terms of impact to power production, the distributions of annual bypass volumes are shown in figure 13. The figure shows that bypasses occurred most often for the "Run of River" approach and that bypass volumes of the same frequency of occurrence were higher for the "Run of River" approach than for the other two alternatives.

REACH 1 AUGUST THROUGH FEBRUARY BASE FLOW RELEASE RESULTS

The 2000 Flow and Temperature Recommendations call for specific ranges of base flow levels depending on the hydrologic classification that was determined at the end of the spring period. Under the Action Alternative, and "Run of River" approach, the total spring volume of unregulated inflow measured on August 1st of each year set the hydrologic classification, which in turn, set the target range of flows to be established for the base flow period. A target range of flows was specified for both Reaches 1 and 2. Depending on the reservoir elevation, the model

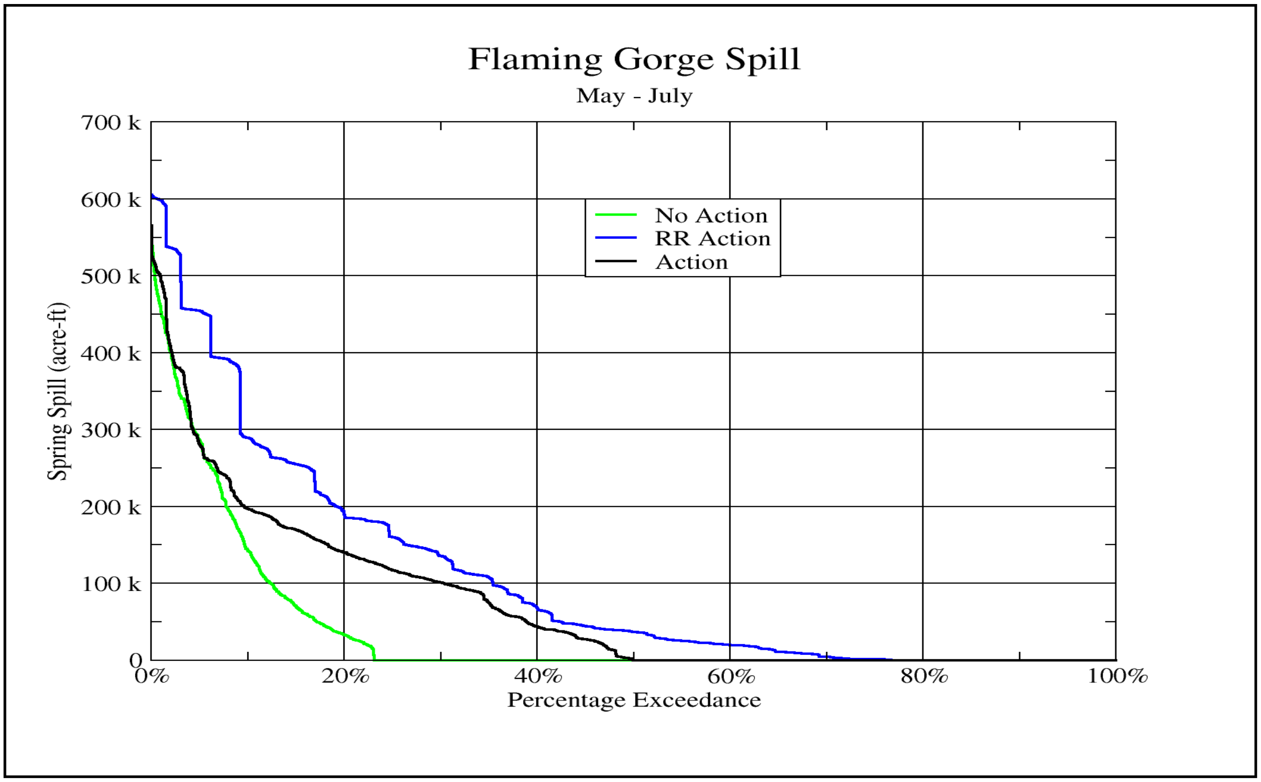

Figure 13.—Annual Bypass Volume Distributions.

determined what release rate would achieve the base flow objectives while also achieving a drawdown target by the end of February. When the reservoir elevation was below the normal operational elevation, the release rate was set to a lower level within the specified range. When the reservoir elevation was above the normal operational elevation, the release rate was set to a higher level within the specified range. In all cases, except when safety of the dam was in question, releases were controlled so that the flow objectives in Reach 2 were always achieved for the hydrologic classification, even when the drawdown target for the end of February could not be achieved. Figure 14 shows that the "Run of River" approach consistently selected base flow levels that were lower than the Action and No Action Alternatives. The most likely reason for this was because the reservoir elevations under the "Run of River" approach were often lower than the corresponding elevations under the Action and No Action Alternatives. To give some perspective to the model results shown in figure 14, the distribution of historic inflows and historic unregulated inflows are also shown in the figure. Unregulated inflows are corrected for river regulation at Fontenelle Reservoir and give a better idea of what inflows would be like without upstream reservoir regulation.

REACH 2 SPRING PEAK FLOW RESULTS

Figures 15, 16, and 17 show the relationships between the peak flows that occurred each spring in Reach 2. Although, the "Run of River" approach did not achieve all of the flow objectives of the 2000 Flow and Temperature Recommendations, the distribution of peak flows generated by the "Run of River" approach, compared to those for the Action and No Action Alternatives, was very similar in Reach 2.

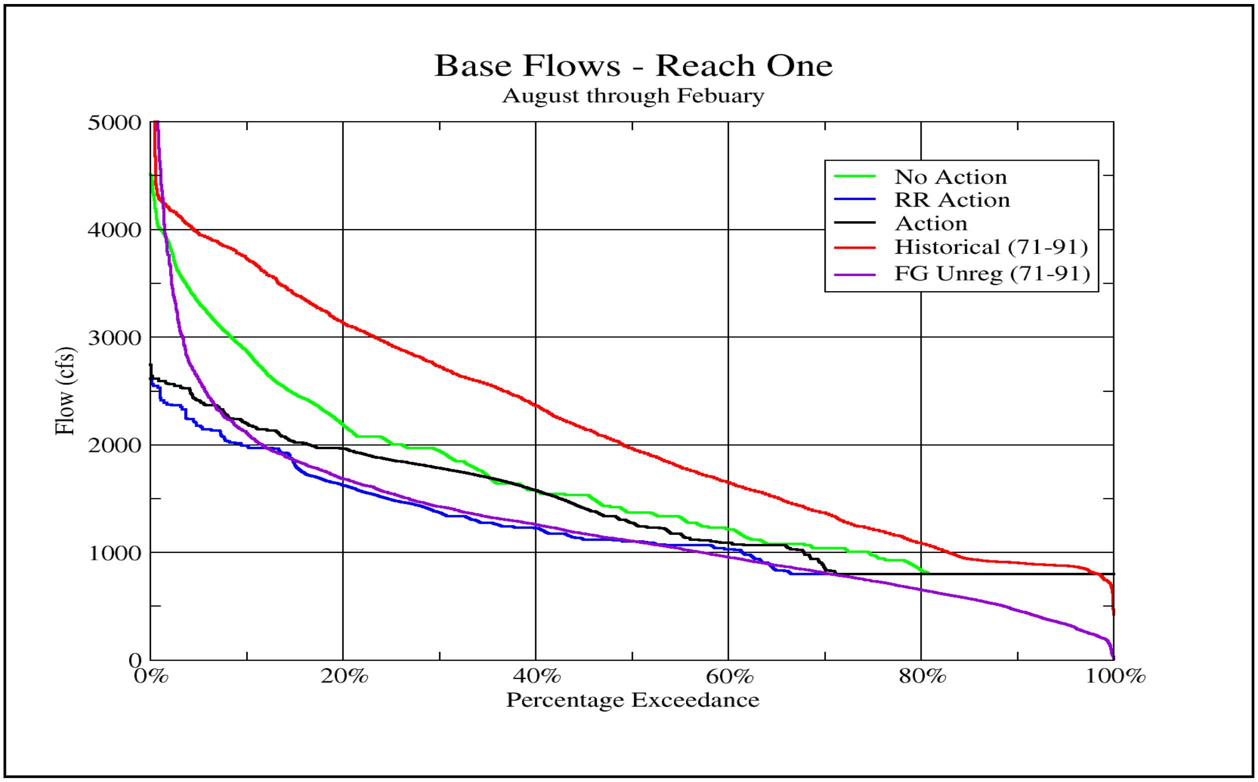

Figure 14.—Exceedance Percentage Flows for Reach 1 Flows During Base Flow Period.

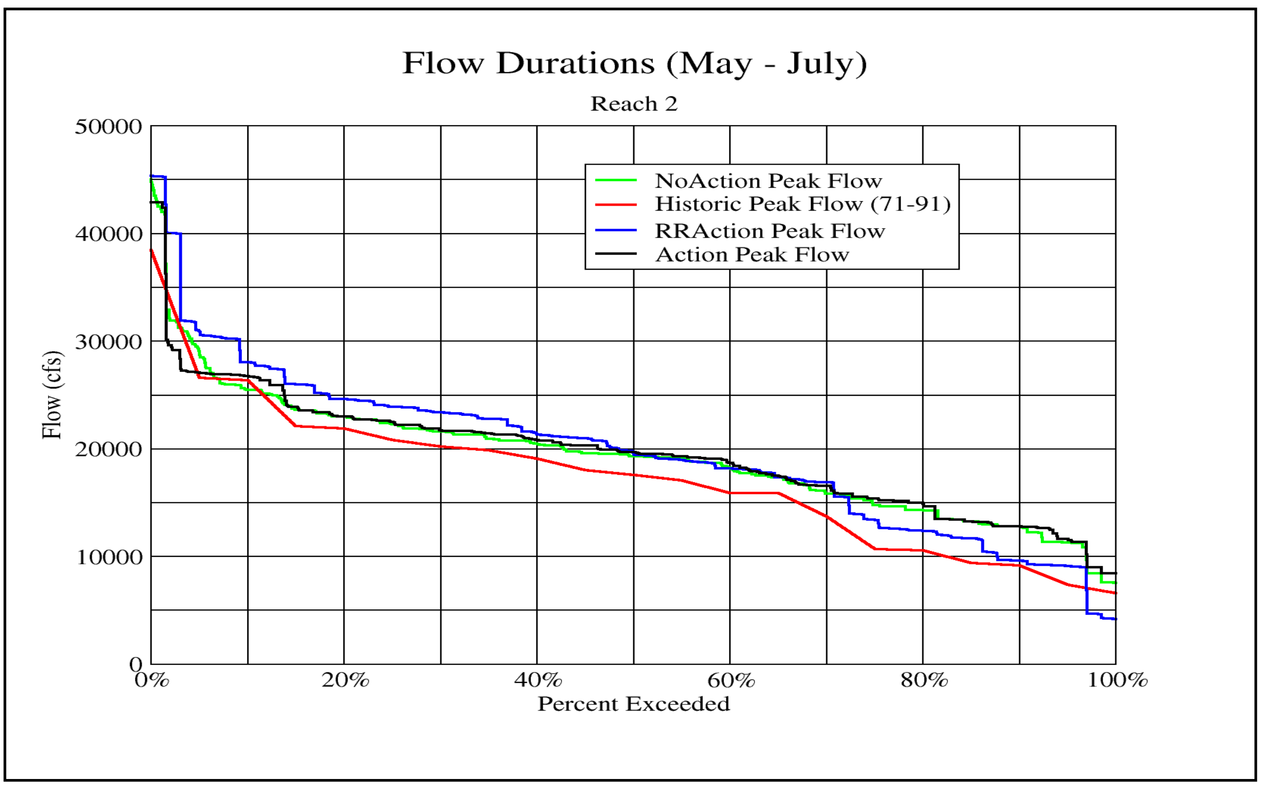

Figure 15.—Distribution of Peak Flows (1-Day Duration) in Reach 2.

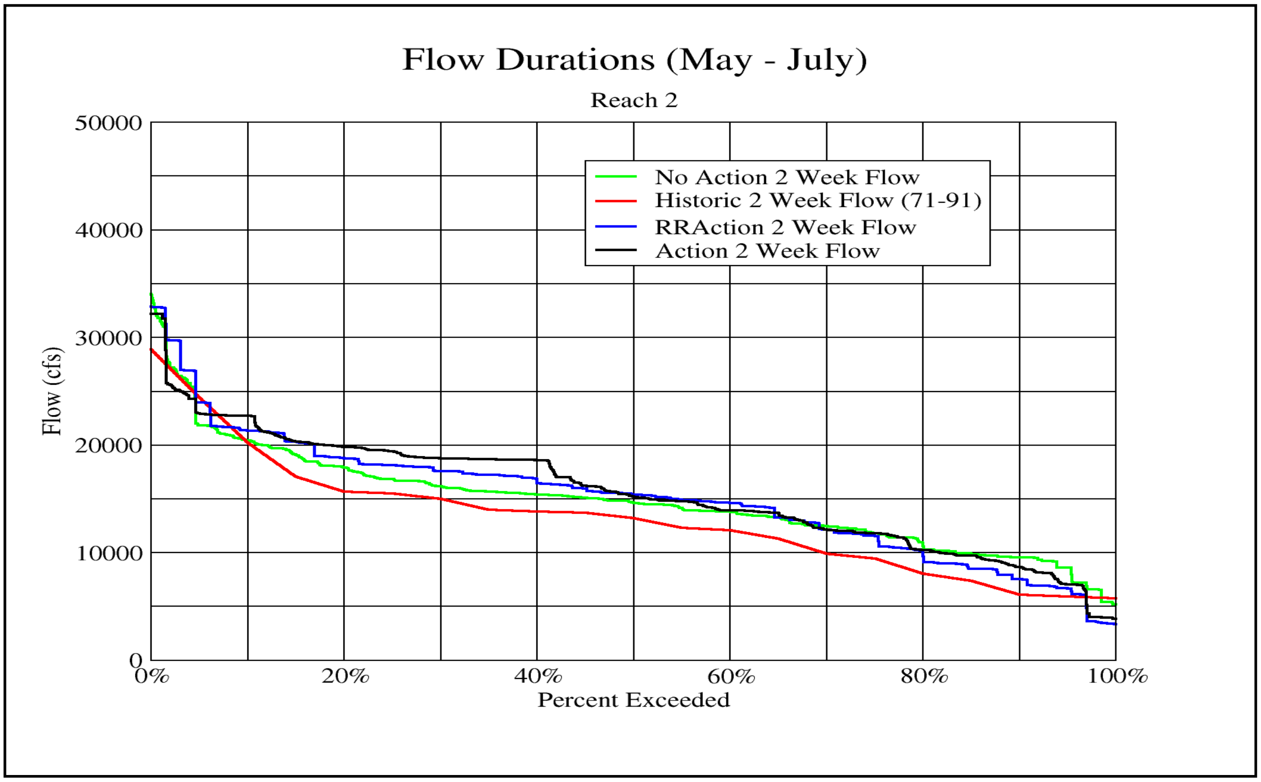

Figure 16.—Distribution of Peak Flows (2-Week Durations) in Reach 2.

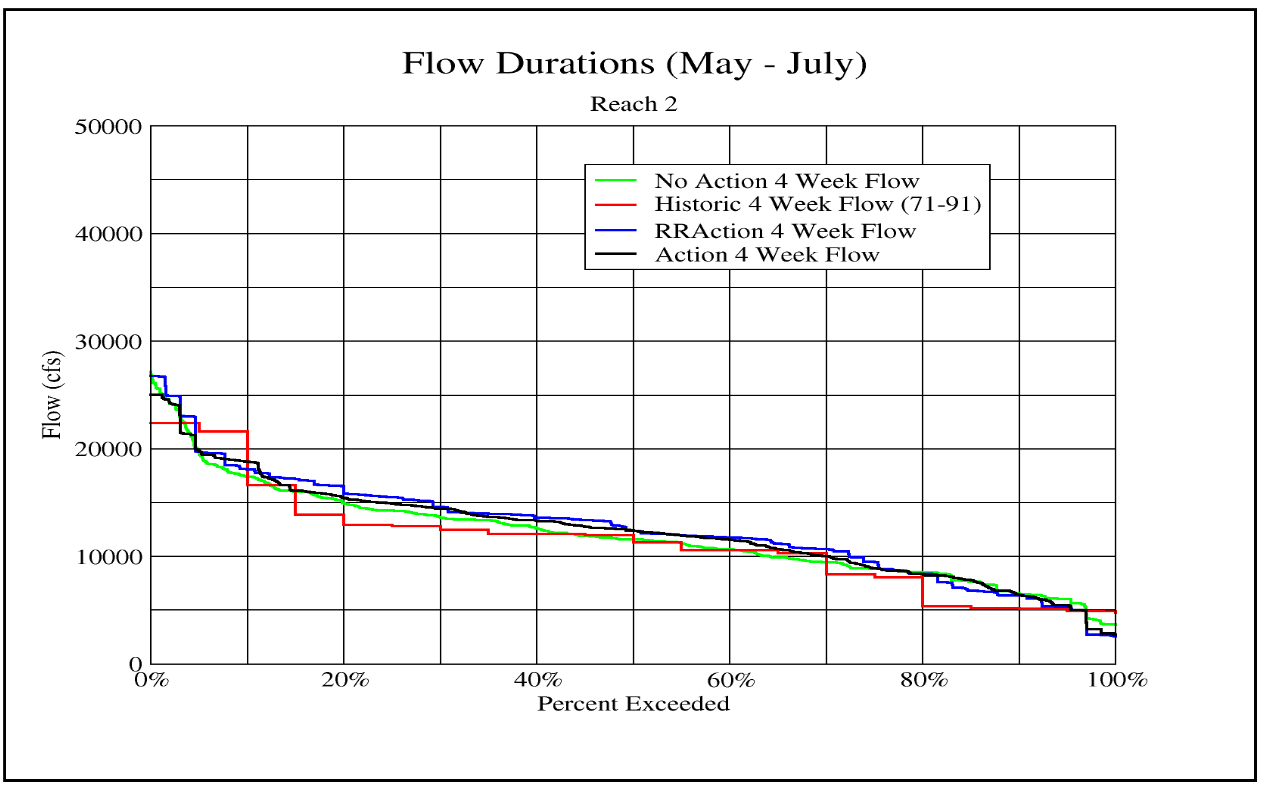

Figure 17.—Distribution of Peak Flows (4-Week Durations) in Reach 2.

Reach 2 Base Flow Release Results

Figure 18 shows the distribution of base flows that occurred in Reach 2. Base flow levels were noticeably lower under the "Run of River" approach. As with Reach 1, the difference between the base flow levels for the Action Alternative and the "Run of River" approach can largely be attributed to the difference between the reservoir elevations generated under the respective rulesets. Typically, the "Run of River" ruleset operated Flaming Gorge Dam such that the reservoir elevations were often lower than when the dam was operated under the Action and No Action Alternatives.

Summary

Preliminary analysis of the historic inflows into Flaming Gorge did show that it might be possible to operate Flaming Gorge under a modified "Run of River" approach to achieve the flow objectives of the 2000 Flow and Temperature Recommendations during the spring. However, this analysis did not account for the current levels of consumptive water use that is occurring along the Green River above Flaming Gorge or the fact that this rate of consumptive use is expected to increase in the future. The Flaming Gorge model, on the other hand, does account for current and increasing consumptive use in the future. Currently, about 450,000 acre-feet of Green River water is consumed above Flaming Gorge Reservoir each year. This is about 25% of the mean annual natural inflow into Flaming Gorge Reservoir. More importantly, diversions for

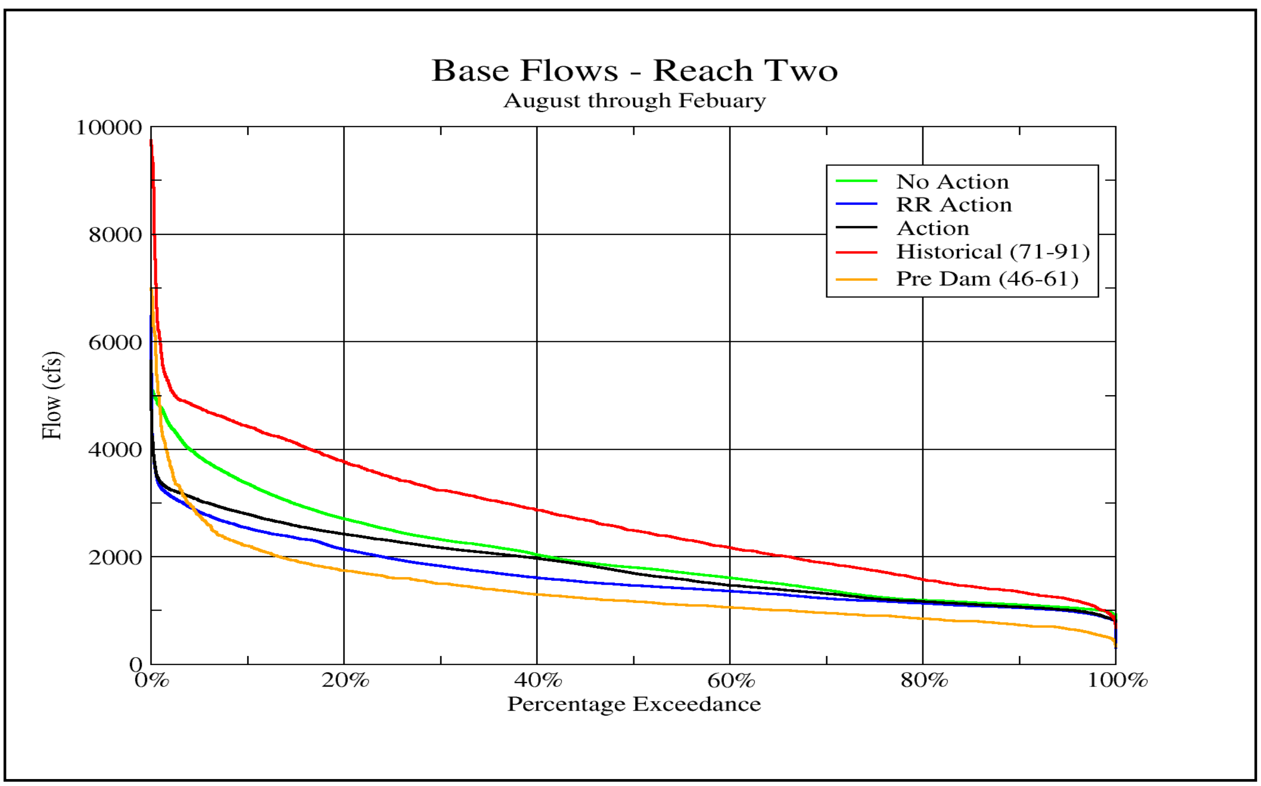

Figure 18.—Exceedance Percentage Flows for Reach 2 Flows During Base Flow Period.

irrigation occur most heavily during the months of May through August. These diversions decrease the unregulated inflow into Flaming Gorge Reservoir during the spring, which in turn, causes the modified "Run of River" methodology to release less water. Water use on the Green River has, and will continue to have, a significant impact on the inflows to Flaming Gorge Reservoir and consequently the impact this increasing use of water will impact the ability of any modified "Run of River" approach to achieving the 2000 Flow and Temperature Recommendations.

While constructing the ruleset for the Action Alternative, it was learned that some of the flow objectives in the 2000 Flow and Temperature Recommendations were more difficult to achieve than others. For example, there are two objectives that call for flows in Reach 2 to be at least 18,600 cfs for a minimum of 2 weeks in at least 40% of all years in one objective, and 18,600 cfs for a minimum of 4 weeks in at least 10% of all years in the other objective. These objectives proved to be the most difficult targets to achieve. To meet this challenge, it was necessary for operational decisions under the Action Alternative to have some input from conditions on the Yampa River. The Action Alternative ruleset assumes that it will be possible to accurately estimate the future flows on the Yampa River given current river flow, snow, temperature, and forecasted temperature conditions in the Yampa River Basin. This assumption allows the Action Alternative ruleset to set releases for the current day such that Reach 2 flows will meet or exceed a target flow objective on the following day within a small degree of error.

Operating Flaming Gorge under the modified "Run of River" methodology, however, does not require information about the Yampa River. Instead, this method relies only on the previous day's unregulated inflow into Flaming Gorge Reservoir for determining what releases are to be made during the current day. As a result, releases from Flaming Gorge, under the modified "Run of River" methodology, were not controlled such that timing with the Yampa Peak was optimal. For this reason, releases under the modified "Run of River" methodology did not achieve all of the flow objectives of the 2000 Flow and Temperature Recommendations even when the volume of water released from Flaming Gorge Dam were typically greater than that released under the Action Alternative. This proved to be the major drawback of the modified "Run of River" methodology because while release volumes during the spring were much higher than those for the Action Alternative, the spring flow objectives of the 2000 Flow and Temperature Recommendations were not fully achieved. Even when the ruleset was adjusted to release 100% of the unregulated inflow, these duration objectives were still not fully achieved. Based on these findings, the modified "Run of River" Alternative proved not to be a viable alternative that could be included for analysis in the Flaming Gorge Environmental Impact Statement.

DOCUMENTATION OF HOW DAILY INFLOWS WERE CREATED FOR THE MODIFIED RUN OF THE RIVER ALTERNATIVE

The available data for development of the Flaming Gorge daily inflows consisted of the following.

1. Flaming Gorge inflows calculated from releases from Flaming Gorge, delta storage and estimated evaporation.
   Period: October 1, 1962 to December 31, 1985

2. Green River flows measured at the Greendale gauge.
   Period: October 1, 1950 to September 30, 1962
3. Green River flows measured at the Lynnwood gauge.
   Period: October 1, 1928 to September 30, 1950
4. Green River flows measured at the Green River, Utah, gauge less Yampa River flows measured as the sum of the Little Snake River flows measured at the Lily gauge and Yampa River flows measured at the Maybell gauge lagged by 2 days. The adjusted Green River flows were then shifted 2 days to account for travel time between Greendale and Green River, Utah.
   Period: January 1, 1921 to September 30, 1928.

This dataset is then corrected so that the daily volumes summed to each month match the monthly volume of inflow calculated by the Flaming Gorge monthly model, which accounts for current and increasing future depletions above Flaming Gorge. This correction is done during the model run by multiplying the daily input flow by the ratio of the modeled monthly inflow volume over the sum of the daily input volumes for the given month. This correction adjusts the daily flows that the monthly volumes will match those used in the Flaming Gorge monthly model.

Operation of Flaming Gorge Dam Final Environmental Impact Statement

Effects of Flaming Gorge Operations Under the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations on Sediment Transport in Green River Technical Appendix

EFFECTS OF FLAMING GORGE OPERATIONS UNDER THE 1992 BIOLOGICAL OPINION AND THE 2000 FLOW AND TEMPERATURE RECOMMENDATIONS ON SEDIMENT TRANSPORT IN GREEN RIVER
TECHNICAL APPENDIX

Page No.

Effects of Flaming Gorge Operations Under the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations on Sediment Transport in Green River Technical Appendix

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1. INTRODUCTION

Flaming Gorge Dam is located on the upper main stem of Green River in Utah (figure 1.1). The operation of the dam influences flow and temperature regimes and the ecology of riverine biota including native fish. The U.S. Fish and Wildlife Service in the 1992 Biological Opinion (the 1992 Biological Opinion) on Operation of Flaming Gorge Dam concluded that the continuation of historic operations at Flaming Gorge Dam was likely to further reduce the distribution and abundance of the federally protected fishes found in the Green River system.

In order to mitigate this problem, the Flaming Gorge flow recommendations investigation was conducted beginning in 1992 under the auspices of the Upper Colorado River Endangered Fish Recovery Program.

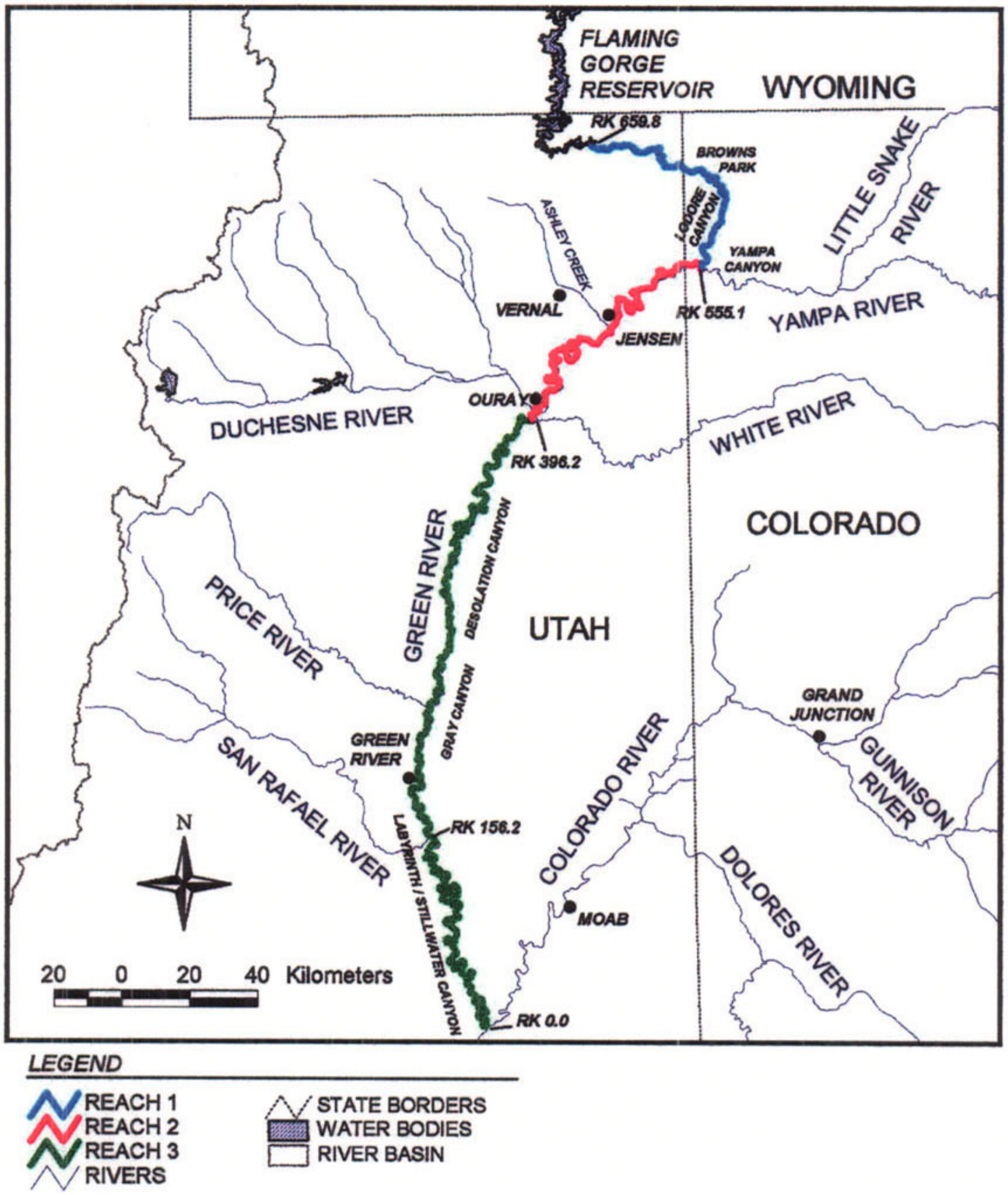

Figure 1.1—The Green River study area.

The 2000 Flow and Temperature Recommendations (the 2000 Flow Recommendations) are documented in a final report by Muth et al. (September 2000).

Clayton and Gilmore (2002) developed the simulation models of reservoir operation and streamflow for the 1992 Biological Opinion, which is referred to as the No Action Alternative, and the 2000 Flow Recommendations, which is referred to as the Action Alternative. The details of the model development and the hydrology results as well as updated flow data are presented in this report and were used to conduct the impact analysis on sediment transport in the Green River downstream from the Flaming Gorge Dam to its confluence with the White River near Ouray in Utah. This portion of the Green River has been divided into three reaches, Reach 1, Reach 2, and Reach 3 (figure 1.1) for impact analysis.

2. STUDY REACHES

The study area for impacts on sediment transport due to differences in flow pattern under the Action and the No Action Alternatives are the three reaches of Green River downstream from the Dam. Reach 1 encompasses the main stem of Green River from Flaming Gorge Dam downstream to its confluence with the Yampa River, and Reach 2 encompasses the mainstream of Green River from its confluence with the Yampa River downstream to the confluence with the White River. Reach 3 encompasses the mainstem of Green River from its confluence with the White River downstream to the confluence with the Colorado River. Long term sediment transport quantities, in terms of sand load and total load are determined for these two reaches by using available sediment rating curves and the flows for the Action and the No Action Alternatives.

3. HYDROLOGY

The hydrology of the Green River below Flaming Gorge Dam for the Action and the No Action Alternatives are presented in *Flaming Gorge Draft Environmental Impact Statement Hydrologic Modeling Report* by R. Clayton and A. Gilmore (February 26, 2002) and supplemental hydrology estimates prepared for Reach 3. The hydrologic modeling results presented in the report are used to evaluate the impacts on sediment transport under the two alternatives. The details of the hydrology model are presented in the report. The average monthly flows for Reach 1 for the Action and the No Action Alternatives are shown in figure 3.1 (all figures are located at the end of this appendix) and the average monthly flows for Reach 2 for the two alternatives are shown in figure 3.2. Figure 3.3 contains the average monthly flow estimates for Reach 3 for the two alternatives. These three figures show the differences in monthly flows for the alternatives. The flow values are also presented in tables 1 and 2 for Reach 1, table 3 for Reach 2, and table 4 for Reach 3.

Table1
Average Monthly and Annual Total Load and Flows for Reach 1

22-Jul-02
Green River Reach 1
Comparison of Alternatives
Using Sed. Rating Curve, Qs=0.000047068*Qw^2.009

Month	Action Qw	Action Qs	No Action Qw	No Action Qs	Qw Action - No Action B6-D6	Qs Action - No Action C6-E6	Percent Qw Action - No Action B6/D6	Percent Qs Action - No Action C6/E6	Action Qs (Tons)	No Action Qs(Tons)	Action Qw (ac-ft)	No- Action Qw(ac-ft)
Jan	1237.45	91.25154	1661.07	181.2136	-423.62	-89.96	74.50%	50.36%	2828.798	5617.622	76087.83	102135.2
Feb	1106.75	73.41528	1423.97	142.6705	-317.22	-69.26	77.72%	51.46%	2055.628	3994.775	61465.79	79083.07
Mar	1268.05	93.29734	1479.83	119.0108	-211.78	-25.71	85.69%	78.39%	2892.217	3689.335	77969.23	90990.95
Apr	1902.90	254.6294	2196.61	288.621	-293.71	-33.99	86.63%	88.22%	7638.883	8658.629	113230.4	130707.1
May	3227.16	789.4469	3477.64	763.5541	-250.48	25.89	92.80%	103.39%	24472.85	23670.18	198430.1	213831.7
Jun	3805.55	1100.887	2703.22	659.3657	1102.33	441.52	140.78%	166.96%	33026.61	19780.97	226446	160852.8
Jul	2247.38	416.7469	983.21	57.42264	1264.17	359.32	228.58%	725.75%	12919.15	1780.102	138186	60455.01
Aug	1620.32	142.1238	1236.71	81.59045	383.60	60.53	131.02%	174.19%	4405.836	2529.304	99629.29	76042.36
Sep	1646.83	148.5881	1370.47	98.32665	276.36	50.26	120.17%	151.12%	4457.643	2949.8	97993.19	81548.53
Oct	1479.81	124.4873	1650.36	146.1216	-170.55	-21.63	89.67%	85.19%	3859.107	4529.768	90989.66	101476.5
Nov	1398.20	114.3954	1958.98	243.9822	-560.78	-129.59	71.37%	46.89%	3431.861	7319.466	83198.68	116567.4
Dec	1329.40	105.035	1893.38	231.0781	-563.98	-126.04	70.21%	45.45%	3256.084	7163.422	81741.62	116419.6
Annual Total									105244.7	91683.37	1345368	1330110
May	3227.16	789.4469	3477.64	763.5541	-250.48	25.89	92.80%	103.39%	24472.85	23670.18	198430.1	213831.7
Jun	3805.55	1100.887	2703.22	659.3657	1102.33	441.52	140.78%	166.96%	33026.61	19780.97	226446	160852.8
Jul	2247.38	416.7469	983.21	57.42264	1264.17	359.32	228.58%	725.75%	12919.15	1780.102	138186	60455.01
Summer Total									70418.62	45231.25	563062.1	435139.5

Table2

Average Monthly and Annual Suspended Load and Flows for Reach 1

26-Jul-02
Green River Reach 1
Comparison of Alternatives
Using Sed. Rating Curve, Qs=0.0000002704*Qw^2.5781

Month	Action Qw	Action Qs	No Action Qw	No Action Qs	Qw Action - No Action B6-D6	Qs Action - No Action C6-E6	Percent Qw Action - No Action B6/D6	Percent Qs Action - No Action C6/E6	Action Qs (Tons)	No Action Qs(Tons)	Action Qw (ac-ft)	No- Action Qw(ac-ft)
Jan	1237.45	35.73213	1661.07	89.79638	-423.62	-54.06	74.50%	39.79%	1107.696	2783.688	76087.83	102135.2
Feb	1106.75	27.5201	1423.97	69.9981	-317.22	-42.48	77.72%	39.32%	770.5628	1959.947	61465.79	79083.07
Mar	1268.05	36.19474	1479.83	46.61334	-211.78	-10.42	85.69%	77.65%	1122.037	1445.013	77969.23	90990.95
Apr	1902.90	143.705	2196.61	152.803	-293.71	-9.10	86.63%	94.05%	4311.149	4584.089	113230.4	130707.1
May	3227.16	642.7417	3477.64	561.4013	-250.48	81.34	92.80%	114.49%	19924.99	17403.44	198430.1	213831.7
Jun	3805.55	963.7196	2703.22	536.3671	1102.33	427.35	140.78%	179.68%	28911.59	16091.01	226446	160852.8
Jul	2247.38	298.4767	983.21	21.30011	1264.17	277.18	228.58%	1401.29%	9252.779	660.3034	138186	60455.01
Aug	1620.32	58.53207	1236.71	28.90967	383.60	29.62	131.02%	202.47%	1814.494	896.1998	99629.29	76042.36
Sep	1646.83	62.50678	1370.47	35.90564	276.36	26.60	120.17%	174.09%	1875.203	1077.169	97993.19	81548.53
Oct	1479.81	50.92449	1650.36	60.32419	-170.55	-9.40	89.67%	84.42%	1578.659	1870.05	90989.66	101476.5
Nov	1398.20	46.60669	1958.98	127.7456	-560.78	-81.14	71.37%	36.48%	1398.201	3832.367	83198.68	116567.4
Dec	1329.40	42.38784	1893.38	120.3333	-563.98	-77.95	70.21%	35.23%	1314.023	3730.333	81741.62	116419.6
Annual Total									73381.38	56333.61	1345368	1330110
May	3227.16	642.7417	3477.64	561.4013	-250.48	81.34	92.80%	114.49%	19924.99	17403.44	198430.1	213831.7
Jun	3805.55	963.7196	2703.22	536.3671	1102.33	427.35	140.78%	179.68%	28911.59	16091.01	226446	160852.8
Jul	2247.38	298.4767	983.21	21.30011	1264.17	277.18	228.58%	1401.29%	9252.779	660.3034	138186	60455.01
Summer Total									58089.36	34154.76	563062.1	435139.5

Table 3
Average Monthly and Annual Sand Load and Flows for Reach 2

5-Sep-03
Green River Reach 2
Comparison of Alternatives
Using Sed. Rating Curve, Qs=0.0000204*(Qw)^2.16 (Sand Load)

Month	Action Qw	Action Qs	No Action Qw	No Action Qs	Qw Action - No Action	Qs Action - - No Action	Percent Qw Action - No Action	Percent Qs Action - No Action	Action Qs (Tons)	No Action Qs(Tons)	Action Qw (ac-ft)	No- Action Qw(ac-ft)
		(Tons/day)		(Tons/day)	B6-D6	C6-E6	B6/D6	C6/E6				
Jan	1600.26	202.0075	2078.81	393.78564	-478.55	-191.78	76.98%	51.30%	6262.233	12207.35	98396.14	127821.2
Feb	1565.57	192.3703	1871.683	318.18166	-306.11	-125.81	83.65%	60.46%	5386.367	8909.086	86947.54	103948
Mar	2303.39	468.0288	2498.78	522.01375	-195.39	-53.98	92.18%	89.66%	14508.89	16182.43	141630.2	153644.3
Apr	5583.25	3462.457	5931.27	3737.021	-348.03	-274.56	94.13%	92.65%	103873.7	112110.6	332226.2	352935.2
May	12099.85	17185.09	12413.10	17693.026	-313.25	-507.93	97.48%	97.13%	532737.9	548483.8	743990.8	763251.5
Jun	11547.95	16068.19	10329.70	13242.874	1218.25	2825.32	111.79%	121.33%	482045.8	397286.2	687150.8	614659.6
Jul	3928.9424	2084.568	2636.43	827.90293	1292.51	1256.66	149.03%	251.79%	64621.6	25664.99	241581.3	162107.7
Aug	2081.61	339.8265	1697.02	216.88671	384.59	122.94	122.66%	156.68%	10534.62	6723.488	127993.3	104345.9
Sep	1944.14	294.1442	1645.227	194.82317	298.92	99.32	118.17%	150.98%	8824.327	5844.695	115684.6	97897.8
Oct	1933.23	291.4628	2109.61	334.42373	-176.38	-42.96	91.64%	87.15%	9035.346	10367.14	118869.5	129714.8
Nov	1854.49	268.0437	2404.08	504.55128	-549.59	-236.51	77.14%	53.13%	8041.31	15136.54	110349.8	143052.6
Dec	1730.25	237.8592	2296.61	469.55755	-566.36	-231.70	75.34%	50.66%	7373.636	14556.28	106388.9	141213.2
Annual Total									1253246	1173473	2911209	2894592
May	12099.85	17185.09	12413.10	17693.026	-313.25	-507.93	97.48%	97.13%	532737.9	548483.8	743990.8	763251.5
Jun	11547.95	16068.19	10329.70	13242.874	1218.25	2825.32	111.79%	121.33%	482045.8	397286.2	687150.8	614659.6
Jul	3928.9424	2084.568	2636.43	827.90293	1292.51	1256.66	149.03%	251.79%	64621.6	25664.99	241581.3	162107.7
Summer Total									1079405	971435	1672723	1540019

Table 4
Average Monthly and Annual Sand Load and Flows for Reach 3

20-Aug-03
Green River Reach 3
Comparison of Alternatives
Using Sed. Rating Curve, Qs=0.00(

Month	Action Qw	Action Qs	No Action Qw	No Action Qs	Qw Action - No Action B6-D6	Qs Action - No Action C6-E6	Percent Qw Action - No Action B6/D6	Percent Qs Action - No Action C6/E6	Action Qs (Tons)	No Action Qs(Tons)
Jan	2347	166	2841	319	-494.50	-153.03	82.60%	52.09%	5156.914	9900.859
Feb	2682	453	3032	614	-349.11	-161.42	88.48%	73.72%	12679.46	17199.3
Mar	3951	1286	4193	1427	-241.15	-141.53	94.25%	90.08%	39861.34	44248.89
Apr	6405	4708	6647	4806	-242.59	-97.25	96.35%	97.98%	141252.1	144169.5
May	13882	41336	14292	41491	-410.02	-154.56	97.13%	99.63%	1281430	1286221
Jun	16201	59368	15189	52639	1012.41	6729.00	106.67%	112.78%	1781051	1579181
Jul	5842	6161	4522	3314	1320.14	2846.84	129.19%	185.91%	190979.9	102727.8
Aug	3030	469	2638	342	391.33	127.50	114.83%	137.29%	14551.24	10598.8
Sep	2824	396	2523	309	300.53	87.65	111.91%	128.39%	11890.99	9261.445
Oct	2992	390	3101	409	-109.10	-18.43	96.48%	95.49%	12096.56	12667.95
Nov	2879	312	3411	539	-532.59	-227.37	84.39%	57.82%	9349.808	16170.78
Dec	2490	211	3079	421	-589.33	-209.80	80.86%	50.14%	6541.229	13044.93
Annual Total									3506840	3245392
May	13882	41336	14292	41491	-410.02	-154.56	97.13%	99.63%	1281430	1286221
Jun	16201	59368	15189	52639	1012.41	6729.00	106.67%	112.78%	1781051	1579181
Jul	5842	6161	4522	3314	1320.14	2846.84	129.19%	185.91%	190979.9	102727.8
Summer Total									3253460	2968130

4. SEDIMENT TRANSPORT ANALYSIS

The change of streamflow pattern from the No Action Alternative to the Action Alternative has impacts on the quantity of sediment transported by the Green River. The magnitude of the difference in sediment transport for the two alternatives was determined using flow duration data for each month of the year and available sediment rating curves for the three reaches of the river for each alternative.

The flow duration curves for Reach 1 are presented in figure 4.1 through 4.12, and the flow-duration curves for Reach 2 are presented in figures 4.13 through 4.24. The flow duration curves are based on daily flows presented in the hydrologic modeling report by Clayton and Gilmore (February 2002). Flow duration for Reach 3 is patterned after the modeled results for Reach 2 and historic tributary inputs in Reach 3.

Four sediment rating curves, two for Reach 1, one for Reach 2, and one for Reach 3, are used to quantify the impacts on sediment transport due to change in flow pattern in the river. Between the two rating curves for Reach 1, one is for determining total load transport and one is for suspended load transport. The one sediment rating curves for Reach 2 is for sand load transport only. The one sediment rating curve for Reach 3 is for sand load transport only.

The sediment rating curves are as follows:

Reach 1:

a) Total load rating curve by Martin et al. (1998)

$Qs = 4.707x10\text{-}5\ Q\ 2.01$

b) Suspended load rating curve by Martin et al. (1998)

$Qsb = 2.704x10\text{-}7\ Q\ 2.58$

Where Qs = total load, tons/day

Qsb = suspended load, tons/day

Q = water discharge, cfs

Reach 2:

Sand load rating curve by Andrews (1986) for USGS gauge Jensen, UT

$Qsl = 2.04x10\text{-}5\ Q\ 2.16$

Where Qsl = sand load, tons/day

Q = water discharge, cfs

Reach 3:

Sand load rating curve by Andrews (1986) for USGS gauge Green River, UT

$Qsl = 2.06x10\text{-}8\ Q\ 2.90$

Where Qsl = sand load, tons/day

Q = water discharge, cfs

The above sediment rating curves and the flow-duration curves presented in figures 4.1 through 4.24 are used in computing the sediment transport quantities for each month by utilizing the method presented in Table 2 of Strand and Pemberton (1982).

4.1 Sediment Transport Quantities for Reach 1

The total load transport quantities determined by the total load rating curve for the reach are shown in figure 4.1.1. Figure 4.1.1 shows the month-by-month total load transported by using the rating curve presented in Martin et al. (1998). The greatest difference in total load transport between the alternatives occurs in the month of July in which total load transported in the Action Alternative is more than seven times the No Action Alternative. The smallest difference in total load transport between the two alternatives is in the month of May when total load transported in Action Alternative is about 103 percent of the total load transported in the No Action Alternative.

During the peak runoff season, May through July, the Action Alternative transported about 70,000 tons of total load compared to nearly 45,000 tons transported by the No Action Alternative (a difference of 55 percent). The flow volume during the peak runoff season was about 536,000 acre-feet under the Action Alternative and about 435,000 acre-feet under the No Action Alternative (a difference of 23 percent).

On an annual basis total load transport in reach 1 is nearly same under both of the alternatives. The annual total load transported in the Action Alternative is about 105,000 tons compared to 92,000 tons transported in the No Action Alternative. This annual difference is about 14 percent. The annual modeled flow volumes were about 1,345,000 acre-feet under the Action Alternative and about 1,330,000 acre-feet under the No Action Alternative. This difference in modeled flow volumes in Reach 1 is about 1 percent. The month by month and the annual quantities of total load transported under the two alternatives and the flow values are shown in table 1.

Martin et al. (1998) also presented a suspended load rating curve for Reach 1. Their suspended load rating curve was used to compare suspended load transport quantities under the two alternatives in Reach 1. The monthly suspended loads computed by using Martin et al. (1998) rating curve is presented in figure 4.1.2. The greatest difference in suspended load transport between the two alternatives was similar to the differences noted for total load transport (figure 4.1.1). During July, suspended load transported in the Action Alternative was 14 times greater than the No Action Alternative. The smallest difference in the transport of suspended load between alternatives occurs in April when flows under the No Action Alternative carried only 6 percent more suspended load than flows under the Action Alternative.

On an annual basis, the Action Alternative carried about 73,000 tons of suspended load compared to roughly 56,000 tons carried by the No Action Alternative, a difference of about 30 percent. The monthly suspended loads along with the annual total suspended load for Reach 1 are presented in Table 2.

4.2 Sediment Transport Quantities for Reach 2

The sand load transport quantities determined for Reach 2 are shown in figure 4.2.1. Figure 4.2.1 shows the month-to-month sand load transport quantities determined by the sand load rating curve by Andrews (1986). The greatest difference in sand load transport between the two alternatives is in the month of July. The Action Alternative carried about 2.5 times more sand load than the No Action Alterative during July. The smallest difference in sand load transport occurs during April, in which the No Action Alternative transported 7 percent more sand load than the Action Alternative.

During the peak runoff season, May through July, the Action Alternative transported about 1,079,000 tons of suspended load compared to roughly 971,000 tons transported by the No Action Alternative, a difference of about 11 percent. The flow volume during the peak runoff season was nearly 1,673,000 acre-feet under the Action Alternative and about 1,540,000 acre-feet under the No Action Alternative, a difference of nearly 9 percent.

On an annual basis the difference in sand load transport between the two alternatives is small. The Action Alternative carried about 1,253,000 tons compared to roughly 1,173,000 tons carried by the No Action Alternative, a difference of about 7 percent. The modeled annual flow volumes were about 2,911,000 acre-feet under the Action Alternative and nearly 2,895,000 acre-feet under the No Action Alternative; a difference of less than one percent. The monthly and annual sand loads for Reach 2 along with the flow values are presented in Table 3.

4.3 Sediment Transport Quantities for Reach 3

The monthly sand load transport quantities determined for Reach 3 are shown in figure 4.3.1. These month by month sand load estimates were determined using the sand load rating curve for Green River at Green River, Utah USGS gauge. Flow information for Reach 3 was estimated from the Flaming Gorge Model (described in the Hydrology Appendix) results for Reach 2 and estimated tributary inflows within Reach 3.

5. CONCLUSIONS

Flow-duration comparisons for May, June and July show that flows greater than power plant capacity (4,600 cfs) occur more frequently under Action Alternative conditions than under No Action Alternative conditions. Martin et al. (1998) documented increased active channel area in reach 1 following a series of special research flow releases greater than 4,600 cfs from Flaming Gorge dam. The maximum mean daily release from Flaming Gorge during this period was 8,420 cfs.

The sediment transport quantities for Reach 1, whether considering suspended load or total load show variation between the Action and the No Action Alternatives on a month-to-month basis. This variation is greatest during the summer month of July. There is difference in monthly total load transport for the two alternatives. Relative to conditions under the No Action Alternative, implementing the Action Alternative will likely result in some additional channel deposition and erosion in the reach during May through September. Additional channel deposition in the reach is likely during October through April under the Action Alternative in comparison to the No Action Alternative. On an annual basis, sediment transport in reach 1 will be slightly greater under the Action Alternative relative to the No Action Alternative. The net result of greater frequency of flows in excess of 4,600 cfs and increased sediment transport associated with these higher flows will be greater active channel area under the Action Alternative relative to conditions under the No Action Alternative.

For Reach 2, there are some differences in monthly sand load discharge between the two alternatives although on an annual basis the difference is small. No total load rating curve is available for Reach 2. Assuming sand load transport to be proportional to total load, sediment deposition will likely occur from October through May in Reach 2 under Action Alternative conditions relative to the conditions under the No Action Alternative. From June through September, sediment will tend to be removed from Reach 2 under the Action Alternative relative to the No Action Alternative. However, on an annual basis, the difference in sediment transport between Alternatives will most likely be small in Reach 2.

For Reach 3, the trends in sand load transport are likely to be similar to those discussed for Reach 2. Annual differences in sediment transport in Reach 3 under the two Alternatives will likely be small.

6. REFERENCES

Andrews, E D, 1986. Downstream Effects of Flaming Gorge Reservoir on the Green River, Colorado and Utah. Geological Society of America Bulletin 97, pp. 1012-1023.

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Martin, J., P. Grams, M. Kammerer, and J. Schmidt, 1998. Sediment Transport and Channel Response of the Green River in the Canyon of Lodore Between 1995-1997, Including Measurements During High Flows, Dinosaur National Monument, Colorado, draft final report. Utah State

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Muth, R., L. Crist, K. LaGory, J. Hayse, K. Bestgen, T. Ryan, J. Lyons, and R. Valdez, 2000. Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam, final report. Upper Colorado River Endangered Fish Recovery Program Project FG-53.

Strand, R. and E. Pemberton, 1982. Reservoir Sedimentation Technical Guideline for Bureau of Reclamation. U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado, 48 p.

Figure 3.1
Green River Reach 1: Average Monthly Flows

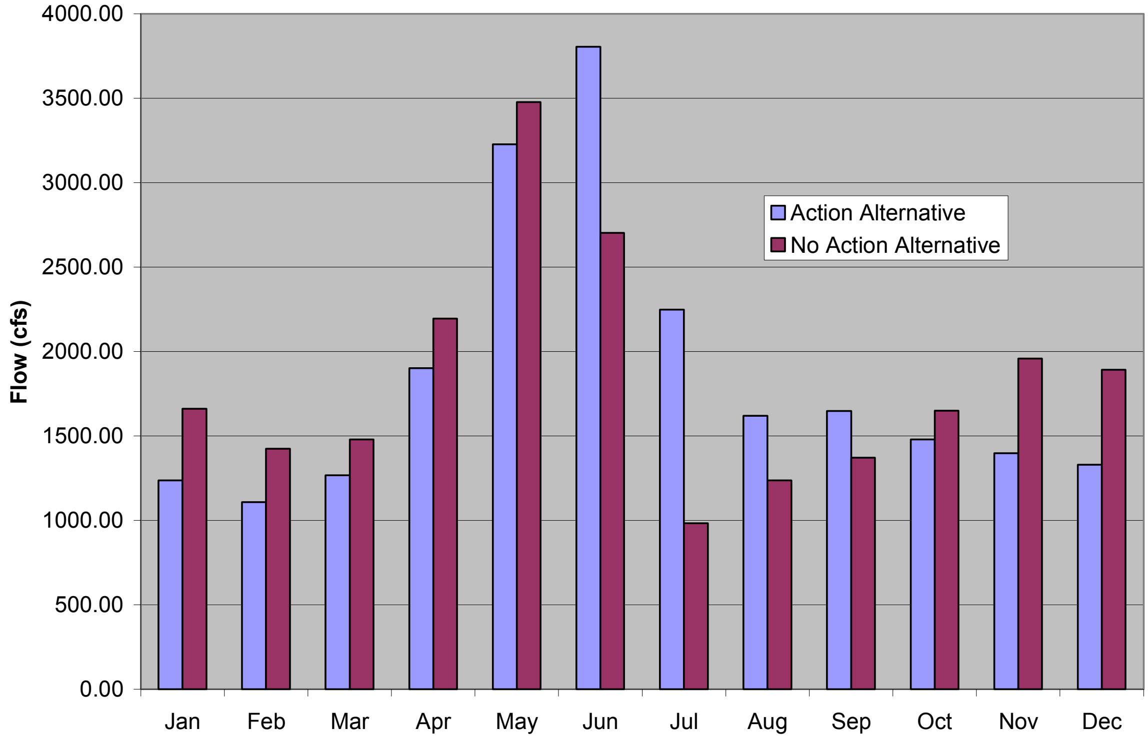


Figure 3.2
Green River Reach 2: Average Monthly Flows

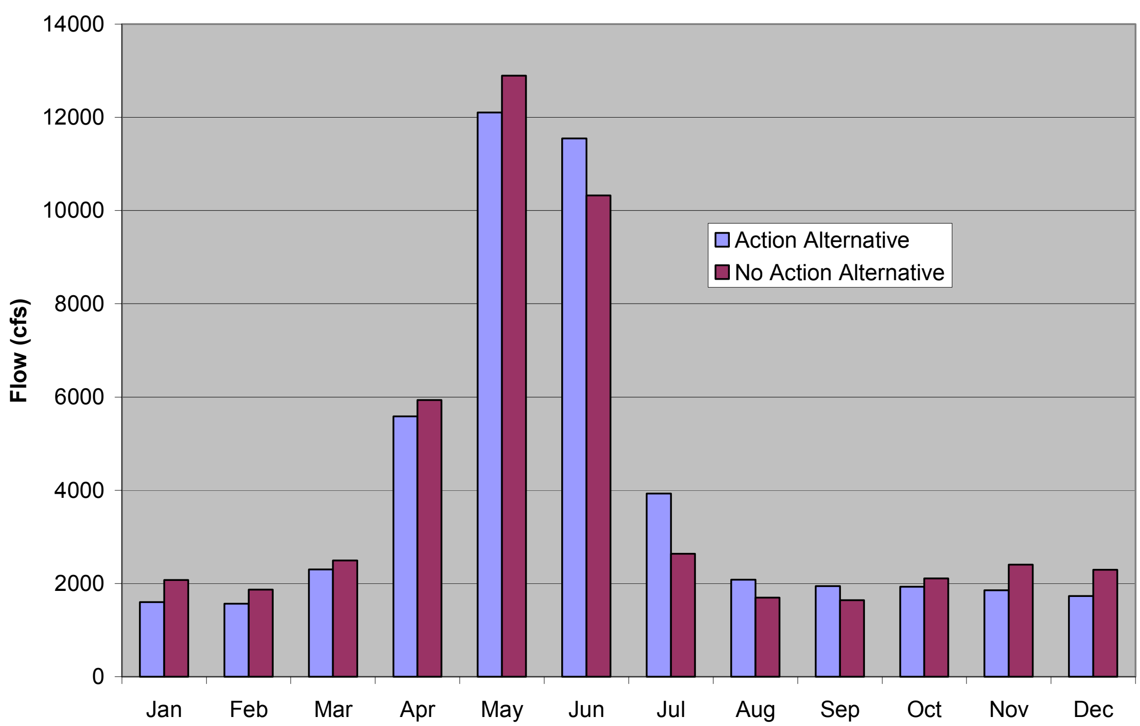


Figure 3.3
Green River Reach 3: Average Monthly Flows

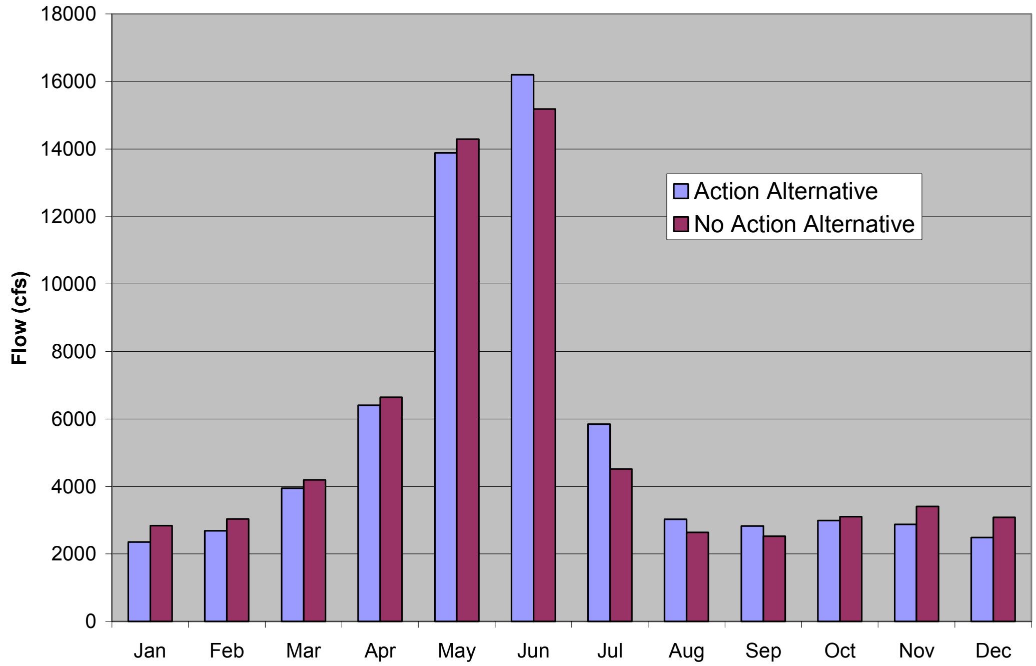


Figure 4.1:Reach One Flows in January
Modelled vs. Historic

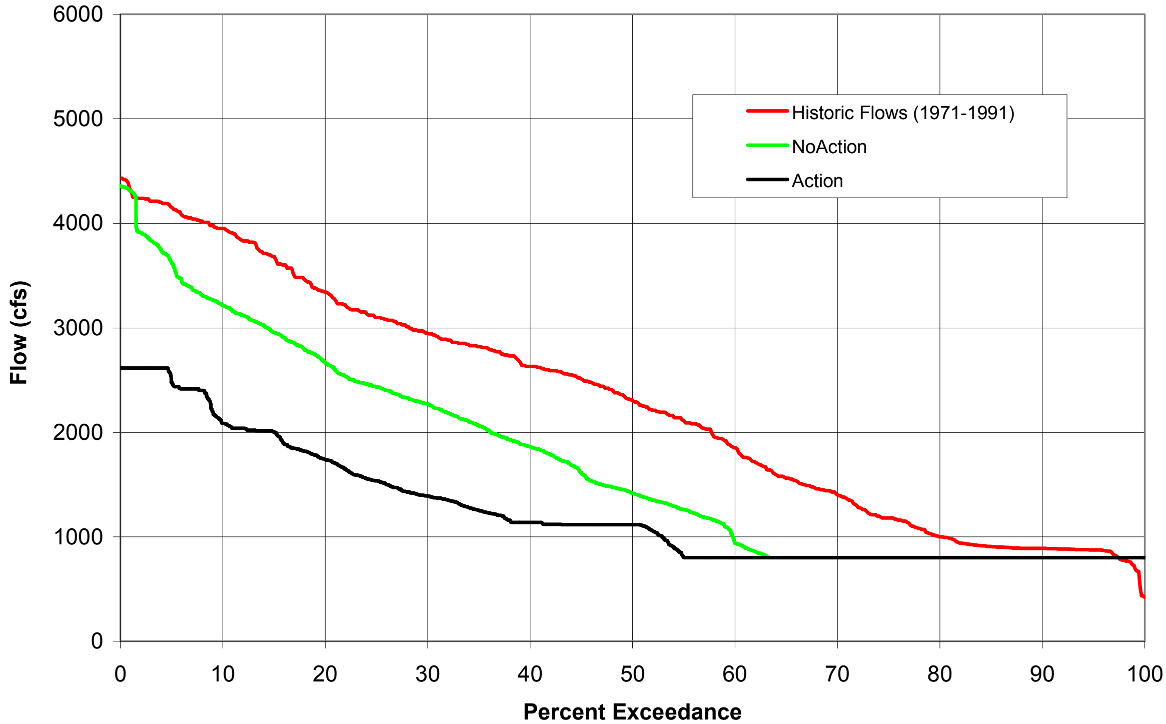
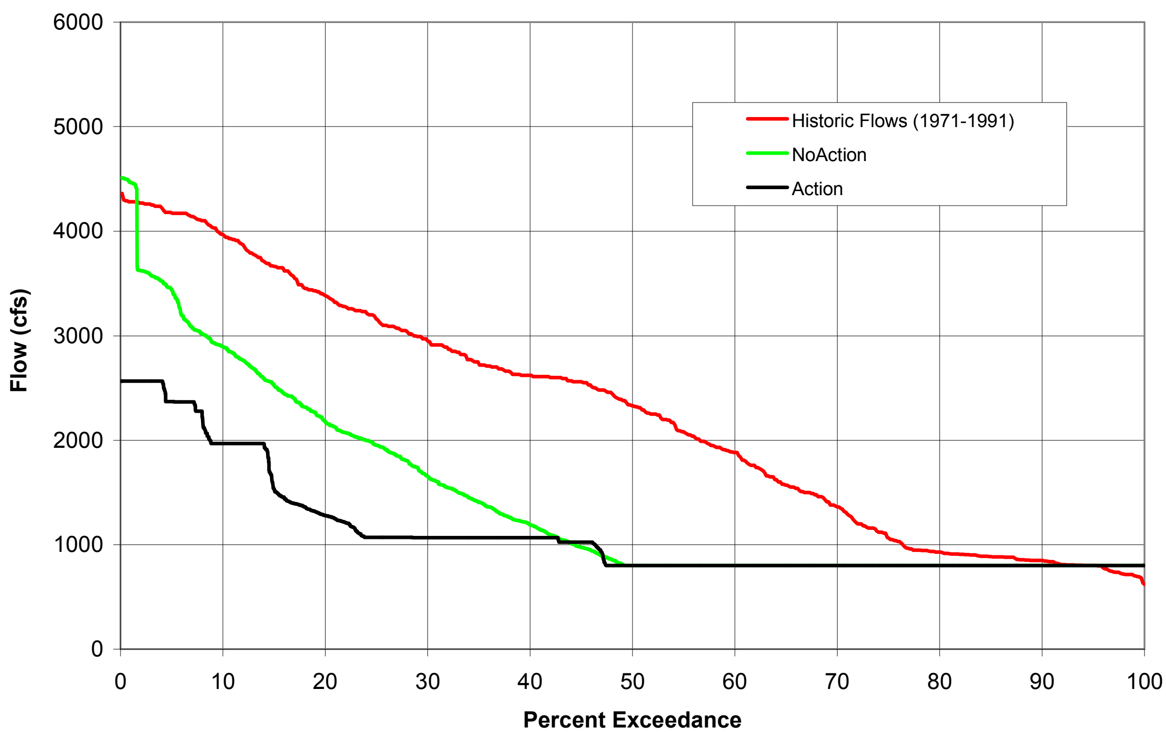


Figure 4.2: Reach One Flows in February
Modelled vs. Historic



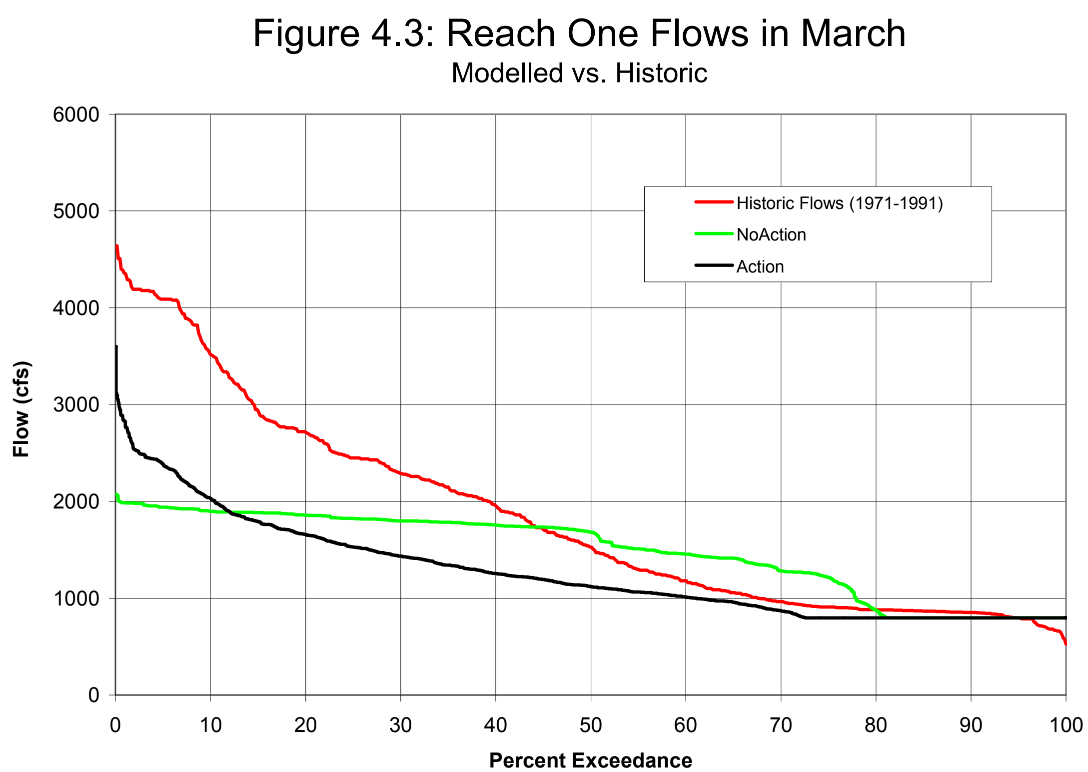


Figure 4.3: Reach One Flows in March
Modelled vs. Historic
Flow (cfs)
Percent Exceedance
Historic Flows (1971-1991)
NoAction
Action
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
100

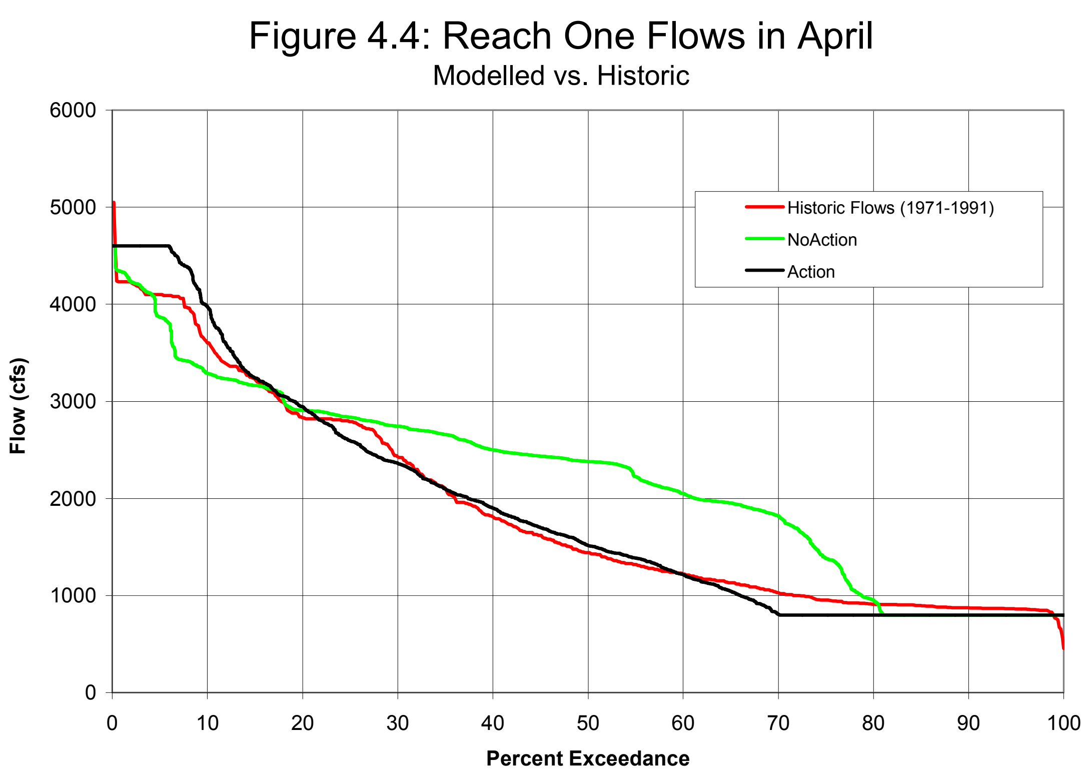


Figure 4.4: Reach One Flows in April
Modelled vs. Historic
Flow (cfs)
Percent Exceedance
Historic Flows (1971-1991)
NoAction
Action
6000
5000
4000
3000
2000
1000
0
0
10
20
30
40
50
60
70
80
90
100

Figure 4.5: Reach One Flows in May

Modelled vs. Historic

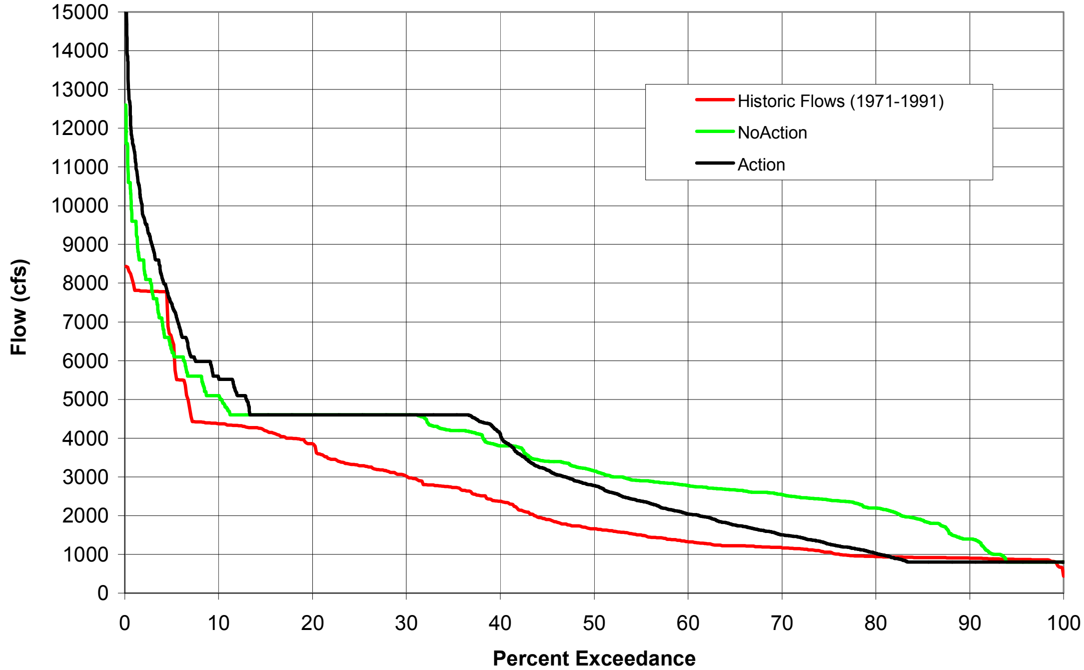


Figure 4.6: Reach One Flows in June

Modelled vs. Historic

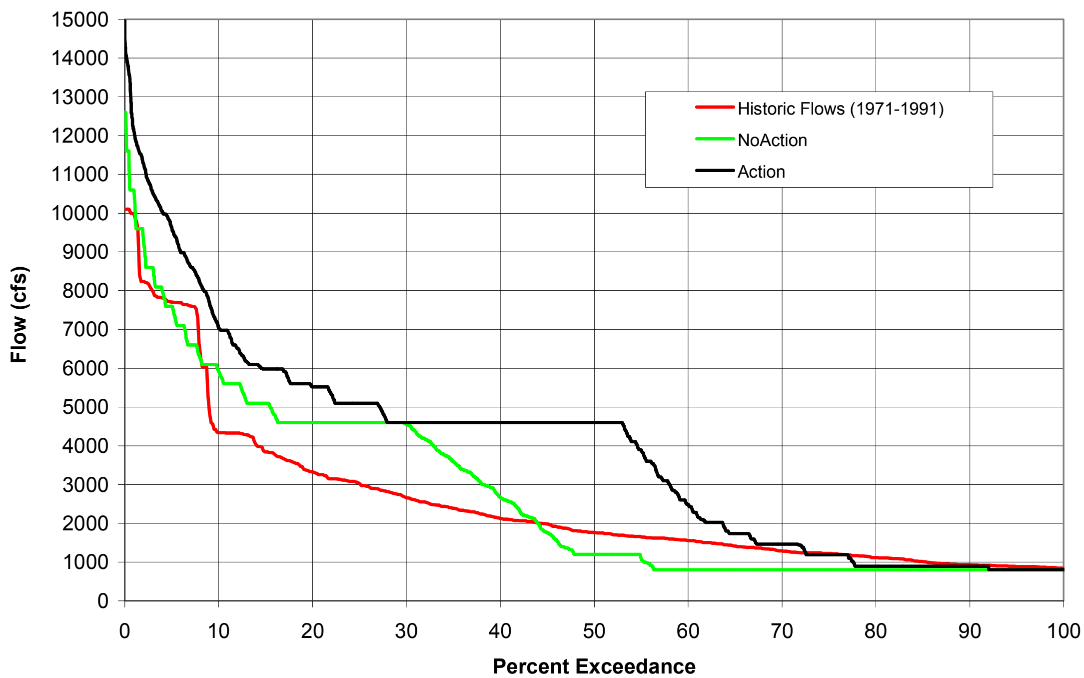


Figure 4.7: Reach One Flows in July
Modelled vs. Historic

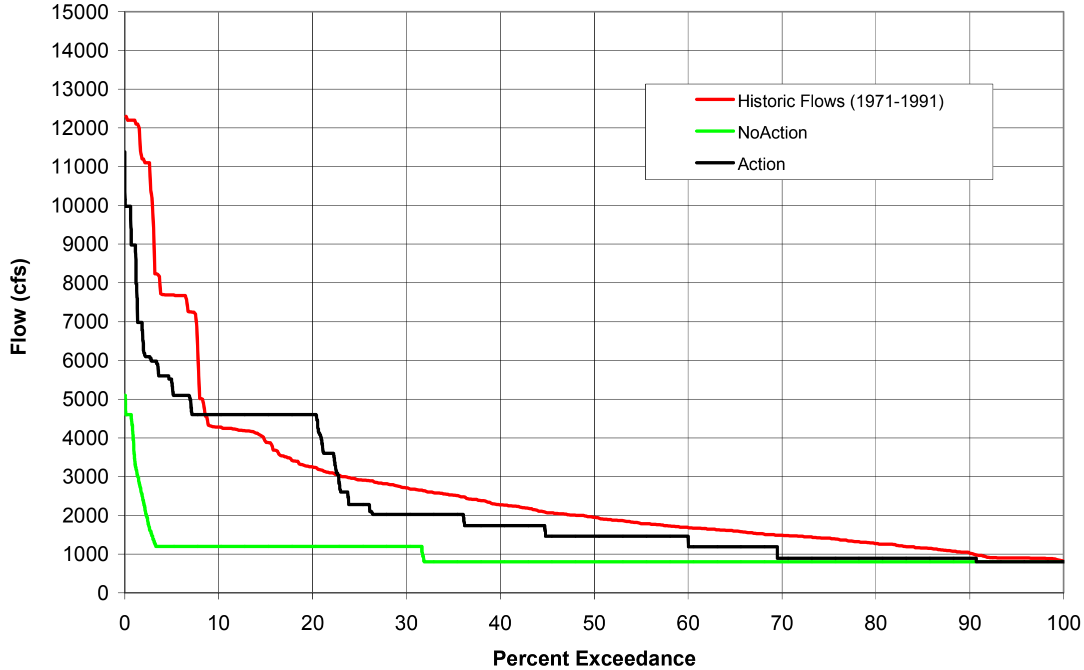


Figure 4.8: Reach One Flows in August
Modelled vs. Historic

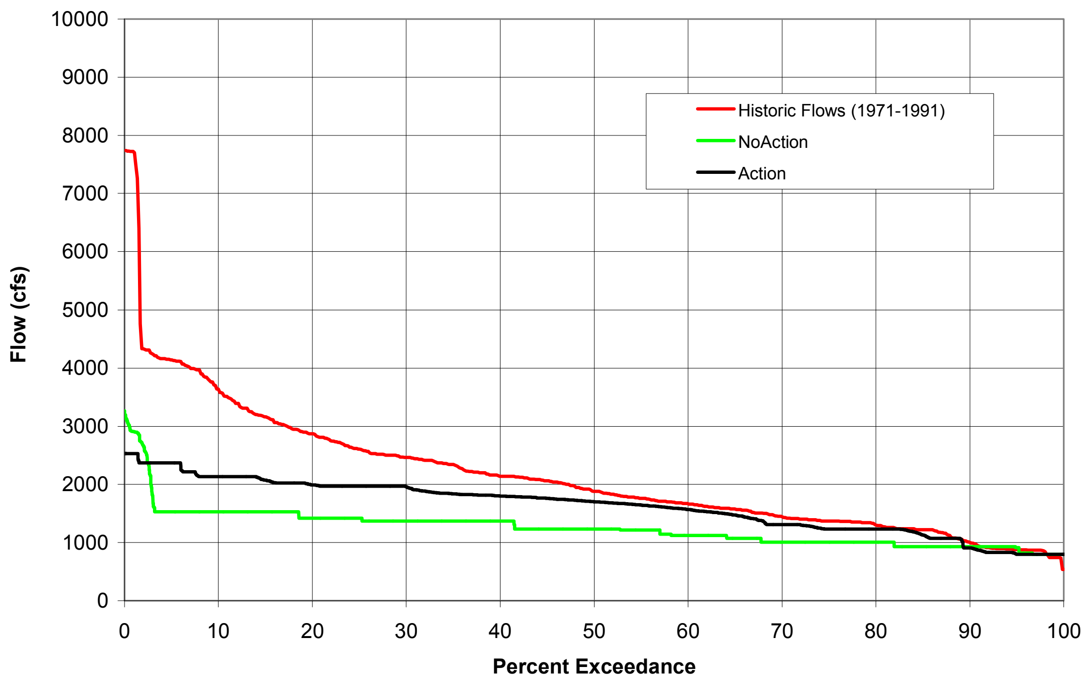


Figure 4.9: Reach One Flows in September

Modelled vs. Historic

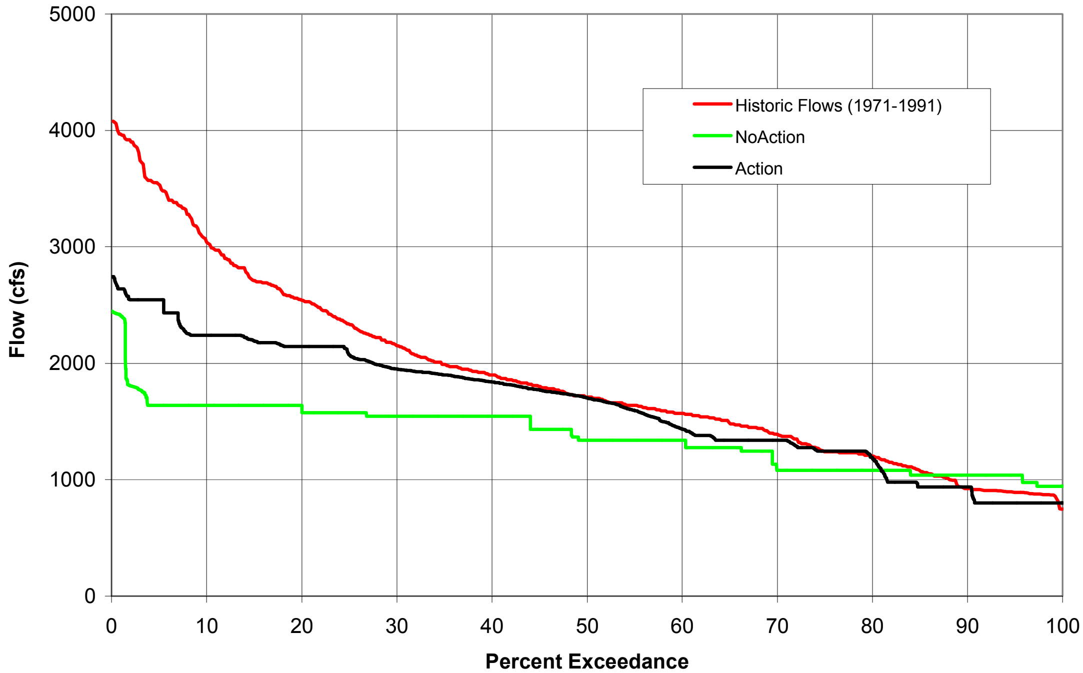


Figure 4.10: Reach One Flows in October

Modelled vs. Historic

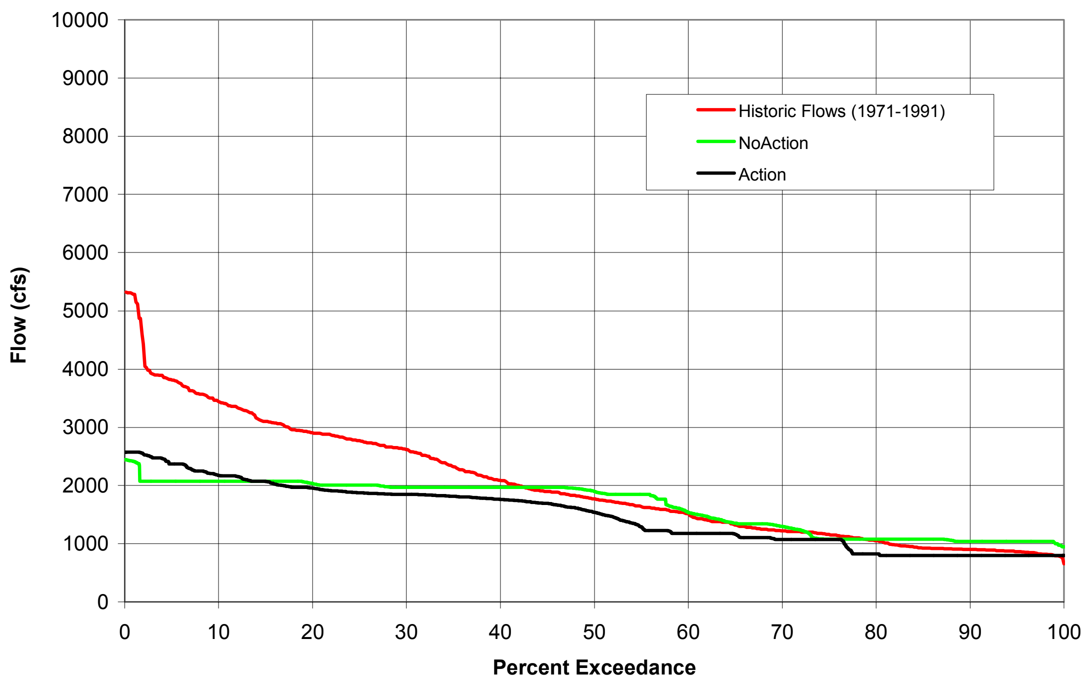


Figure 4.11: Reach One Flows in November

Modelled vs. Historic

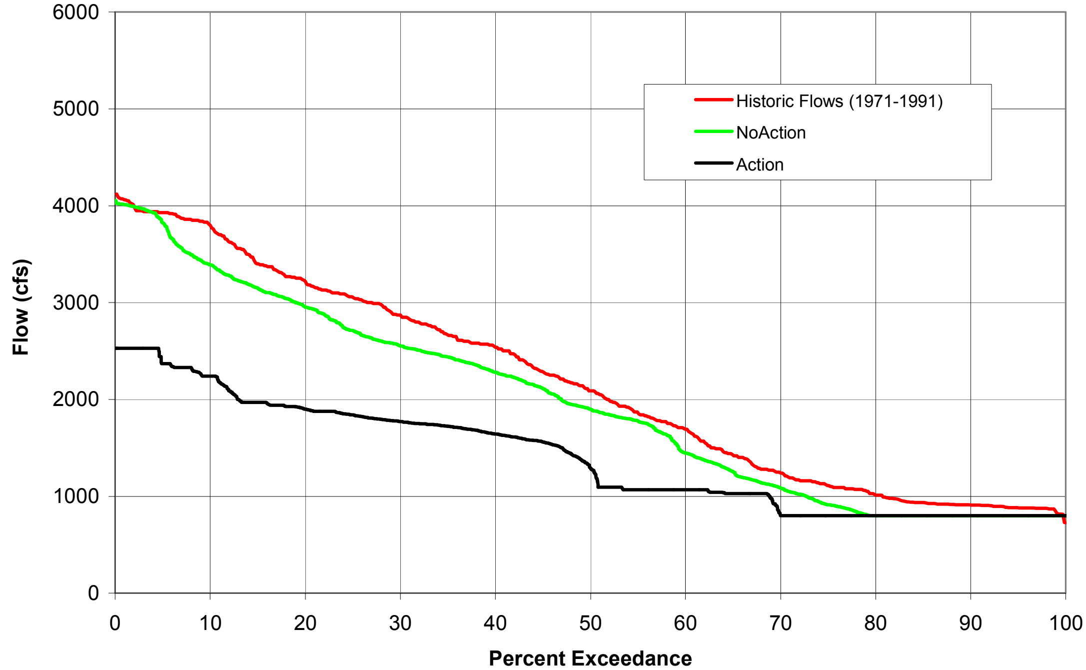


Figure 4.12: Reach One Flows in December

Modelled vs. Historic

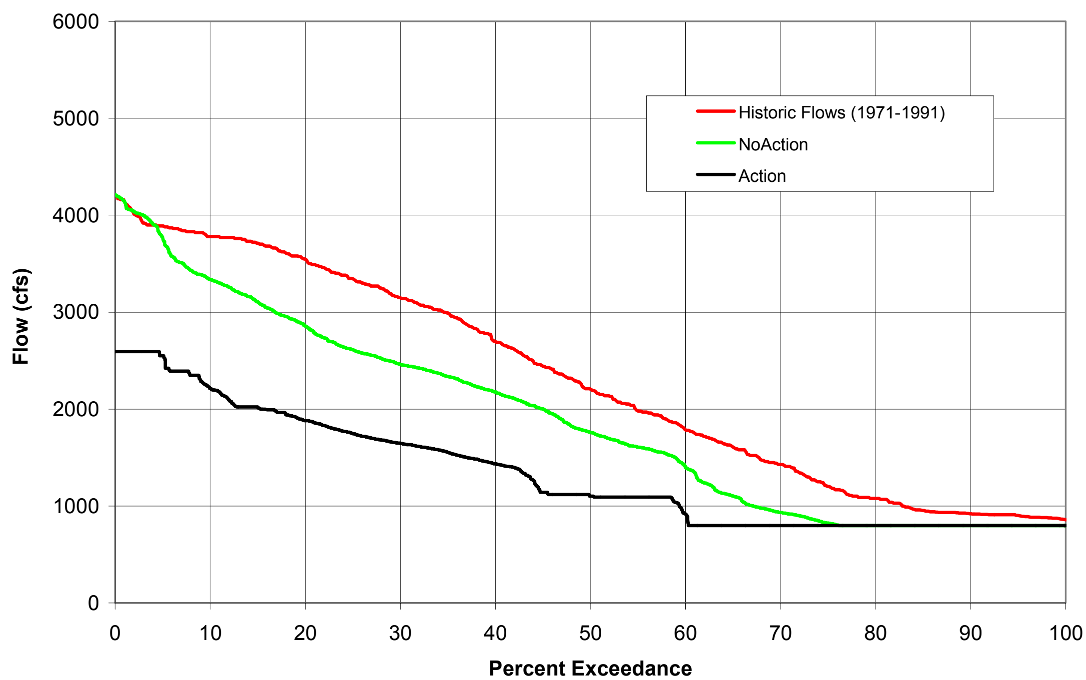


Figure 4.13: Reach Two Flows in January
Modelled vs. Historic

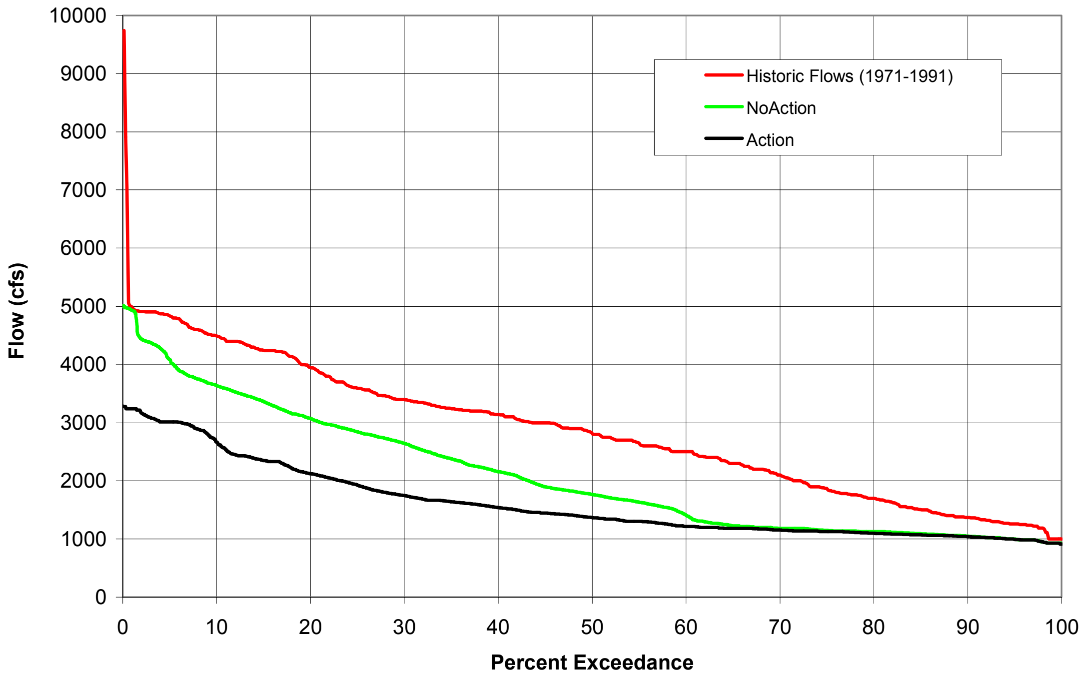


Figure 4.14: Reach Two Flows in February
Modelled vs. Historic

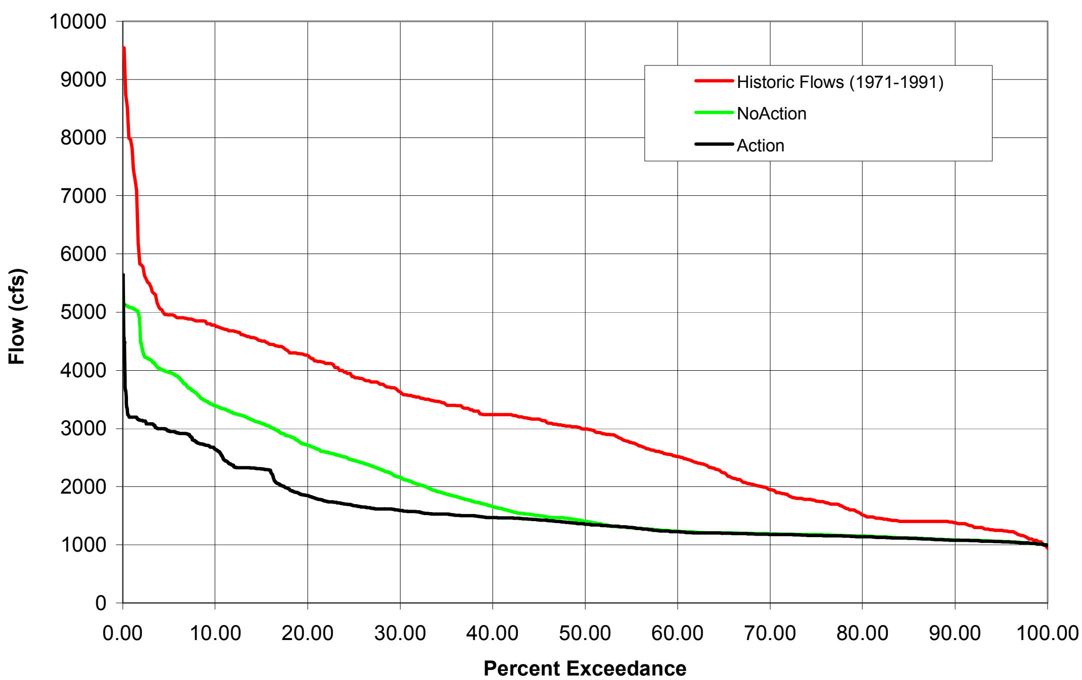


Figure 4.15: Reach Two Flows in March

Modelled vs. Historic

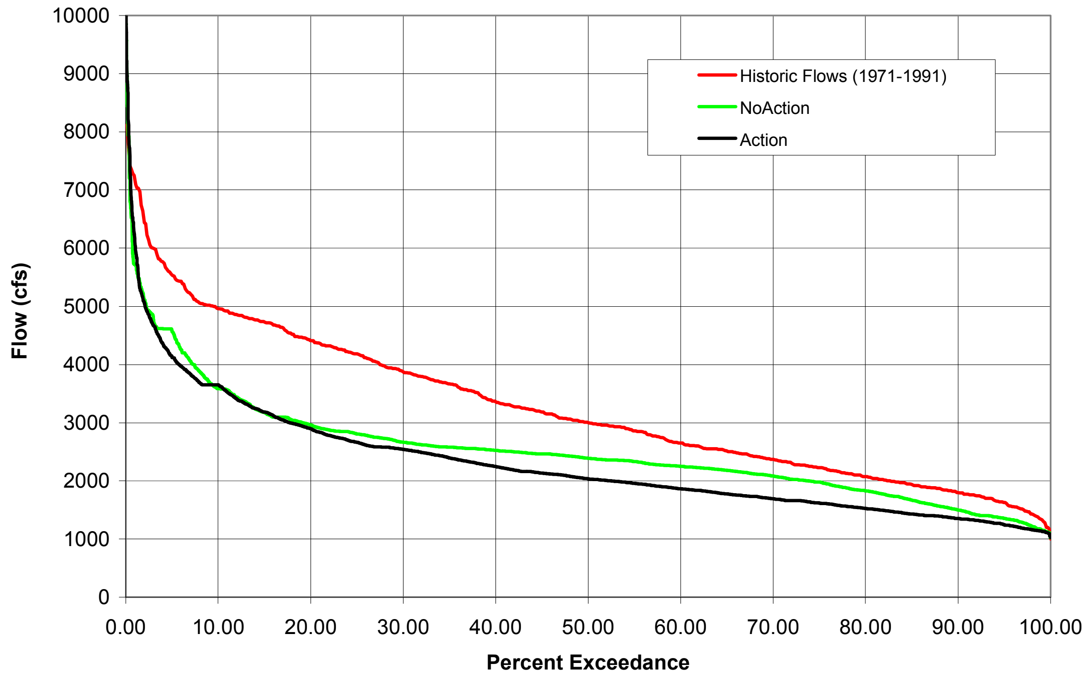


Figure 4.16: Reach Two Flows in April

Modelled vs. Historic

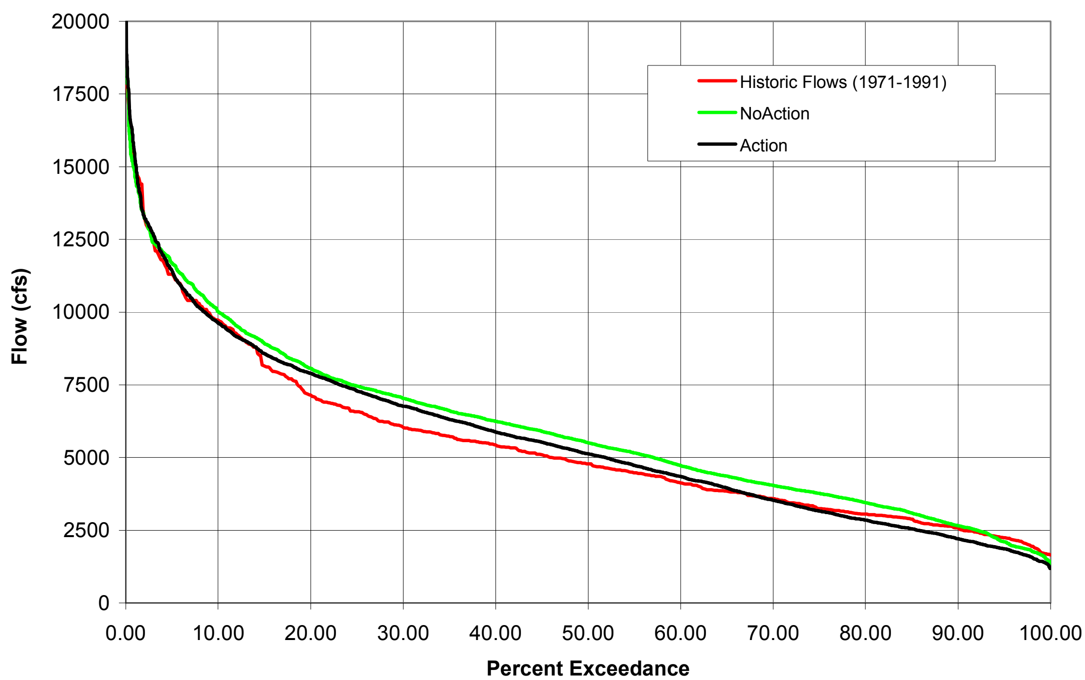


Figure 4.17:Reach Two Flows in May

Modelled vs. Historic

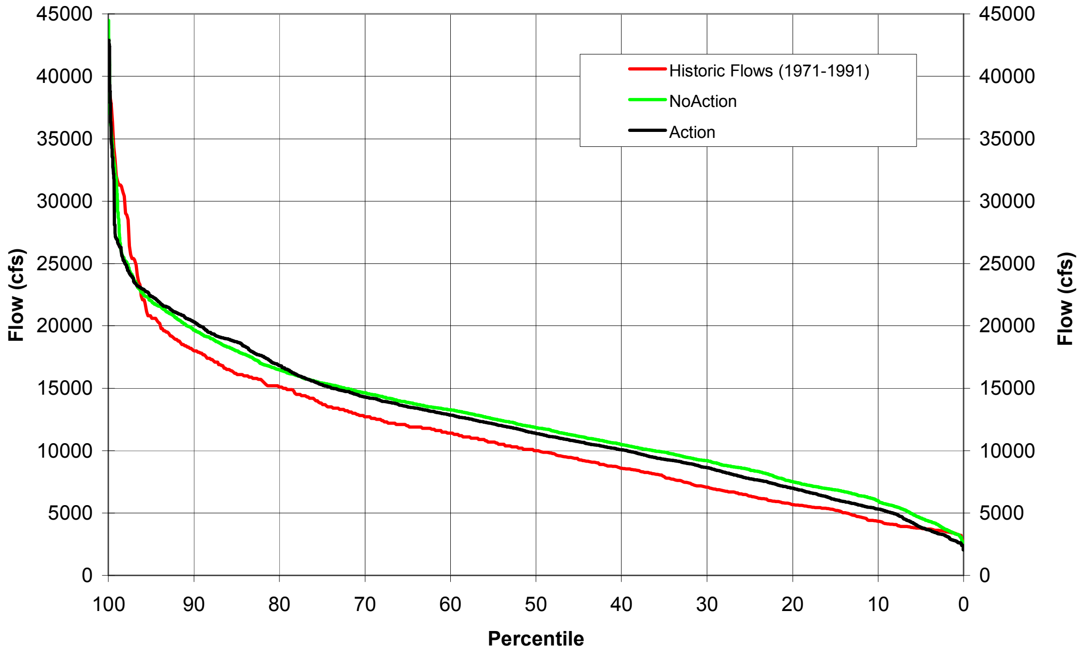


Figure 4.18: Reach Two Flows in June

Modelled vs. Historic

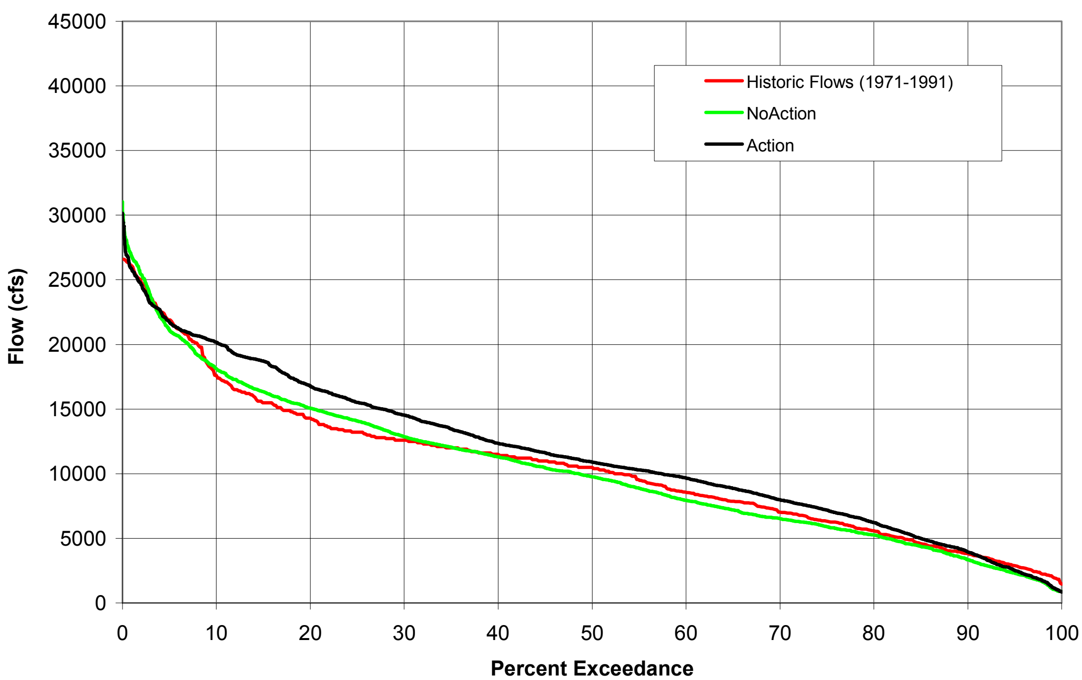


Figure 4.19: Reach Two Flows in July

Modelled vs. Historic

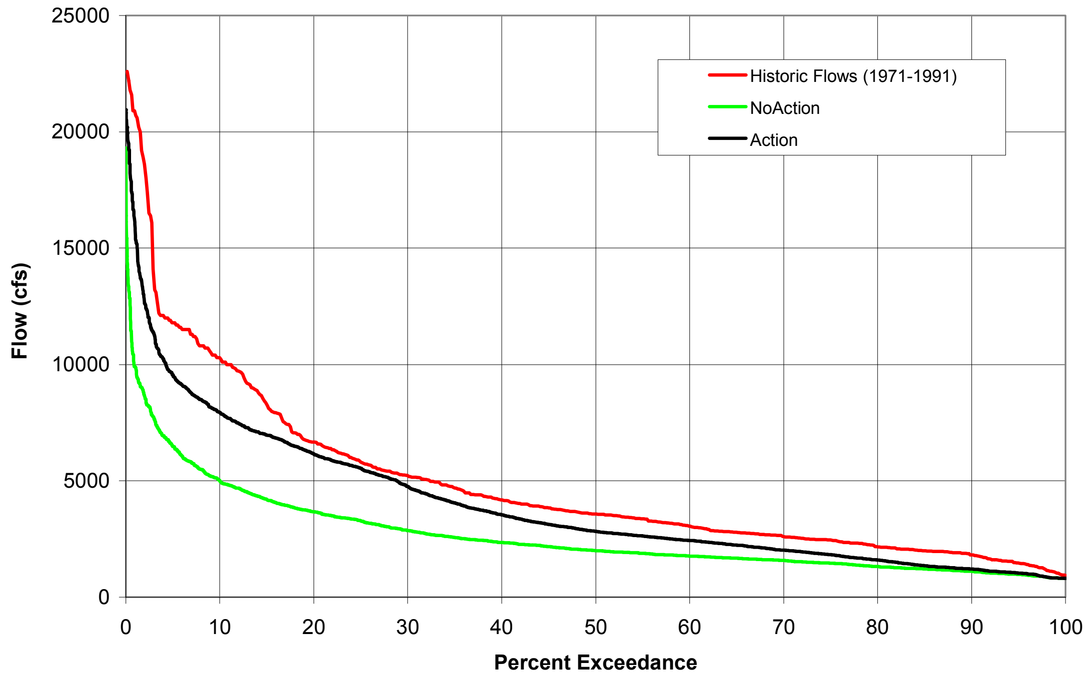


Figure 4.20: Reach Two Flows in August

Modelled vs. Historic

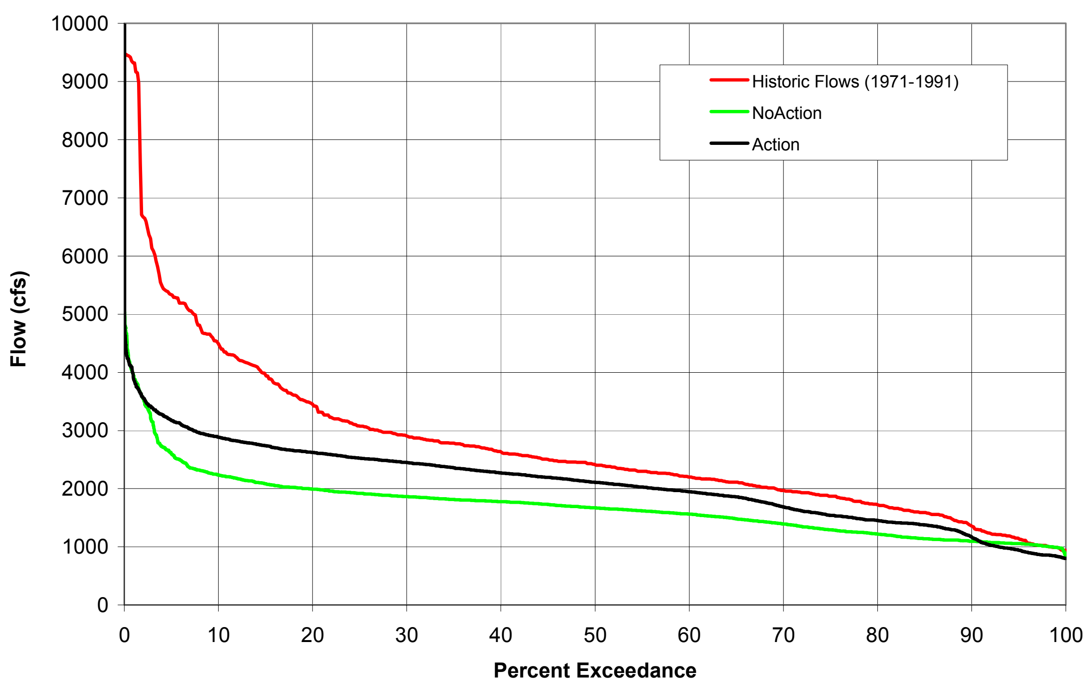


Figure 4.21: Reach Two Flows in September

Modelled vs. Historic

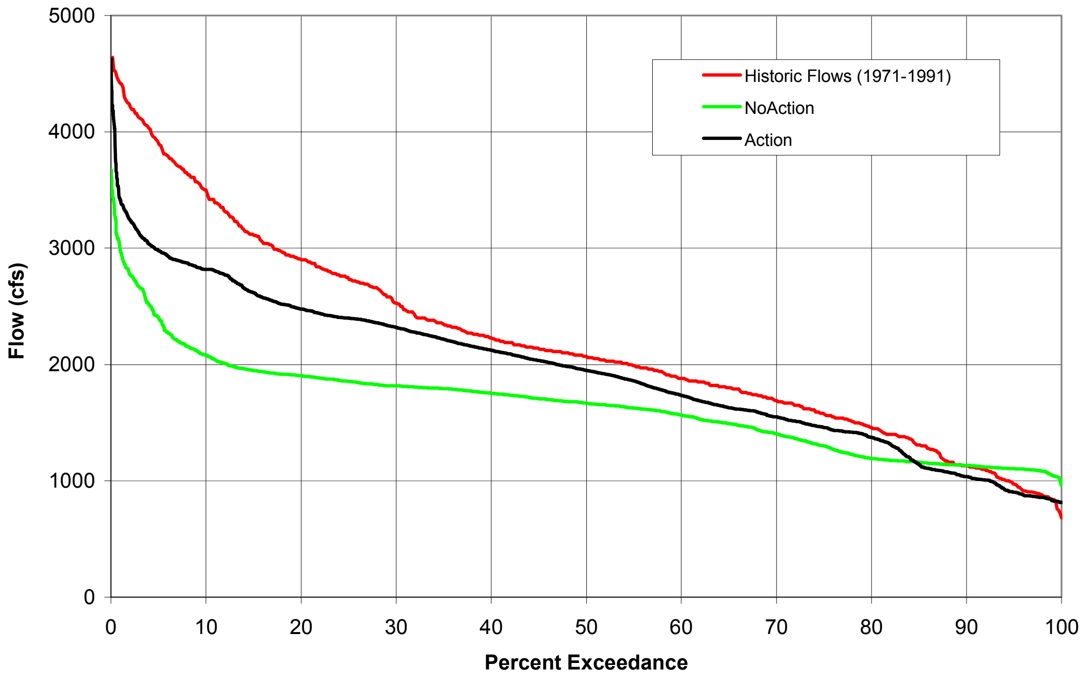


Figure 4.22: Reach Two Flows in October

Modelled vs. Historic

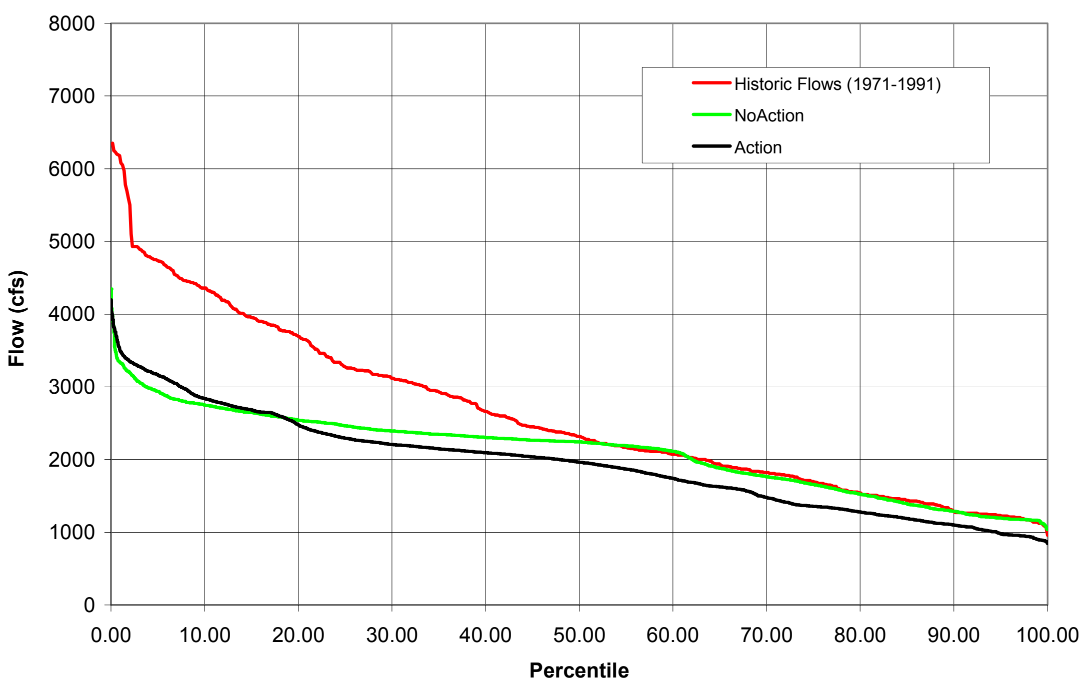


Figure 4.23: Reach Two Flows in November

Modelled vs. Historic

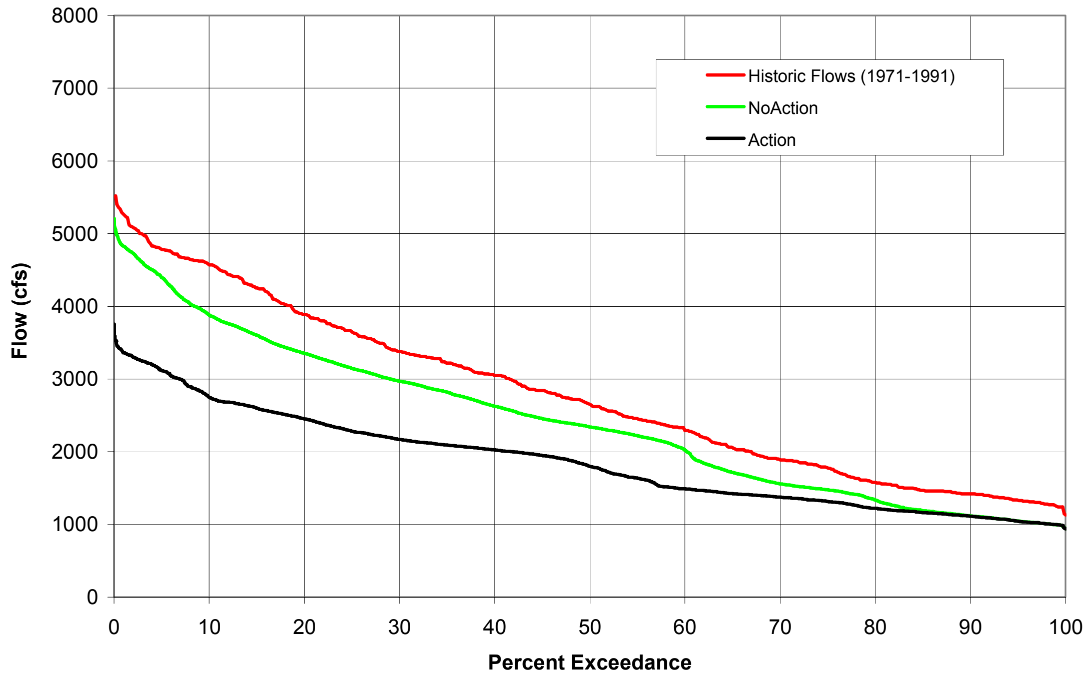


Figure 4.24: Reach Two Flows in December

Modelled vs. Historic

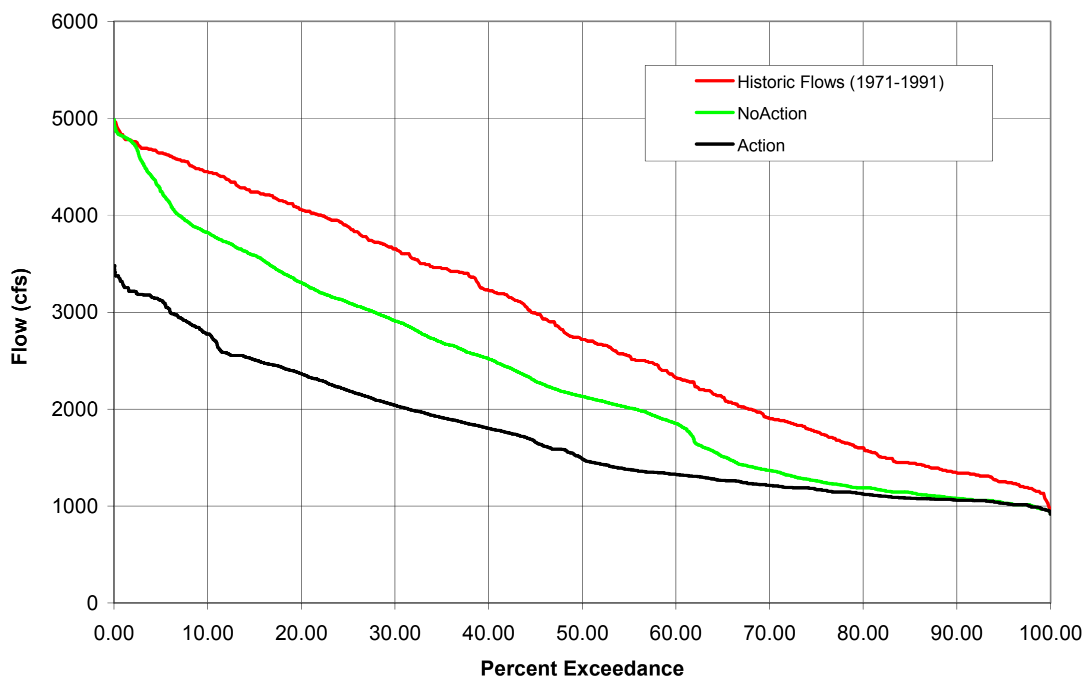


Figure 4.1.1
Green River Reach 1: Total Load Using Sediment Rating Curve by Martin et al.(1998)

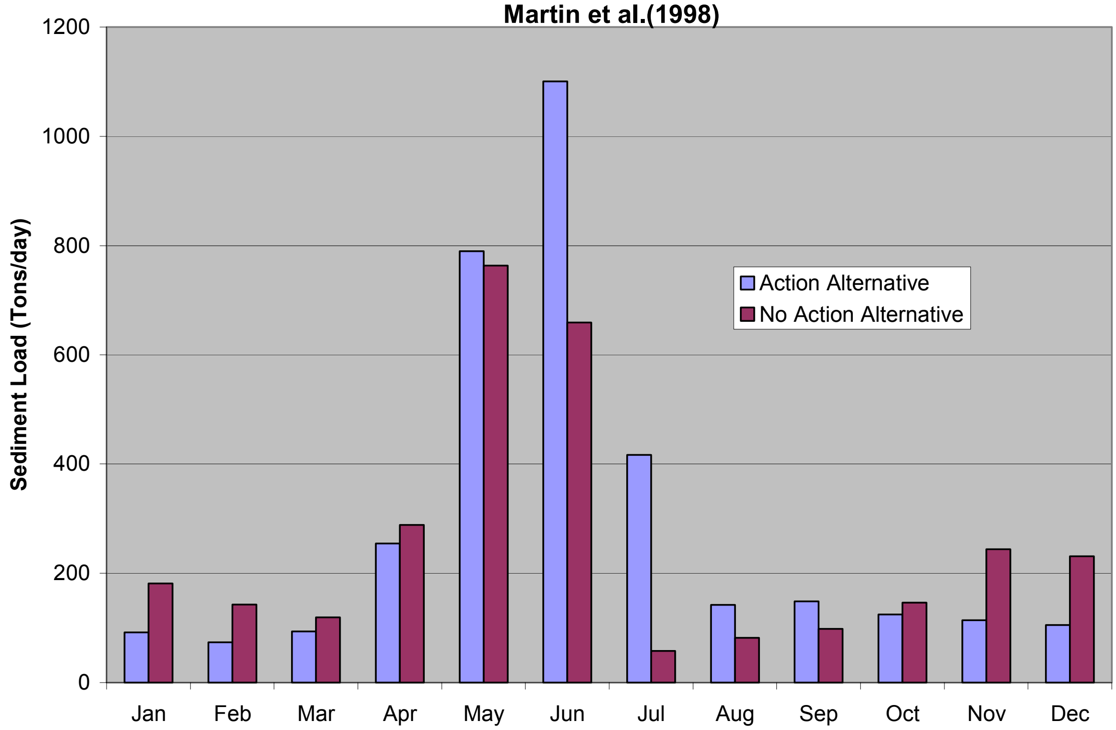


Figure 4.1.2
Green River Reach 1: Suspended Load Using Sediment Rating Curve By Martin et al.(1998)

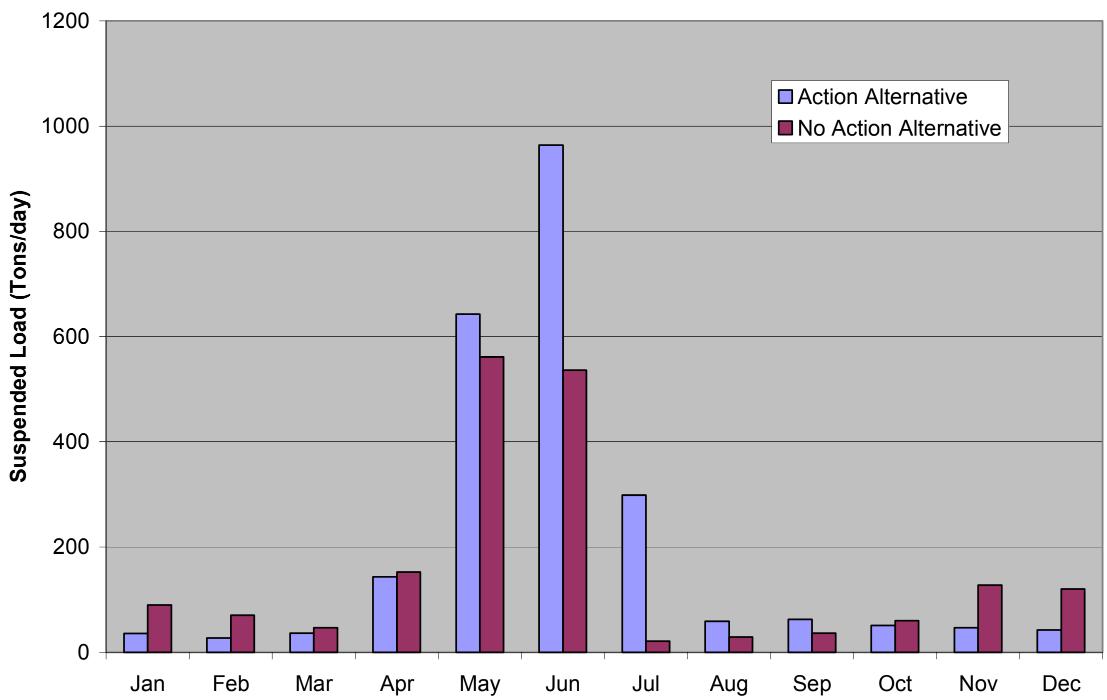


Figure 4.1.3
Green River Reach 2: Sand Load Using Sediment Rating Curve by Andrews (1986)

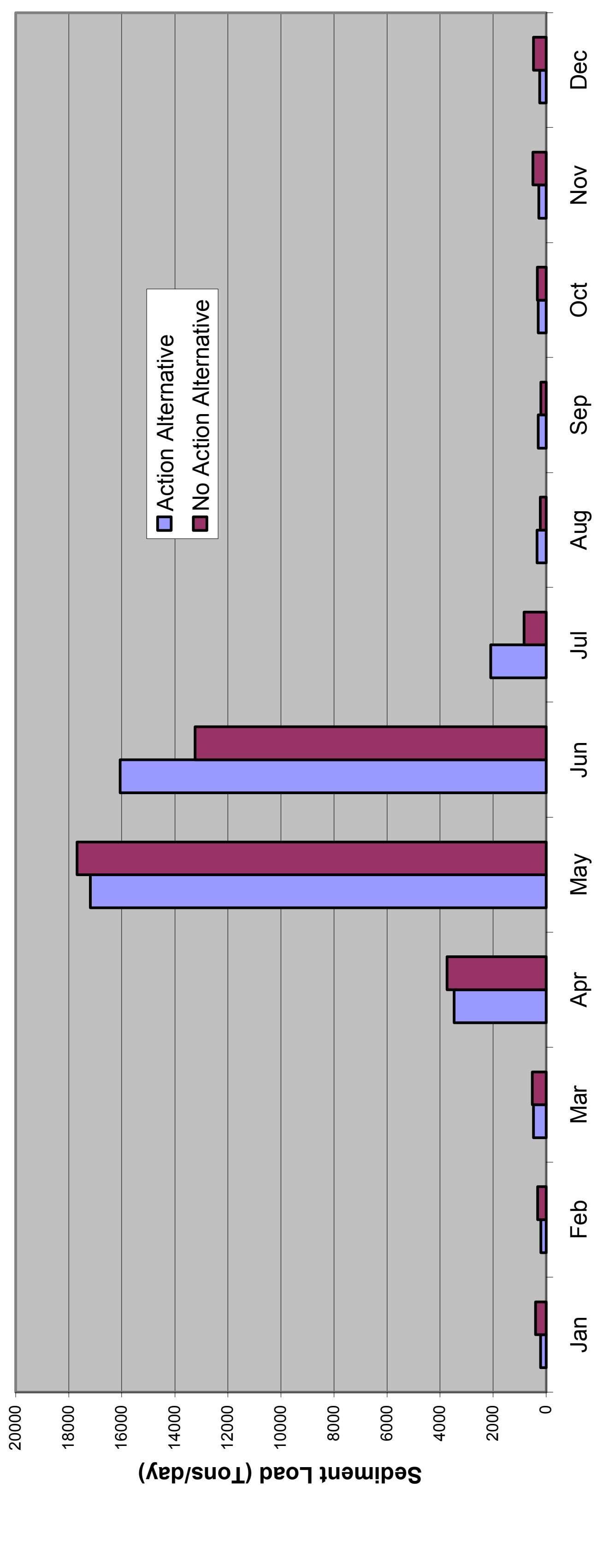
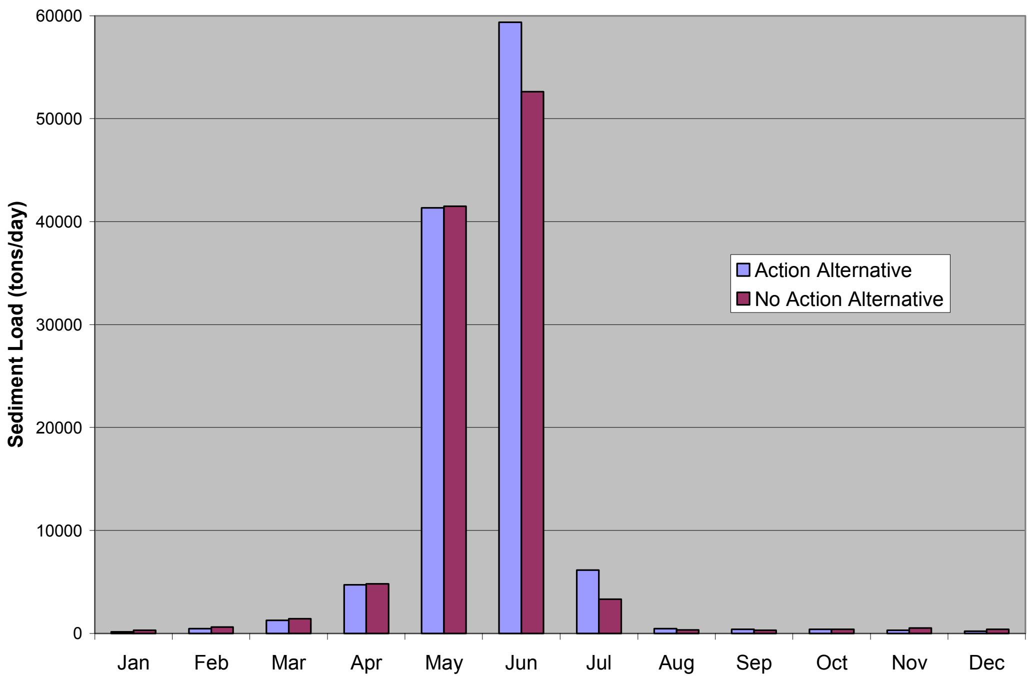


Figure 4.1.4
Green River Reach 3: Sandload Using Sediment Rating Curve by Andrews (1986)



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The Bureau of Reclamation funded this project, and its staff provided valuable technical information and advice throughout the conduct of the study. The authors of this report thank several Bureau of Reclamation staff members, including Beverley Heffernan for her leadership role in the Flaming Gorge Environmental Impact Statement and review of critical modeling assumptions as they pertain to hydropower system operations and economic evaluations. Robert Hamilton organized and led meetings for the Flaming Gorge Environmental Impact Statement Power Systems Working Group. Dave Harpman provided power system analysts with equations that describe the Flaming Gorge powerplant and reservoir. He also supplied analysts with spot market price forecasts from the Aurora model. Larry Anderson provided technical information and advice on the operation and physical limitations of the Flaming Gorge Dam, powerplant, and turbines. Andrew Gilmore, Richard Clayton, and Thomas Ryan informed power system analysts about the Green River and RiverWare models. They also gave technical advice on how to apply Flaming Gorge model results to power system simulations. In addition, Andrew Gilmore and Richard Clayton made all of the Flaming Gorge model runs for this study and selected the representative hydrology trace. Jane Blare reviewed draft power systems methodology reports. Flaming Gorge operators Warren Blanchard and Milo McPherson provided information about current powerplant operations. Clayton Palmer from the Western Area Power Administration supplied information concerning key modeling assumptions regarding institutional constraints imposed on the operations of the Flaming Gorge Dam. Kirk Lagory from Argonne National Laboratory helped power system analysts interpret various aspects of environmental impact statement alternatives, and both Vladimir Koritarov and Michael North reviewed and provided comments on this report. The authors also thank members of the Colorado River Energy Distributors Association including Cliff Barrett, Leon Pexton, and Ted Pampton for their participation in the Flaming Gorge Environmental Impact Statement Power Systems Working Group.

NOTATION

The following is a list of the acronyms and abbreviations (including units of measure) used in this document.

ACRONYMS AND ABBREVIATIONS

Argonne	Argonne National Laboratory
BPA	Bonneville Power Administration
CRSP	Colorado River Storage Project
CRSS	Colorado River Simulation System
CSC	Customer Service Center
EIS	Environmental Impact Statement
EOM	end of month
FGEIS	Flaming Gorge Environmental Impact Statement
GenOpt	Generation Optimization
GTMax	Generation and Transmission Maximization
NPV	net present value
PO&M-59	Power Operations and Maintenance
Reclamation	Bureau of Reclamation
SLCA/IP	Salt Lake City Area Integrated Projects
SSARR	streamflow synthesis and reservoir regulation
USFWS	U.S. Fish and Wildlife Service
Western	Western Area Power Administration
WL	water lag
WLF	water lag factor
WSCC	Western Systems Coordinating Council

UNITS OF MEASURE

AF	acre-feet
cfs	cubic-feet per second
ft	foot (feet)
GWh	Giga-watt hour(s)
hr	hour(s)
HP	horsepower
lbs	pound(s)
MW	Mega-watt
MWh	Mega-watt hour(s)
TAF	thousand-acre-feet

Power System Analysis Technical Appendix

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October 2002

ABSTRACT

This report describes the methods that were used to simulate the hourly operations of the Flaming Gorge Dam and powerplant that meet environmental flow constraints at a downstream gauge located near Jensen, Utah. Operations are simulated under two alternative sets of flow constraints that include current limitations and a new set of flow recommendations formulated by the Fish and Wildlife Service. The methodology is also used to estimate the total economic benefits of powerplant electricity generation. This report documents these economic benefits and compares the two alternatives. Economic benefits are also estimated for a Cumulative Impact Scenario in which there are no environmental restrictions imposed on powerplant operations. Simulated operations and economic estimates are in support of the Bureau of Reclamation's Flaming Gorge Environmental Impact Statement.

1. INTRODUCTION

The Bureau of Reclamation (Reclamation) has been studying the potential effects on endangered species in the Green River below Flaming Gorge Dam and reservoir. These studies are in response to their obligations under Section 7 of the Endangered Species Act and have included close coordination with the U.S. Fish and Wildlife Service (USFWS), as well as numerous other agencies and interested members of the public. The USFWS has formulated flow recommendations for endangered fish species downstream from Flaming Gorge Dam and Reclamation is addressing impacts to other resources in the Green River related to such flow recommendations in an Environmental Impact Statement (EIS).

This report describes various aspects of the Flaming Gorge Environmental Impact Statement (FGEIS) that will affect powerplant operations at the dam. It also provides a detailed description of the methodology that was used to simulate dam and powerplant operations under two FGEIS alternatives. The analyses conducted under this power systems study provide an estimate of the economic impacts of EIS alternatives over a 25-year period from 2002 though 2026, inclusive. Cumulative impacts of all operational restrictions at Flaming Gorge are estimated by comparing the economic benefits of power production at Flaming Gorge to a scenario that has no environmental restrictions. Economic estimates are based on the quantity of energy produced by Flaming Gorge and spot market prices. Benefit calculations are performed on an hourly basis. Restrictions specified by each of the alternatives have to some degree an affect on the economic value of the Flaming Gorge hydropower resource.

2. FLAMING GORGE DAM AND POWERPLANT OVERVIEW

The Flaming Gorge Dam is part of the Colorado River Storage Project (CRSP) that was authorized by a Congressional Act of April 11, 1956. It is located on the Green River in northeastern Utah about 32 miles downstream from the Utah/Wyoming border. The concrete thin-arch structure that was built by Reclamation has a maximum height of 502 feet and a crest length of 1,285 feet. Flaming Gorge Reservoir has a total capacity of 3,788,700 acre-feet (AF) at a reservoir water elevation of 6040 feet above sea level. The reservoir has an active capacity of 3,515,700 AF and a surface area of 42,020 acres. Construction of the Flaming Gorge Dam began in October 1956 and the reservoir was topped out in late 1962 ***(Flaming Gorge Flow Recommendations Document, Section 3.2, Page 56)***. To the extent possible the dam has been operated at near-full reservoir levels while attempting to avoid spills.

The powerplant began commercial operation in 1963 with three generating units. Each unit originally had a capacity of 36 Mega-watt (MW) for a plant total of 108 MW. Since that time, the three units were upgraded to approximately 50.65 MW thereby increasing the total installed capacity to 151.95 MW (***Form PO&M-59)***. However, due to turbine limitations the operable capability of the powerplant is approximately 141.0 MW. On average, the Flaming Gorge Dam powerplant generates about 528.9 Giga-watt-hours (GWh) of electricity annually.

The Western Area Power Administration's (Western) CRSP Management Center markets CRSP power resources, including Flaming Gorge, and hydroelectric powerplants of the Collbran and Rio Grande projects. Energy and capacity from these projects, collectively referred to as the Salt Lake City Area Integrated Projects (SLCA/IP), are marketed to more than 140 customers in six western states on both a long-term and short-term firm basis (***ANL/DIS/TM-10)***. Generation from the Flaming Gorge powerplant also serves the energy requirements of special project uses such as irrigation and can be used to fulfill utility system requirements for spinning reserves and area load control. Electricity is also sold on the spot market when available energy exceeds firm contractual obligations. Spot market activities also include purchasing energy at relatively low prices during off-peak hours and using the stored energy for sale when spot market prices are high. This hydro-shifting activity allows Western to maximize the economic value of hydropower resources.

The FGEIS power systems methodology focuses on the operations of the Flaming Gorge Dam subject to environmental flow constraints at a critical downstream reach on the Green River. Power generation from

Flaming Gorge is injected into the transmission grid. The economic value of this generation is based on the market price of electricity at the Four Corners delivery point.

3. EIS ALTERNATIVES

The FGEIS contains two alternatives. The first is referred to as the No Action Alternative. It assumes that Green River flow constraints established under the 1992 Biological Opinion will continue through the end of the study period. The dam is currently operated to meet flow limitations specified by this alternative. The second is referred to as the Action Alternative. It assumes that Flaming Gorge Dam operations will comply with a new set of USFWS flow recommendations. The Action Alternative requires monthly and hourly water release patterns from the Flaming Gorge Dam that differ from those established by the 1992 Biological Opinion.

The economic impacts of altering generation patterns to meet new flow requirements under the Action Alternative are estimated in this analysis. Most of the facets of the Action Alternative that affect the economic value of the power system are precisely documented. However, there is a set of rules that will be assumed under both alternatives that is not based on written documentation, but rather on verbal agreements and current operational practices. Essentially, these are temporary agreements made among various institutions that are assumed to continue throughout the study period. However, these unwritten rules may or may not continue in the future. Tables 3.1 and 3.2 show key operational elements and gauge flow constraints contained in the two alternatives that will affect the economic value of the Flaming Gorge power resource.

3.1 Green River Flow Constraints

The FGEIS defines three reaches shown on figure 3.1 Flaming Gorge Flow Recommendations Document, P. 2-2. For the power systems analysis conducted in this study, the only flow constraints considered are at reach 2 as measured at the Jensen Gauge. Reach 2 begins at the confluence of the Green and Yampa Rivers; that is, about 65.1 miles downstream from Flaming Gorge Dam. Reach 2 extends for about 98.8 miles downstream from the Yampa to the confluence of the White River. The Jensen Gauge is located nearly 28.6 miles downstream of the Yampa confluence. Therefore, a Flaming Gorge water release must travel about 93.7 miles (i.e., 65.1 + 28.6) before it registers at the Jensen Gauge.

Jensen Gauge flows are primarily a function of Flaming Gorge releases and Yampa inflows. Since Yampa inflows are not controlled, releases from Flaming Gorge must be regulated such that flows are in compliance with Jensen Gauge requirements. However, water releases from Flaming Gorge are not required by EIS alternatives to compensate for large and unpredictable changes in Yampa inflows. On the other hand, FGEIS alternatives require that the general pattern of Yampa inflows be accounted for when scheduling Flaming Gorge releases.

Green River flow constraints under the No Action Alternative are based on four time periods that includes a spring spike, a summer season, a winter season and a post-winter flow period. Each of these periods is listed in tables 3.1 and 3.2 for the No Action and Action Alternatives, respectively.

Except for the post-winter period, time period designations are identical for both alternatives. The post-winter period for the Action Alternative begins 1 month earlier than in the No Action Alternative.

The No Action Alternative requires that flows at the Jensen Gauge remain within 12.5 percent of the daily average flow during the summer and autumn seasons. This allows for a maximum daily fluctuation of

Table 3.1. Assumptions for the No Action Alternative (1992 Biological Opinion)

Spring Flows (Spike)	Summer	Winter	Post-Winter
Period of spike, inclusive	Day after end of spike to Oct 31, inclusive	Nov 1 to Apr 31, inclusive	May 1 until the start of spike, inclusive
No gauge constraints	Requires Jensen Gauge flows to remain within a 12.5% of the daily average		No gauge constraints
	Jensen Gauge flows limits are constant among all days of a month.		
Restrict daily water releases from Flaming Gorge			
	Daily average gauge flows range from 31 to 51 m^3/s	Daily average gauge flows range from 31 to 68 m^3/s	
		Ice cap issues not considered	
Assumed that Yampa flows are constant throughout a month			
Operational rules: 800 cfs minimum flows, 800 cfs maximum up-ramp rate, 800 cfs maximum down-ramp rate, single hump per day.			

Table 3.2. Assumptions for the Action Alternative (2000 Flow and Temperature Recommendations)

Spring Flows (Spike)	Summer	Winter	Post-Winter
Period of spike, inclusive	Day after end of spike to Oct 31, inclusive	Nov 1 to February 28 (29), inclusive	March 1 until the start of spike, inclusive
No gauge constraints	Jensen Gauge stage flows limited to an intra-day change of 0.1 meters		No gauge constraints
Restrict daily water releases			
	3% daily average gauge constraint does <u>not</u> apply		
	Consistent with the Flaming Gorge model daily average gauge flows are between 26 to 85 m^3/s		
	Consistent with the Flaming Gorge model will not utilize 40%/25% variation around year mean flows		
Assumed that Yampa flows are constant throughout a month			
Operational rules: 800 cfs minimum flows, 800 cfs maximum up-ramp rate, 800 cfs maximum down-ramp rate, single hump per day.			

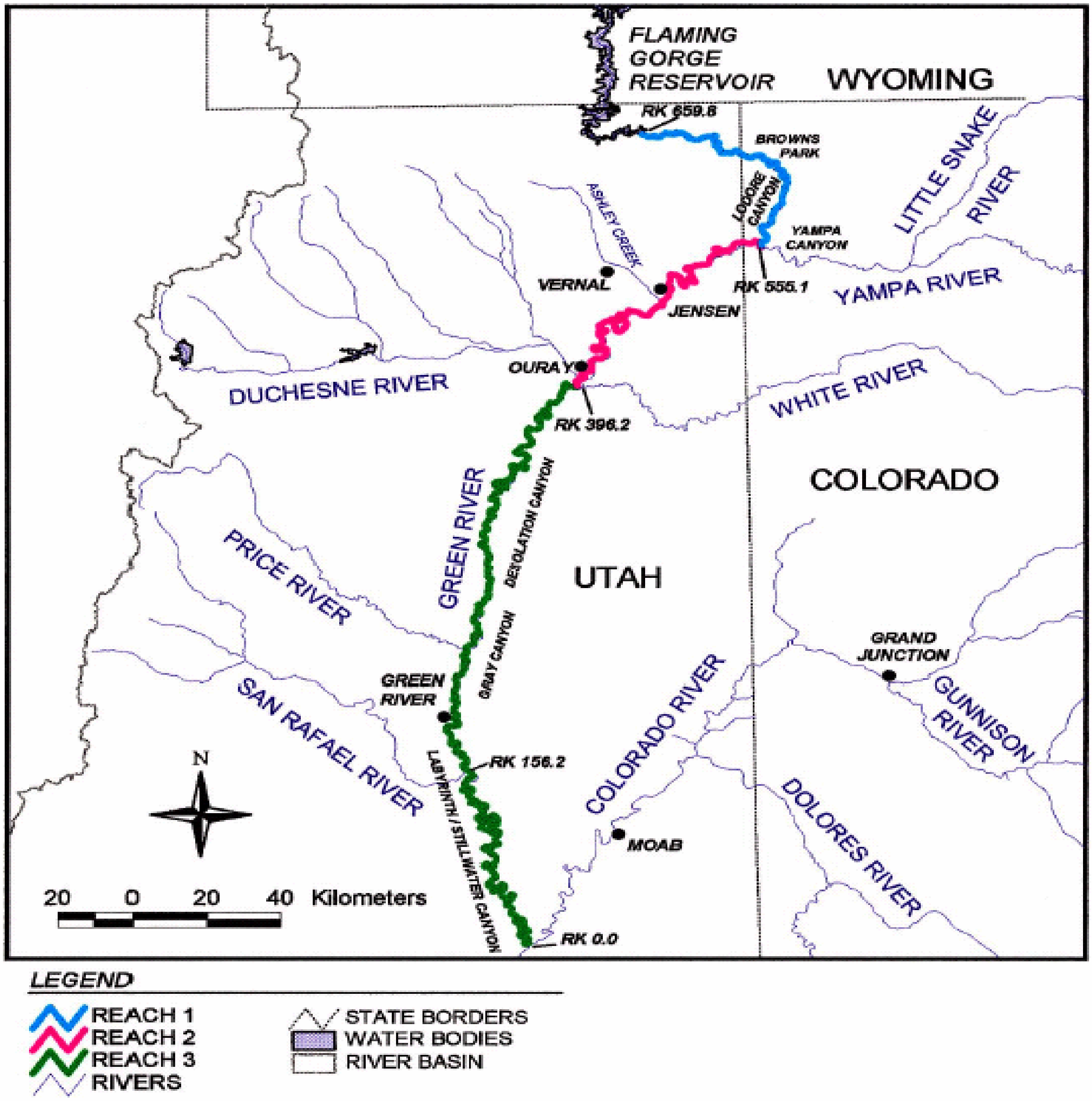

Figure 3.1. Critical Reaches Downstream From the Flaming Gorge Dam.
Source: 2000 Flow and Temperature Recommendations Report.

25 percent; that is, 12.5 percent higher than the average and 12.5 percent lower than the average. Although it is not specified by the No Action Alternative, for this study it is assumed that the 25-percent maximum daily fluctuation requirement will also constrain dam operations in the winter season. This is consistent with historic short-term verbal agreements and current operational practices. This agreement may or may not continue in the future and operations may change.

The Action Alternative specifies Jensen Gauge flow constraints in terms of Green River stage change. The intra-day stage change is limited to 0.1 meters (i.e., 0.328 feet) from the average stage. Figure 3.2 shows the relationship between the stage and flow rates at the Jensen Gauge Data Source: Email from Richard Clayton on September 16, 2002 with attached files jesu.q$15 & jesu.xls.

As shown in figure 3.3, when the 0.1-meter gauge constraint (i.e., Action Alternative) is expressed in terms of percent change, the Action Alternative is more stringent than the No Action Alternative over the entire range of the gauge flows. However, the difference is significantly smaller at lower gauge flows. Table 3.4 shows a comparison of the two alternatives at the lower flow rates. At 800 cubic feet per second (cfs), the Action Alternative has approximately a 23-percent flow range; that is, a range that is 2 percent less than the No Action Alternative. Unlike the No Action Alternative that has a 12.5-percent allowable flow range both above and below the daily average, these percentages are asymmetrical for the Action Alternative. At a stage of 3.1 ft a 9.9-percent flow decrease below the daily average is allowed for the Action Alternative while an 11.6-percent increase above the daily average sets the upper flow bound. This occurs since flow stages as shown in figure 3.2 are non-linear.

Although the Action Alternative is more restrictive, the lower flow rates are expected to occur more frequently than higher flow rates. Difference in the gauge flow flexibility between the two scenarios is usually from 2 percent to 4 percent. Figure 3.4 shows the flow rate exceedance curve for the Action Alternative for all days of the 25-year study period. The curve is based on Flaming Gorge model projections of daily Flaming Gorge releases and inflows from the Yampa Data Source: Email from Andrew Gilmore with attached files RepresentativeTraceAction.xls. The figure shows that the range for the Action Alternative drops to 21.2 percent at 2,060-cfs flow rate. Daily average flows are less than 2,060 cfs about 50 percent of the time.

The No Action Alternative requires the daily average flow at the Jensen Gauge to remain constant over a period (e.g., season). While the range of allowable flows at the Jensen Gauge under the No Action Alternative remains constant, the window of allowable flows at the Jensen Gauge under the Action Alternative can change from one day to the next by up to 3 percent. The intent of this daily change allowance is to permit Reclamation to adjust water releases in response to unpredicted changes in the system hydrology. Therefore, for the purpose of modeling power system operations, water releases from Flaming Gorge are not permitted to change from one day to the next.

3.2 Flaming Gorge Operational Rules

The hourly average water release from the Flaming Gorge Dam must be at least 800 cfs as mandated in 1967 Flaming Gorge Flow Recommendations Document, P. 3-6. This directive was given in order to establish and maintain tailwater trout fisheries. Over a period of one week, the 800 cfs minimum release accounts for approximately 11.1 thousand acre-feet (TAF). Weekly water releases above this level can be used at the discretion of dispatchers within other dam operational and downstream flow constraints. Typically a dispatcher releases this water through the turbines when it has the highest economic value as indicated by spot market prices.

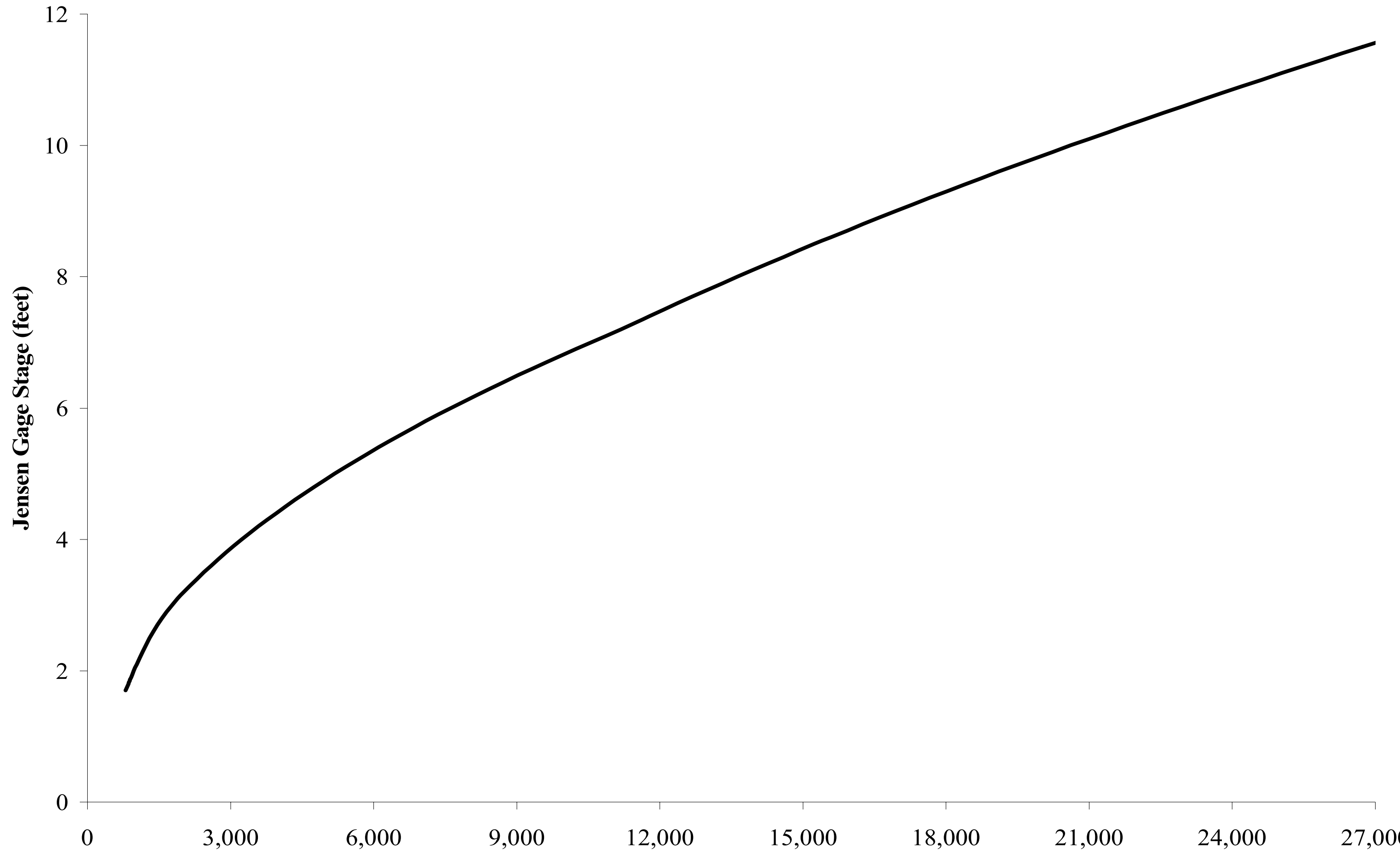

***Figure 3.2. Green River Stage as a function of Flow Rate at the Jensen Gauge*.**

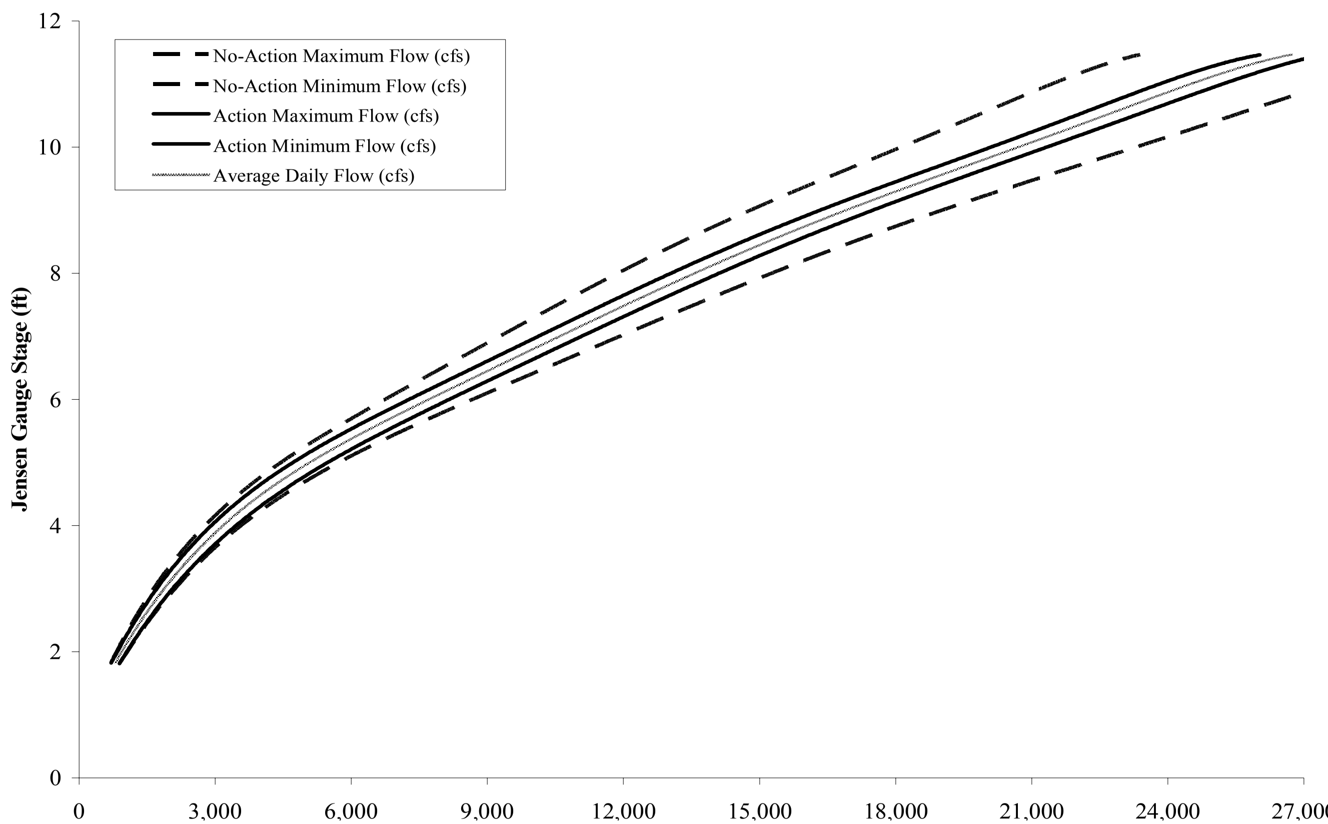

Figure 3.3. Allowable Flow Range for the No Action and Action Alternatives.

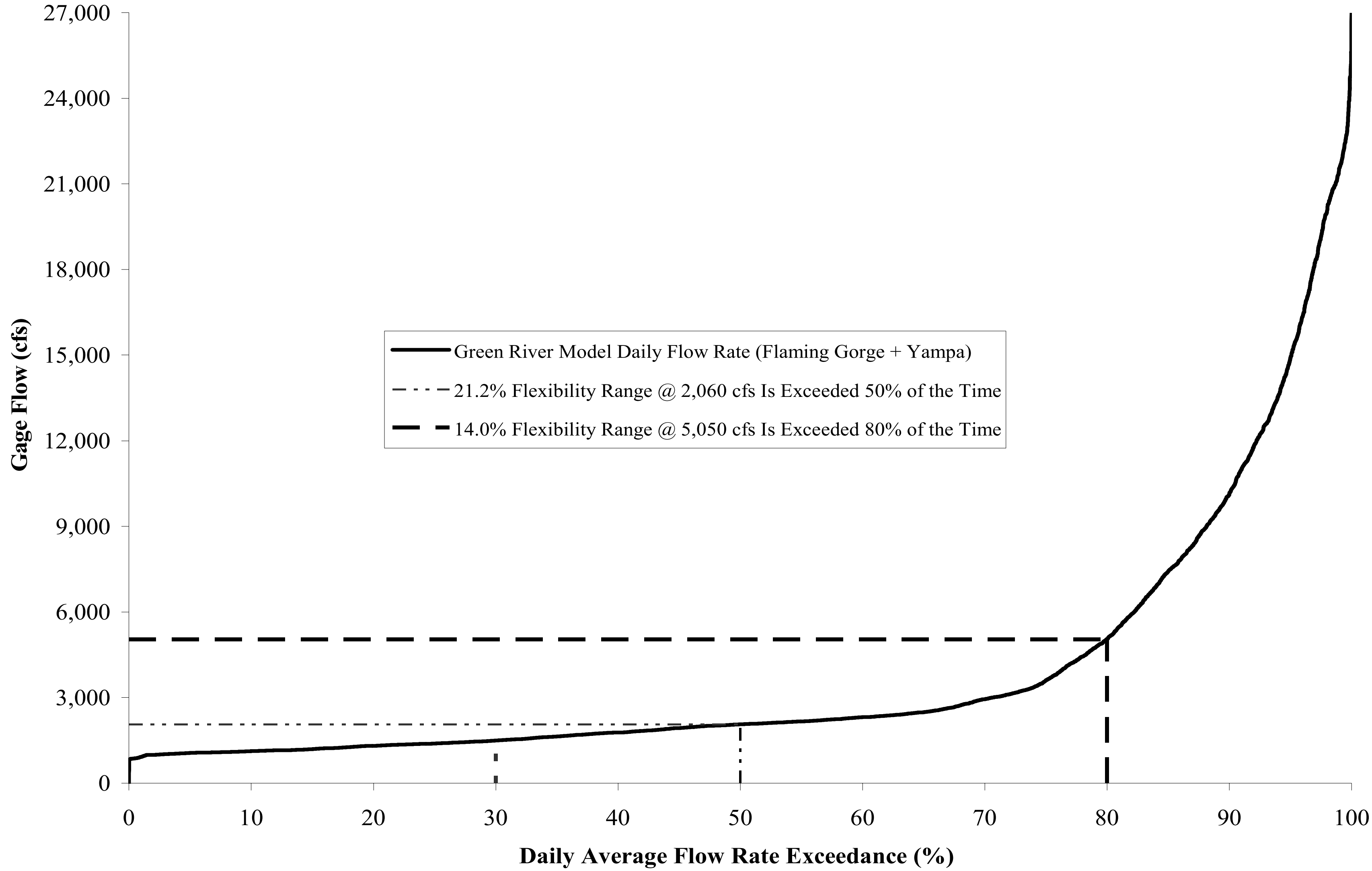

Figure 3.4. Projected Daily Average Flow Rate Exceedance Curve at the Jensen Gauge for the Action Alternative.

Table 3.3. Spike Period Dates and Duration

Year	No Action Alternative			Action Alternative		
	Start Date	End Date	Duration (days)	Start Date	End Date	Duration (days)
2002	24-May	22-Jun	30	30-May	09-Jul	41
2003	15-May	05-Jun	22	19-May	12-Jun	25
2004	08-May	31-May	24	13-May	10-Jun	29
2005	10-May	31-May	22	12-May	27-May	16
2006	15-May	09-Jun	26	22-May	05-Jun	15
2007	06-May	28-Jun	54	07-May	08-Jun	33
2008	09-May	31-May	23	10-May	25-May	16
2009	13-May	26-Jun	45	17-May	28-Jun	43
2010	01-May	29-Jun	60	12-May	18-Jun	38
2011	01-May	31-May	31	10-May	05-Jun	27
2012	15-May	26-Jun	43	24-May	18-Jul	56
2013	29-May	19-Jun	22	02-Jun	07-Jul	36
2014	11-May	11-Jun	32	04-May	27-Jun	55
2015	13-May	04-Jun	23	18-May	18-Jun	32
2016	08-May	04-Jul	58	28-May	23-Jun	27
2017	15-May	03-Jul	50	30-May	26-Jun	28
2018	15-May	05-Jun	22	16-May	25-Jun	41
2019	10-May	20-Jun	42	01-Apr	28-Jun	89
2020	28-May	03-Jul	37	02-Jun	25-Jul	54
2021	19-May	20-Jun	33	21-May	21-Jul	62
2022	27-May	20-Jun	25	02-Jun	16-Jun	15
2023	29-May	24-Jun	27	07-Jun	31-Jul	55
2024	18-May	08-Jun	22	22-May	16-Jun	26
2025	15-May	20-Jun	37	21-May	28-Jun	39
2026	18-May	09-Jun	23	22-May	09-Jun	19
Minimum			22			15
Average			33.3			36.7
Maximum			60			89

Table 3.4. Comparison of Alternative Gauge Constraints at Low Flow Rates

Stage (feet)	Average Flow (cfs)	No Action Alternative			Action Alternative		
		Minimum Flow (cfs)	Maximum Flow (cfs)	Range (%)	Minimum Flow (cfs)	Maximum Flow (cfs)	Range (%)
1.70	800	700	900	25.0	708	892	23.0
1.80	856	749	963	25.0	764	949	21.7
1.90	913	799	1,027	25.0	820	1,011	20.9
2.10	1,032	903	1,161	25.0	934	1,137	19.6
2.30	1,160	1,015	1,305	25.0	1,055	1,275	18.9
2.50	1,300	1,138	1,463	25.0	1,185	1,435	19.2

There are two other operational rules that are not written, but have been agreed upon by Reclamation and Western for near-term system operations. These include up- and down-ramp rate limits of 800 cfs per hour and a daily one-hump restriction.

The hourly ramp rate restriction limits the change in water release rates from one hour to the next. For example, if the water release from Flaming Gorge is 2,400 cfs at noon, then releases at 1 PM must remain within a band that ranges from 1,600 to 3,200 cfs. From the beginning of 1992 through April 8, 2001, the 800-cfs ramp rate restriction has been violated less than 1% of the time based on HourlyReleaseInspection.xls file. Figure 3.5 shows the ramp rate exceedance curve for 1996, a typical ramping year.

As agreed upon by the two institutions for near-term operations, releases are currently limited to a single "hump" per day. When restricted to a single daily hump, dam releases are permitted to change the ramp direction only twice per day—once in the up direction and once in the down direction. Flat flow periods in between the up and down ramp rate phases are allowed. This includes periods when flows are constant or continuously ramp either up or down throughout a day. Releases typically ramp up from a low rate at night to a higher one during the daytime and then back down to a lower release rate during the following night. After March of 1993 through the present, the single hump restriction has been part of the Flaming Gorge operational regime. However, there were situations in the past when very minor zigzag patterns of increasing and decreasing flows were embedded into a larger single-hump pattern. Figure 3.6 shows an example of 1 day when this zigzag pattern occurred. The one-hump restriction reduces the economic value of the hydropower resources and does not allow plant operators to send pulses of water down the Green River to meet gauge constraints.

4. POWER SYSTEM MODELING

One objective of this study is to simulate operations at the Flaming Gorge Dam such that it maximizes the value of the hydropower resource while complying with both operational limitations and flow constraints at the Jensen Gauge. Several models are used to perform these simulations. Some models simulate the hydrology of the Green River and others are used to optimize the hourly operations of the hydropower resource. The set of modeling tools that were selected to perform these tasks was integrated into a modeling system referred to as the Flaming Gorge Power Modeling Package. Model integration, as depicted in figure 4.1, enables data and information to be exchanged among package components.

4.1 Flaming Gorge Model

The Flaming Gorge model provides long-term simulations of the Flaming Gorge Dam. It was written by Reclamation to simulate reservoir operations on the Green River and the requirements specified under FGEIS alternatives. The model is based on the same philosophy and principles as the RiverWare modeling software and its predecessor, the Colorado River Simulation System (CRSS). RiverWare and CRSS have been used by Reclamation for numerous long-term policy studies including the Glen Canyon Dam EIS and the Power Marketing (***EIS Salt Lake City Area Integrated Projects Electric Power Marketing Final Environmental Impact Statement U.S. DOE Western Area Power Administration Jan 1996)***. The Flaming Gorge model projects the operations of Flaming Gorge including monthly and daily water release volumes from the dam. It also predicts reservoir elevations and volumes on a monthly basis.

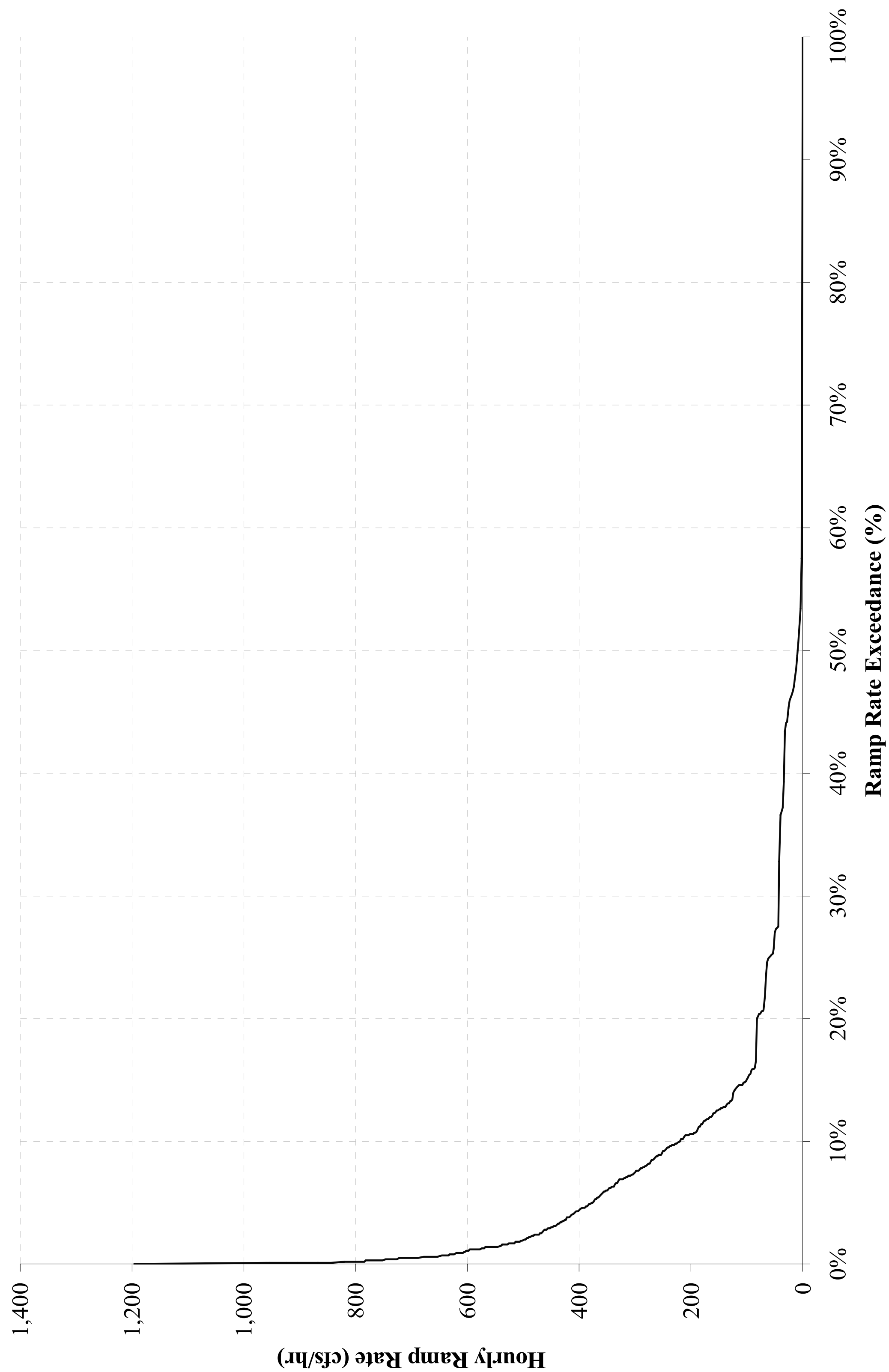

Figure 3.5. Ramp Rate Exceedance Curve for 1996.

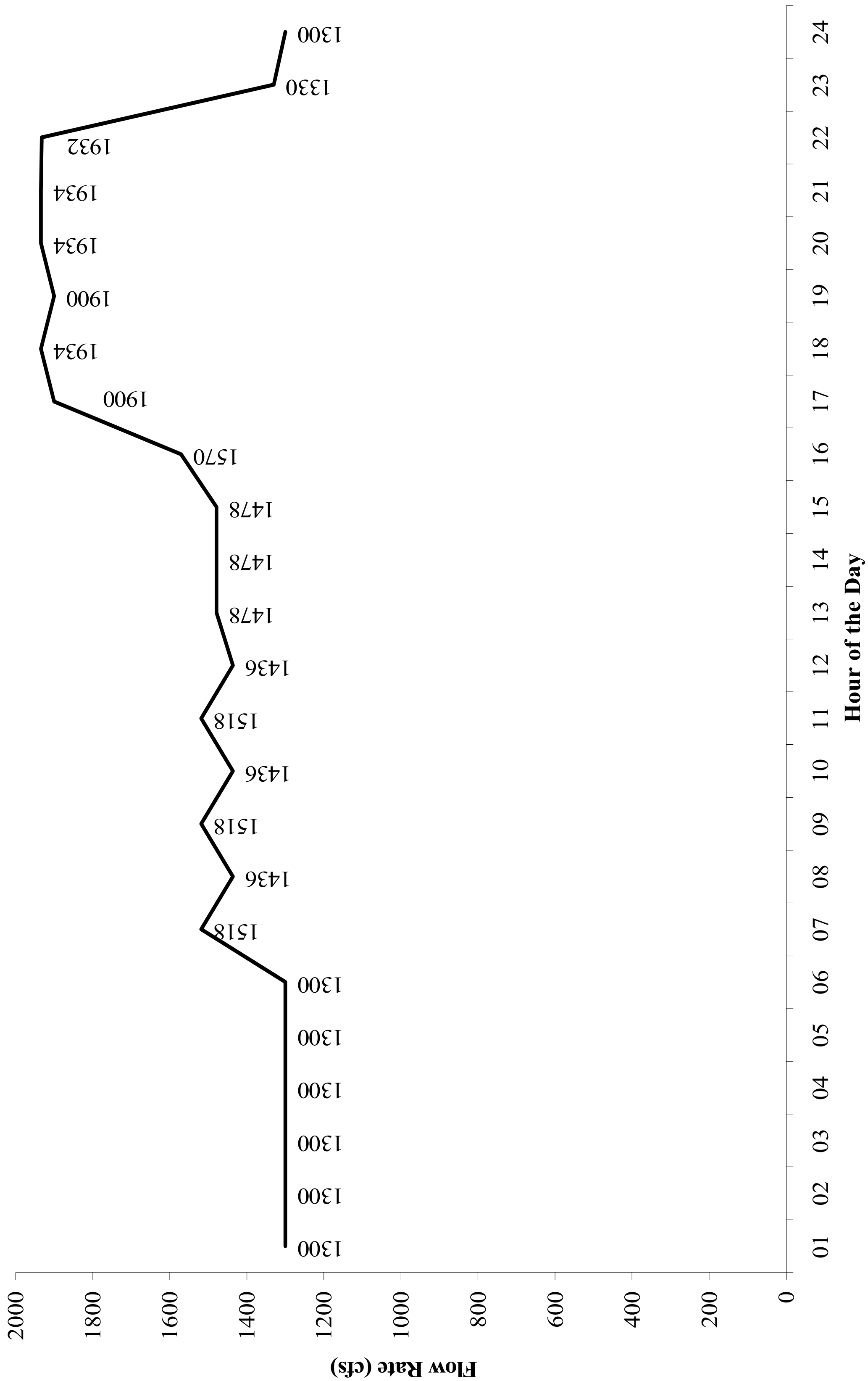

Figure 3.6. Minor Violation of Single Daily Hump Agreement on August 16, 1996.

The Flaming Gorge model contains a database of historical inflows. Since future inflows beyond the near future (i.e., 2 to 6 months) are largely unpredictable, these historic inflows are used to predict numerous possible outcomes. The hydrologic inflows from 1921 through 1985 were adjusted for upstream regulation, projected consumptive uses, and losses at inflow points in the basin. The first year that Yampa data were collected is 1921, marking the beginning of the historical sequence, and 1985 is the last year that reliable and consistent data were compiled.

The Flaming Gorge model simulated Flaming Gorge for the period from January 2002 through December 2040 using the state of the reservoir at the end of December 2001 as the initial condition. To assess future hydrologic uncertainty, the model was run in an “index sequential mode.” In this mode, the model is run multiple times, where each run is based on a different hydrologic trace extracted from the historic record (***Labadie, et al., 1990)***. The first trace uses the adjusted historic sequence in which 1921 hydrology is assumed to occur in 2002 and hydrology for 1922 is used to represent 2003. These hydrology assignments continue sequentially through 2040 in which it is assumed that 1960 hydrology will be repeated. The second trace is similar to the first except that historic hydrology assignment begins with 1922 data instead of 1921. Therefore, 2002 is assigned 1922 hydrology data and 2003 is assigned 1923 data.

Using the index sequential method, a total of 65 possible monthly and daily futures were projected for each alternative. It is assumed that any one of these historical inflow sequences may be repeated in the future and that each trace has an identical probability of occurrence in the future.

Since the Flaming Gorge model contains a database with known inflow traces (i.e., it contains a perfect forecast of the future), it would be unrealistic to use that information to simulate Flaming Gorge Dam operations. Therefore, forecast errors are computed and subtracted from the perfect inflow forecast to produce a more realistic simulation of the future. In the model, dam operators make decisions based on the imperfect forecast, but the unadjusted inflows (i.e., inflows with no errors) occur. Errors resulting from imperfect forecasts propagate to subsequent months since it is assumed that each month’s forecast error is correlated to the previous month’s error. Reclamation staff developed equation 4.1, a hydrology forecast error equation.

$$E_i = a_i x_i + b_i E_{(i-1)} + c_i + z_r d_I \tag{4.1}$$

where

E_i	= the error in the forecast for the current month in million acre-feet;
$E_{(i-1)}$	= the forecast error for the previous month;
x_i	= the natural inflow into the Flaming Gorge Reservoir for the current month through July;
z_r	= a randomly determined mean deviation taken from a normal distribution; and
d_i	= the standard error of the estimate for the regression equation.

The regression coefficients a_i, b_i, and c_i are based on a multiple linear regression analysis of actual inflows and forecasted values over the 1965 to 1999 time period.

The Flaming Gorge model operates the system using the forecast trace and a set of system operator rule sets. The rules that are input into the model are consistent with the restrictions specified by a FGEIS alternative. Errors associated with the forecast incorporate uncertainty into the model and help to facilitate the simulation of operator decisions with inflow uncertainty. Based on the forecast, the Flaming

Gorge model simulates operations at the Flaming Gorge Dam such that it will usually comply with alternative specifications. However, forecasted flows do not always come to fruition and the model will at times violate one or more FGEIS alternative flow requirements; that is, there is some probability that there will be a flow violation at the Jensen Gauge.

It is impractical from a computational standpoint to perform detailed economic analyses for all 65 possible hydrologic traces; therefore, Reclamation staff selected the 37th hydrological trace (i.e., run 36) as a representative sequence of future inflows. This trace was selected since inflow volumes for the first 20 years is the closest to the mean inflow volume of all 65 traces. The trace is used in this analysis to simulate powerplant operations and to estimate the economic benefits associated with the alternatives.

4.2 SSARR Model

The Streamflow Synthesis and Reservoir Regulation (SSARR) model is a numeric model of the hydrology of a river basin system SSARR User Manual. It was initially developed by the U.S. Army Corps of Engineers North Pacific Division to assist hydrological systems analysts for the planning, design, and operation of water control works. The SSARR model was further developed for operational river forecasting and river management activities in connection with the Cooperative Columbia River Forecasting unit, sponsored by the National Weather Service, U.S. Corps of Engineers, and the Bonneville Power Administration. Numerous river systems in the U.S. and abroad have been modeled with SSARR by various agencies, organizations, and universities.

SSARR is comprised of a generalized watershed model and a stream flow and reservoir regulation model. The watershed model simulates rainfall-runoff, snow accumulation, and snowmelt-runoff. Algorithms are included for modeling snow pack cold content, liquid water content, and seasonal conditioning for melt. Interception, evapotranspiration, soil moisture, base flow infiltration, and routing of runoff into system streams are accounted for. The river system and reservoir regulation model routes stream flows from upstream to downstream points through channel and lake storage, and reservoirs under free flow or controlled-flow modes of operation.

The basic routing method used in the watershed and river models is a “cascade of reservoirs” technique, wherein the lag and attenuation of the flood wave is simulated through successive increments of lake-type storage. A channel is represented as a series of small “lakes” that represent the natural delay of runoff from upstream to downstream points.

In this analysis, SSARR is used to forecast the hourly flows at the Jensen Gauge. SSARR is given both hourly Flaming Gorge water releases as determined by the Generation Optimization (GenOpt) model and Yampa inflow data from the Flaming Gorge model. Upon completion of a SSARR simulation, the resulting gauge flows are examined to determine if Flaming Gorge water releases will result in a violation at the Jensen Gauge. If any violation is found, then the GenOpt model is run again with a revised set of input data. This process is repeated until an acceptable solution is found.

4.3 AURORA Model

Electricity generated from the Flaming Gorge powerplant is injected into the power grid to serve system loads. Since utility systems are connected via transmission lines, the value of this energy is a function of system dynamics and constraints over a large geographical area; that is, the Western Systems Coordinating Council (WSCC) region. The economic value of Flaming Gorge energy is set equal to the spot price of energy times the quantity of electricity injected into the grid.

Projections of future spot prices for this analysis are based on AURORA model simulations. This model has been used in the past to simulate the WSCC region for the Bonneville Power Administration (BPA). AURORA uses fundamentals of competitive markets to forecast hourly electric prices (***http://www.epis.com/products/AURORA/aurora.htm)***. The pricing structure used by AURORA satisfies the requirements of both supply and customer demand in a dynamically changing competitive energy market. In AURORA, the hourly pricing of energy is determined by the economic dispatch of regional resources to meet regional energy requirements. The model incorporates hourly information on demand, supply, fuel costs, transmission costs, and availability. The hourly dispatch of resources is based on the lowest cost resource available to meet customer demand. The energy price at any time is the cost of the last resource that is dispatched into each market area. Spot prices vary among market areas and energy delivery points to reflect regional production costs, transportation costs, and transmission line constraints. Price projections also reflect numerous assumptions concerning the future such as delivered utility fuel prices, electricity demand growth rates, changes in hourly electricity consumption patterns, and advancements in generation technologies.

Since AURORA model simulations span many years, additional capacity must be constructed in the future to meet the growing demand for electricity. The model projects a capacity expansion path based on an open utility market structure. Spot prices reflect these new capacity additions and their impact on the market.

Flaming Gorge energy injections into the grid are very small compared to total WSCC loads. Therefore, it is assumed that power injections into the grid for both alternatives will not change regional electricity prices.

4.4 GENOPT Model

The GenOpt model optimizes the economic value of electricity generated at Flaming Gorge while complying with all powerplant operational constraints. The model uses the same approach as the Generation and Transmission Maximization (GTMax) model that was used for a number of studies conducted by Western and Argonne to evaluate the economic value of power resources in the CRSP system. GenOpt was constructed to customize the mathematical formulation of the problem for the purposes of the FGEIS. Also, the customization streamlined the modeling process and significantly decreased simulation runtime.

The Flaming Gorge powerplant in GenOpt is modeled as a single generating entity. Under this representation, the three units at the plant turn on and off as many times as necessary during a simulated period in order to maximize the economic value of the hydropower resource. This may entail turning a turbine on and off several times in a single day.

The model's objective function, shown in equation 4.2, is to maximize the value of water releases from the Flaming Gorge Dam. The value of the plant power is maximized when the plant's limited water potential is used to generate energy when market prices are the highest.

$$\text{Max} \sum_{h} Gen_h \times SP_h, \tag{4.2}$$

where

Gen_h = Generation in Mega-watt hours (MWh) during hour h; and

SP_h = spot market price ($/MWh) during hour h.

The spot price of electricity, SP_h, in the above equation is a model input and for this study is based on AURORA model projections.

Water that is released through the turbines is converted to electricity and sold to the market. As shown in equation 4.3, the amount of water and associated generation is based on block-level conversion factors. These conversion factors are a function of both the reservoir elevation level and the designation of powerplant block.

$$TR_h = \sum_b BGEN_{b,h} / CF_{b,e}, \quad \text{where} \tag{4.3}$$

TR_h = turbine water release (cfs) during hour *h,* for power block *b*;

$BGEN_{b,h}$ = generation from powerplant block *b* during hour *h*; and

$CF_{b,e}$ = power conversion factor (MWh/cfs) for powerplant generating block b at reservoir elevation e.

Each generation block has a defined limit that is specified in equation 4.4. The block limits are a function of several factors such as reservoir elevation level, maximum turbine flow rates, and turbine efficiencies. These limits and associated power conversion factors are input into the model. The procedure used to determine values for these parameters is described in section 5.

$$BGEN_{b,h} \le BLOCKMAX_{b,e}, \tag{4.4}$$

where

$BLOCKMAX_{b,e}$ = maximum power output (MW) for block *b.*

Except for the second block, all other blocks in GenOpt must have a lower conversion factor than the one loaded before it; for example, block 3 must be more efficient than block 4. As discussed in section 5.1, this simplifying assumption may result in minor errors when estimating powerplant output levels; that is, errors are less than 3 MW.

Blocks and associated conversion factors are defined such that the first block is the amount of power that is generated at the minimum mandatory release rate. As specified in equation 4.5, the minimum average hourly release for all hours is 800 cfs. This minimum release rate applies to both alternatives.

$$800 = BGEN_{1,h} / CF_{1,e} \tag{4.5}$$

Electricity that is sold at spot market prices in equation 4.1 is computed by summing up the generation levels for all blocks as shown in equation 4.6.

$$GEN_h = \sum_b BGEN_{b,h}, \tag{4.6}$$

As formulated in equation 4.7, total dam water releases are a function of both turbine and non-turbine releases. Under certain wet hydrological conditions and spike flows it may be necessary to release some water through the dam's bypass tubes and spillways. Typically, the GenOpt model will only spill water when the powerplant is generating at its maximum capability during all hours of a simulated period or as required to simulate a spring spike. Note that non-power water releases are not associated with generation in equation 4.3 and therefore do not increase the objective function value given in equation 4.2.

$$DR_h = TR_h + NTR_h, \tag{4.7}$$

where

DR_h = water release (cfs) from the Flaming Gorge Dam in hour h; and

NTR_h = non-turbine water release (cfs) from Flaming Gorge through bypass tubes and spillways in hour h.

The average water release rate during a day is computed by equation 4.8. It equals the sum of all hourly releases in a day divided by 24 hours.

$$ADR_d = \sum_{h=1,24} DR_h / 24, \tag{4.8}$$

where

ADRd = average daily water release (cfs) from the Flaming Gorge powerplant during day d.

Maximizing the economic value of water releases is subject to powerplant operational constraints. One such constraining factor limits the amount of water that can be released during a specific time period. For the No Action and Action Alternatives during a spike release period, the average daily flow must equal the amount that is specified by the Flaming Gorge model. This restriction also applies to both alternatives (refer to table 3.1). It is represented in the model by equation 4.9. To maximize the value of the hydropower resource, the GenOpt model releases as much water as possible through turbines when spot market prices are the highest. During low priced periods water releases are at a minimum.

$$ADR_d = GRDR_d, \tag{4.9}$$

where

$GRDR_d$ = average daily Flaming Gorge water release (cfs) from Flaming Gorge model.

As shown in equation 4.10 water releases in GenOpt over a multiple-day period must equal the total amount that is specified by Flaming Gorge model simulations. Typically this multi-day period equals one week.

$$\sum_d ADR_d = \sum_d GRDR_d \tag{4.10}$$

Equations 4.11 and 4.12 restrict the change in hourly water releases from the dam. Water releases from one hour to the next for both increasing levels and decreasing levels cannot differ by more than 800 cfs. The GenOpt model starts multi-hour ramping periods such that it can obtain maximum generation levels when prices are the highest and relatively low generation when electricity prices are inexpensive.

$$DR_h - DR_{h+1} \leq 800 \tag{4.11}$$

$$DR_{h+1} - DR_h \leq 800 \tag{4.12}$$

The single daily hump restriction is assured by equations 4.13 and 4.14. It is assumed that the lowest release rate (i.e., generation level) of the day will occur during hour, *h*, that has the lowest spot price; that is the minimum daily SP_h. On the other hand, release rates are the fastest during the hour of the day with the highest spot prices.

$$DR_{h-1} - DR_h \geq 0 \tag{4.13}$$

for hours, *h*, of the day that are from midnight to the hour with the lowest daily spot price, SP_h, and also for hours of the day from the highest spot price until the last hour of the day.

$$DR_h - DR_{h-1} \geq 0 \tag{4.14}$$

for hours, *h*, of the day that are from the hour with the lowest daily spot price to the hour with the highest spot price.

GenOpt also includes equation 4.15 that relates Flaming Gorge releases and Yampa inflows to flows at the Jensen Gauge. These flows are calculated only when there are gauge constraints as specified in tables 3.1 and 3.2.

$$JF_h = AYF_m + \sum_{p=\min l, \max l} \mathrm{DR}_{h-p} \mathrm{WLF}_p , \tag{4.15}$$

where

- JF_h = GenOpt estimate of stream flow (cfs) at the Jensen Gauge in hour *h*;
- AYF_h = average inflows from the Yampa (cfs) during month *m*;
- WLF_p = fraction of Flaming Gorge water that reaches the Jensen Gauge *p* hours after it has been released from the dam;
- *minl* = the minimum time, in hours, that a Flaming Gorge water release takes to travel to the Jensen Gauge; and
- *maxl* = the maximum time, in hours, that a Flaming Gorge water release takes to travel to the Jensen Gauge.

The water lag factors, *WLF*, in equation 4.15 represent the relationship between water releases from the Flaming Gorge reservoir and water flows at the gauge. As a wave of water travels downstream from the Flaming Gorge Dam it attenuates or flattens out as it travels downstream. This attenuation becomes more pronounced the farther the wave travels downstream from the dam. Also, the farther downstream a given point (e.g., a gauge) is from the dam, the longer it takes for the wave of water to reach it. It usually takes a minimum of about 20 to 25 hours for a water release from Flaming Gorge to register at the Jensen Gauge.

Figure 4.2 shows a model run in which water releases are constant in all but the first hour of a SSARR simulated period. During the first hour a relatively high volume of water (i.e., wave of water) is released. The SSARR model projects that 24-hours (i.e., *minl*) after the pulse release from Flaming Gorge, water flows at the Jensen Gauge begin to increase above the base level. About 35 hours after the high volume release, the flow rate at the Jensen Gauge is at a peak and after 50 hours (*maxl*) water flow rates return to the base level.

A *WLF* relates the fractional amount of water from a Flaming Gorge release that will pass the Jensen Gauge in a one-hour time period and the time that it takes that portion of the water to travel to the gauge. As shown in figure 4.3, about 9.9 percent of the wave's water volume flows past the gauge during the 35th hour after the water was released from the dam. Hours both prior to and after the 35-hour lag time have smaller amounts of water that flow past the gauge.

The *WLF*s roughly form a bell-shaped distribution. Typically this distribution is skewed to the left toward shorter travel times. The sum of the water lag factors equals 1.0; that is, it is assumed that all of the water released from the Flaming Gorge Dam flows past the Jensen Gauge at some time in the future.

In addition to operational constraints at the dam, the GenOpt model also restricts Jensen Gauge flows. Equation 4.16 is used to compute the daily average flow at the gauge.

$$AJF_d = \sum_{h=1,24} JF_h / 24, \tag{4.16}$$

where

AJF_d = average daily flow rate (cfs) at the Jensen Gauge.

For the No Action Alternative all daily average flows at the gauge are constant from one day to the next over a multi-day period; that is, a month period or from the end of the spike period through the end of the month. Equation 4.17 ensures that daily average flows passing the gauge are identical.

$$AJF_d - AJF_{d+1} = 0 \tag{4.17}$$

Both the No Action and Action Alternatives also restrict gauge flows within a day. Equation 4.18 restricts the intra-day hourly flows.

$$AJF_d \times (1 - LGL_d) \leq JF_h \leq AJF_d \times (1 + UGL_d) \tag{4.18}$$

where

UGL_d = gauge upper flow limit (fraction) for day *d* (e.g., 0.125 for the No Action Alternative); and

LGL_d = gauge lower flow limit (fraction) for day *d* (e.g., 0.125 for the No Action Alternative).

As described in section 3.1, Jensen Gauge flows are limited to 12.5 percent of the daily average for the No Action Alternative. The lower and upper gauge limits for the Action Alternative are based on 0.1-meter stage change. The daily average flow rate along with the river stage plot shown in figure 3.3 are used to express the limits in terms of a fraction.

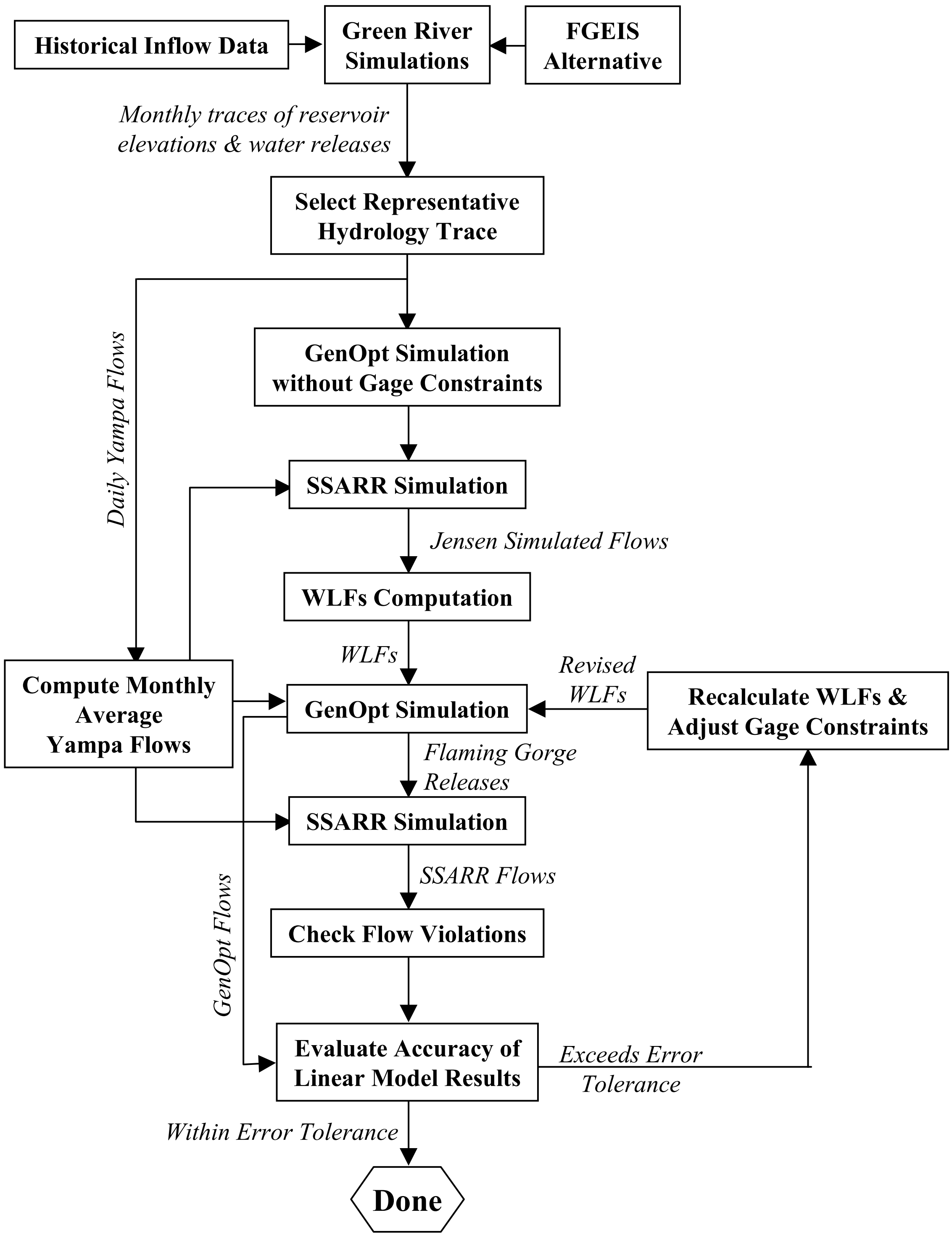

Figure 4.1. Overview of the Flaming Gorge Power Modeling Package.

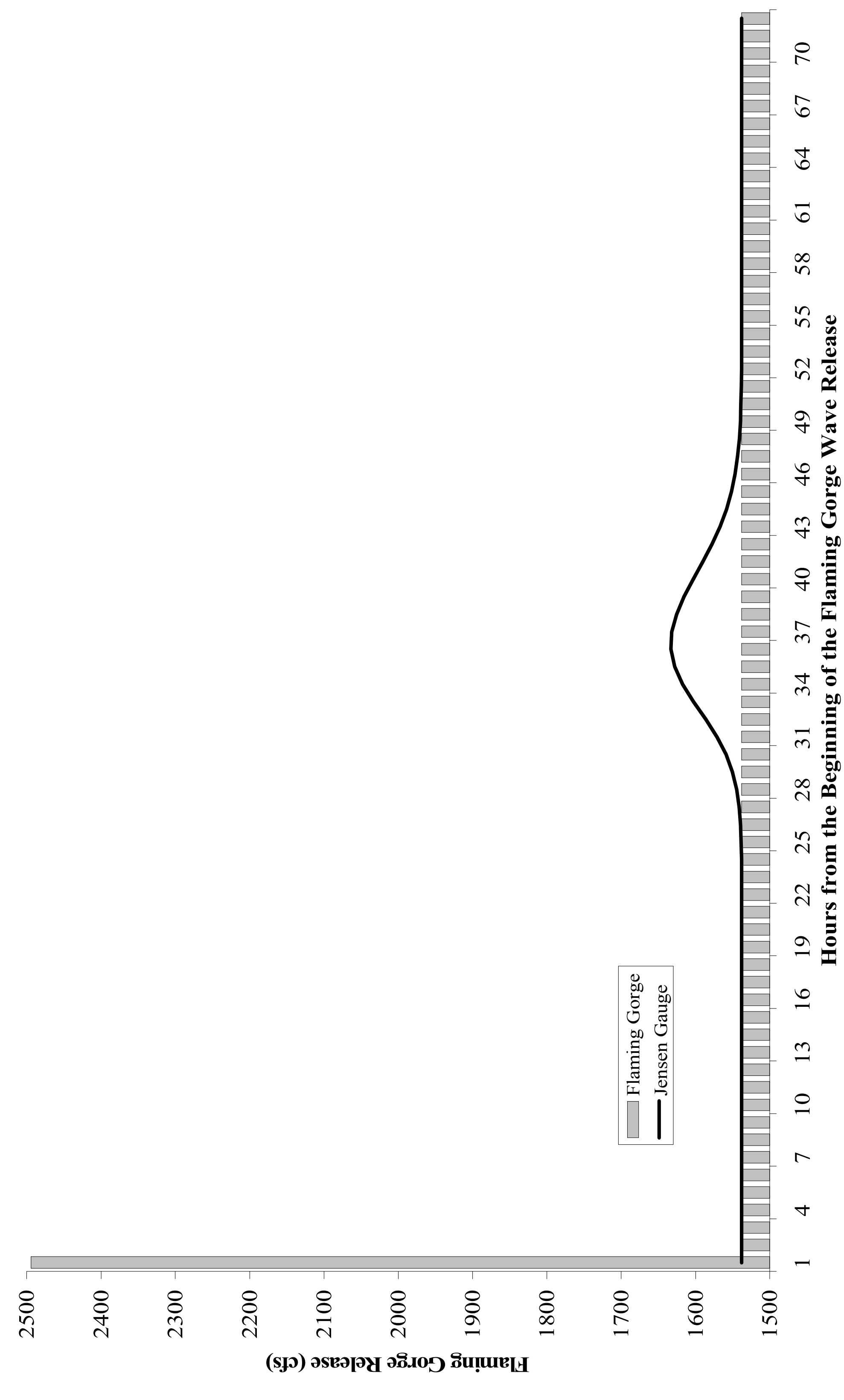

Figure 4.2. Travel Time for a Wave of Water Released From Flaming Gorge to the Jensen Gauge.

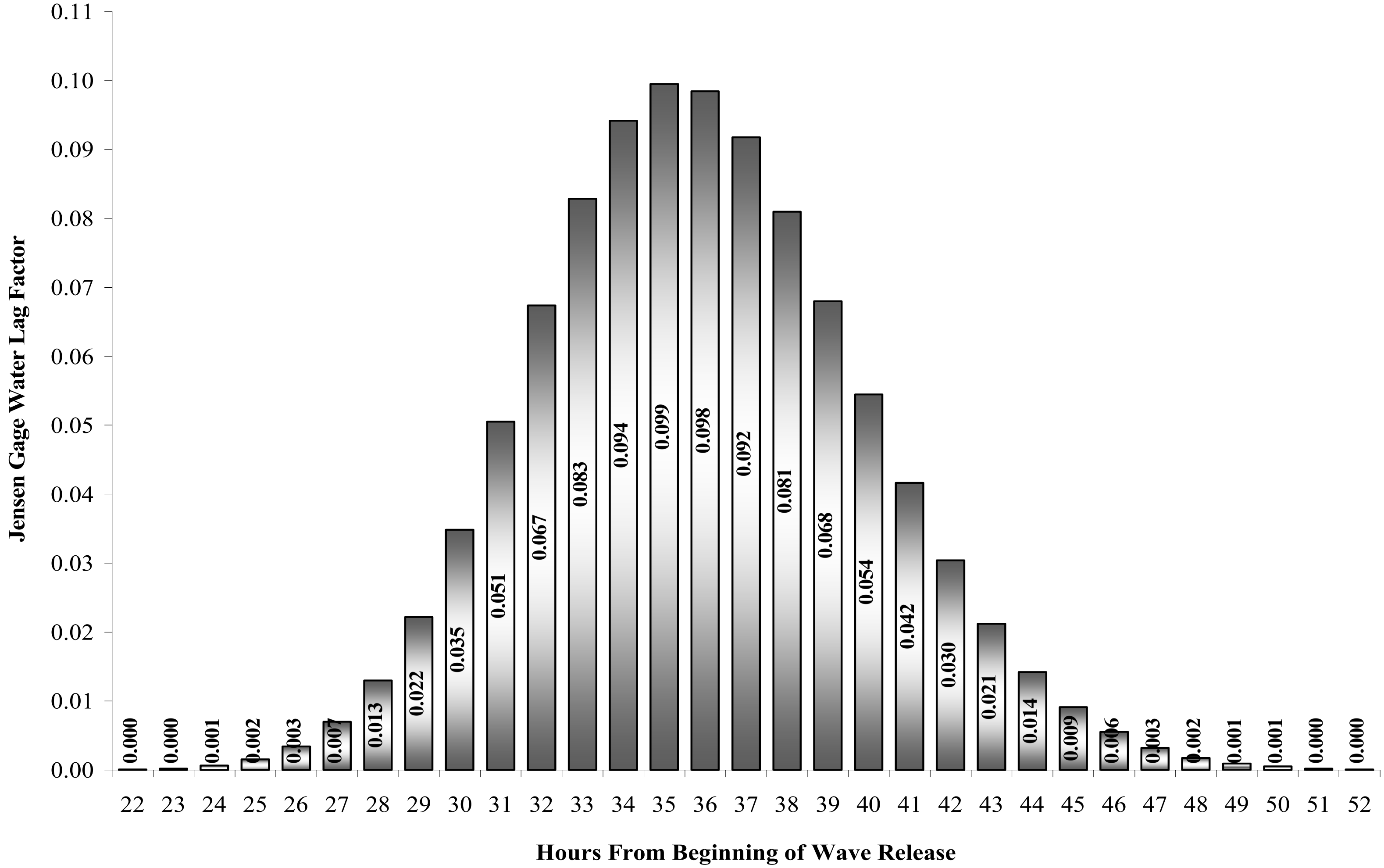

Figure 4.3. Water Release Lag Factors for Flaming Gorge Travel to the Jensen Gauge.

4.5 WL Algorithm

The Water Lag (WL) algorithm computes *WLF*s based on SSARR simulations of Green River flows at the Jensen Gauge. The objective of the model, shown in equation 4.19, is to compute a set of *WLF*s that minimizes gauge flow differences estimated by equation 4.15 and those estimated by SSARR.

$$\text{Min} \sum_h ABS(SJF_h - JF_h), \tag{4.19}$$

where

SJF_h = stream flow (cfs) at the Jensen Gauge estimated by SSARR.

The *WLF*s are based on a known set of water releases and Yampa inflows that are identical to the ones used as input into the SSARR model. The WL algorithm computes Jensen Gauge flows using equation 4.20. Both Yampa inflows and Flaming Gorge releases are known and the algorithm solves for *WLF*.

$$JF_h = AYF_M + \sum_{p=\min l, \max l} SDR_{h-p} WLF_p, \tag{4.20}$$

where

SDR_{h-p} = Flaming Gorge releases that are input into the SSARR model.

*WLF*s are subject to constraints provided in equations 4.21 and 4.22 that ensure that the shape of the *WLF*s follows a bell shaped curve as shown on figure 4.3. When the lag time, *p*, is less than the lag hour with the largest *WLF* (i.e., lag hour with the peak influence on the gauge), equation 4.21 requires that the *WLF* for the previous lag hour be less than the next lag hour. For example in figure 4.3, all *WLF*s for lags of 24 hours to 35 hours (i.e., hour with the largest value or 0.099) must be greater than or equal to the previous lag value.

$$WLF_{p+1} - WLF_p \geq 0 \tag{4.21}$$

For lag hours greater than the one with the largest *WLF*, equation 4.22 is used.

$$WLF_p - WLF_{p+1} \geq 0 \tag{4.22}$$

The lag time with the maximum *WLF* value is determined by running the SSARR model for numerous combinations of Flaming Gorge Dam releases and Yampa inflows. These runs were used to create the surface shown in figure 4.4. For example, when Yampa inflows are zero and 800 cfs is released from the Flaming Gorge Dam, the Jensen Gauge will have the highest *WLF* for lag hour 44.

As the release from Flaming Gorge increases from 800 cfs to approximately 3,500 cfs, the lag time to the maximum *WLF* (i.e., peak influence on the gauge) decreases from about 44 hours to about 28 hours. As

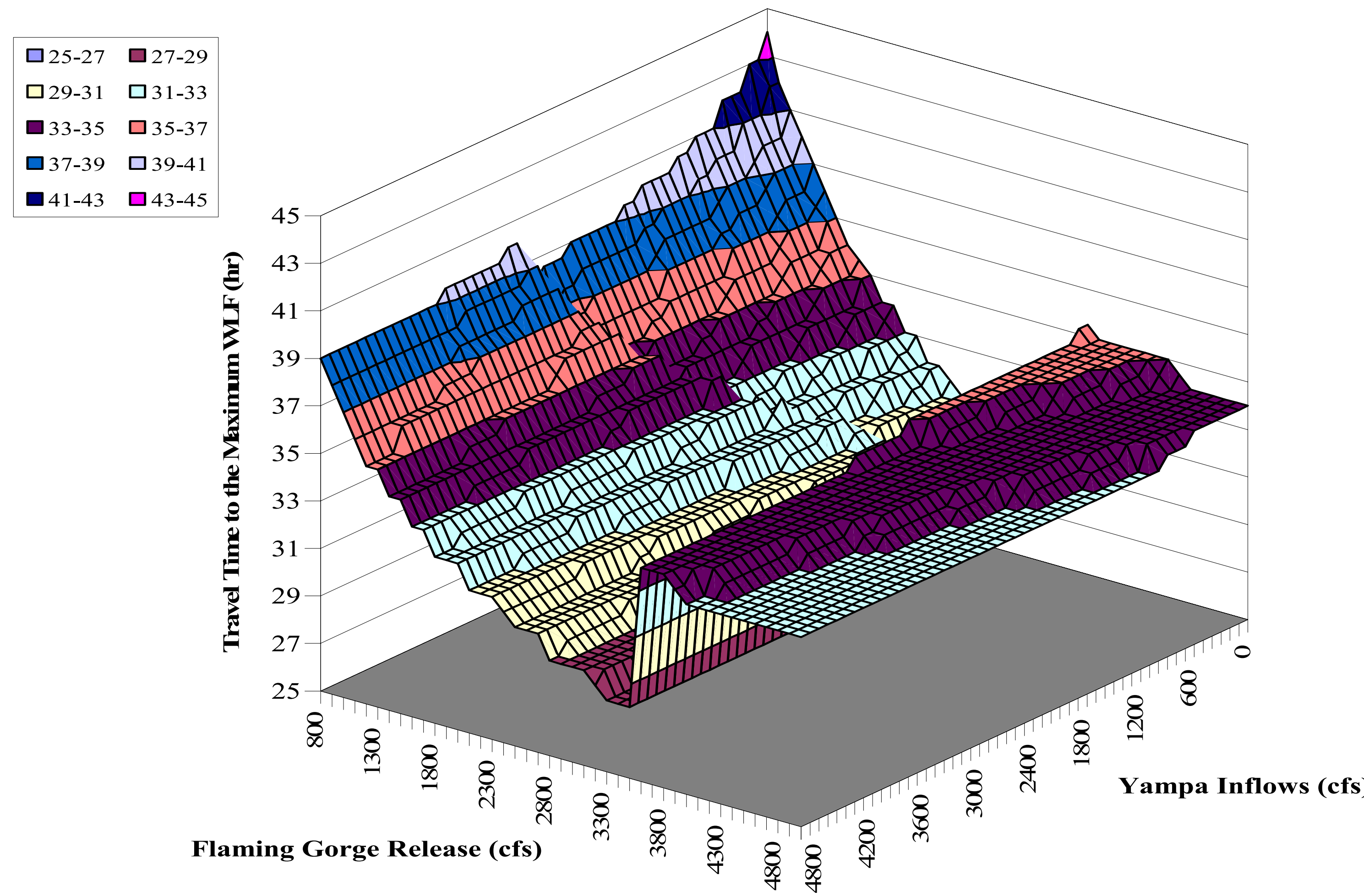

Figure 4.4. Travel Times for the Maximum WLF to Reach the Jensen Gauge as a Function of Flaming Gorge Releases and Yampa Inflows.

release rates increase beyond this level the lag time to the maximum *WLF* abruptly increases to about 35 hours. At higher release rates water spills out of the main river channel and the flow rate decreases. Flow rates above the 3,500 cfs level slowly shorten lag times.

Although less dramatic, a similar pattern is observed with Yampa inflows. Note in figure 4.4 for a Flaming Gorge release of 800 cfs that the lag time to the maximum *WLF* abruptly increases when Yampa inflows are greater than 2,500 cfs.

Based on Flaming Gorge model results for Flaming Gorge daily releases and Yampa inflows, the lag time with the largest *WLF* value was approximated. This lag time and the ones surrounding it are separately run through the WL algorithm. The GenOpt model uses the set of *WLF*s that yields the smallest error.

4.6 Model Integration

The main advantages of using equation 4.15 in the GenOpt model are that the equation is based on SSARR simulations and that the mathematical problem can be quickly solved. Also, since the equation is linear it can be directly incorporated into the GenOpt model making it possible to simultaneously maximize the economic value of hourly reservoir operations while complying with downstream flow restrictions. However, the linear representation of Jensen Gauge flows is only an approximation of the complex behavior of Green River flows. Despite these shortcomings, the linear representation in GenOpt produces flow estimates that are very similar to the ones output from SSARR provided that *WLF*s are estimated for a specific hydrological condition.

The determination of *WLF*s in the WL algorithm poses a problem since it requires a set of known Flaming Gorge releases, Yampa inflows, and SSARR flow simulation results for the Jensen Gauge. The GenOpt model can approximate Flaming Gorge releases, but equation 4.15 requires an estimate of *WLF*s as input data. This is a classic “chicken-and-egg” problem. As shown in the flow chart on figure 4.1, an iterative method is used to solve it. First, an initial GenOpt model is run with the assumption that there are no gauge constraints. In this simulation, equation 4.15 and gauge constraint equations 4.16 through 4.18 are not considered.

Next, the SSARR model is run with GenOpt’s initial estimates of Flaming Gorge releases. As shown in figure 4.5, this first SSARR simulation typically results in a gauge flow violation. Simulated flows for the No Action Alternative are about 200 cfs above the maximum limit and about 50 cfs below the minimum limit. Flaming Gorge water releases follow the spot market price trends with minimum releases at night when prices are the lowest and significantly higher releases during the day when prices peak. Daytime releases are almost 3.5 times higher than the minimum release rate.

Based on initial Flaming Gorge releases and SSARR results, the WL algorithm is then run to produce an initial set of *WLF*s. These *WLF*s are then input into GenOpt and the model optimizes Flaming Gorge releases such that both dam operational and Jensen Gauge constraints are not violated. The GenOpt model also estimates gauge flows. However, since the GenOpt gauge flow simulation is only a linear approximation, actual flows may violate gauge constraints based on the more detailed SSARR simulation. As shown in figure 4.6, gauge flows estimated by SSARR using the revised set of Flaming Gorge releases are about 30 to 40 cfs higher than the maximum limit during each day. Low flows, however, never violate the limit. Since the initial set of *WLF*s is based on Flaming Gorge releases without gauge constraints, the GenOpt model under- predicts peak gauge flows. However, compared to the initial simulation, gauge violations for the second GenOpt run are significantly smaller.

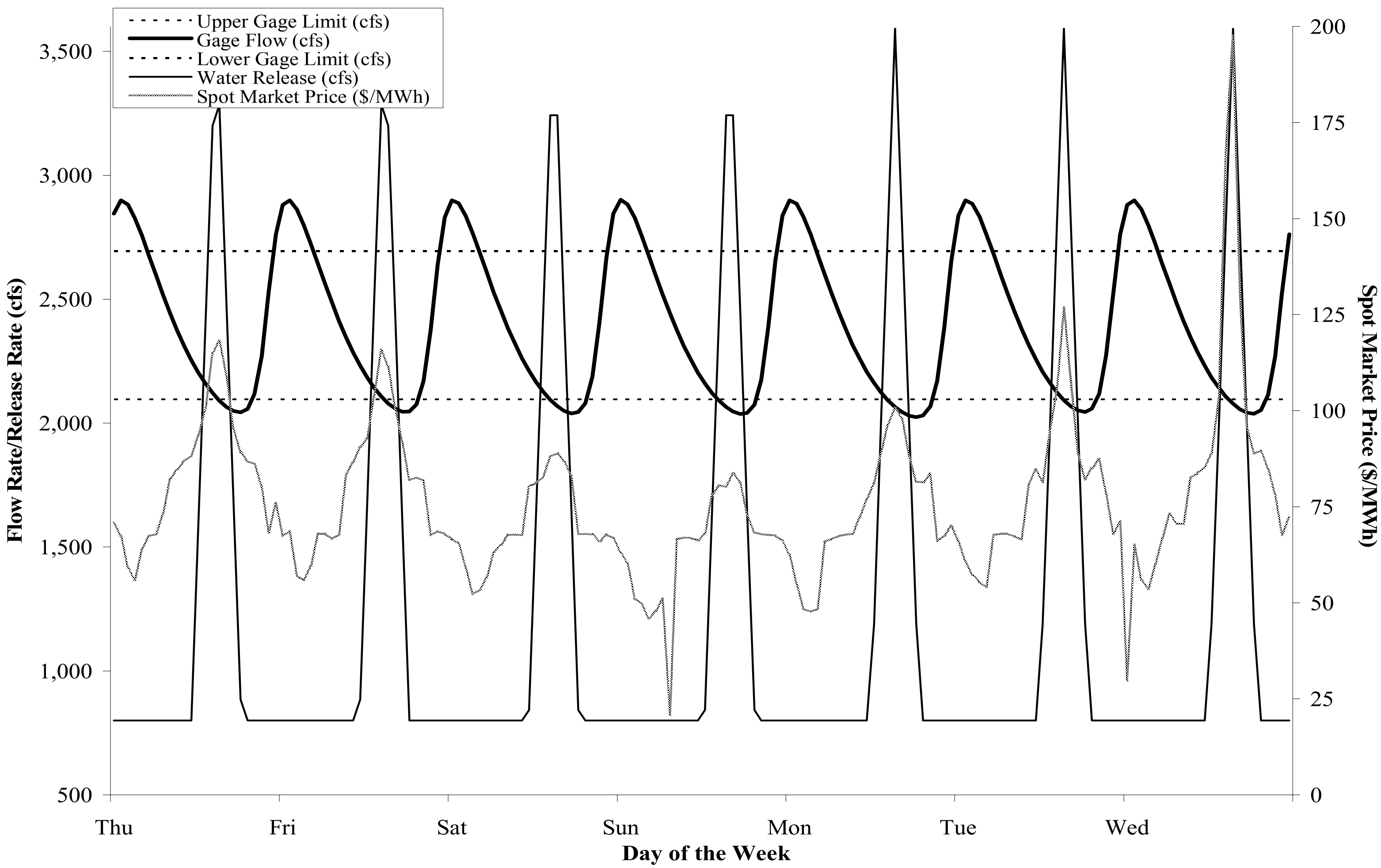

Figure 4.5. Flaming Gorge Releases and Simulated Jensen Gauge Flows Assuming No Gauge Constraints.

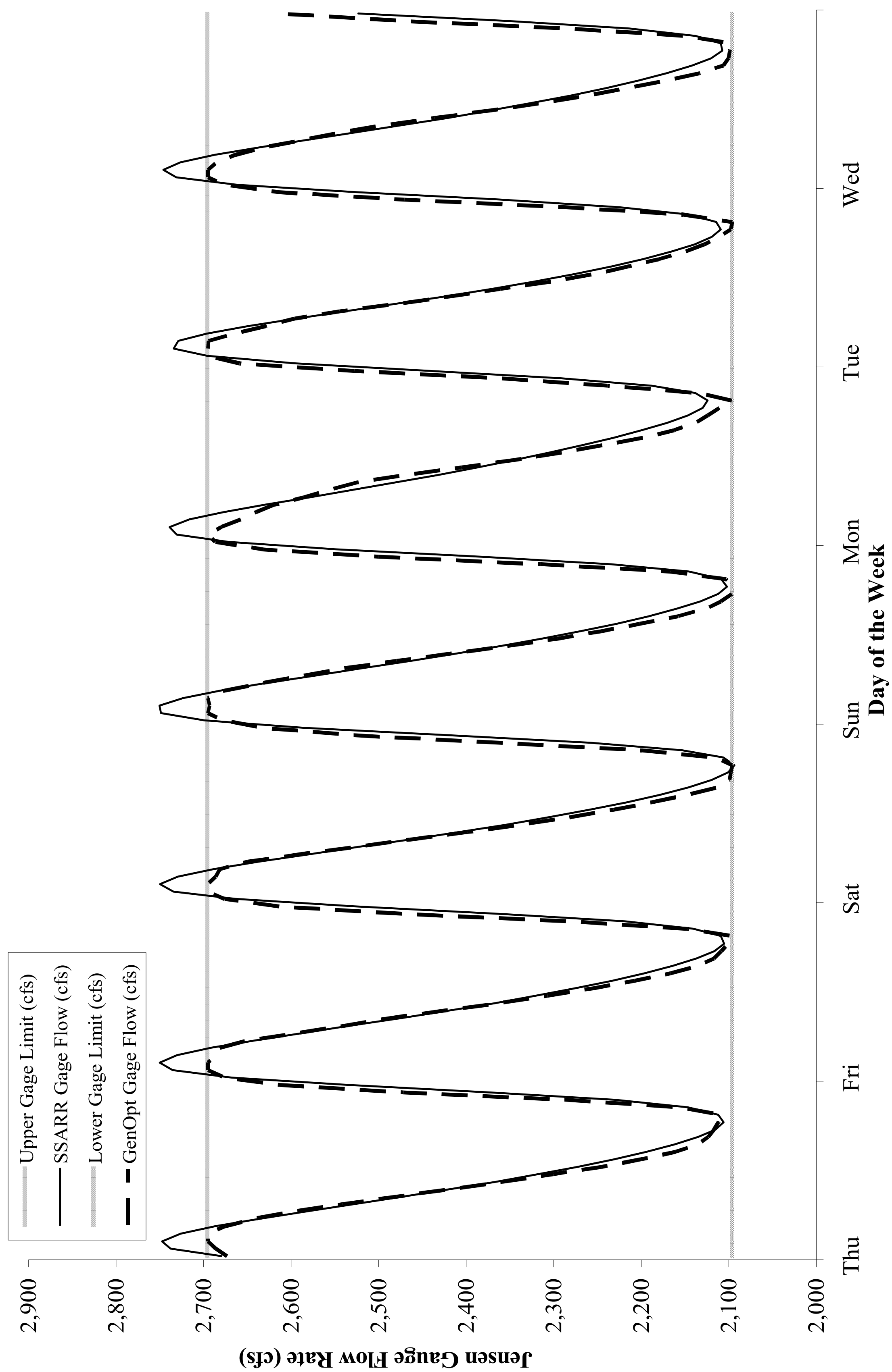

Figure 4.6. Comparison of Jensen Gauge Flow Estimated by the GenOpt and SSARR Models for the First Iteration.

Compared to the initial run without gauge constraints, peak releases from Flaming Gorge are lower; that is, from about 35,000 cfs to 29,000 cfs. As shown on figure 4.7, water releases during the peak hours were shifted to the less valuable shoulder hours. This shifting of water decreases peak Jensen Gauge flows and increases the lower flows.

The updated dam releases from GenOpt along with the new SSARR results are input into the WL algorithm to update estimates of *WLF*s. Since the *WLF*s are based on a set of Flaming Gorge releases that are closer to compliance than the initial set, the linear representation of Jensen Gauge flows improves.

The new *WLF*s are input into the GenOpt model and Flaming Gorge releases are recomputed. The SSARR model is also run again. Figure 4.8 shows that violations estimated by SSARR for the second iteration are very small; that is, about 5 to 25 cfs during peak flows. Also, compared to the first iteration, estimates of gauge flows by the GenOpt model are closer to SSARR simulations. As shown on figure 4.9, the lower violation level was the result of shifting more water from peak release periods to shoulder hours.

The process of sequentially running GenOpt, SSARR, and the WL algorithm continues in an iterative process until there are no gauge violations based on SSARR simulations. Figure 4.10 shows that results for the final iteration have no gauge violations as simulated by the SSARR model. Peak releases from Flaming Gorge are much lower than the initial run without gauge constraints and less water is released when it has the highest value.

Updating the *WLF*s via the iteration process may never achieve compliance in some situations since the linear representation produces results that do not always exactly match SSARR projections. In these situations a successive relaxation method is used to adjust the gauge limits input into GenOpt.

When compliance is not achieved after a user specified number of iterations, a gauge limit input into GenOpt is adjusted such that it is slightly more stringent than the one specified by an alternative. For example, if SSARR gauge flow simulations are over the limit by a maximum of 0.2 percent for the No Action Alternative, then the upper gauge flow limit input into GenOpt is lowered from 12.5 percent to 12.4 percent. That is, the gauge limit given to GenOpt is reduced by one-half of the violation level as expressed in equation 4.23 where the adjustment parameter, *UAP*, is set equal to 0.5.

$$AUGL_{i,d} = AUGL_{i-1,d} - (UAP_d \times UVL_d), \tag{4.23}$$

where

$AUGL_{d}$ = adjusted gauge upper flow limit (fraction) for day d and iteration i, where $AUGL_{1,d}$ is set equal to UGL_d;

UAP_d = upper flow limit adjustment parameter (fraction) for day d and iteration i; and,

UVL_d = maximum violation above the upper flow limit in day d (fraction).

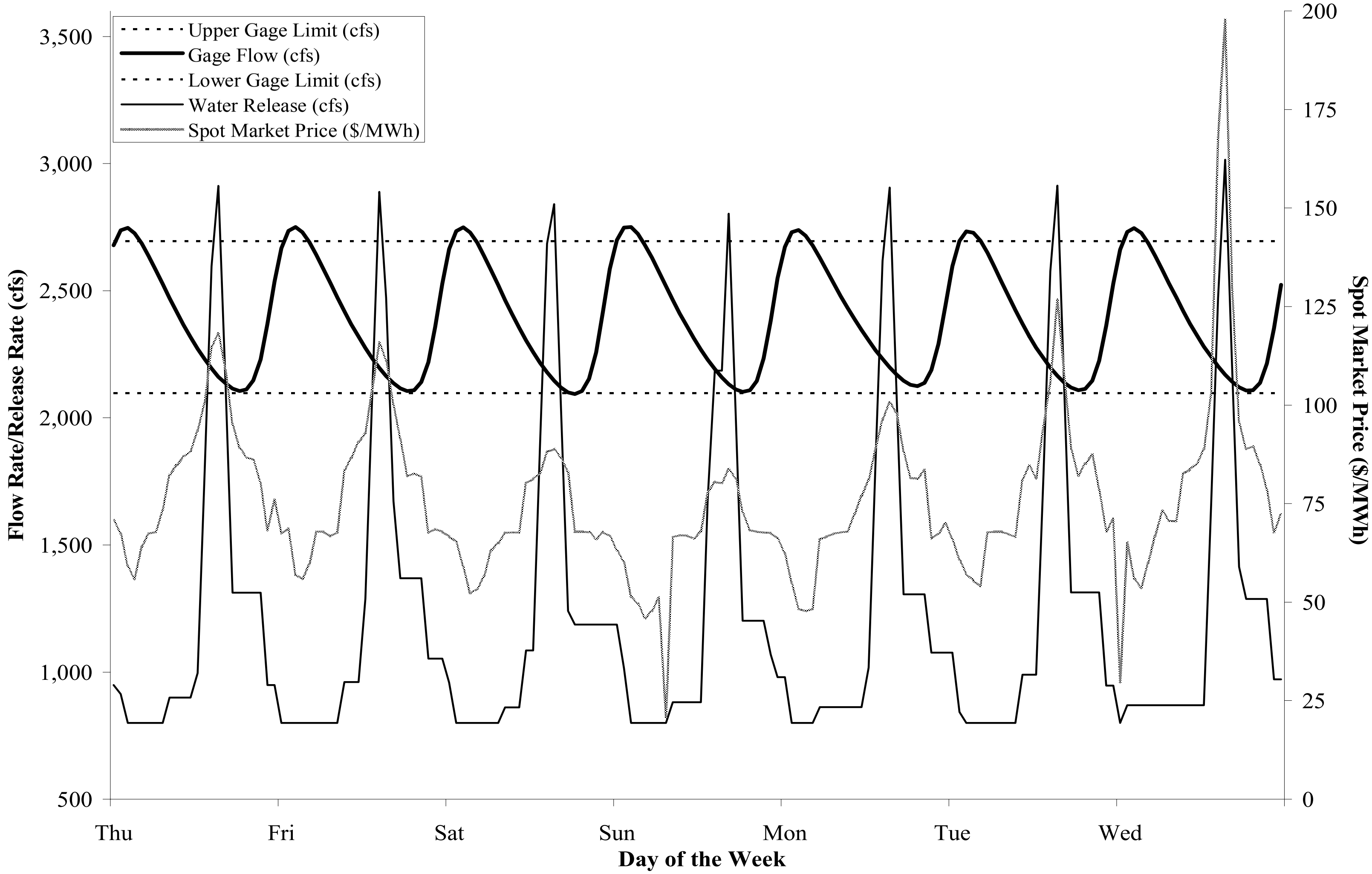

Figure 4.7. Flaming Gorge Releases and Simulated Jensen Gauge Flows for the First Iteration.

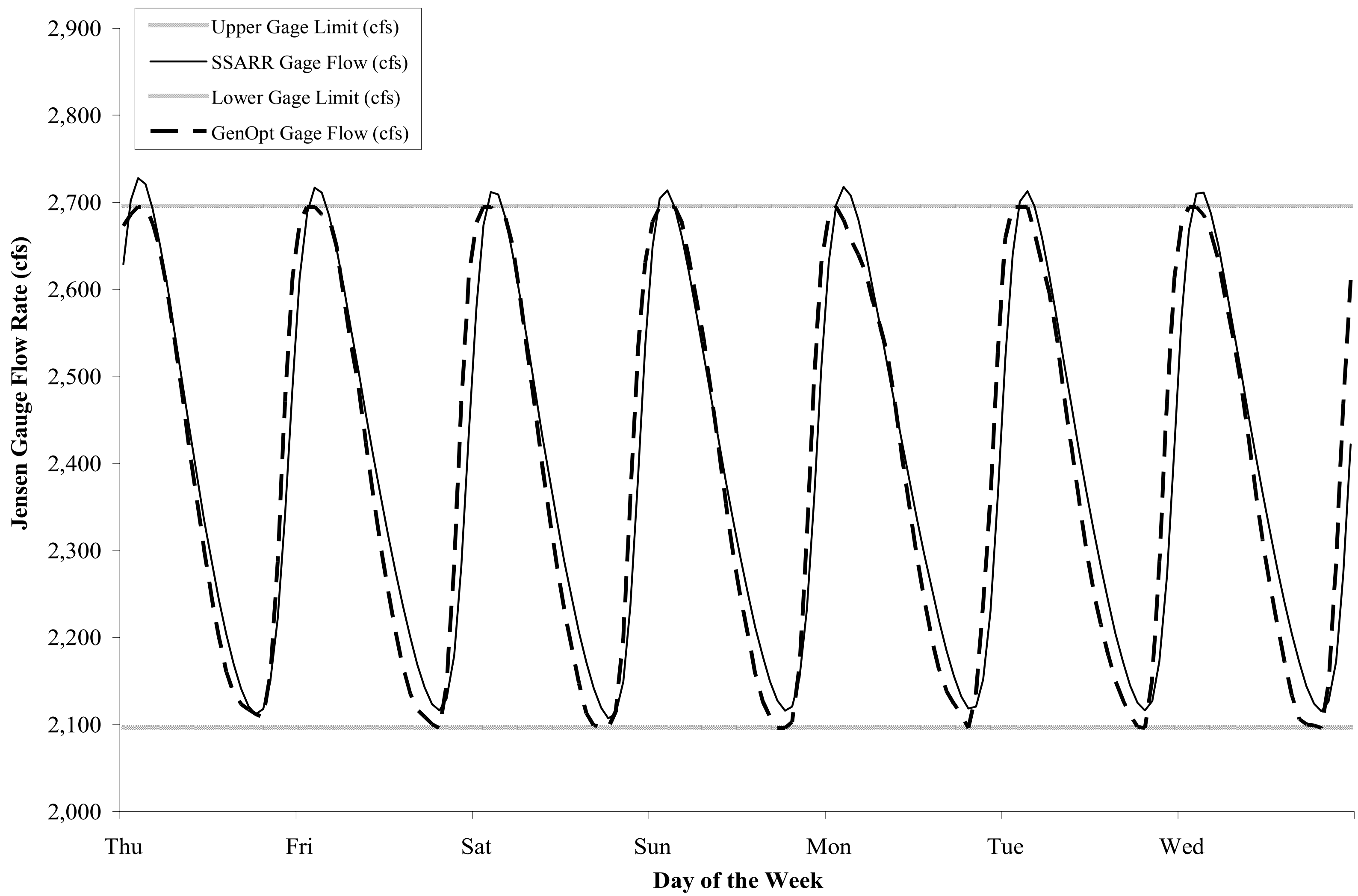

Figure 4.8. Comparison of Jensen Gauge Flow Estimated by the GenOpt and SSARR Models for the Second Iteration.

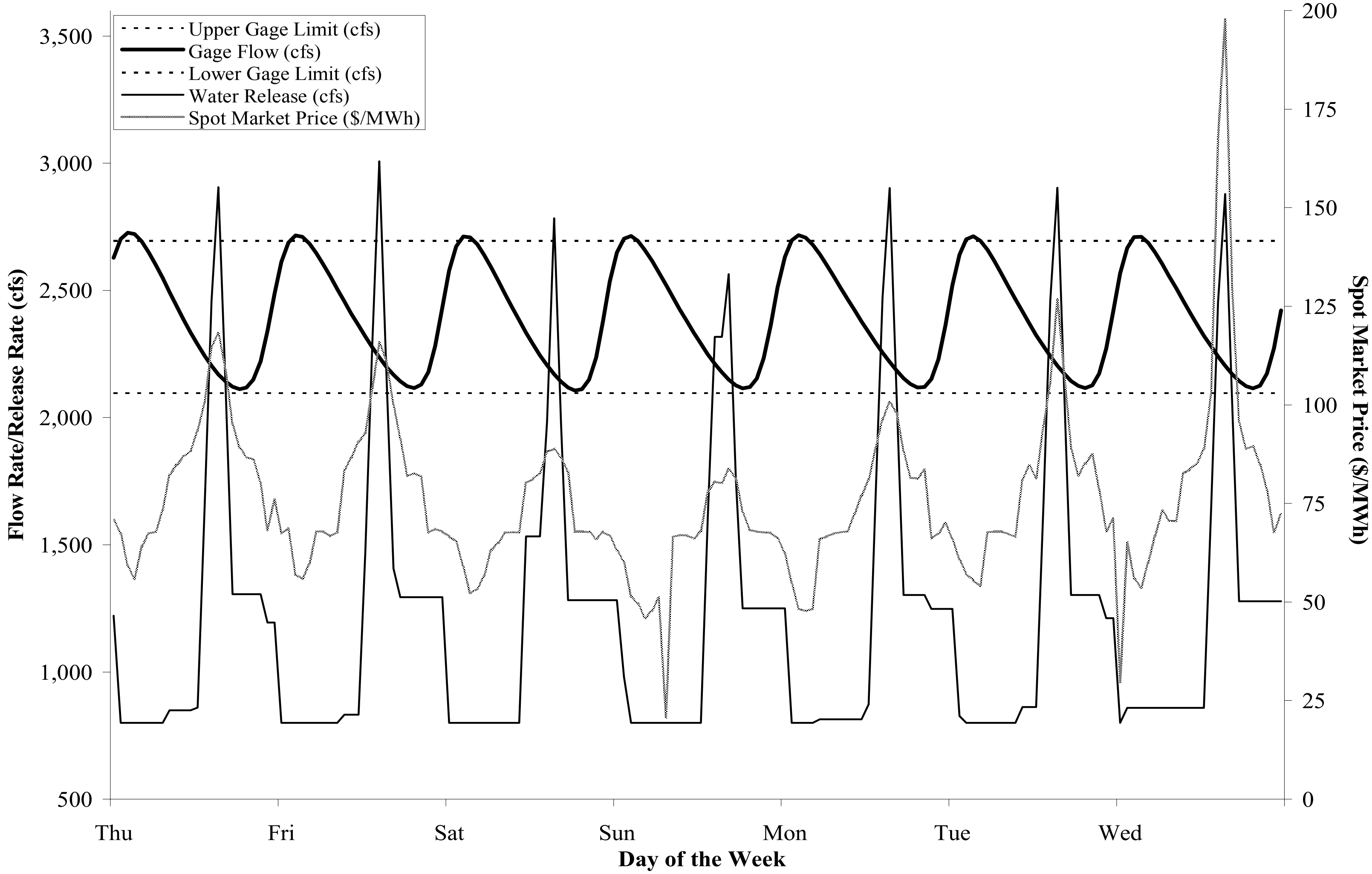

Figure 4.9. Flaming Gorge Releases and Simulated Jensen Gauge Flows for the Second Iteration.

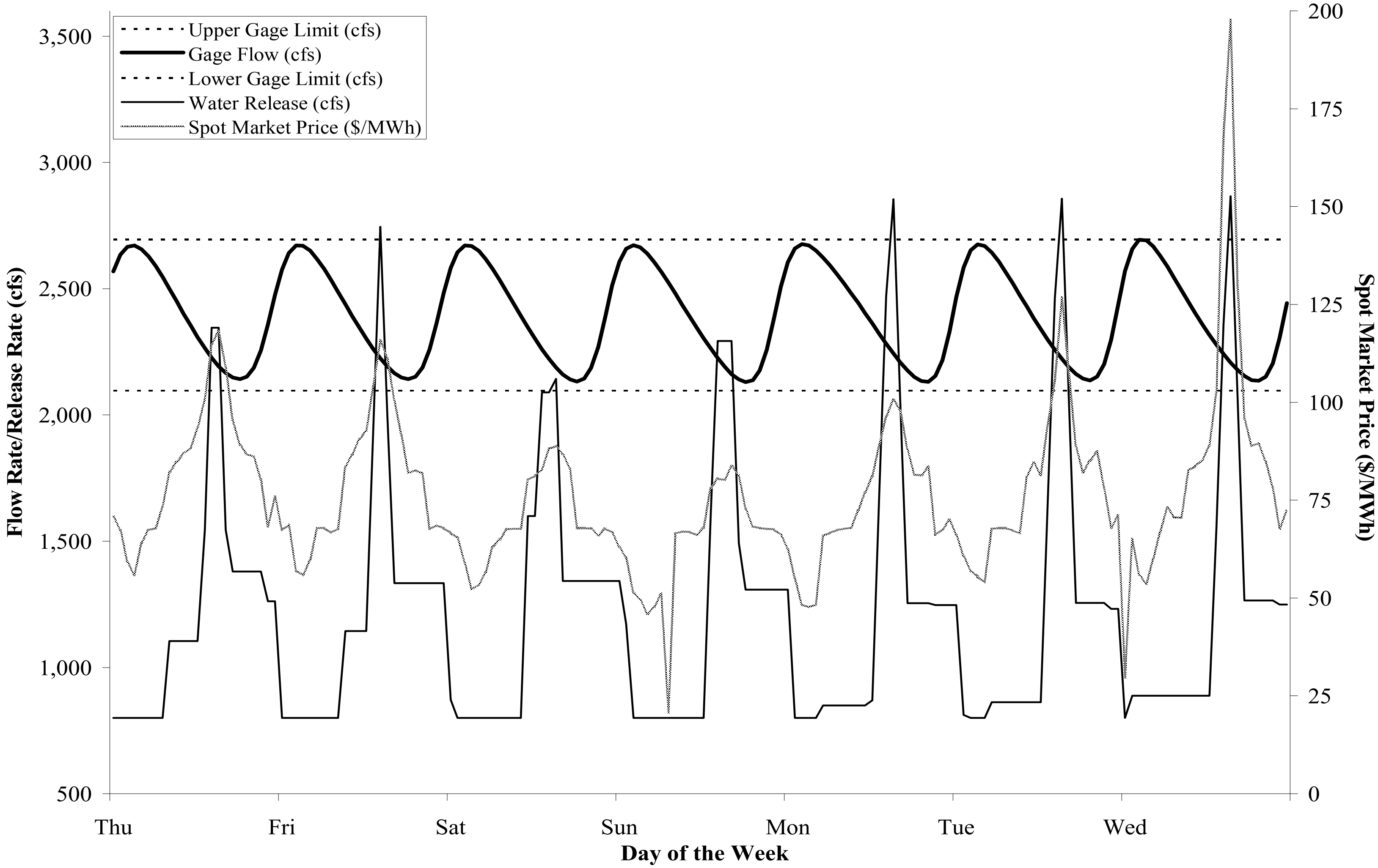

Figure 4.10. Flaming Gorge Releases and Simulated Jensen Gauge Flows for the Final Iteration.

The violation level, *VL*, can be either positive or negative. A positive value indicates a violation while a negative value indicates that the GenOpt model is over complying with gauge flow limits. Over compliance occurs when the difference between SSARR model simulated flow and the limit is greater than a user specified tolerance level and slack values for gauge constraint equations from GenOpt results are zero.

The adjustment parameter, *LAP*, changes or adapts among iterations. The number assigned to it is based on a set of rules that track the parameter's value relative to its previous assigned value and the number of directional changes (i.e., from + to – or vice-versa) of the violation, *LVL*, in all previous iterations. The rule set also places bounds on the adjustment parameter, *AP*, under various situations to ensure that the search space remains within a feasible region and to guide the convergence process.

Lower gauge limits are adjusted using a similar process in equation 4.24

$$ALGL_{i,d} = ALGL_{i-1,d} - (LAP_d \times LVL_d), \tag{4.24}$$

where

$ALGL_d$ = adjusted gauge upper flow limit (fraction) for day d and iteration i, where $ALGL_{1,d}$ is set equal to LGL_d;

LAP_d = upper flow limit adjustment parameter (fraction) for day d and iteration i; and,

LVL_d = maximum violation above the upper flow limit in day d (fraction).

This heuristic process does not guarantee an optimal result since the linear representation of Jensen Gauge flows is imperfect. However, it is well within the range of SSARR simulation error and future uncertainties such as spot market prices and hydrology forecasts. For the purposes of the FGEIS, the modeling process provides a good measure of the operational constraints that are required at Flaming Gorge to meet downstream flow requirements and the associated economic impacts on power systems.

4.7 Compatibility Issues and Boundary Conditions

GenOpt, SSARR, and WL algorithm runs are performed on a monthly basis whereby each month was assumed to be independent of the months that precede and follow it. This assumption was made since in some cases it is impossible to comply with Jensen Gauge constraints given the daily water releases from Flaming Gorge projected by the Flaming Gorge model. In each of these cases, the compliance problem was due to an abrupt increase or decrease in daily releases between two consecutive days that were in two different months; for example, June 30, 2003 and July 1, 2003. Similarly, Flaming Gorge model results also contained cases with abrupt Yampa inflow changes. These abrupt inflow changes between months also created gauge compliance problems.

By treating each month as an independent model run, the boundary problem between two successive months was alleviated. Other boundary conditions stemming from the long lag time between Flaming Gorge water releases and Jensen Gauge flows were also addressed. When these boundary conditions are not considered, Flaming Gorge releases at the beginning of a simulated month do not recognize water releases from the dam that occurred prior to the simulation month. These prior releases will affect gauge flows in the current period. Likewise, releases at the end of the month will affect gauge flows in the next month.

To deal with this boundary condition, monthly simulations were extended by 2 days. Yampa inflows and Flaming Gorge releases for the last day of the month were assumed to continue throughout the 2-day extension period. However, spot market price projected for the 2 days following the current simulation month were used. This assumption preserves weekly spot price patterns and resultant generation patterns. Conceptually the boundary condition at the beginning of a simulation month is treated in a similar manner except that the model includes a 2-day period prior to the current simulation month. These 2 days are assumed to have characteristics that are identical to the last 2 days of the first week in the month. GenOpt model results are only considered for the simulated month; that is, extension period results are not used.

Non-compliance problems also occurred in the modeling of Flaming Gorge releases when Yampa inflows change rapidly over a short time period. Therefore, the Yampa flows input into the model are based on monthly averages. This assumption is compatible with FGEIS alternatives that do not require Flaming Gorge operations to compensate for unpredictable Yampa inflows.

Another issue that arose during the modeling process involved Green River inflow forecast errors. Jensen Gauge flow constraints that specify a daily minimum and maximum level shown in tables 3.1 and 3.2 were not input into the GenOpt model for either alternative. Projected daily releases from the Flaming Gorge model did not always comply with this requirement. Since the Flaming Gorge model includes an inflow-forecast error, non-compliance events will occur. In most of these cases it is impossible for the GenOpt model to allocate a daily water release volume among hours of the day such that there are no violations at the Jensen Gauge.

5. Flaming Gorge Powerplant Characteristics

This section describes the methods that were used to estimate GenOpt input values for the Flaming Gorge powerplant. These characteristics are used by GenOpt to estimate the powerplant's generation capability and power conversion factors. As described in detail below, the powerplant's maximum generation level and conversion of turbine water releases (i.e., kinetic energy) to electricity are dynamic and change as a function of both reservoir elevation level and powerplant operations.

5.1 Powerplant Capacity and Capability

The Flaming Gorge Powerplant has three generating units each with an installed capacity of 50.65 MW for a total of 151.95 MW (***Form PO&M-59)***. However, due to turbine limitations the operable capability of the powerplant is approximately 141 MW; that is 47.0 MW per turbine **(*Larry Andersen, Email sent on 7/10/2002*).** Figure 5.1 shows the installed capacity and maximum recorded generation in a month as reported in PO&M 59. Prior to unit rewinds that began in March 1991, the powerplant's maximum generation level routinely exceeded the installed capacity. At that time, the powerplant was able to operate with overload factors of 25 percent without adversely affecting the turbines or generators. Once rewinds were completed in April 1992, maximum hourly generation levels did not increase significantly.

The capability of the powerplant is not only a function of the installed capacity and turbine limits, but also of several other factors. Some of these include:

(1) number of turbines in operation,
(2) turbine efficiency level,
(3) turbine overload capability,
(4) the maximum turbine flow rate,
(5) plant's power factor,

(6) reservoir elevation level, and
(7) tail water elevation.

This analysis uses equation 5.1 to estimate the capability of the Flaming Gorge Powerplant; that is, the maximum continuous generation level that the plant can sustain without adverse effects on the equipment.

$$PCAP_h = \mathrm{Min}\{47.0 \times NT_h, FML_h\}, \tag{5.1}$$

where

$PCAP_h$ = powerplant capability (MW) in hour h;

NT_h = number of operating turbines in hour h; and

FML_h = capability (MW) limited by the turbine's maximum flow rate in hour h.

The powerplant capability is constrained by the turbine operational limit of 47 MW each and by the maximum flow rate through the turbines.

The maximum flow rate through a turbine and hence the computed value for *FML* in equation 5.1 is a function of the net head. The net head is computed by subtracting the tail water elevation from the reservoir elevation, where the tail water elevation is estimated by equation 5.2. This equation is identical to the one that is in the RiverWare model.

$$TWE_h = 5600.2 + (1.709 \times DR_h) - (0.2039 \times DR_h^{\,2}) + (0.01147 \times DR_h^{\,3})\}, \tag{5.2}$$

where

TWE_h = tail water elevation (ft) in hour h; and

DR_h = water release (cfs) including both turbine and non-turbine releases in hour h.

As shown in figure 5.2, the tail water elevation level rises as the flow rates from the dam increases. Flows include both turbine and non-turbine releases.

The maximum flow through the Flaming Gorge Powerplant is estimated by equation 5.3. This equation is also contained in the RiverWare model.

$$TRMax_h = [593.8 + (2.222 \times N_h) + (0.0002616 \times N_h^{\,2})] \times NT_h, \tag{5.3}$$

where

$TRMax_h$ = maximum water release rate (cfs) through operational turbines in hour h; and,

N_h = net head (ft) in hour h.

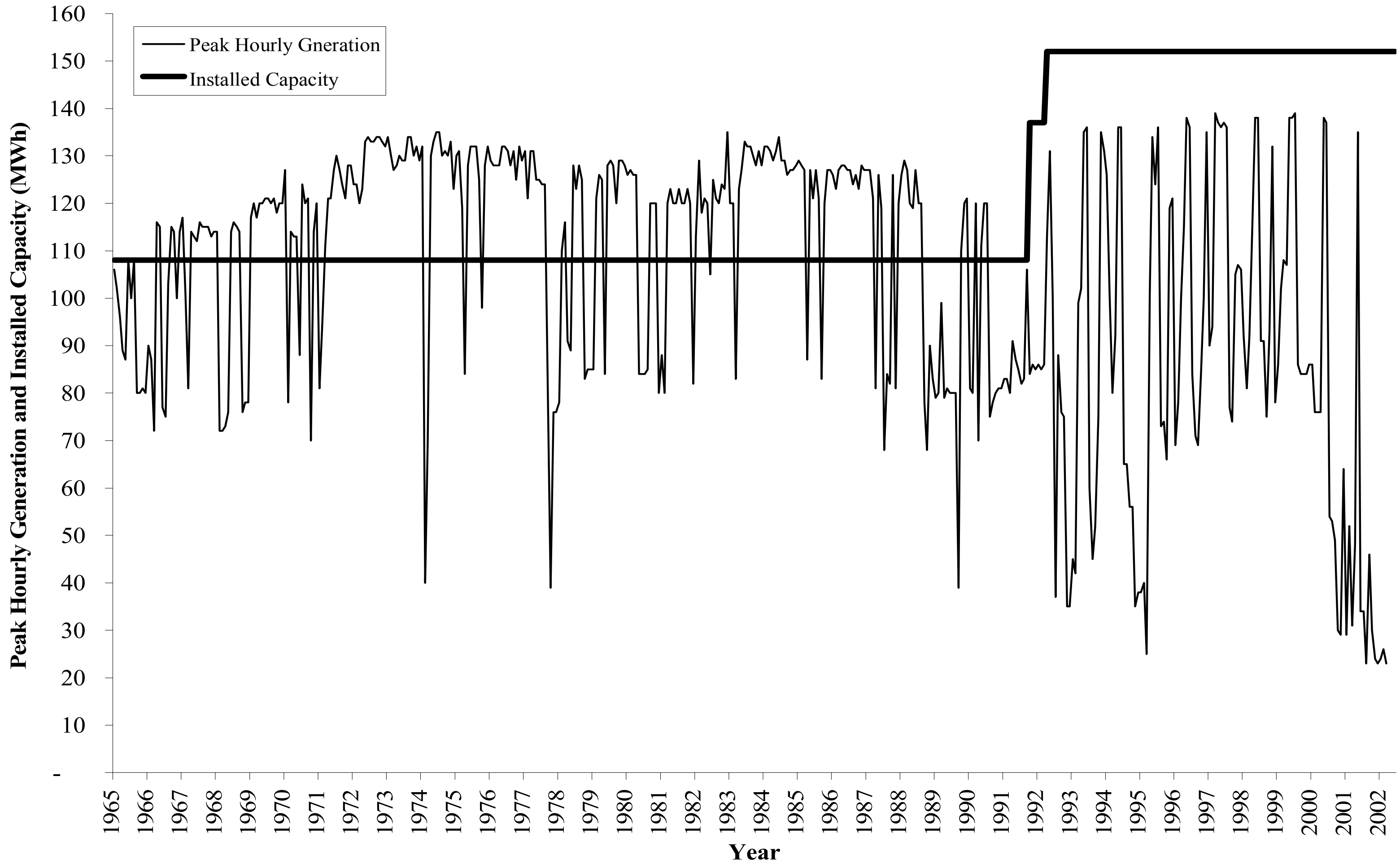

Figure 5.1. Comparison of Capacity and Maximum Recorded Generation in Each Month.

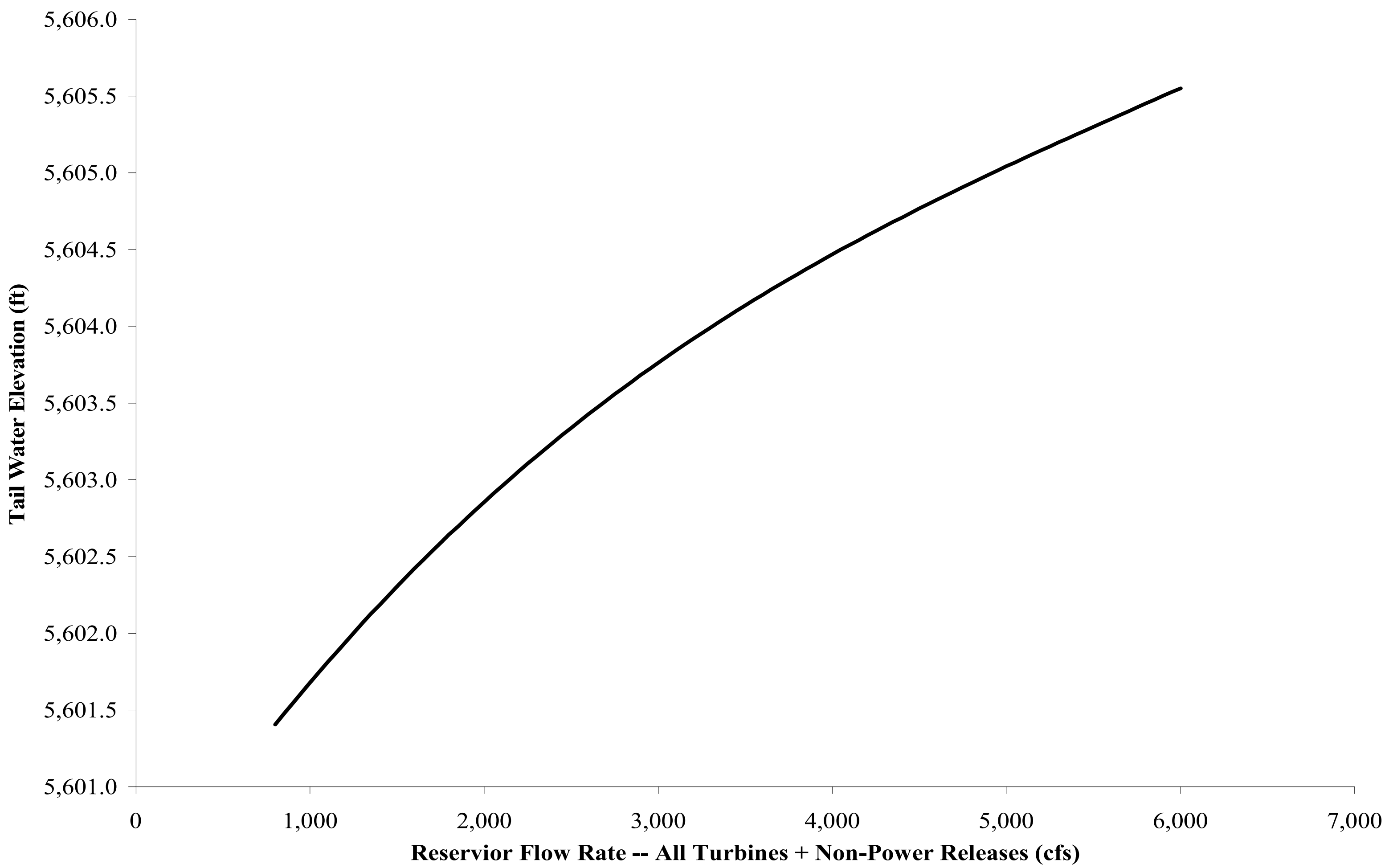

Figure 5.2. Flaming Gorge Tail Water Elevation as a Function of Total Dam Releases.

As shown in figure 5.3, the maximum turbine flow increases with higher heads. However, the turbines are not usually operated at the higher flow rates since it would produce more energy than the powerplant's generating capability (i.e., 47 MW x *NT*) resulting in potential damage to turbines and related power equipment.

Based on the net head and the turbine flow rate limit, the maximum generation level is computed by equation 5.4 (i.e., universal power equation) (***Modeling Hourly Operations at the Glen Canyon Dam GCPS09 version 1.0, September 1996, p. 47)***.

$$FML_h = (SWW \times EFF \times PF \times TRMax_h \times N_h)/(hptokw \times 1000), \tag{5.4}$$

where

SWW = 62.4, the specific weight of water at 50 degrees Fahrenheit (lb/ft^3);

EFF = turbine efficiency (fraction);

PF = plant's power factor (fraction); and

hptokw = 737.5 conversion factor (kw/ft-lbs).

For this analysis, the plant's power factor, *PF*, is set equal to 0.95. This value is based on historic reactive power requirements (***Personal Communication, Larry Andersen)***.

As shown in figure 5.4, the turbine efficiency parameter is a function of both turbine output level, in terms of horsepower (HP), and net head. Equations 5.5 through 5.7 are used to estimate the turbine efficiency curves for three net head levels that include 400, 420, and 440-feet, respectively. When the reservoir elevation is not at one of these three levels, the turbine efficiency is based on linear interpolation. The equations are based on curves contained in Reclamation's Hydraulic Turbine Data profiles for the Flaming Gorge Powerplant **(No. 2512 4-20-62)**. This profile is provided in Appendix A1.

$$\begin{aligned} EFF400 &= 25.098 + (6.6653 \times PHP) - (0.3259 \times PHP^2) + (8.36312\text{e-}03 \times PHP^3) \\ &\quad - (1.01932\text{e-}04 \times PHP^4) + (4.51414\text{e-}07 \times PHP^5), \end{aligned} \tag{5.5}$$

where

PHP = powerplant output (HP); and

EFF400 = turbine efficiency for at a net head of 400 feet (fraction).

$$\begin{aligned} EFF420 &= 6.86486 + (8.41418 \times PHP) - (0.39346 \times PHP^2) + (9.5572\text{e-}03 \times PHP^3) \\ &\quad - (1.11467\text{e-}04 \times PHP^4) + (4.83267\text{e-}07 \times PHP^5), \end{aligned} \tag{5.6}$$

where

EFF420 = turbine efficiency for at a net head of 420 feet (fraction).

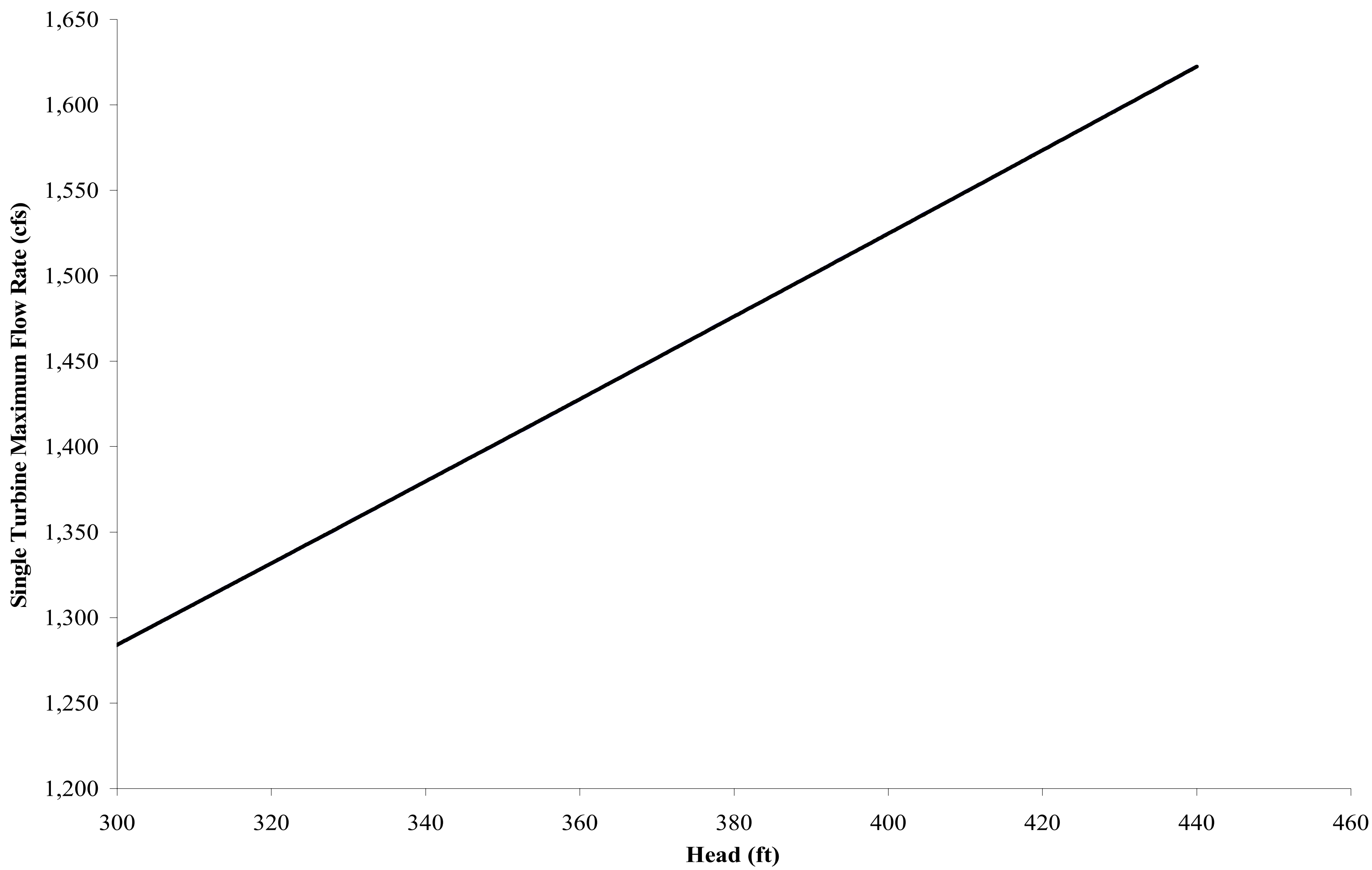

Figure 5.3 Maximum Flow Rate through a Single-Turbine as a Function of Head.

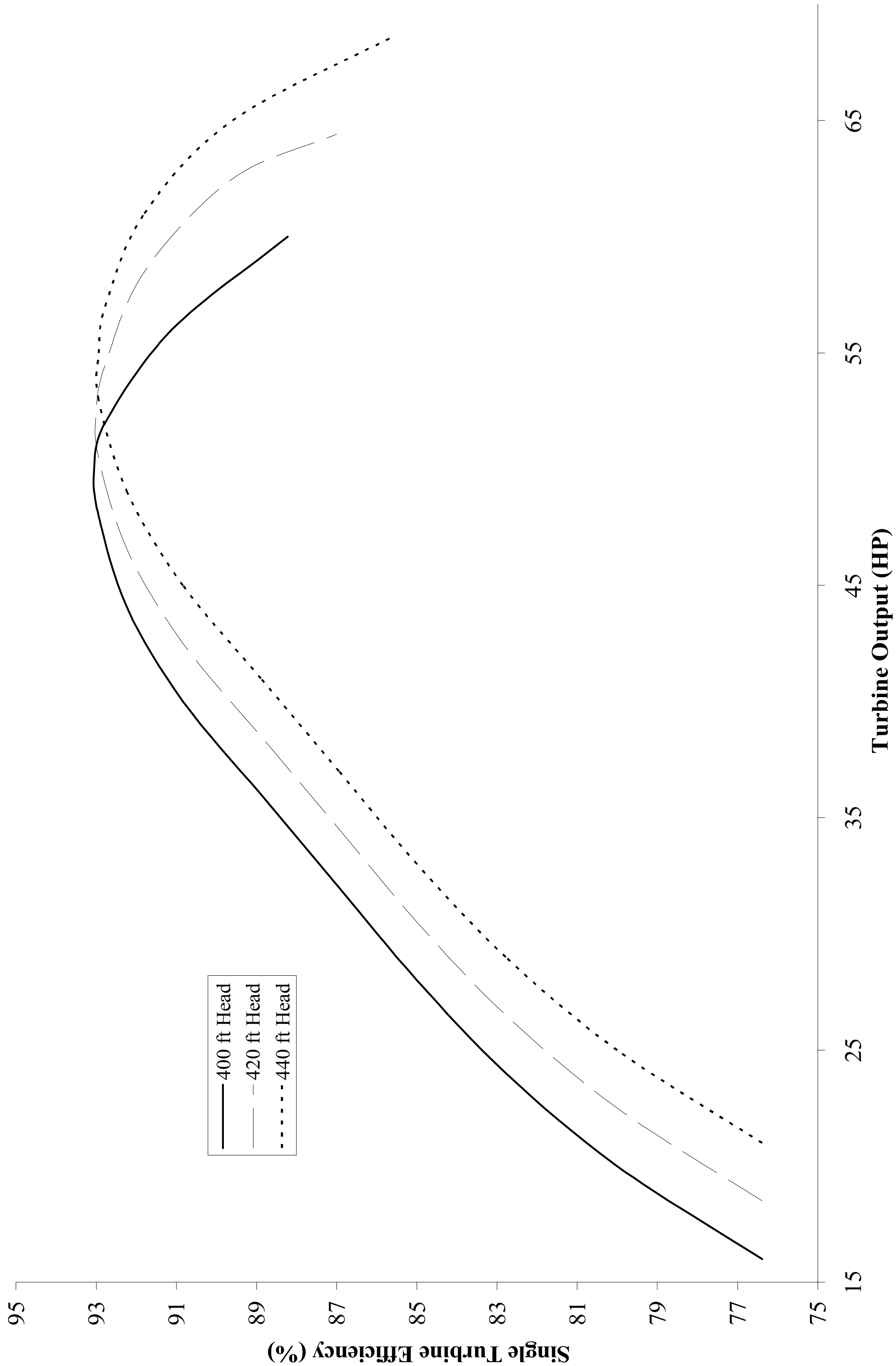

Figure 5.4. Turbine Efficiency as a Function of Flaming Gorge Power Output.

$$EFF440 = -20.69 + (11.1294 \times PHP) - (0.500487 \times PHP^2) + (1.15304e-02 \times PHP^3) - (1.28141e-04 \times PHP^4) + (5.35890e-07 \times PHP^5), \tag{5.7}$$

where

EFF440 = turbine efficiency for at a net head of 440 feet (fraction).

Figure 5.5 shows the results of equation 5.1 and compares it to historical maximum generation levels for the range of reservoir elevations that are projected by the Flaming Gorge model through the year 2026. The figure shows that for a few observations the hourly maximum generation level was slightly higher than the ones computed by equation 5.1. This may have been the result of low reactive power requirements during this time period and therefore a higher power factor than the 0.95 assumed in this study.

The number of turbines operating, *NT*, in equation 5.3 is typically set to 3. However, each unit is taken off-line for approximately 2 weeks annually to perform routine maintenance. For both the No Action and Action Alternatives, most future years have periods when flows are at minimum level (i.e., 800 cfs) for a four-week period or longer. It is assumed that maintenance will be performed during this time since only one unit is typically operated when the dam release level is 800 cfs. However, there is a 4-year period from 2016 through 2019 when the representative trace has daily flows that exceed the minimum all year long. The assumed time periods for scheduling the maintenance during this 4-year period are shown in table 5.1. These maintenance periods were selected since monthly release levels were very low (i.e., barely above the minimum). When daily releases from the dam are similar for 2 or more months, periods that have lower projected spot market prices are selected for the maintenance period.

Table 5.1. Assumed Maintenance Periods

Year	Alternative	
	No Action	Action
2016	Jan 19 - Feb 29	Jan 19 - Feb 29
2017	Feb 18 - Mar 31	Jan 18 - Feb 28
2018	Mar 4 - Apr 14	Feb 1 - Mar 14
2019	Feb 18-Mar 31	Feb 15 - Feb 28 & Dec 4 - Dec 31

5.2 Power Conversion and Generation

The Flaming Gorge Dam has injected more than 20,235 GWh of electricity into the power grid from November, 1963 through the end of June, 2002 (***based on Form PO&M-59 data)***. Between 1964, the first full year of operation, and 2001 the Flaming Gorge Powerplant generated an average of about 528.9 GWh of electricity annually. However, as shown in figure 5.6, the powerplant has historically displayed a large degree of annual variability. Generation levels were as low as 251.6 GWh in 1990 and as high as 877.1 GWh in 1984; that is, generation varied by a factor of almost 3.5.

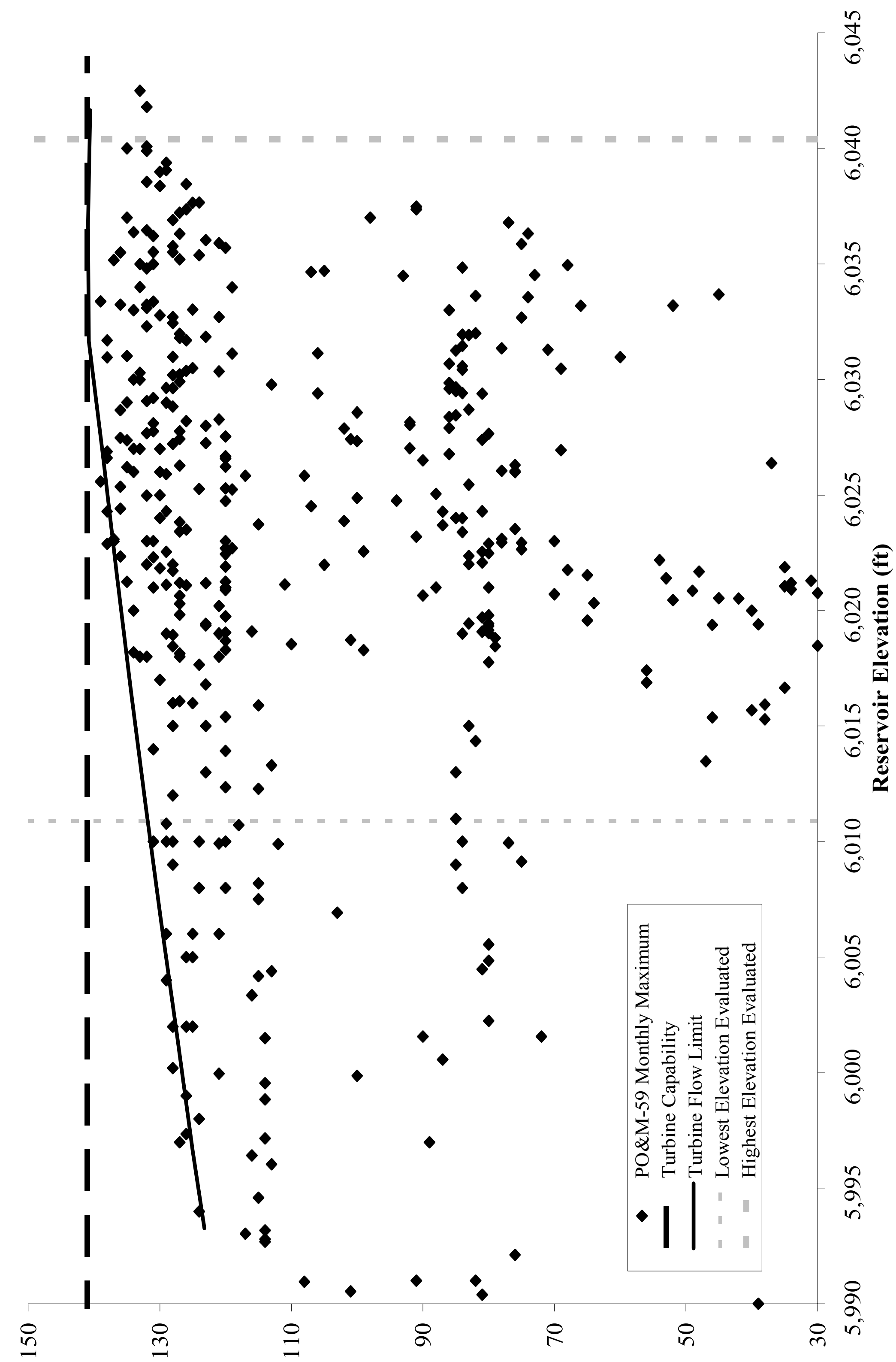

Figure 5.5. Comparison of Historical Monthly Maximum Generation and the Plant Capability Curve.

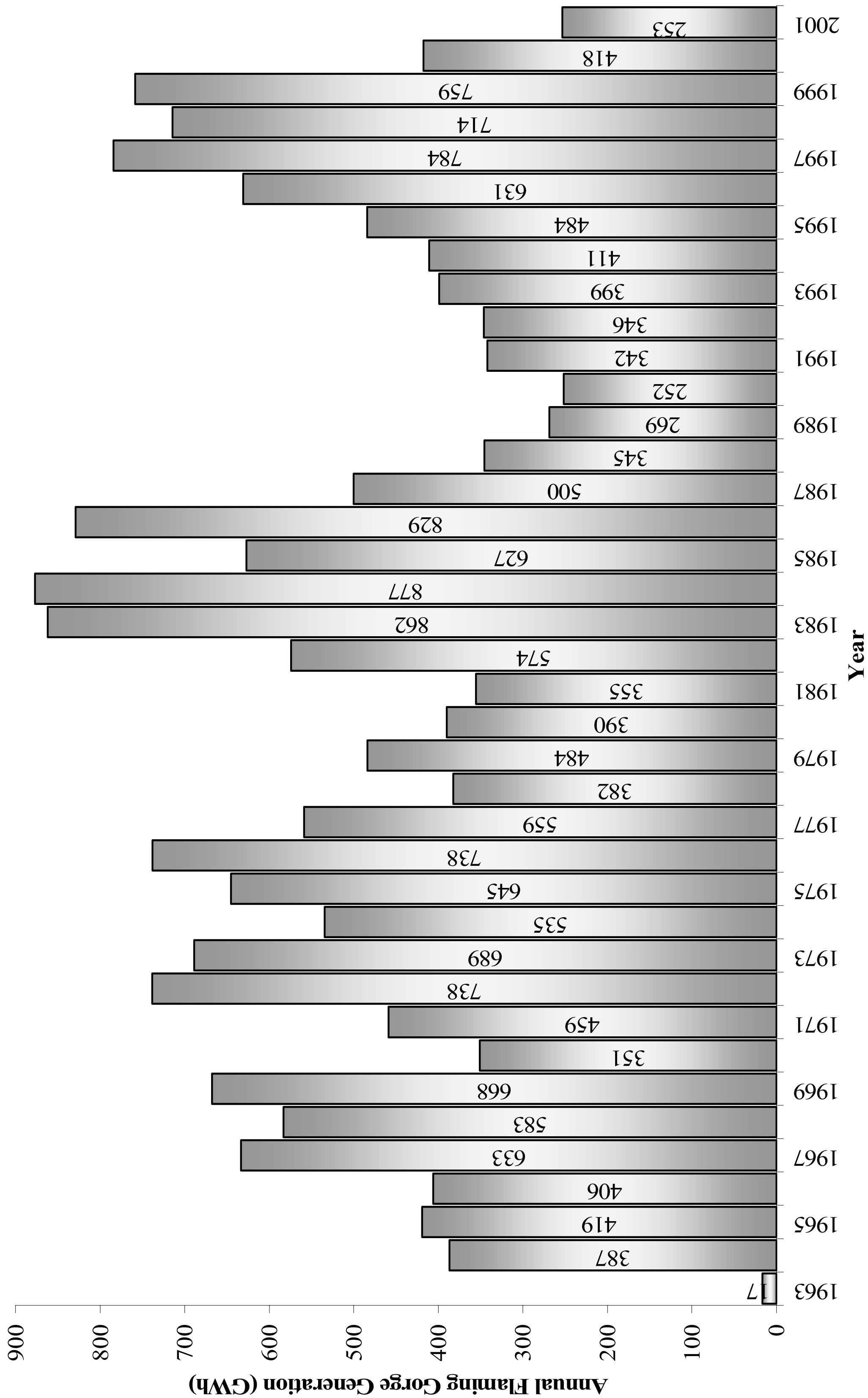

Figure 5.6. Annual Generation from the Flaming Gorge Dam.

Alternatives will affect monthly water release volumes and reservoir elevations at Flaming Gorge. Therefore, operable capability blocks and associated power conversion factors were estimated monthly for each alternative. Estimates are based on the universal power equation, equations 5.2 and 5.3, and equations 5.5 through 5.7. The sum of the capability blocks equals the amount computed by equation 5.1.

Although the powerplant is modeled in GenOpt as a single entity, power conversion factors and capability blocks were based on unit-level computations. An algorithm was written that optimizes generation and water releases through each turbine given a total water release from the dam. The algorithm uses a cellular automata procedure that contains a lattice of three cells (i.e., columns) each of which represent a single turbine. The cellular automata procedure also uses simple rules for allocating water among the three turbines based on the state of the neighboring cell (i.e., turbine) as it proceeds from one discrete step to the next (i.e., rows). Through this process all possible states for allocating a fixed amount of water among turbines are tested in a water volume increment that is specified by the user (***Melanie Mitchell, "An Introduction to Genetic Algorithms").***

Conceptually, the turbines are lined up in a single row. In the initial state all of the water release is allocated to the rightmost turbine (refer to step 1 below). To advance to the next step one increment of water release (e.g., 1 cfs) is reallocated from the rightmost turbine to the turbine (i.e., cell) on the left (step 2 below). If it is not possible to remove water from the rightmost turbine (i.e., zero or minimum turbine flow rate as in step 4 below), then a search is performed to locate the nearest turbine containing a non-zero water release. An increment of water is then reallocated from this non-zero release turbine to the turbine on the left. The remaining turbine water is then reallocated to the rightmost one (step 5 below). The final step occurs when all of the water is allocated to the leftmost turbine (step 10 below).

An example pattern for a dam with three turbines and a total flow of 3 cfs is as follows:

Step 1: [0-0-3]

Step 2: [0-1-2]

Step 3: [0-2-1]

Step 4: [0-3-0]

Step 5: [1-0-2]

Step 6: [1-1-1]

Step 7: [1-2-0]

Step 8: [2-0-1]

Step 9: [2-1-0]

Step 10: [3-0-0]

For each step, the amount of water that is shifted to a non-power release is determined after initial turbine water release allocations have been performed. If a turbine is allocated more water than its physical maximum flow or generation capability, then the excess water is also reallocated to non-power releases. Total powerplant generation is calculated with the equations presented in this section. The step (i.e., combination of turbine releases) with the highest generation is selected as the optimal allocation of water releases.

Results from this algorithm for dam releases ranging from 800 cfs to the maximum powerplant rate are shown in figure 5.7. The graph, which is based on a full reservoir condition (i.e., maximum head), shows that generation as a function of flow rate is non-linear. At low release rates all of the water is routed through a single turbine. However, as the release rate increases to a level that is near the maximum of a single turbine, some of the water is routed through a second turbine. The third turbine is put into operation when doing so will produce higher generation levels than the level that can be achieved by running only two turbines.

Generation levels using the cellular automata procedure and engineering equations described above were compared to actual operations as documented on Western's web site (***site address: http://www.wapa.gov/crsp/operatns/fgSCADAdata.htm).*** Table 5.2 shows that the computed estimates of generation are very similar to the recorded values for a large range of flow rates and reservoir elevation levels. Power equations underestimate generation levels at most by 5 MW and overestimate generation levels by as much as 4 MW. This difference can be attributed to a number of factors including measurement errors at the powerplant, power factor errors (i.e., actual value may not be 0.95), equation coefficient inaccuracies, and powerplant operators who allocate water among turbines differently from the cellular automata routine. Also, the tail water equation has a tendency to underestimate the tail water elevation by about 1 ft as compared to the recorded value.

As described in section 4.4, the GenOpt model separates the powerplant into generation blocks. Block level generation capabilities and incremental power conversion factors for full-reservoir conditions were estimated from the curve in figure 5.7. The first block is set equal to the power that is produced at the minimum release rate; that is, 800 cfs. As shown in figure 5.8, the second block is loaded to the point where the incremental conversion factor is at a maximum (i.e., first derivative of the curve is at a

Table 5.2. Comparison of Recorded Generation Levels and Computed Estimates

Power Release (cfs)	Date	Hour	Reservoir Elevation (ft)	Tail Water Elevation (ft)	Head (ft)	Recorded Generation (MW)	Estimated Generation (MW)	Generation Difference (MW)
800	07/02/01	4 AM	6013.5	5602.6	410.9	22	23	1
970	12/31/00	6 PM	6020.3	5602.8	417.5	28	30	2
1,030	09/04/00	3 AM	6021.3	5602.9	418.4	30	32	2
1,560	03/09/00	3 AM	6026.2	5603.4	422.8	44	46	2
1,700	01/10/00	4 AM	6027.4	5603.5	423.9	49	51	2
1,910	08/03/99	10 PM	6033.5	5603.8	429.7	62	59	-3
2,000	12/21/99	8 AM	6028.4	5603.9	424.5	60	62	2
2,120	08/04/99	12 PM	6033.5	5604.0	429.5	65	67	2
2,400	12/09/98	1 AM	6032.7	5604.3	428.4	74	77	3
2,470	12/26/99	4 PM	6028.1	5604.3	423.8	75	78	3
2,780	12/25/99	7 PM	6028.2	5604.4	423.8	86	86	0
2,820	02/19/99	7 PM	6028.6	5604.4	424.2	86	87	1
3,250	07/15/99	8 AM	6032.5	5605.0	427.5	100	99	-1
3,320	02/21/99	9 PM	6028.5	5605.2	423.3	101	96	-5
3,500	04/12/99	1 PM	6024.9	5605.3	419.6	106	110	4
3,500	04/03/99	6 AM	6025.6	5605.3	420.3	107	110	3
4,450	07/04/99	3 AM	6031.6	5605.6	426.1	135	136	1
4,550	05/17/99	7 AM	6025.4	5605.7	419.7	135	135	0

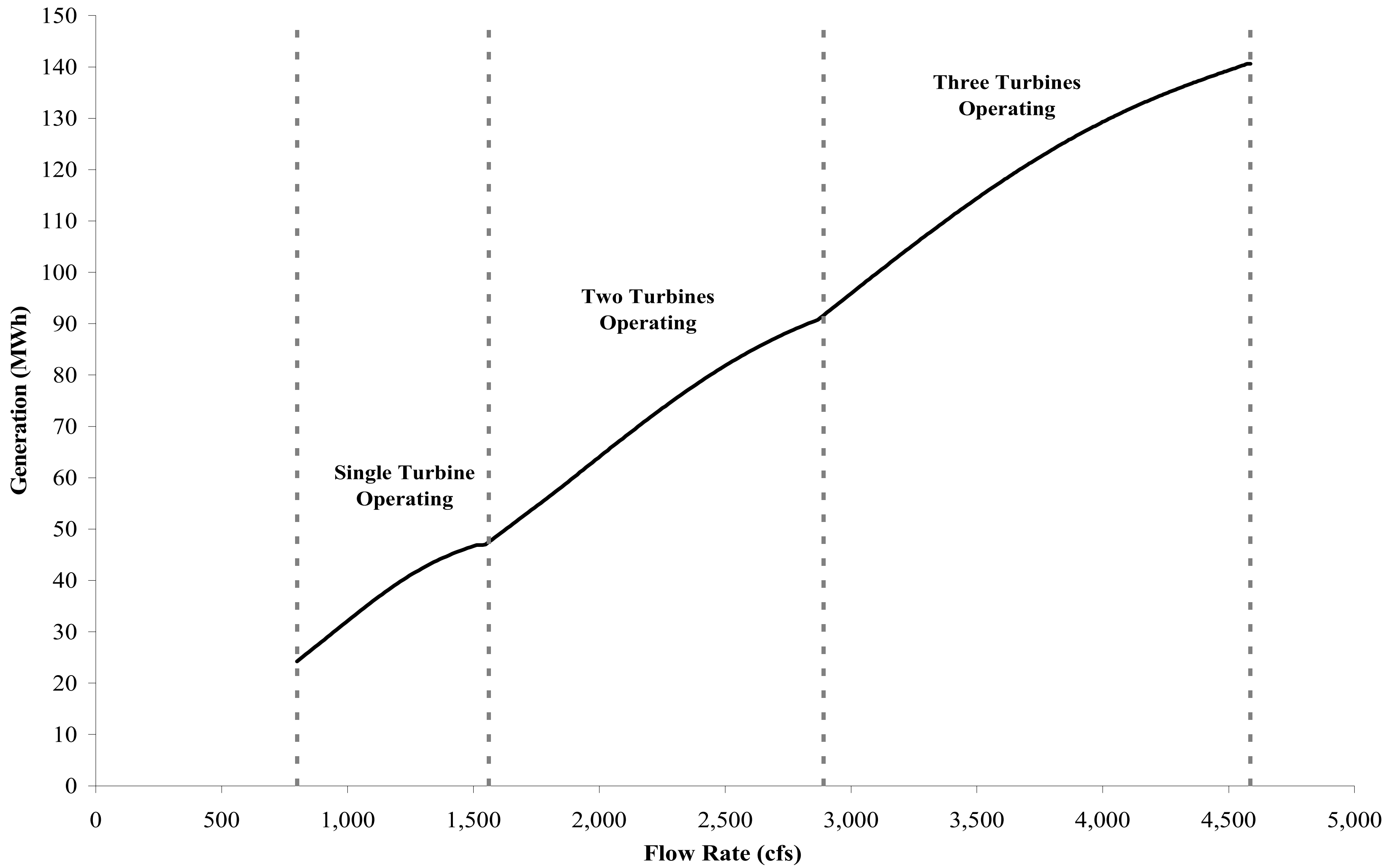

Figure 5.7. Optimal Unit Loading and Generation Level as a Function of Flaming Gorge Release Rate.

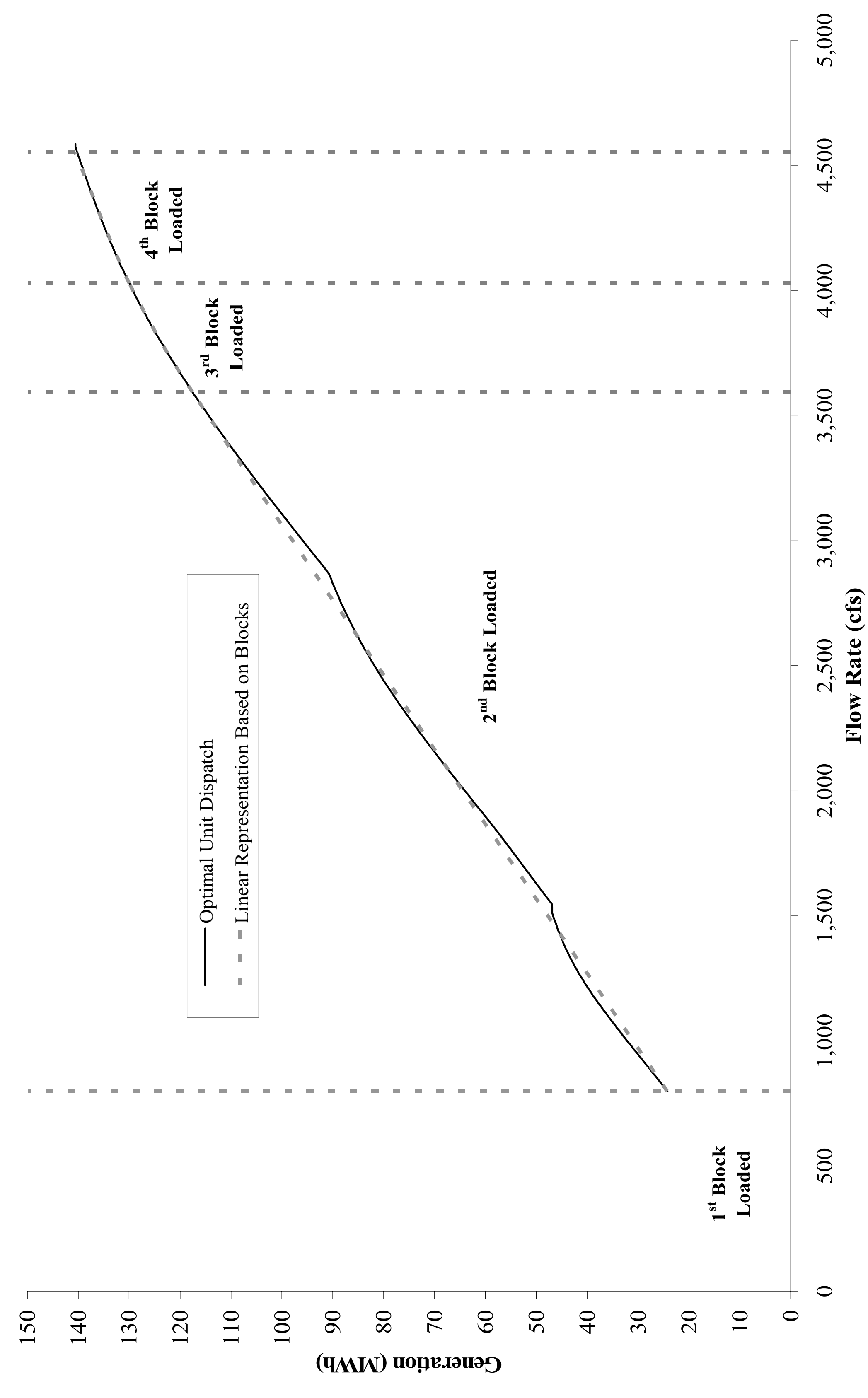

Figure 5.8. Power Block Representation for the Flaming Gorge Powerplant.

maximum). The fourth block ends at the generating capability of the plant and extends backwards to approximately the midpoint between the plant capability and the end of the second block. The third block lies between the second and the fourth. Using this approach, incremental block conversion factors decrease after the second block. The advantage of the blocked capability approach is that it can easily be represented in the GenOpt modeling framework. However, it can lead to computational errors. Figure 5.8 shows that the optimal unit dispatch curve and the piecewise-linear curve based on blocked capabilities are very similar. The maximum generation error of about 2 MW is at point where a second turbine is brought into operation. An error of approximately the same magnitude occurs at the point where the third turbine is brought on-line.

Power production estimates for three operational turbines similar to the one in figure 5.7 were made for 10 Flaming Gorge reservoir elevations that span the range projected by the Flaming Gorge model. Block-level generation capabilities and associated power conversion factors associated with these 10 reservoir elevation levels are shown in table 5.3. When the reservoir elevation for a month is not at one of these levels, block capabilities and incremental power conversion factors are estimated by linear interpolation.

Since units are put into maintenance, power production for the 10 reservoir elevation levels were also made for two other conditions; namely, one turbine in operation and two turbines in operation.

Table 5.3. Capability Blocks and Associated Conversion Factors

	Block 1		Block 2		Block 3		Block 4	
Reservoir Elevation (ft)	Incremental Capability (MW)	Incremental Conversion Factor (MWh/10^3 cfs)	Incremental Capability (MW)	Incremental Conversion Factor (MWh/10^3 cfs)	Incremental Capability (MW)	Incremental Conversion Factor (MWh/10^3 cfs)	Incremental Capability (MW)	Incremental Conversion Factor (MWh/10^3 cfs)
5993	21.9	27.3	80.3	29.6	12.1	25.0	9.0	18.6
5997	22.0	27.6	81.0	29.9	12.5	25.1	9.6	19.3
6002	22.3	27.9	82.0	30.3	13.1	25.2	10.0	19.6
6007	22.6	28.2	83.4	30.7	13.5	25.4	10.3	19.9
6012	22.8	28.5	85.2	31.0	13.7	25.7	10.5	19.7
6017	23.1	28.8	86.7	31.4	14.5	26.0	10.3	19.3
6022	23.3	29.1	88.5	31.8	14.6	26.3	10.2	18.7
6027	23.6	29.4	90.0	32.2	15.0	26.4	10.1	22.3
6032	23.8	29.7	91.1	32.6	14.4	27.0	11.5	18.6
6037	24.0	30.0	92.2	33.0	13.7	27.7	11.0	18.6
6042	24.3	30.3	93.3	33.4	12.5	28.6	10.6	20.2

Block-level generation capabilities and associated power conversion factors for both of these combinations of turbine outages were also derived and input in the GenOpt model.

The conversion factors generated by the methodology described above were compared to historical values. Figure 5.9 shows historical power conversion factors as computed from PO&M–59 data. It also shows calculated conversion factors as a function of reservoir elevation at minimum flows and at the point of highest efficiency.

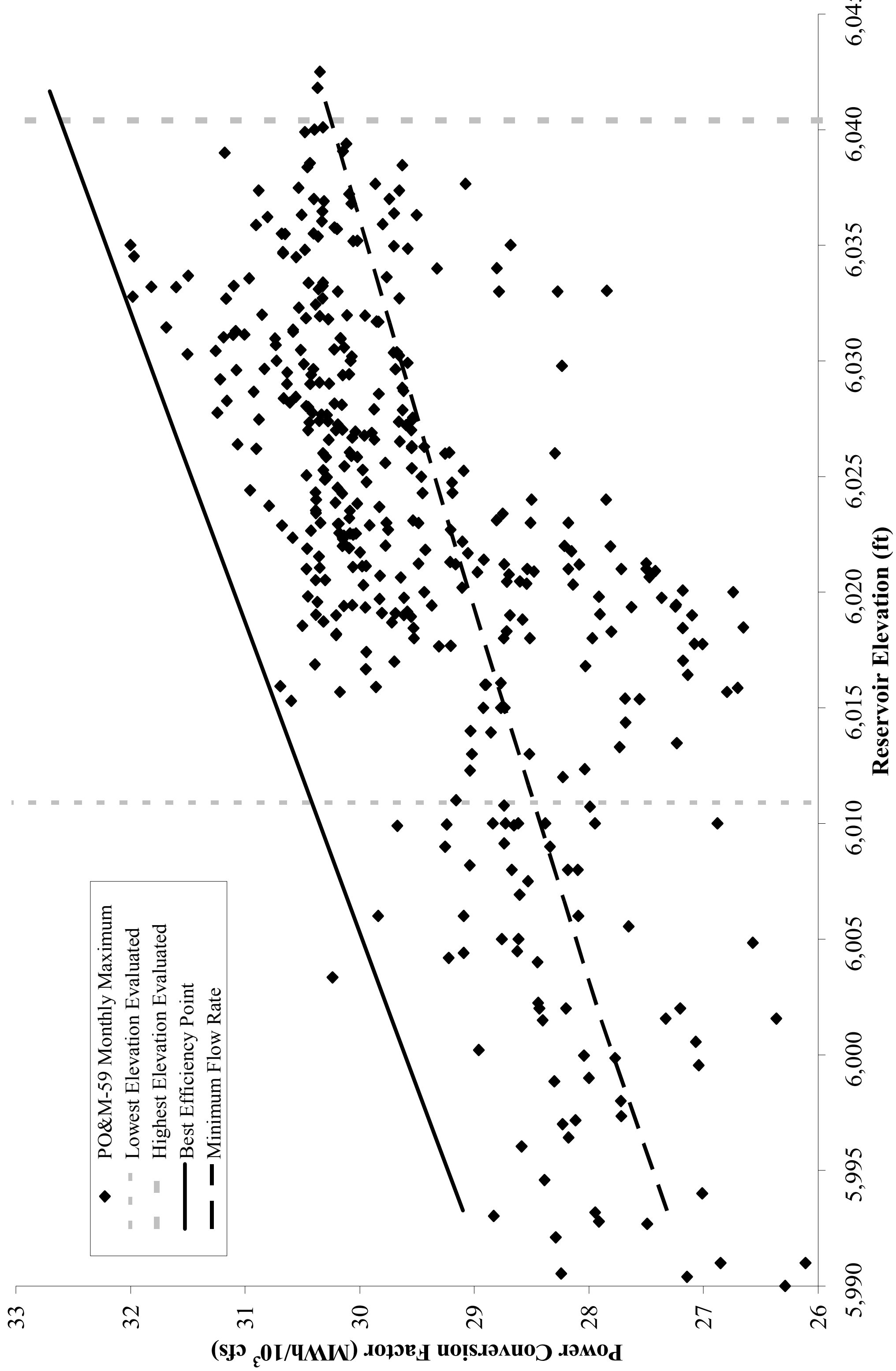

Figure 5.9. Comparison of Historical Power Conversion Factors and Computed Efficiency Curves.

6. PROJECTED SPOT MARKET PRICES

The projected economic value of electricity generated from the Flaming Gorge powerplant is closely tied to the estimated price of electricity on the spot market. The AURORA Model was used to estimate spot prices for various delivery points into the WSCC grid. For this analysis, AURORA spot price forecasts for Four Corners were used to compute the economic value of Flaming Gorge energy. It was assumed that the operations of Flaming Gorge would not affect spot market prices. This assumption is generally true since it makes a very small contribution to the total supply of the WSCC system.

6.1 Average Annual and Seasonal Prices

Average annual spot market prices for the Four Corners delivery point in nominal dollars are shown in figure 6.1 The figure shows that the average price is expected to decrease from the year 2002 through 2005. Prices increase thereafter through 2020, the last AURORA projection year. From 2020 through 2026 it was assumed that spot prices would remain constant. The maximum spot price during a year typically occurs during the summer months when electricity demands are the highest. As shown in the figure, peak spot prices can be more than 10 to 20 times the annual average. On the low price side, projected spot prices are about one-fourth of the average. These lower prices typically occur during the night and very early morning hours.

Prices not only change annually over time, but also have a very distinct seasonal pattern. Figure 6.2 shows average monthly prices used in this analysis. Averages are based on hourly values from the 2002 to 2026 time period. Prices are typically the highest in July and August with relatively low prices in the springtime. A secondary peak price season occurs during the wintertime. As described in section 7, this seasonal variation in spot prices along with the amount of water that is released in each month has a significant impact on the projected economic value of the Flaming Gorge power resource.

6.2 Daily Spot Market Price Patterns

Spot market prices not only change as a function of year and season but also by the time of the day and by the type of day. Figure 6.3 shows projected average hourly prices in January 2005 for weekdays and weekends. The price pattern is typical for the wintertime with relatively high prices in the morning and evening hours. Prices dip during midday hours and are the lowest during the nighttime. Weekend prices typically follow the same pattern as the weekday but are noticeably lower during peak demand hours. The one-hump release restriction at Flaming Gorge will not allow dispatchers to respond to the winter two-hump price pattern.

Projected spot market prices for April 2005 are generally less expensive and have less volatility compared to other times of the year. Demand is relatively low and energy is typically supplied by resources with low production costs such as hydro powerplants, nuclear units, and coal-fired steam generators. The two-hump price pattern that is characteristic of the wintertime continues in the springtime but it is less pronounced. Weekend prices are relatively flat ranging from about 20 to 26 $/MWh.

During the summer months the projected price pattern changes to a one-hump pattern that peaks in the late afternoon. Figure 6.5 shows that in July 2005 spot market prices are projected to peak at 4 PM during both weekdays and weekends. Flaming Gorge can follow this price pattern more easily than the wintertime two-hump pattern. Since demands are typically lower on the weekend, spot prices are expected to be significantly lower. Figure 6.6 shows hourly average prices projected by the AURORA model for October 2005. Relative to the summer, prices in October are significantly lower, but remain somewhat higher than prices in the springtime.

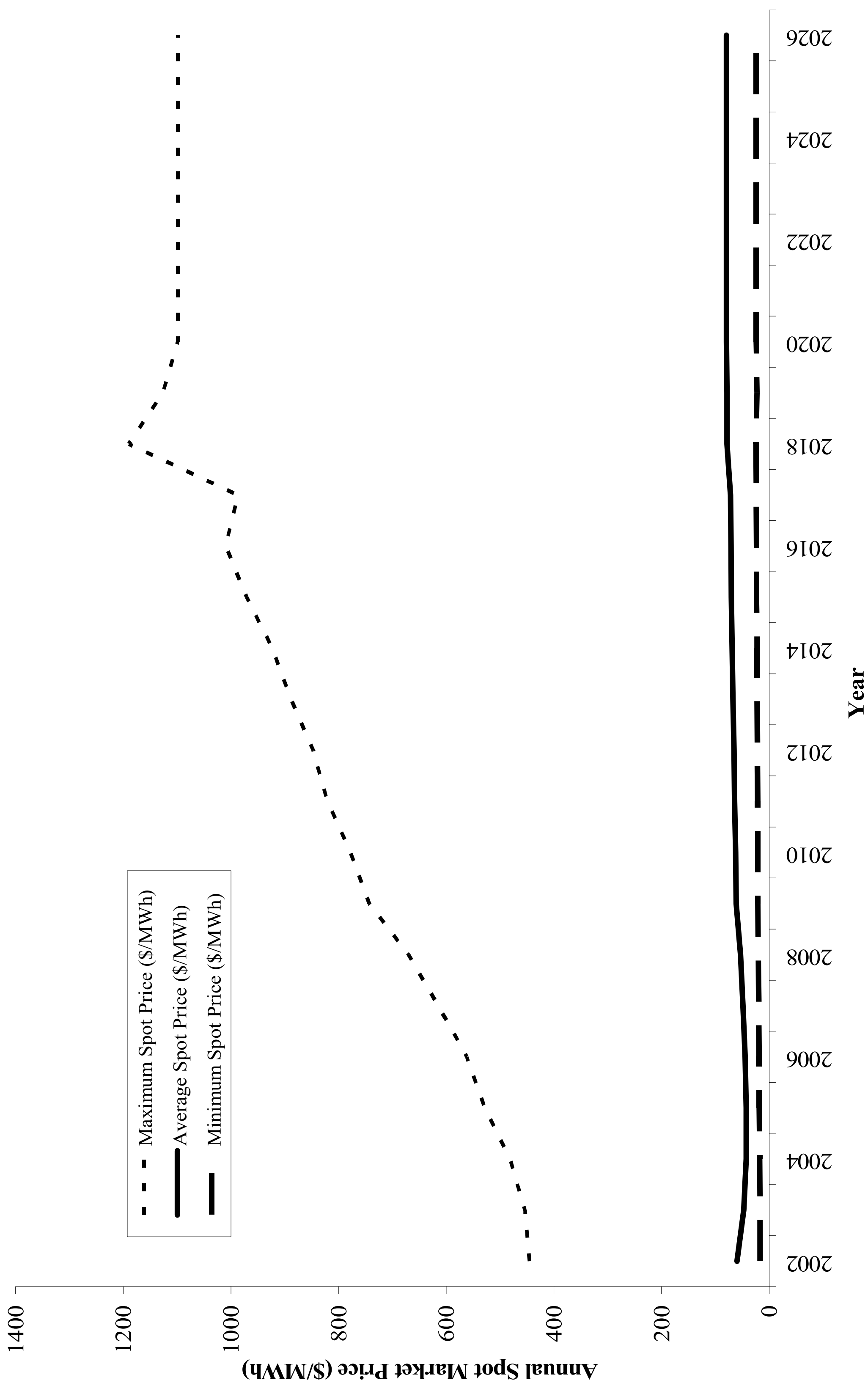

Figure 6.1. Average Annual Spot Market Prices Projected by the AURORA Model.

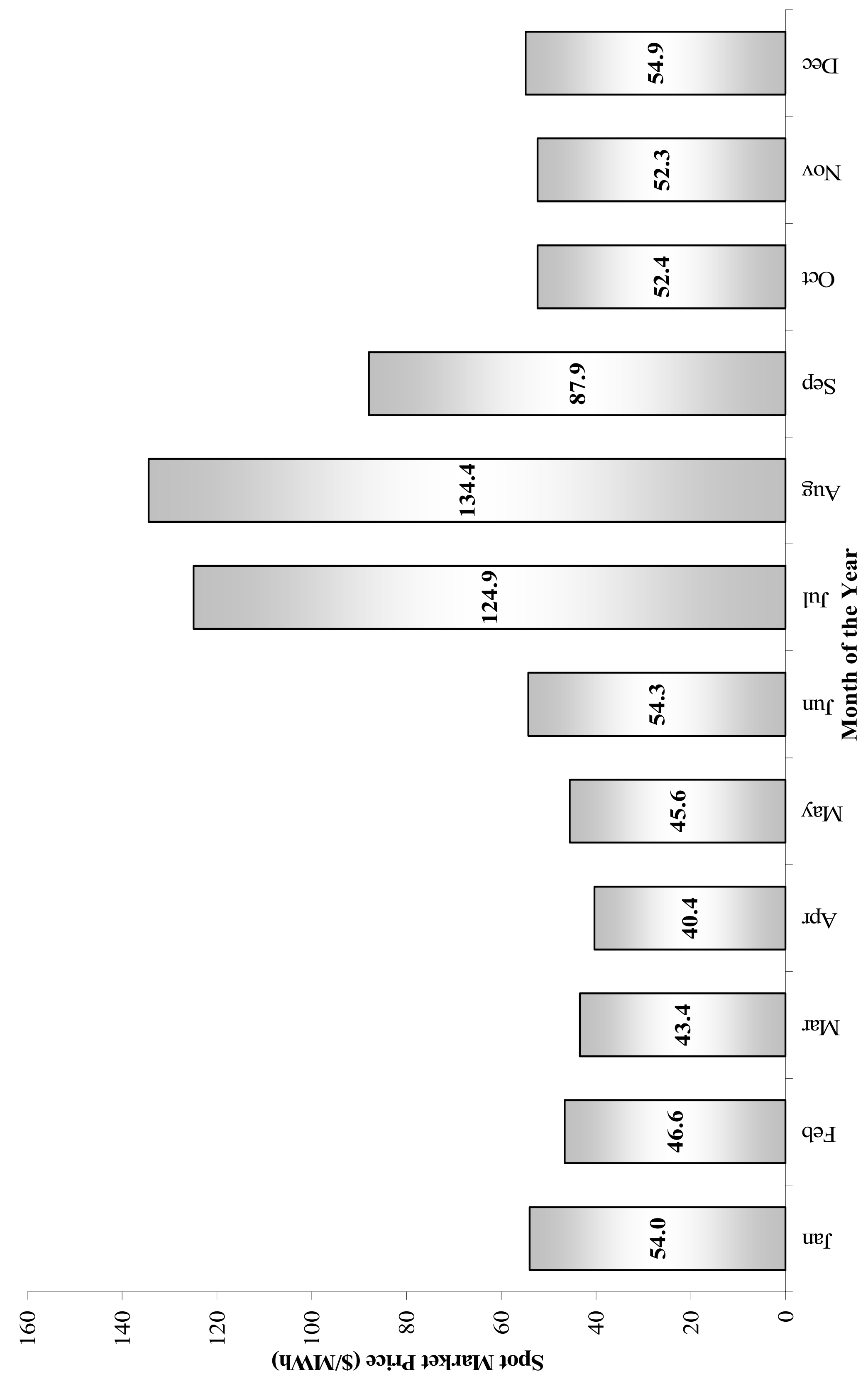

Figure 6.2. Average Monthly Spot Market Prices Over the Study Period.

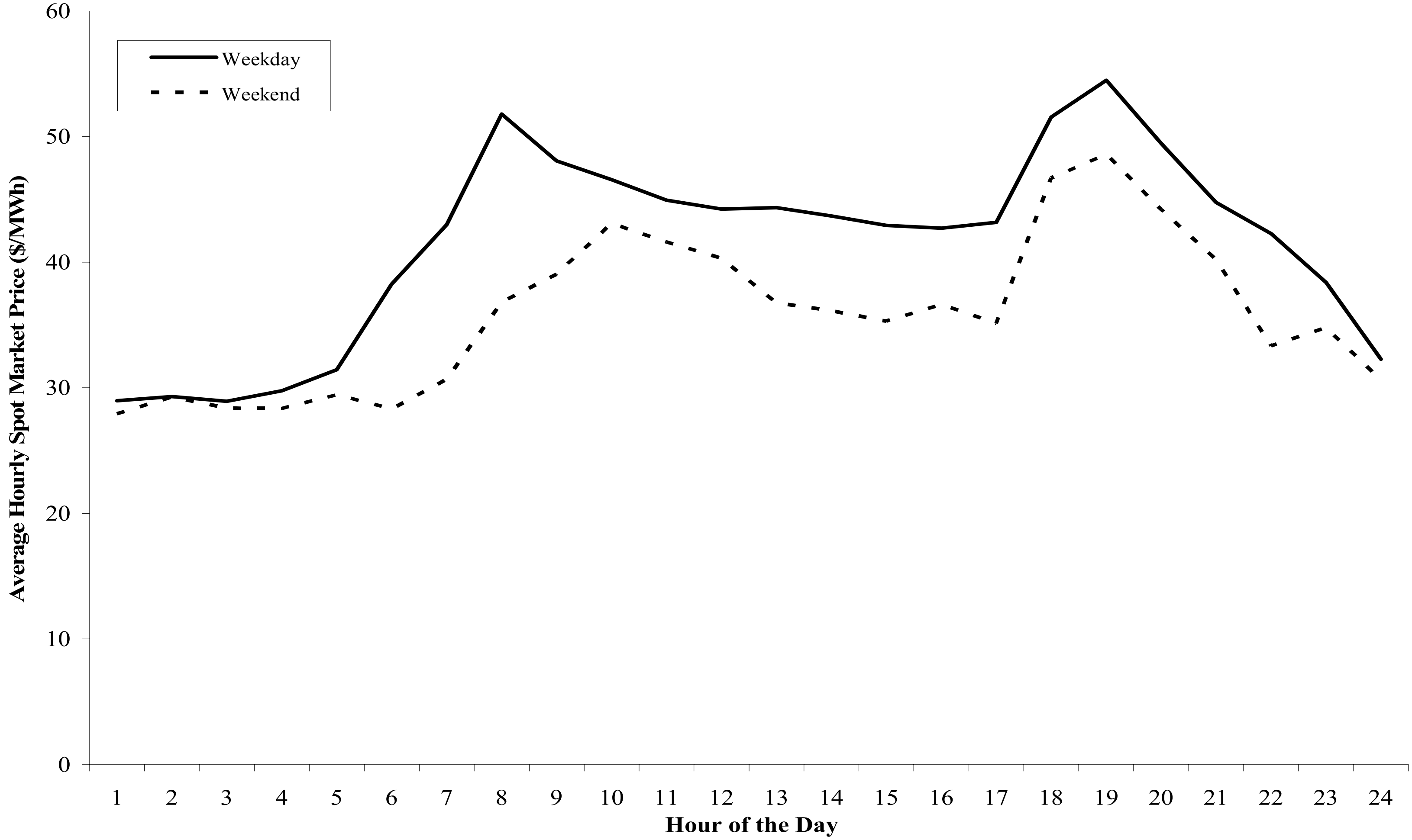

Figure 6.3. Projected Average Spot Market Prices for a Weekday and Weekend in January.

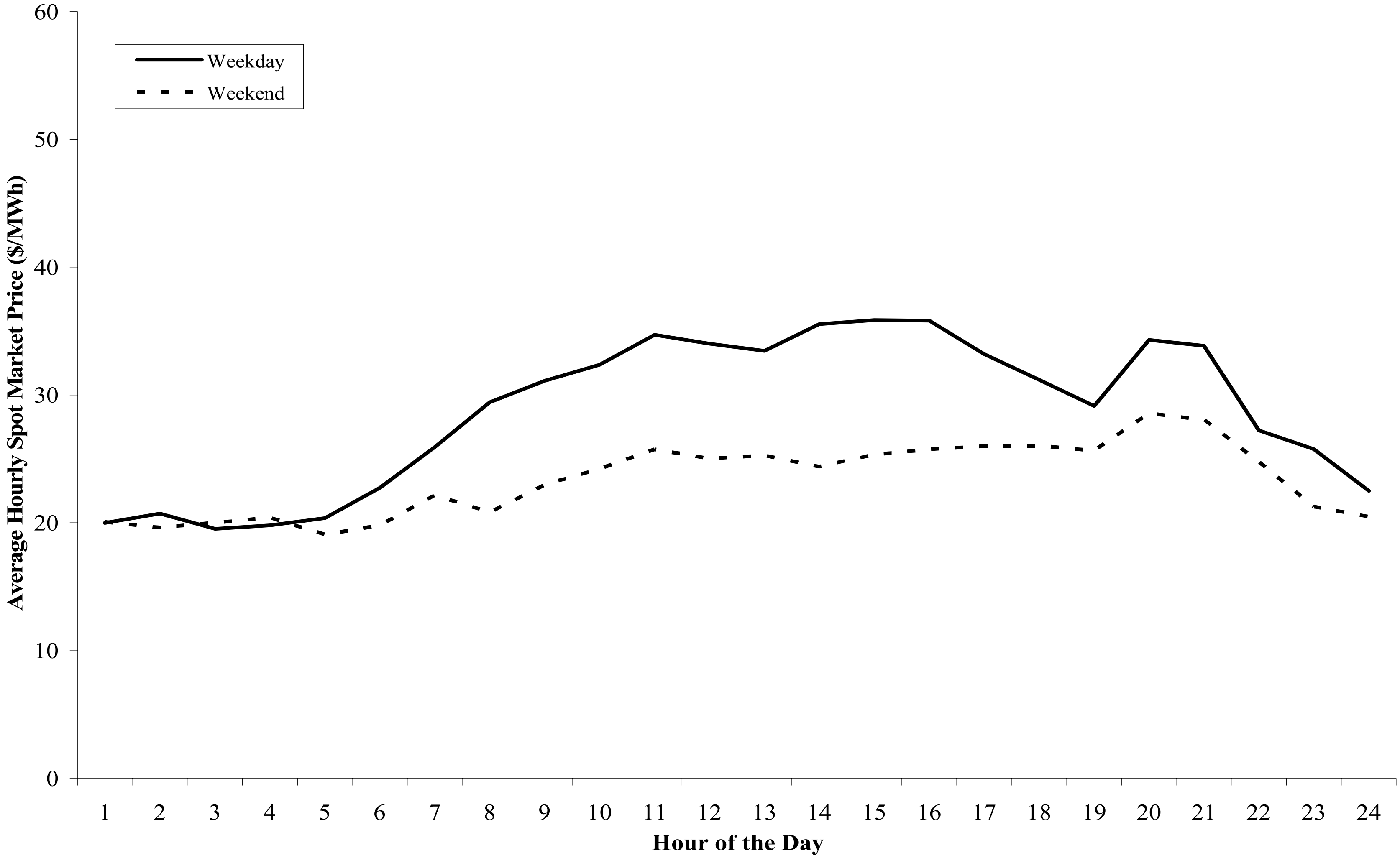

Figure 6.4. Projected Average Spot Market Prices for a Weekday and Weekend in April.

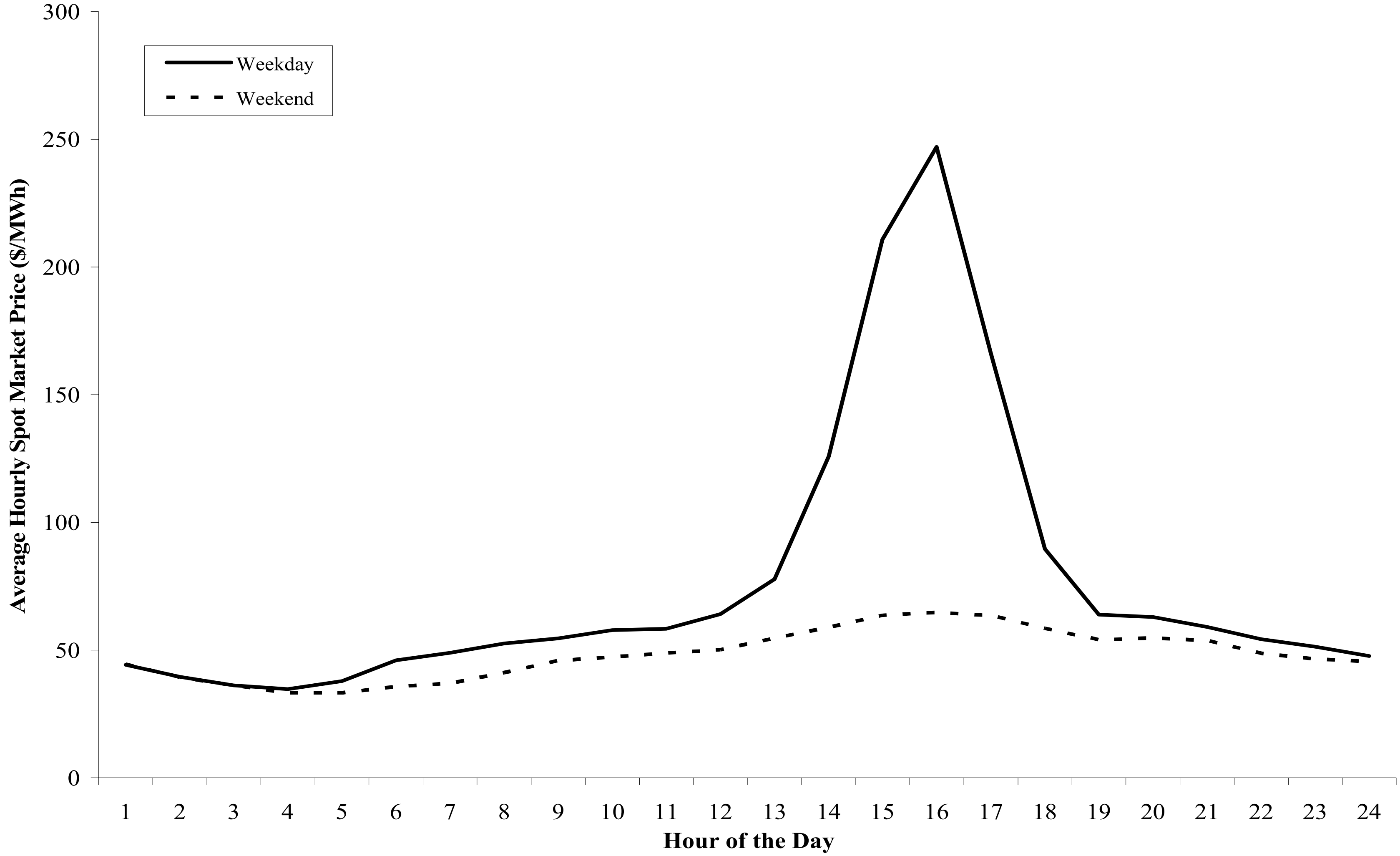

Figure 6.5. Projected Average Spot Market Prices for a Weekday and Weekend in July.

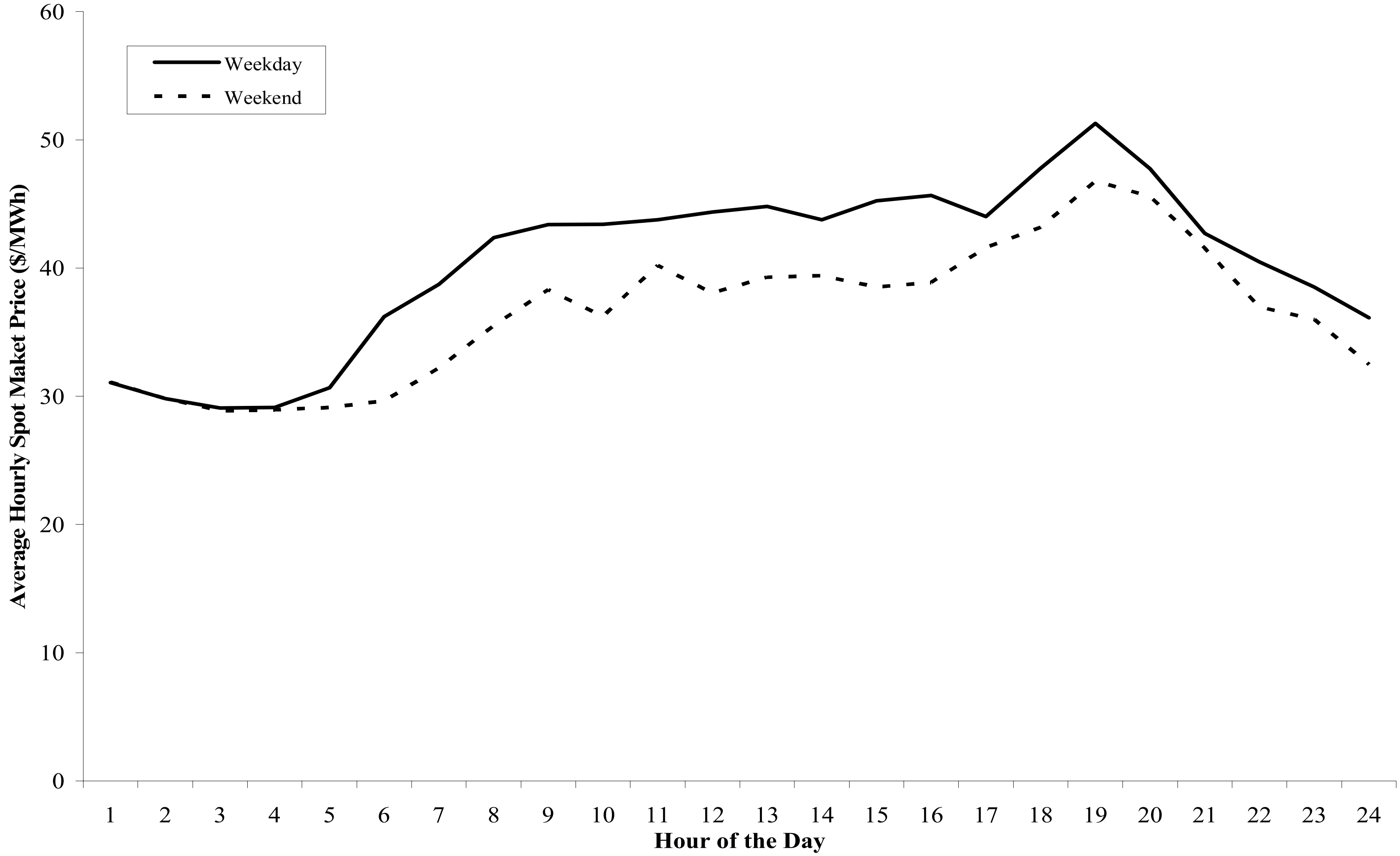

Figure 6.6. Projected Average Spot Market Prices for a Weekday and Weekend in October.

Spot market prices during the past 2 years in the WSCC have been very volatile and were subject to a number of market forces and rule modifications in the California market that heavily influenced WSCC prices. The forecasts presented in this section are much higher than current spot market prices. However, the projections were more consistent with prices at the time the AURORA model runs were performed.

Future prices in the open market may significantly differ from those used for this analysis. Although prices are uncertain, the general seasonal pattern of higher prices in the winter and summer with lower prices in the spring and autumn has persisted in the past and is expected to continue into the future. Also, the daily price patterns that are exhibited in figures 6.3 through 6.6 are reasonable.

Since the same forecast is used for both alternatives the relative differences between the two alternatives in terms of percentage is a more robust measure of the economic impacts of the alternative than the absolute dollar values.

7. MONTHLY FLAMING GORGE OPERATIONS AND YAMPA INFLOWS

The Flaming Gorge model simulates water releases from the Flaming Gorge Dam on a daily basis and estimates the reservoir elevation level at the end of each month. Both water releases and reservoir elevations influence the economic value of the Flaming Gorge power resource. To a large extent daily water releases dictate the amount of energy that will be generated. For the No Action Alternative, the sum of the daily water releases in a month constrains monthly generation levels. The reservoir elevation level directly influences both the generation capability and power conversion factors.

7.1 Flaming Gorge Reservoir Elevations

Forecasts of end-of-month (EOM) Flaming Gorge reservoir elevations for the representative trace for both the No Action and Action Alternatives are shown in figure 7.1. The average EOM reservoir elevation level over the 25-year study period is about 6026 feet above sea level for both alternatives. However, the No Action Alternative has a higher range of elevations from 6010.9 to 6040.4 feet versus a range of 6015.6 to 6037.4 feet for the Action Alternative.

The higher degree of reservoir variability is also evident by comparing the annual minimum and maximum elevation levels shown in figures 7.2 and 7.3 for the No Action and Action Alternatives, respectively. These two figures also show that the annual average reservoir elevation has a higher degree of variability under the No Action Alternative.

Reservoir elevation levels predicted under both alternatives are well within historical extremes after full operations began in November 1967 (***Flow Recommendations Report, Pages 3-4)***. In April 1970, the reservoir elevation reached a low at approximately 5967 feet and in June 1983 the reservoir elevation was over 6042 feet (***PO&M-59)***.

7.2 Flaming Gorge Water Releases

The Flaming Gorge model also projects a high degree of variability for monthly water releases. Figure 7.4 shows average monthly water release rates in terms of cfs for both alternatives. Average water releases

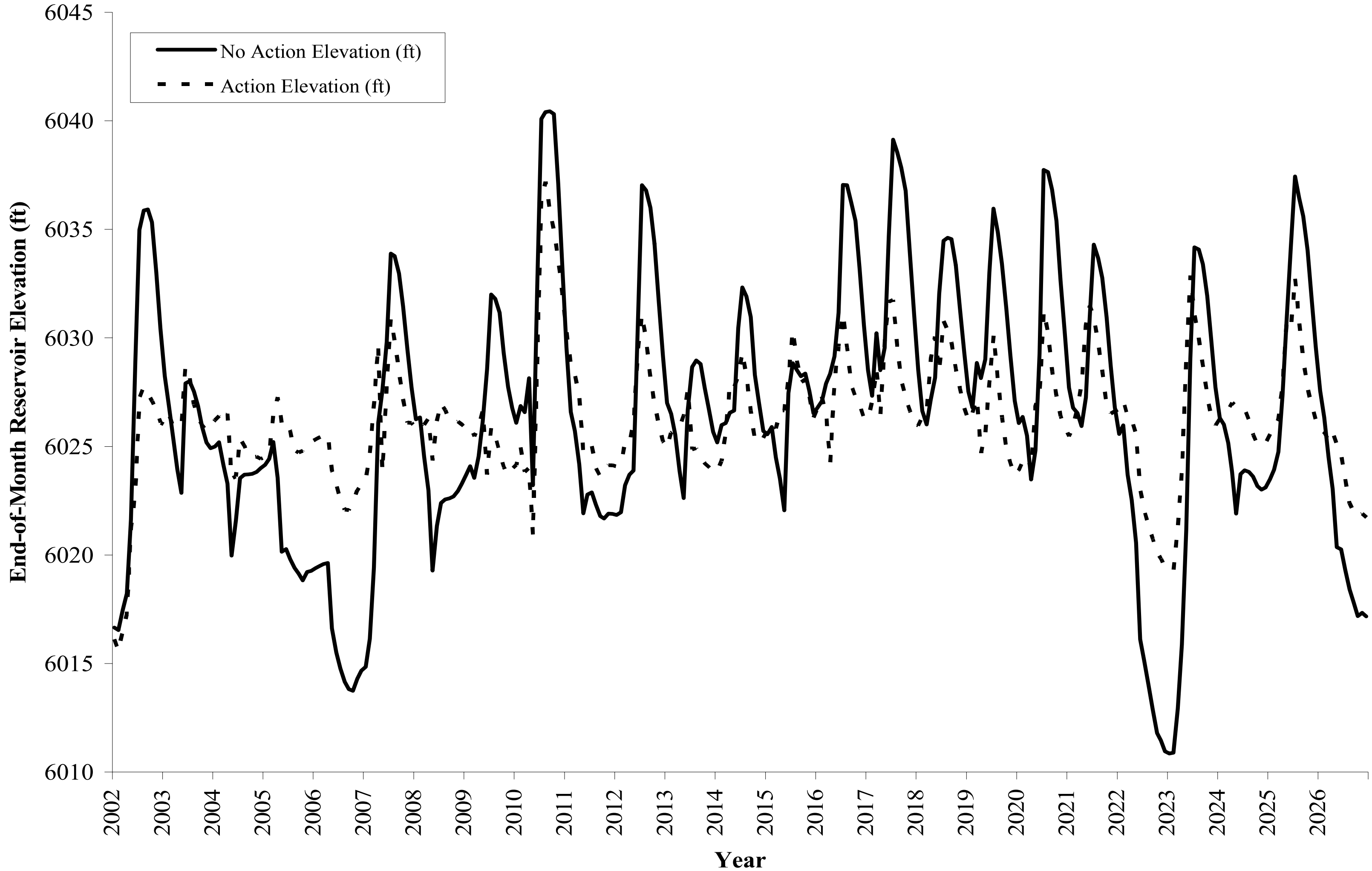

Figure 7-1. Monthly Reservoir Elevations Projected by the Flaming Gorge Model for the No Action and Action Alternatives (Representative Trace – Run 36).

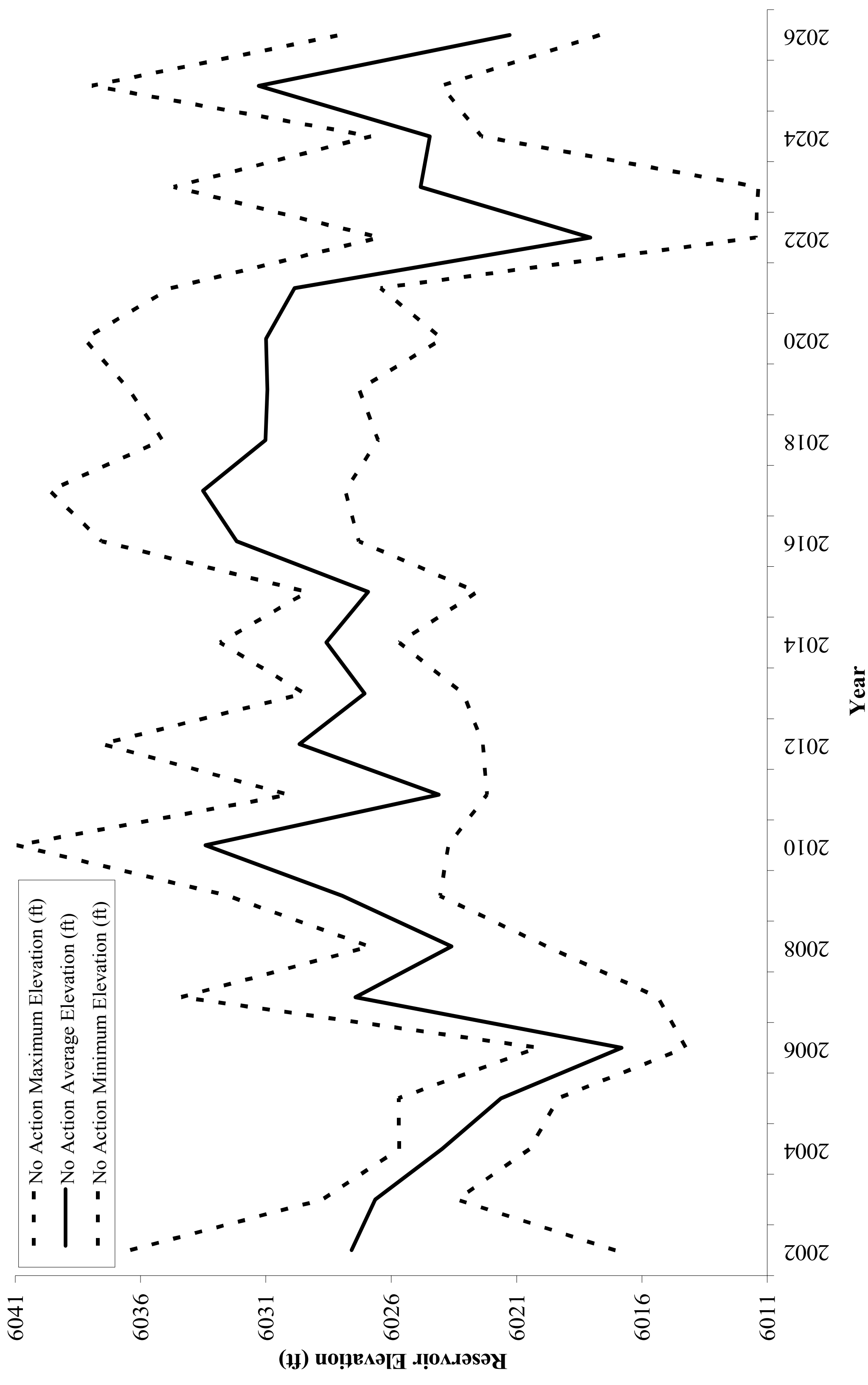

Figure 7-2. Average and Range of Monthly Reservoir Elevations Projected by the Flaming Gorge Model for the No Action Alternative (Representative Trace — Run 36). Alternatives (Representative Trace – Run 36).

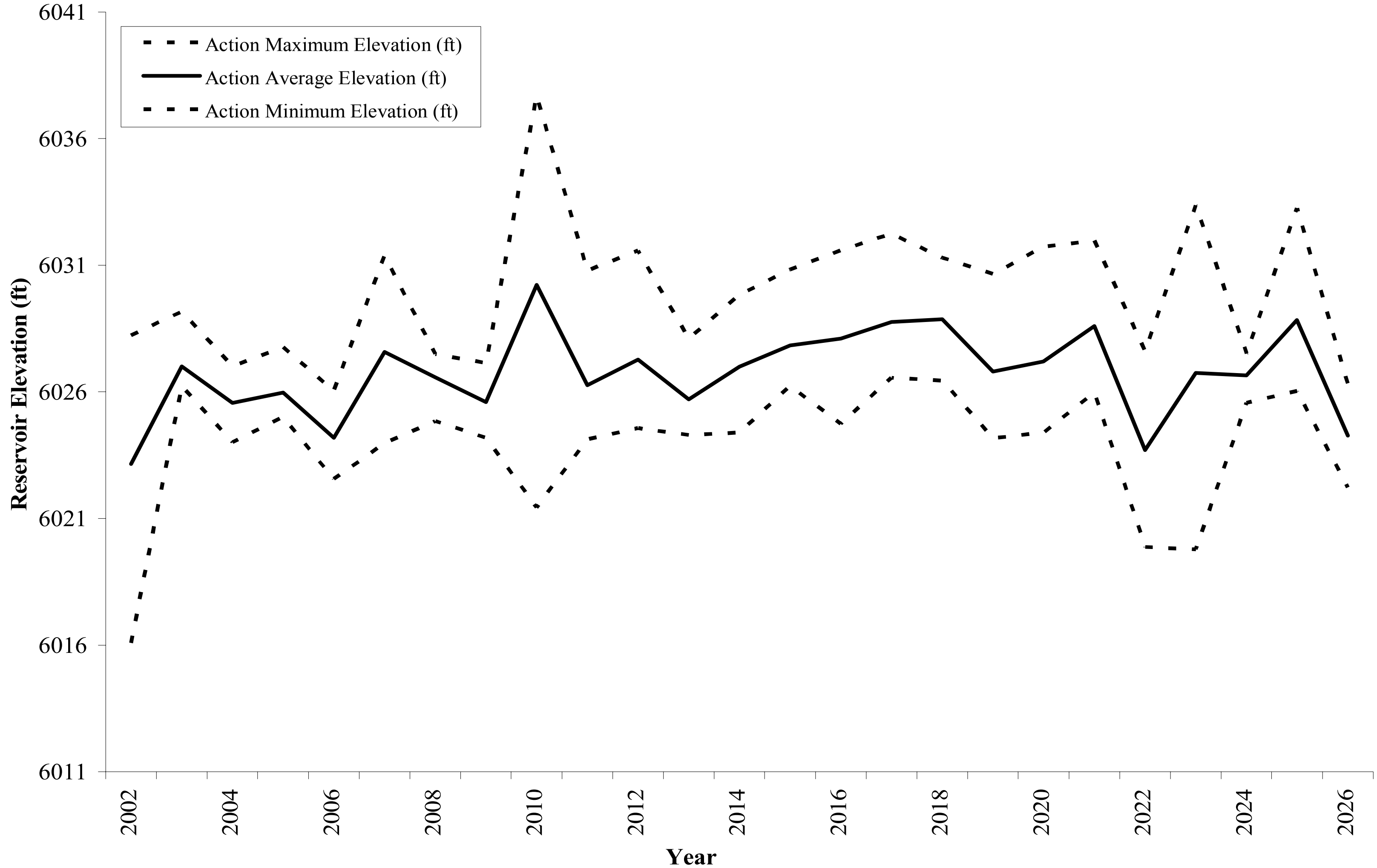

Figure 7-3. Average and Range of Monthly Reservoir Elevations Projected by the Flaming Gorge Model for the Action Alternative (Representative Trace — Run 36). Alternatives (Representative Trace – Run 36).

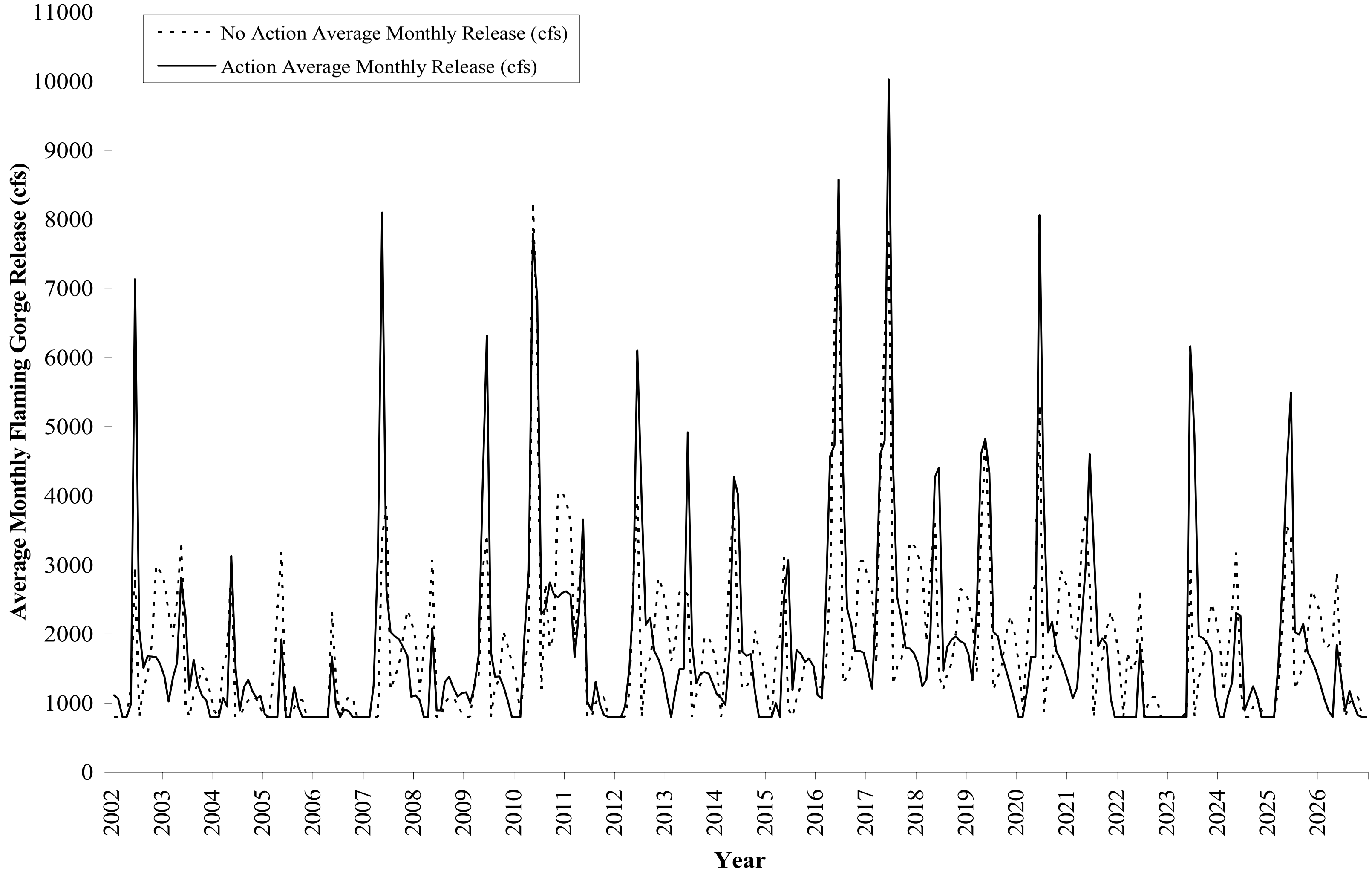

Figure 7-4. Monthly Releases from Flaming Gorge Projected by the Flaming Gorge Model for the No Action and Action Alternatives (Representative Trace – Run 36).

over the study period are nearly identical for the alternatives at about 1,840 cfs. For the Action Alternative, monthly water releases range from 800 to 15,000 cfs. Monthly releases for the No Action Alternative range from 800 cfs to 11,500 cfs. Since the maximum powerplant release is less than 5,000 cfs, it is projected that both alternatives will have non-power water releases. Most of these spills occur during spring spike periods.

During periods of low releases when the release level is 800 cfs, the powerplant has very little operational flexibility since this equals the minimum flow requirement. The only flexibility that the operator has is to decide which turbine(s) to release the water through. There is no operational flexibility during very high release periods when all of the turbines are operated at the maximum flow rate. Under both extreme cases there are no differences between the two alternatives. The largest economic and operational differences occur when releases are at a more moderate level.

Figures 7.5 and 7.6 show average water releases and the range of flows by month over the study period for the No Action and Action Alternatives, respectively. For both alternatives, the lowest average monthly flow rates are about 800 cfs. Only 2 months, September and October, under the No Action Alternative have minimum flow rates that slightly exceed 800 cfs. The highest flow rates occur during May and June under both alternatives. These high maximum flow rates extend into July under the Action Alternative. In general, the range of flow rates is highest during the late spring and early summer period.

On average the Action Alternative releases more water during times of the year when power generation has the greatest value. Table 7.1 shows that during the 3 months with the highest spot market prices (i.e., July, August, and September) the Action Alternative has significantly higher water releases. This is most noticeable for the month of July when releases for the Action Alternative are on average more than twice those of the No Action Alternative. On the other hand, releases for the Action Alternative are on average lower during the other months of the year when spot prices are less expensive.

Table 7.1 Average Monthly Spot Market Prices and Water Release Rates from the Flaming Gorge Dam for the No Action and Action Alternatives

Month	No Action Average Release Rate (cfs)	Action Average Release Rate (cfs)	Average Spot Market Price ($/MWh)
Jan	1,675	1,108	54
Feb	1,350	1,006	47
Mar	1,493	1,286	43
Apr	2,153	1,900	40
May	3,445	3,213	46
Jun	2,884	4,223	54
Jul	937	2,054	125
Aug	1,267	1,650	134
Sep	1,357	1,633	88
Oct	1,668	1,444	52
Nov	1,970	1,328	52
Dec	1,862	1,205	55
Average	1,838	1,838	66

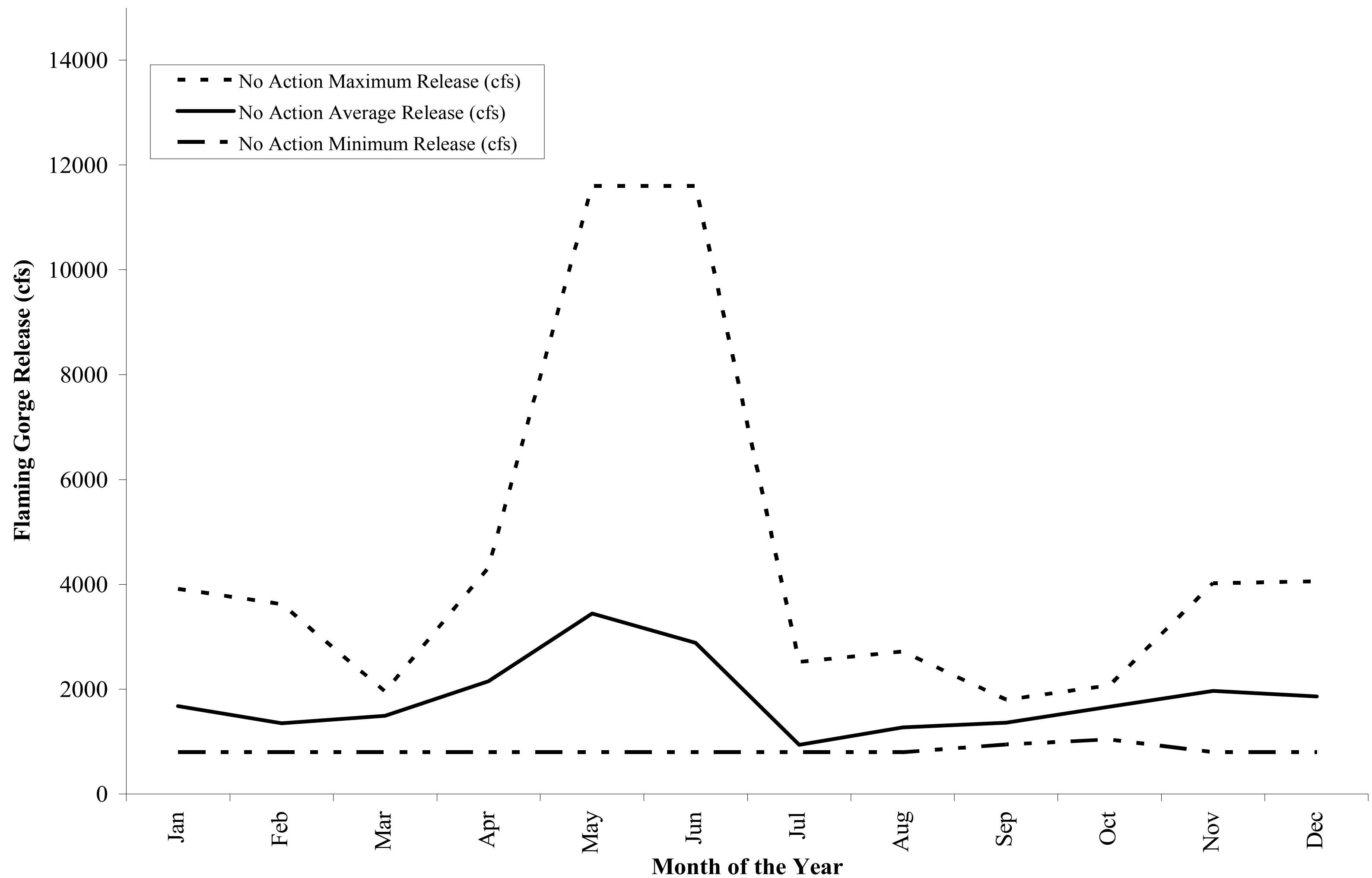

Figure 7-5. Average and Range of Monthly Releases Projected by the Flaming Gorge Model for the No Action Alternative (Representative Trace – Run 36).

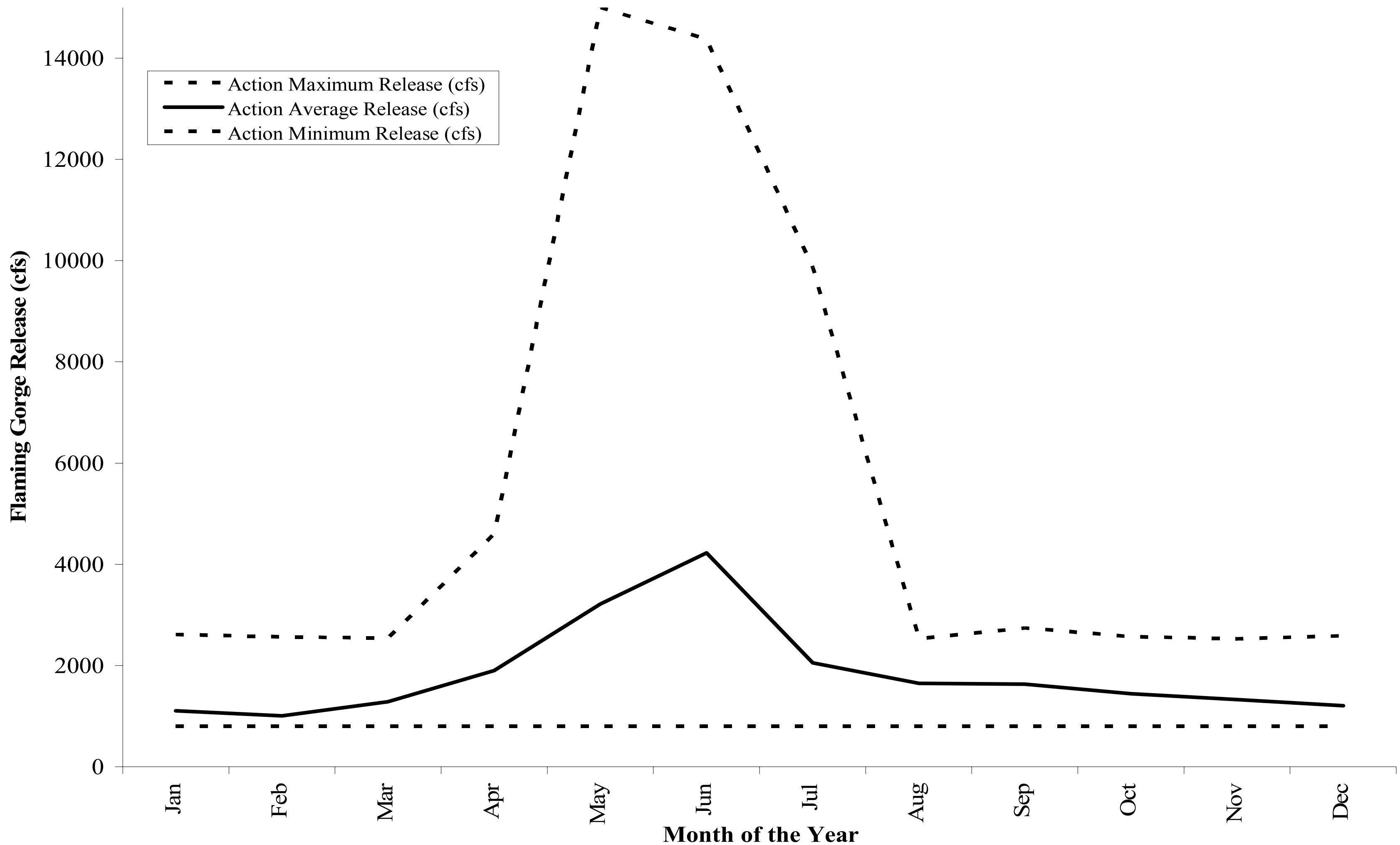

Figure 7-6. Average and Range of Monthly Releases Projected by the Flaming Gorge Model for the Action Alternative (Representative Trace – Run 36).

7.3 Yampa Inflows

Figure 7.7 shows monthly Yampa inflows for the 2002 through 2026 study period. Inflows are highly cyclical with large inflows during the late spring and early summer and very low inflows during the rest of the year. Although this strong cyclical pattern exists, the figure also shows that annual peak inflows vary significantly among years.

The cyclical pattern and annual variability are highlighted in figure 7.8. In the month of May, Yampa inflows range from about 1,800 cfs to more than 21,700 cfs. In contrast the inflow range in January is from about 110 to 700 cfs. Yampa variability is very high largely due to the fact that it is not regulated (i.e., there are no dams) and that it carries significant amounts of snowmelt from the mountains.

8. ECONOMIC COMPUTATIONS AND RESULTS

The economics of the No Action and Action Alternatives are based on net present value (NPV) calculations of the hourly value of Flaming Gorge generation over the 25-year study period. The value of generation is computed by multiplying hourly electricity production by the hourly spot market price. All NPV calculations are based on an annual discount rate of 5.5 percent. The nominal value of Flaming Gorge hourly generation is totaled for a weekly period and discounted to the beginning of the simulation year from the middle of the week. The annual beginning of year revenues are then discounted to January 1, 2002.

The economic impact of implementing flow recommendations under the Action Alternative is measured as the difference in the NPV between the Action and the No Action Alternatives. Table 8.1 shows that operating under Action Alternative constraints will increase the economic value of the Flaming Gorge Powerplant by approximately 5.5 percent above the No Action Alternative. The Action Alternative has a higher economic value despite projected higher non-turbine releases and lower generation levels. Table 8.2 shows that non-power releases for the Action Alternative are projected to be almost twice as much as the No Action Alternative. This is the main factor that leads to a total reduced power output of about 4.5 percent over the 2002-2026 study period.

Table 8.1. Comparison of the Economic Benefits of the Flaming Gorge Powerplant under the No Action and Action Alternatives

	No Action Alternative	Action Alternative	Increase Above the No Action Alternative (%)
Nominal Value (10^6 $)	806	851	5.5
NPV (10^6 $)	403	423	5.0

Table 8.2. Comparison of the Water Release and Generation from the Flaming Gorge Powerplant under the No Action and Action Alternatives

	No Action Alternative	Action Alternative	Increase Above the No Action Alternative (%)
Average Water Release (cfs)	1,839	1,839	0.0
Average Non-turbine Release (cfs)	64	125	94.6
Generation (GWh)	11,904	11,374	-4.5

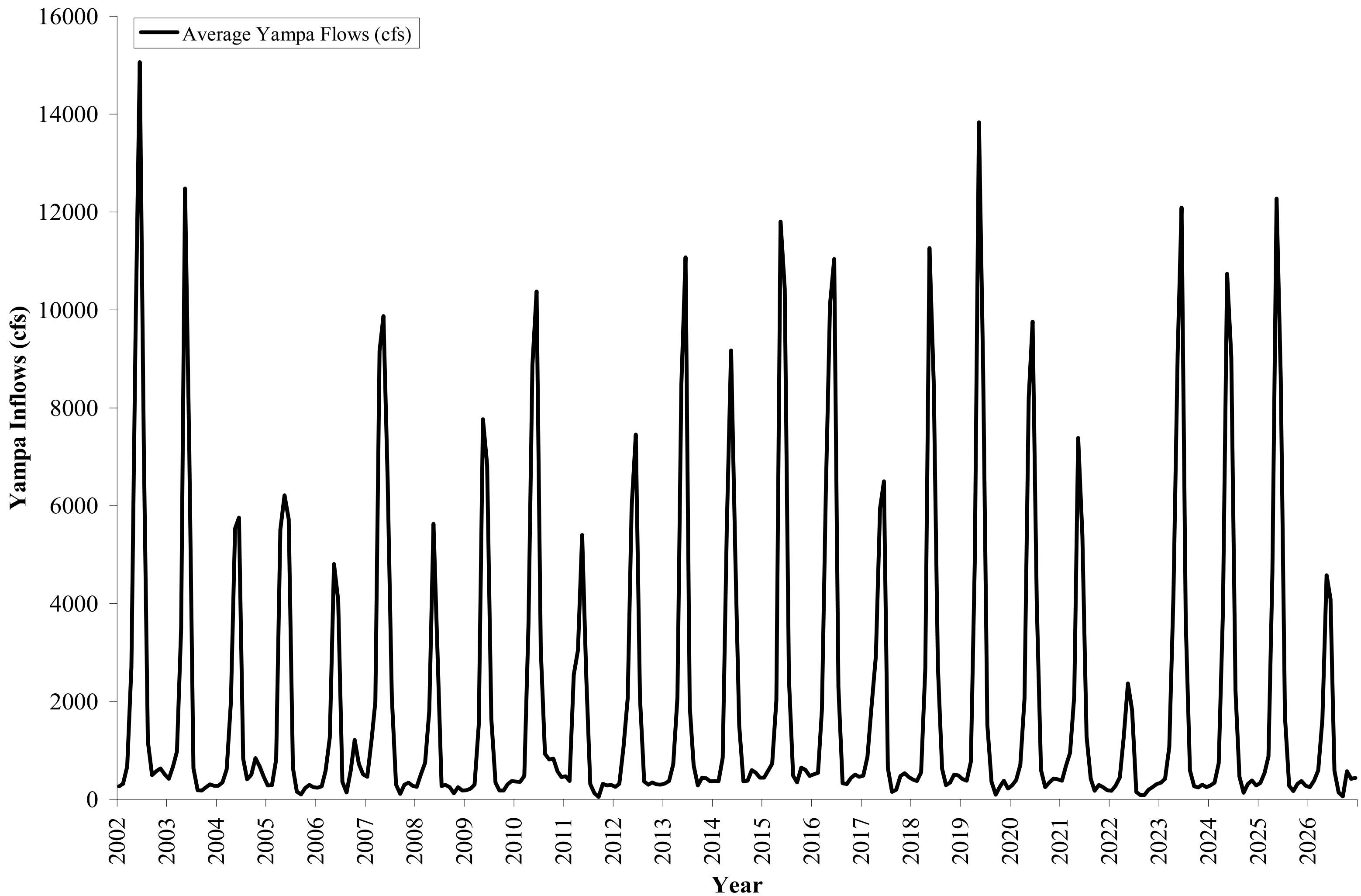

Figure 7-7. Monthly Yampa Inflow Projections from the Flaming Gorge Model (Representative Trace – Run 36).

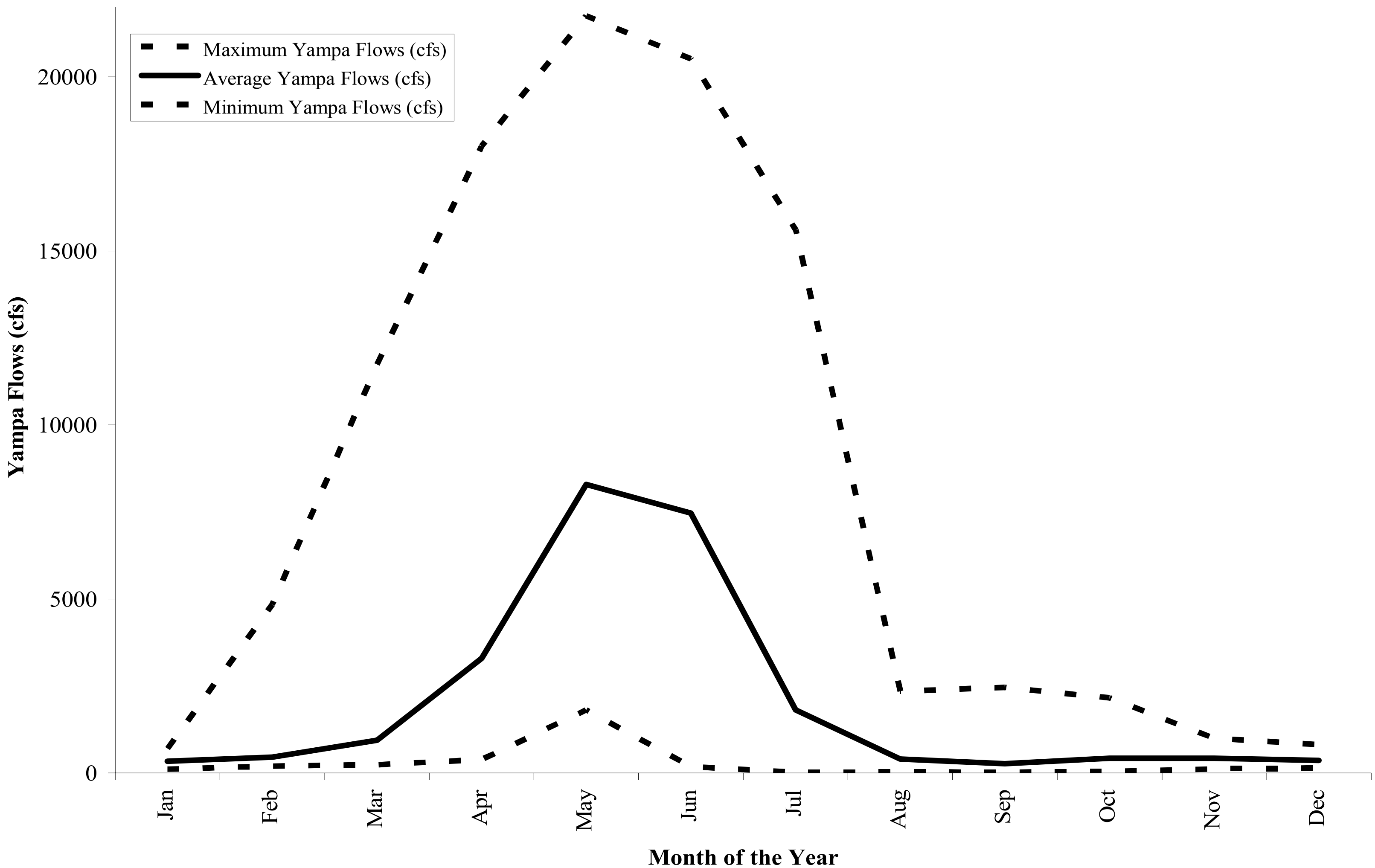

Figure 7-8. Average and Range of Monthly Yampa Inflows Projected by the Flaming Gorge Model for the No Action Alternative (Representative Trace – Run 36).

Although the Action Alternative is projected to have an overall higher economic benefit, there are some years that the benefits are expected to be negative. Table 8.3 shows that the Action Alternative has lower nominal revenues during 10 years of the 25-year study period. In each of these years annual generation for the No Action Alternative is significantly higher than for the Action Alternative.

Table 8.3 Comparison of the Annual Economic Benefits of the Flaming Gorge Powerplant under the No Action and Action Alternatives

		No Action Alternative			Action Alternative				
Year	Average Spot Market Price ($/MWh)	Average Power Release (cfs)	Annual Generation (GWh)	Nominal Value (Millions $)	Average Power Release (cfs)	Annual Generation (GWh)	Nominal Value (Millions $)	Generation Above the No Action Alternative (GWh)	Nominal Value Above the No Action Alternative (Million $)
2002	60.0	1,548	415.8	26.0	1,631	428.9	27.4	13.1	1.5
2003	47.5	1,750	471.0	21.8	1,456	386.3	18.9	-84.8	-2.8
2004	42.6	1,222	321.3	13.5	1,257	330.2	14.5	8.9	1.1
2005	42.7	1,233	322.3	13.3	947	245.8	11.0	-76.5	-2.3
2006	44.9	1,036	264.6	12.3	903	233.0	10.8	-31.6	-1.5
2007	48.6	1,760	470.1	24.2	1,981	530.2	27.2	60.0	3.0
2008	53.3	1,381	366.2	18.9	1,150	304.0	18.1	-62.2	-0.8
2009	61.1	1,619	431.4	25.9	1,674	441.0	29.1	9.6	3.2
2010	62.3	2,540	687.0	46.0	2,452	666.2	45.8	-20.8	-0.2
2011	64.2	1,805	484.0	27.5	1,616	432.7	26.7	-51.3	-0.8
2012	65.4	1,771	476.4	31.5	1,981	526.6	41.1	50.2	9.6
2013	67.6	1,875	506.0	32.3	1,620	427.4	32.6	-78.6	0.3
2014	68.6	1,843	495.6	35.1	1,766	467.5	35.6	-28.0	0.5
2015	70.3	1,467	391.0	27.2	1,510	401.0	32.7	10.0	5.5
2016	70.9	2,327	630.4	44.9	2,739	728.9	56.6	98.5	11.8
2017	71.6	2,793	757.3	51.5	2,812	749.2	58.4	-8.0	7.0
2018	78.5	2,275	622.3	50.2	2,027	545.4	46.7	-76.9	-3.5
2019	78.3	2,272	614.6	48.0	2,372	628.7	50.9	14.2	2.9
2020	79.3	2,138	580.4	46.0	1,985	528.8	50.9	-51.6	4.9
2021	79.4	2,218	602.2	46.6	2,001	534.3	48.6	-68.0	2.0
2022	79.4	1,288	335.8	27.8	887	228.2	18.1	-107.6	-9.7
2023	79.4	1,447	385.9	32.8	1,744	461.3	46.3	75.4	13.5
2024	79.3	1,406	373.5	28.2	1,204	316.7	28.1	-56.8	-0.1
2025	79.4	1,886	509.7	43.7	2,069	556.2	49.5	46.5	5.8
2026	79.4	1,472	389.5	30.9	1,060	275.9	24.9	-113.6	-6.1

The primary reason that the Action Alternative has a higher overall economic value despite lower generation levels is that more power is being generated when it has the highest economic value. As shown on figure 8.1, average weekly generation for the Action Alternative is significantly higher during the high priced summer months as compared to the No Action Alternative. Note that throughout the summer price spike period for weeks 26 through 40 that the average generation level is always higher for the Action Alternative. On the other hand, generation levels during much of the rest of year are lower under the Action Alternative.

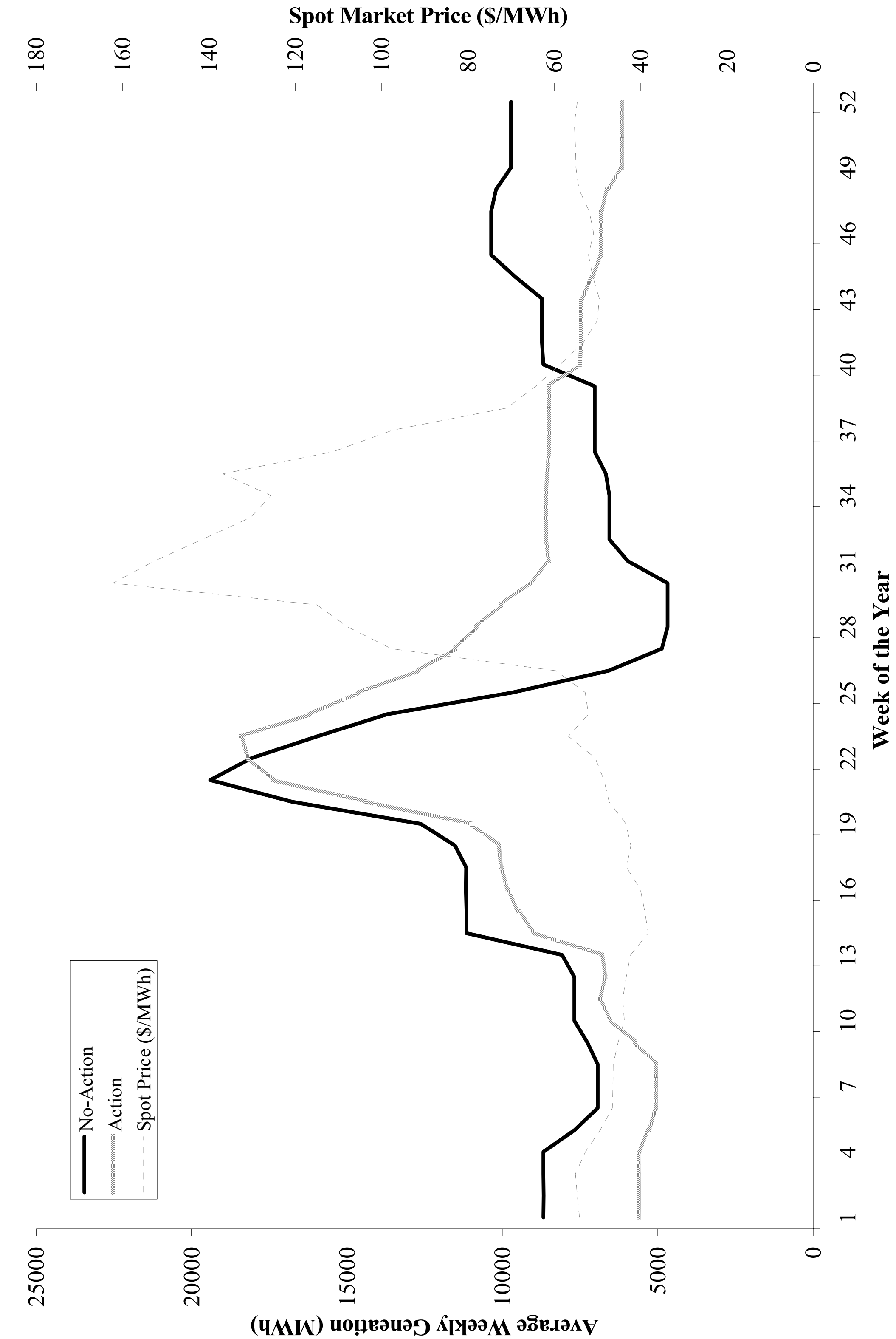

Figure 8-1. Average Weekly Generation Levels and Spot Market Prices for the No Action and Action Alternatives.

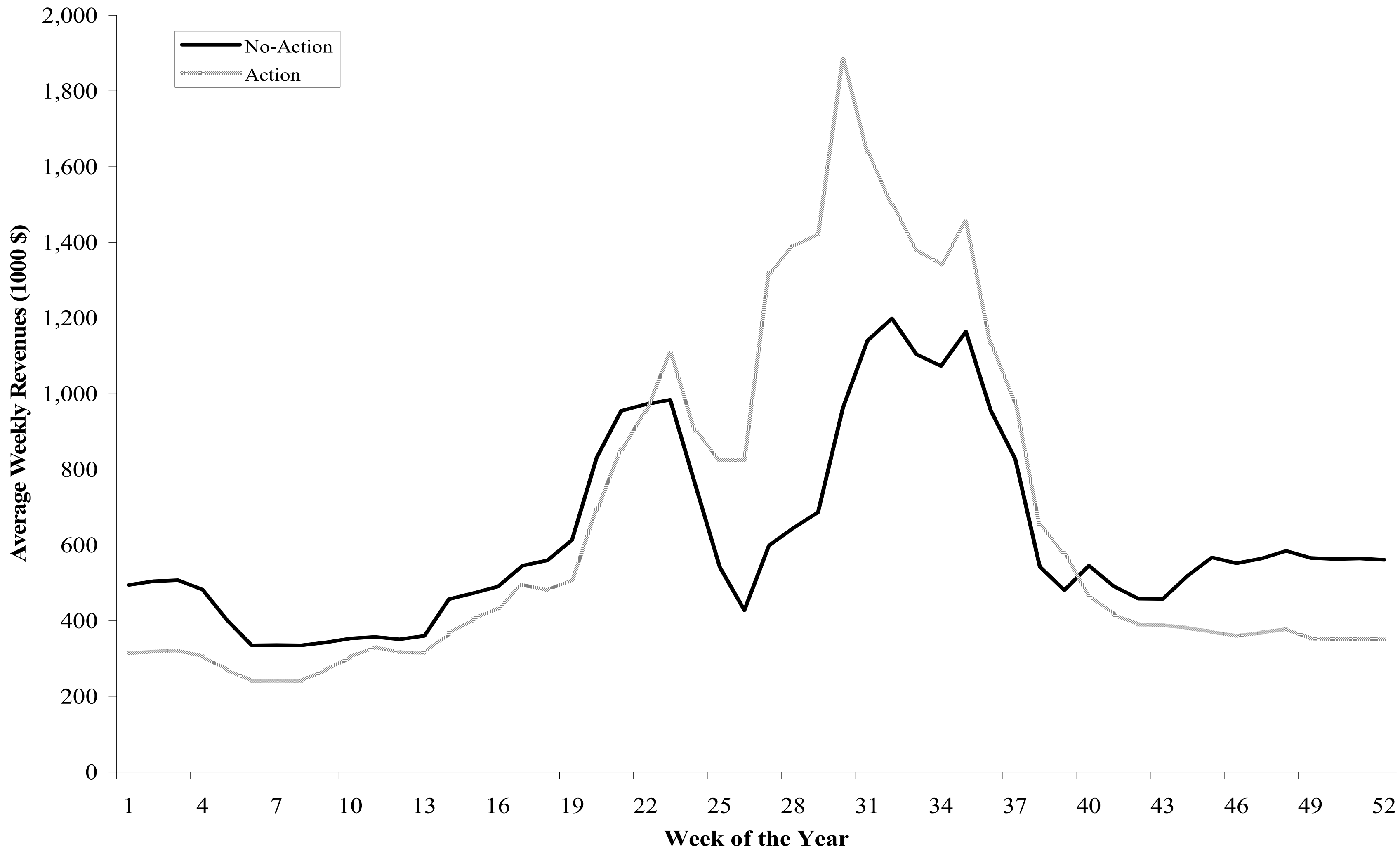

Figure 8-2. Average Weekly Revenues for the No Action and Action Alternatives.

Average nominal revenues for the two Alternatives are shown in figure 8.2. Consistent with the weekly distribution of generation levels and spot market prices, the Action Alternative has much higher revenues during the summer. These gains more than offset lower revenue streams during the other seasons. If price differences among the seasons of the year were projected to be smaller, then the Action Alternative would have a lesser economic advantage relative to the No Action Alternative and under some spot price scenarios an economic disadvantage.

With similar monthly release levels, hourly operations under the two alternatives are alike. Figures 8.3 and 8.4 show Flaming Gorge release patterns and resultant Jensen Gauge flows under average hydropower conditions for the No Action and Action Alternatives, respectively. The figure shows that release patterns and hence generation for both alternatives are able to respond to market price signals. During the most expensive spot market hours water releases are relatively high. In general, however, release levels for the No Action Alternative fluctuate slightly more than for the Action Alternative. This is partially due to a slightly larger average release rate over the week for the No Action Alternative (i.e., 2,722 cfs) compared to the Action Alternative (i.e., 2,370 cfs). Also, the No Action Alternative has a slightly larger Jensen Gauge flow window compared to the Action Alternative.

The upper bounds of the gauge flow window for the No Action Alternative are fixed through the simulated week at +/- 12.5 percent of the average weekly flow rate. As shown in figure 8.4. the gauge flow rate window is somewhat smaller for the Action Alternative

Similar release patterns in response to market prices and gauge constraints are displayed under both wetter and drier hydropower conditions. Figures 8.5 and 8.6 show generation patterns for relatively dry conditions for the No Action and Action Alternatives, respectively. For both alternatives release rates are at the minimum allowable levels (i.e., 800 cfs) when prices are at their lowest levels. Peak dam releases occur during the daytime when prices are high, but ramp rate and the single-hump limitations constrain release levels well below the turbine maximum. Only two of the three turbines would be operated under these conditions.

When hydropower conditions are relatively wet, the powerplant is mainly limited by operational constraints for the No Action Alternative. Figure 8.7 shows that Jensen Gauge flows do not approach either the upper or lower limits during most the simulated week. Instead ramp-rate and the one-hump limitations along with turbine constraints dictate the release pattern. For the Action Alternative, gauge limitations are more constraining, as shown in figure 8.8. However, the economic impact of these limitations is minor since the powerplant is operating at its maximum level most of the time. Releases are only slightly lower during the lowest priced hours.

The hourly Flaming Gorge release patterns presented in this section are based on a relatively complex search routine that seeks to maximize the economic benefits of hydropowerplant operations. In doing so the mathematical algorithms find solutions that are often at the edge of compliance with little or no margin for error. Historically, operators have not used this type of approach and have been more conservative by operating the Flaming Gorge Dam well within the gauge flow limits. Given a more conservative approach the economic difference between the two alternatives may be smaller.

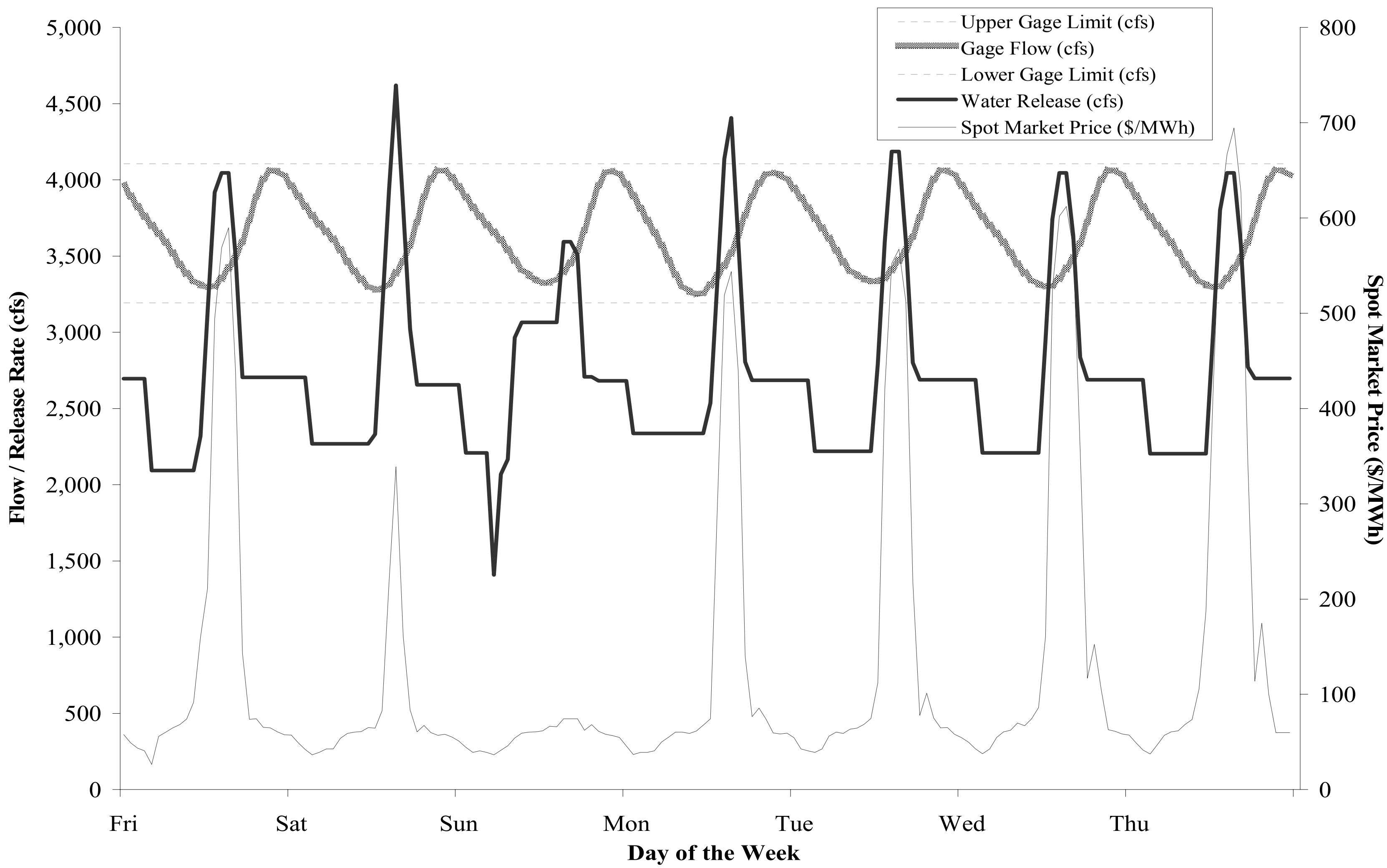

Figure 8-3. Hourly Flaming Gorge Dam Operations and Resultant Gauge Flows for the No Action Alternative Under Average Hydropower Conditions.

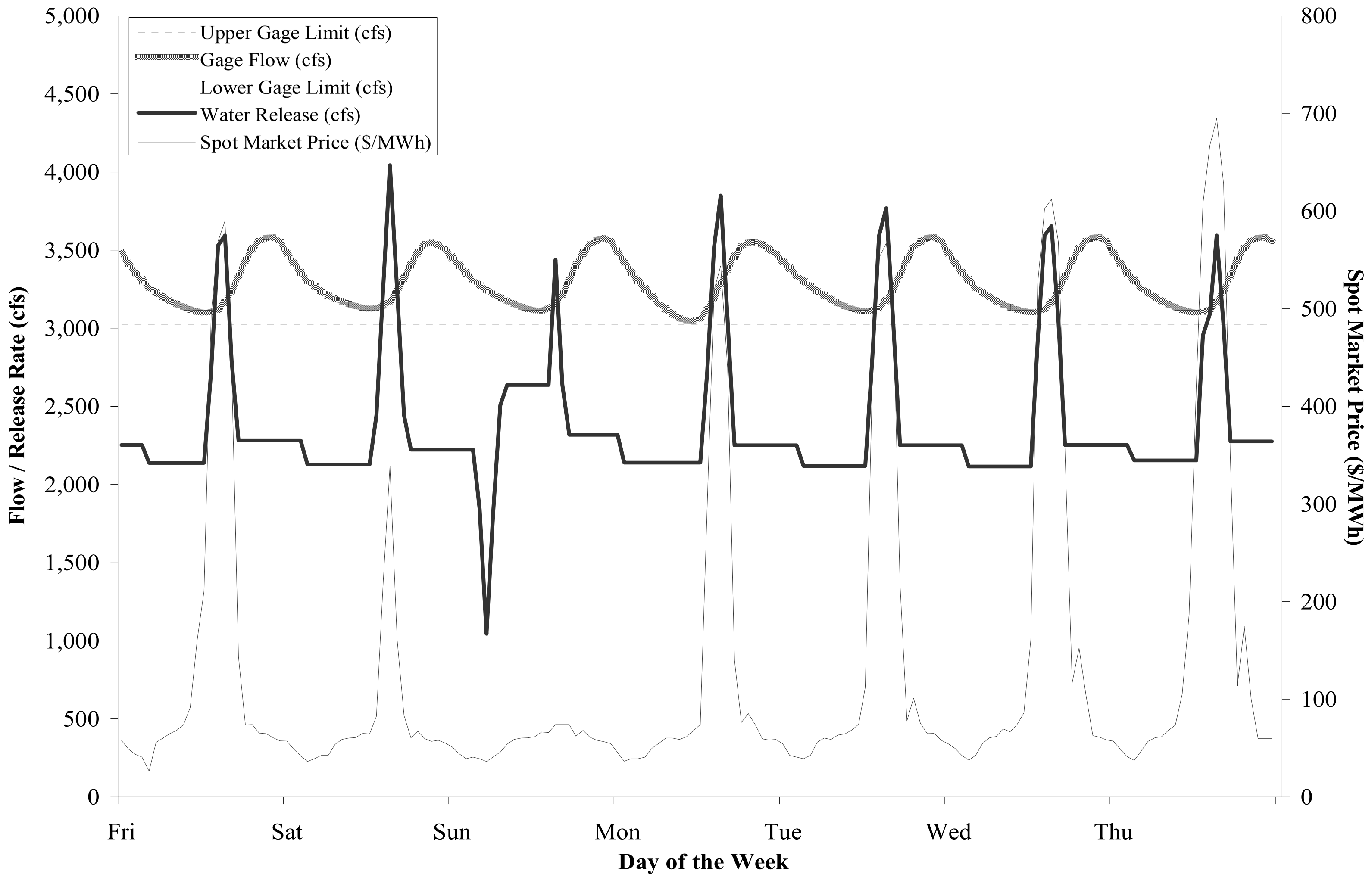

Figure 8-4. Hourly Flaming Gorge Dam Operations and Resultant Gauge Flows for the Action Alternative Under Average Hydropower Conditions.

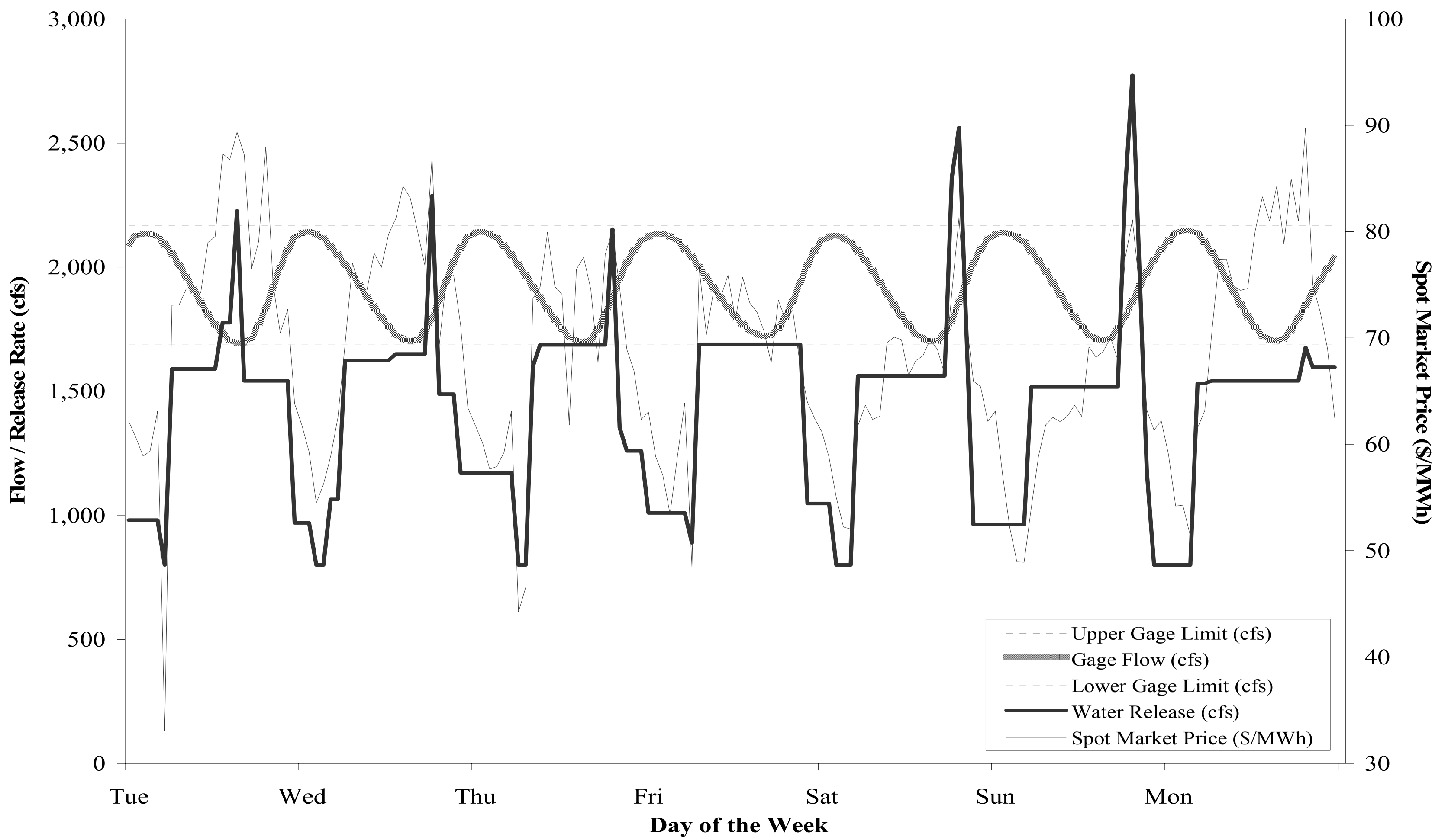

Figure 8-5. Hourly Flaming Gorge Dam Operations and Resultant Gauge Flows for the No Action Alternative Under Relatively Dry Hydropower Conditions.

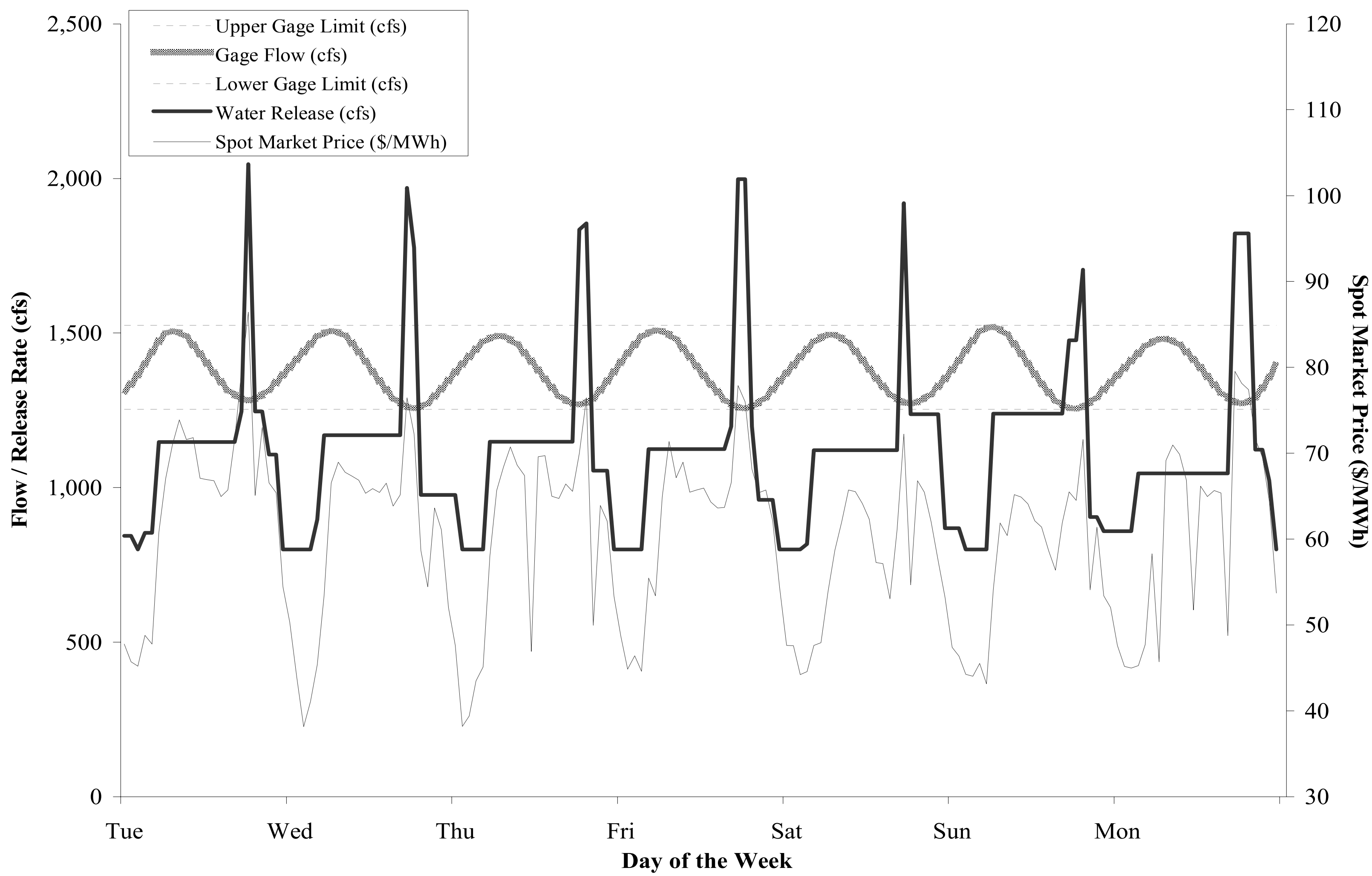

Figure 8-6. Hourly Flaming Gorge Dam Operations and Resultant Gauge Flows for the Action Alternative Under Relatively Dry Hydropower Conditions.

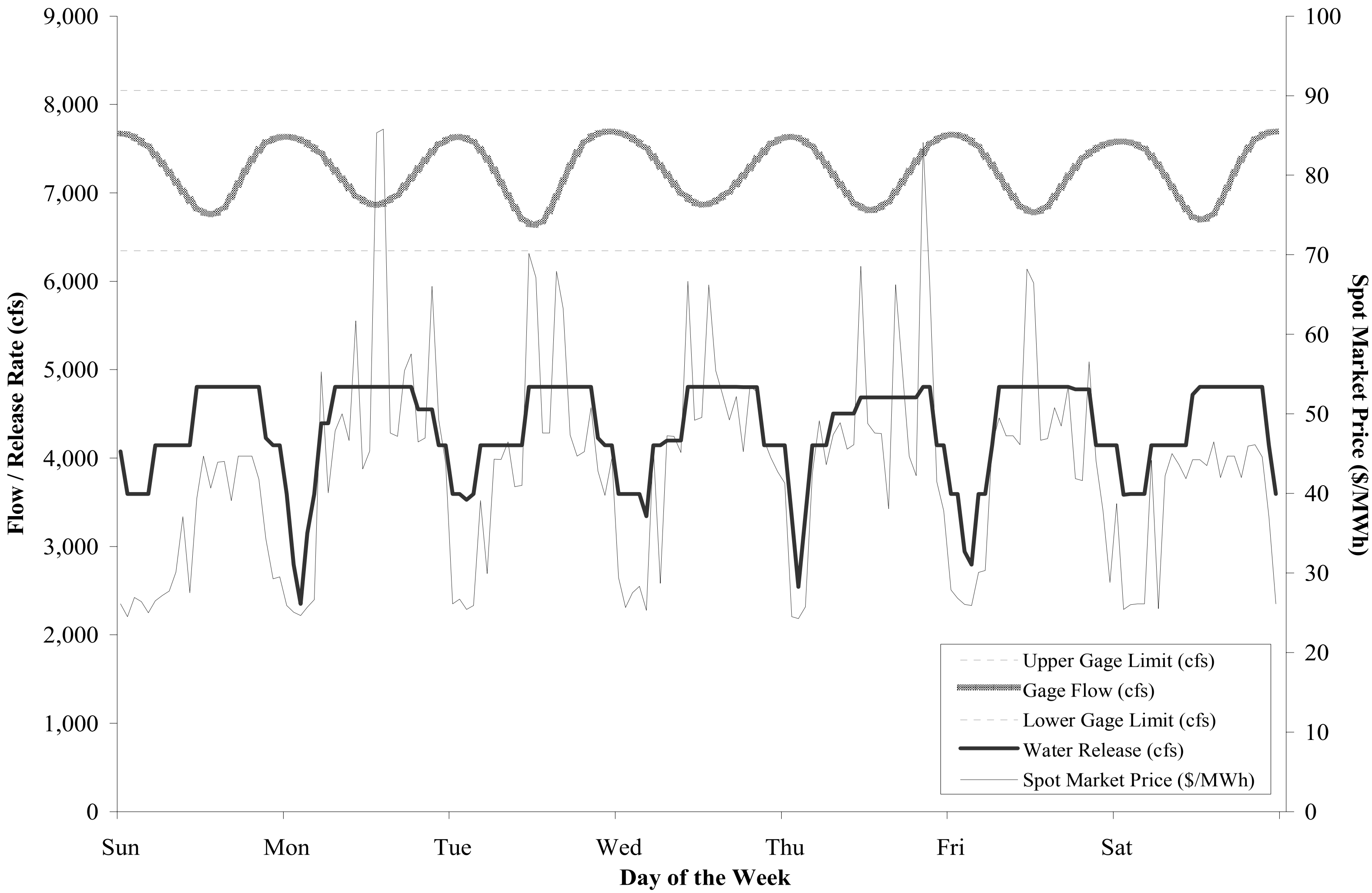

Figure 8-7. Hourly Flaming Gorge Dam Operations and Resultant Gauge Flows for the No Action Alternative Under Relatively Wet Hydropower Conditions.

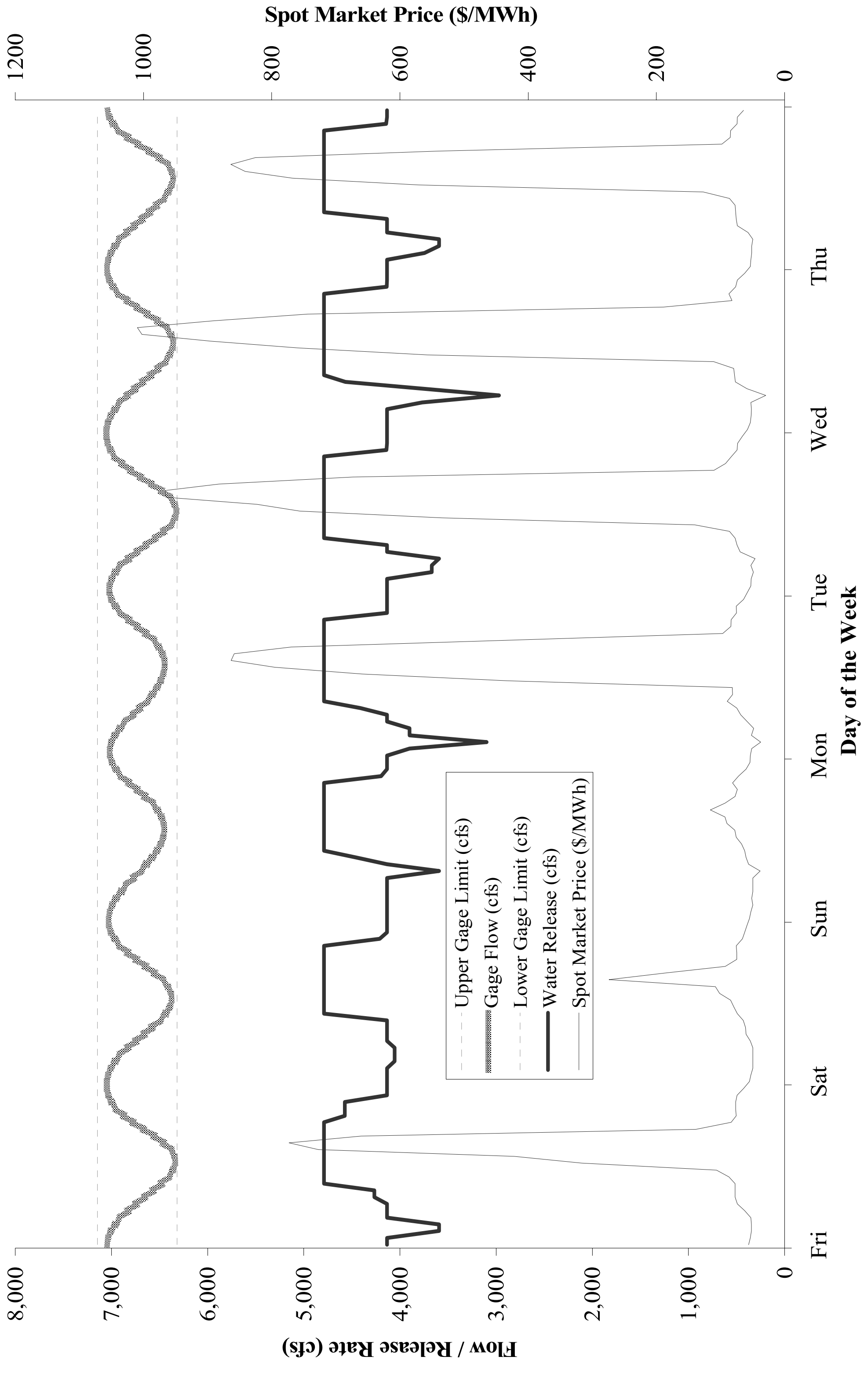

Figure 8-8. Hourly Flaming Gorge Dam Operations and Resultant Gauge Flows for the Action Alternative Under Relatively Wet Hydropower Conditions.

9. CUMULATIVE IMPACT

An additional hydropower analysis was performed to estimate the cumulative economic costs of environmental regulations associated with Flaming Gorge Powerplant operations. The Cumulative Impact Scenario assumes that there are no biological constraints except for the 800 cfs minimum flow requirement. This scenario is for comparison purposes only and is not an alternative under consideration. Instead, it reflects the economic impacts on the economic value of power from environmental constraints enacted since 1973. Power simulations of the Cumulative Impact Scenario are performed using the same model systems approach as the No Action and Action Alternatives. Also, an additional run of the Flaming Gorge model was made to reflect the removal of biological constraints.

9.1 Green River Simulations

Flaming Gorge model simulated monthly water releases volumes for the Cumulative Impact Scenario are guided by a drawdown target that is set to 6,026 ft for April 1st. The fill target for August 1st is set to 6,033 ft. During the spring, forecast errors do not affect decisions regarding operational planning. Therefore, when the forecast is lower than the actual hydrology the elevation will exceed the 6,033 ft. target. On the other hand, a high forecast will result in a lower reservoir elevation on April 1st. During the base flow it is assumed that there are no forecast errors. The outflow is always limited to powerplant capacity except when the spillway gates are in danger of being overtopped. A model parameter is specified such that non-power releases occur when the elevation exceeds 6040 ft. (i.e., the top of the spillway gates). Spills and turbine releases are scheduled such that reservoir elevation is lowered to 6,040 ft.

Average monthly water releases over the study for the Cumulative Impact Scenario and the No Action Alternative are shown in figure 9.1. On average, water releases during the summer months are significantly higher for the Cumulative Impact Scenario. Note that these are the months that have the highest value of electricity. In addition to having higher water releases during the summer months, water releases among days of a simulated month were not restricted; that is, only monthly water volumes constrain powerplant operations. This allows for greater water releases and generation levels during days of the month that have the highest electricity prices.

9.2 Powerplant Operations

Powerplant operations for the Cumulative Impact Scenario not only benefit from larger water releases during the summer months, but there are significantly fewer non-power water releases. Most of the non-power releases for the Alternatives are attributable to spring spike flows. Table 9.1 shows that non-power release for the No Action Alternative is more than five times higher than the Cumulative Impact Scenario. Lower spills and more operational flexibility translate into a 2.7% higher generation level.

Ramp-rate constraints and the single daily hump requirement do not restrict hourly generation patterns for the Cumulative Impact Scenario. Therefore, operations respond more quickly and efficiently to market price signals. Figure 9.2 shows typical operations for a summer day. Generation levels quickly increase from the minimum flow level (i.e., energy produced by 800 cfs) to the point of maximum water-to-power conversion efficiency when prices begin to increase in the morning. When prices spike in the afternoon, generation levels increase to the maximum powerplant capability.

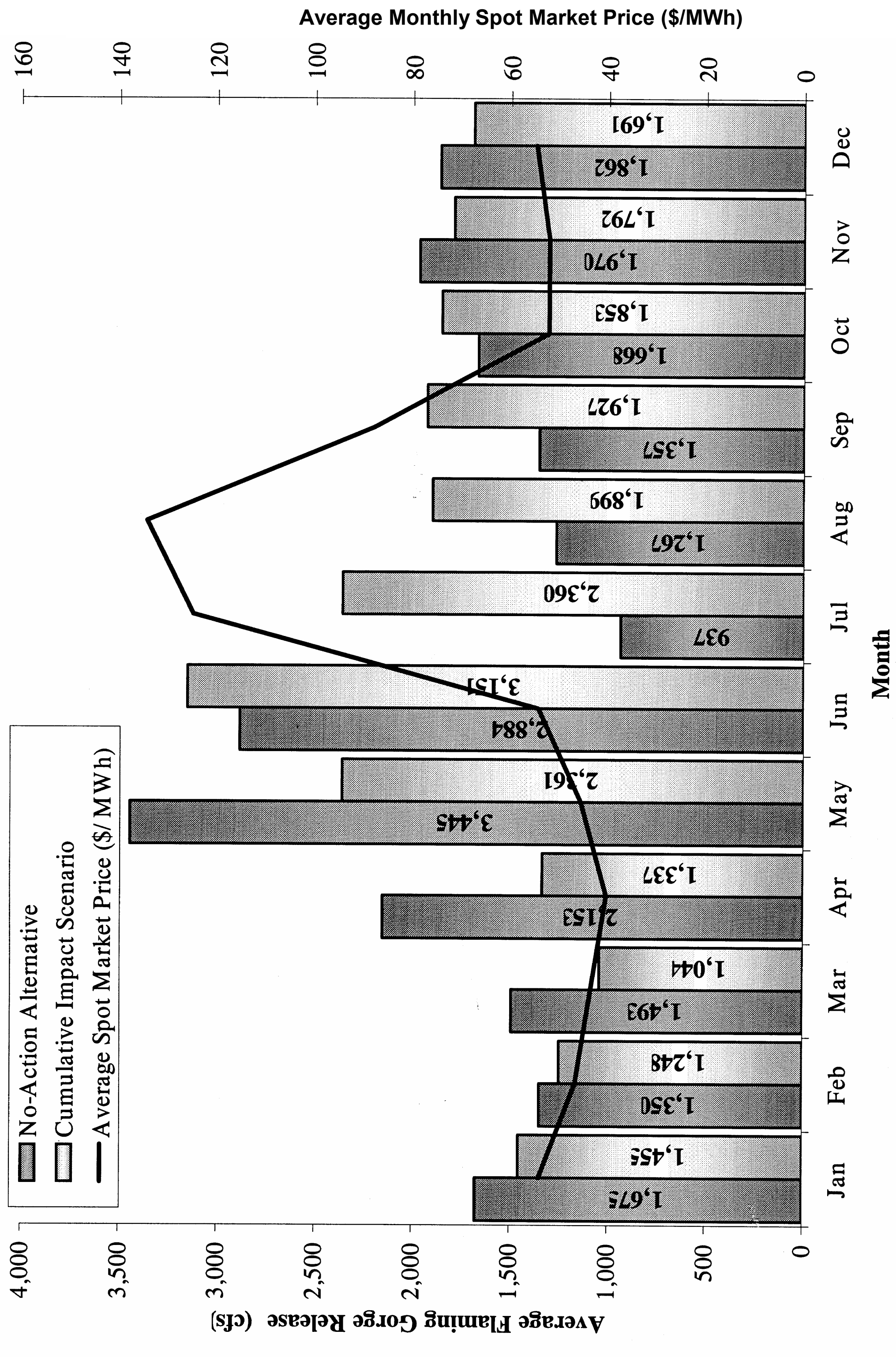

Figure 9-1. Comparison of Monthly Average Water Releases for the No Action Alternative and the Cumulative Impact Scenario.

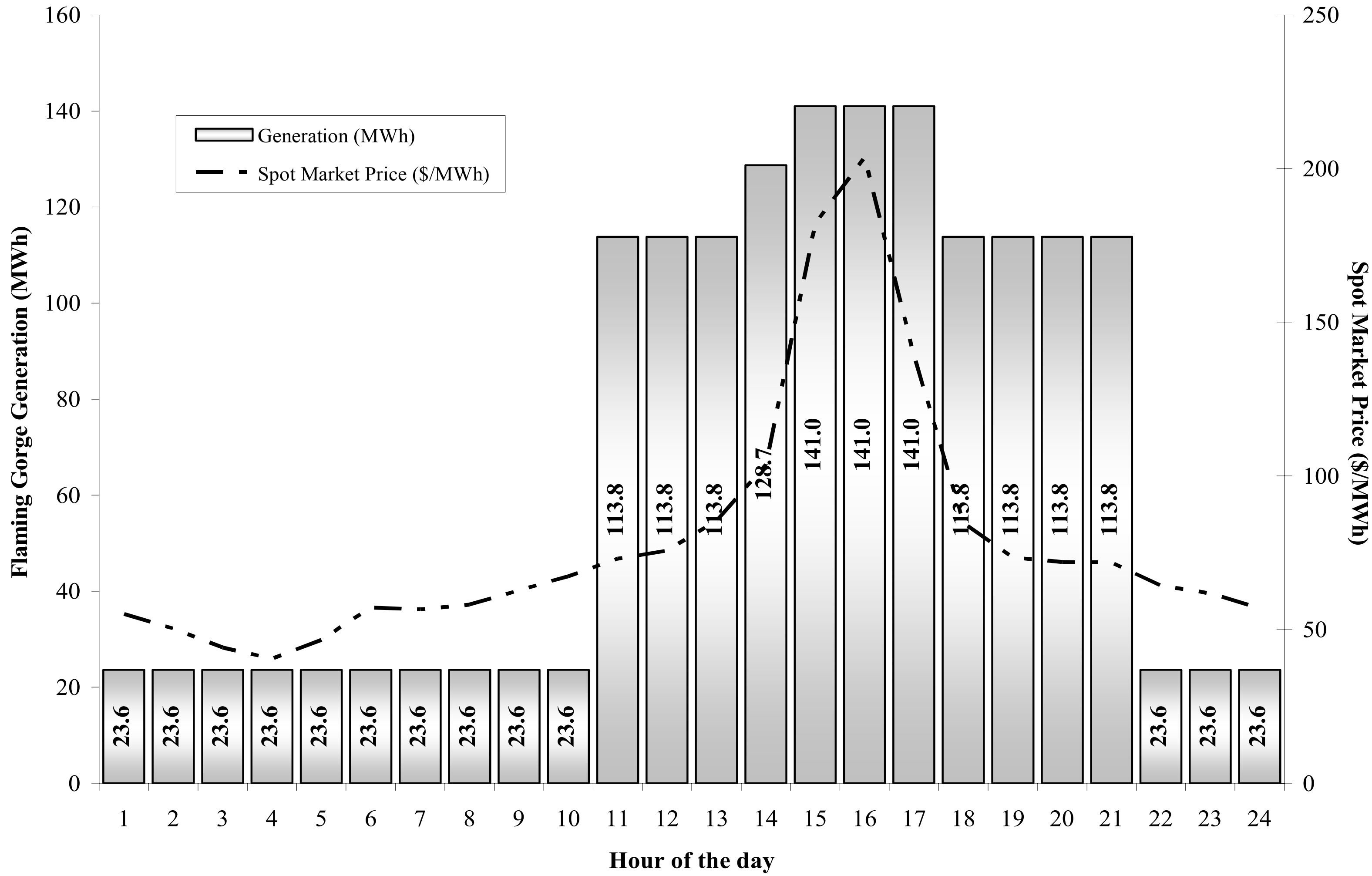

Figure 9-2. Typical Daily Generation Pattern During a Summer Weekday for the Cumulative Impact Scenario.

Table 9.1. Comparison of the Water Release and Generation from the Flaming Gorge Powerplant between the No Action Alternative and the Cumulative Impact Scenario

	No Action Alternative	Cumulative Impact Scenario	Increase Above the No Action Alternative (%)
Average Water Release (cfs)	1,839.2	1,843.7	0.2
Average Non-turbine Release (cfs)	64.4	11.6	-81.9
Generation (GWh)	11,904.1	12,229.7	2.7

With environmental constraints removed, the economic value of power production over the 25-year simulation period is significantly greater as compared to both the No Action and Action Alternatives. As shown in table 9.2, the Cumulative Impact simulation has an economic value that is about 29% higher than the No Action Alternative.

Table 9.2. Comparisons of the Economic Value of EIS Alternatives and the Cumulative Impact Scenario

	No Action Alternative (millions $)	Action Alternative (millions $)	Cumulative Impact (millions $)	Comparison of Cumulative Impact to No Action (%)
Nominal	$806.1	$850.6	$1,065.1	32.1
NPV	$403.1	$423.1	$521.4	29.3

10. REFERENCES

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Fulp, T., Vickers, B., Williams, B., and King, K., 1996, *Replacement of the Colorado River Simulation System (CRSS)*, Draft Report, in final preparation, Bureau of Reclamation.

Harpman, David A. and Rosekrans, A. Spreck, 1996, Modeling Hourly Operations At Glen Canyon Dam – Colorado River Storage Project, Arizona (GCPS09 Version 1.0), Bureau of Reclamation, Denver, Colorado.

Mitchell, Melanie, *An Introduction to Genetic Algorithms*, The MIT Press, Cambridge, Massachusetts, London, England, Sixth printing, 1999

Muth, Robert T., et al., *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam*, Final Report, Upper Colorado River Endangered Fish Recovery Program Project, September 2000.

United States Army Corps of Engineers, Streamflow Synthesis and Reservoir Regulation Model Users Manual, Draft, August 1987

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Western Area Power Administration Web Site, http://www.wapa.gov/crsp/operatns/fgSCADAdata.htm.

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APPENDIX A:

HYDRAULIC TURBINE DATA FOR FLAMING GORGE

FLAMING GORGE POWER PLANT COLORADO RIVER STORAGE PROJECT.
SPECIFICATIONS NO. DS-5263 UNITS 1, 2 AND 3 DATE May 17, 1960
TURBINE NAMEPLATE RATING: H.P. 50,000; HEAD 365 FT.; SPEED 240 R.P.M.
GENERATOR RATING IN KV-A 40,000 POWER FACTOR 90 PERCENT.

Turbine mfr. The James Leffel Co. Type Francis
Cost per unit f.o.b. factory $266,183.33 Weight 310,000 lbs.
Cost per h.p. $4.38 Weight per h.p. 5.10 lbs.
Type of scroll case Welded plate steel spiral. Weight heaviest part 50,000 lbs.
Type of draft tube Elbow with plate steel liner-one pier
Weight of runner 21,500 lbs. Weight of rotating parts 45,000 lbs.
Weight of turbine parts including hydraulic thrust to be carried by generator thrust bearing 225,000 lbs. New; 310,000 lbs. Worn rings

Governor capacity in foot-lbs. 105,000 Pipe size 3 inches.
Gov. mfr. Woodward Governor Co. Time element 5 seconds.
Cost per unit f.o.b. factory $39,758.33 Weight 15,550 lbs.

Generator mfr. Westinghouse Electric Corp.
Generator WR^2 7,000,000 lbs. at one foot radius.
Turbine WR^2 160,000 lbs. at one foot radius.
Regulating constant of unit ($\overline{R.P.M.}^2 \times WR^2 \div$ Design H.P.) 6,990,000

n_s of runner 29.9 at 400 ft. design head when delivering 50,000 h.p. (Best eff. gat
N_s of runner 33.1 at 400 ft. design head when delivering 60,800 h.p. (Full gate).
H.P. at 400 ft. (Design head) 60,800; at 100 percent of design head; 1530 c.f.s.
H.P. at 440 ft. (Max. head) 69,400; at 110 percent of design head; 1620 c.f.s.
H.P. at 260 ft. (Min. head) 30,600; at 65 percent of design head; 1190 c.f.s.
H.P. at 350 ft. (Mfrs. Rated Hd.) 50,000; at 87.5 percent of design head; 1400 c.f.s.
H.P. at best efficiency equals 82.2 percent of h.p. at full gate.
Runaway speed at 440 ft. hd. 445 r.p.m. equals 185 percent of normal speed.

DIMENSIONS OF TURBINE:

Unit spacing 36.0 ft. Dia. of shaft 26 inches.
Max. dia. of runner 8.50 ft. Dia. of cover plate 12.05 ft.
Dia. of gate circle 9.75 ft. Number of wicket gates 20.
Height of distributor case 1.615 ft. Number of stay vanes 19.
Dia. at scroll case inlet flange 8.00 ft. Dia. at top of draft tube 7.80 Ft=D.
Ouside radii of stay vanes 6.92 to ft. Distributor ℄ Elev. 5601 Ft.
Distance from center line of distributor to top of draft tube 2.29 ft.
Depth of draft tube 22.5 ft. equals 289 percent of dia. D_3.
Length of draft tube 31.58 ft. equals 405 percent of dia. D_3.
Width of draft tube 29.00 ft. equals 372 percent of dia. D_3.
Distance from center line of turbine to center line of scroll case inlet 11.25 ft.
Distance from center line of distributor to minimum tailwater, (Elev. 5601.6 ft.)
(One unit operating at full load) -0.6 ft.

Pressure regulator mfr. None Type Size inches.
Cost per unit f.o.b. factory Weight lbs.

REMARKS:
Placed in operation

Figure A.1. Listing of Turbines, Generator, and Related Equipment Characteristics at the Flaming Gorge Powerplant.

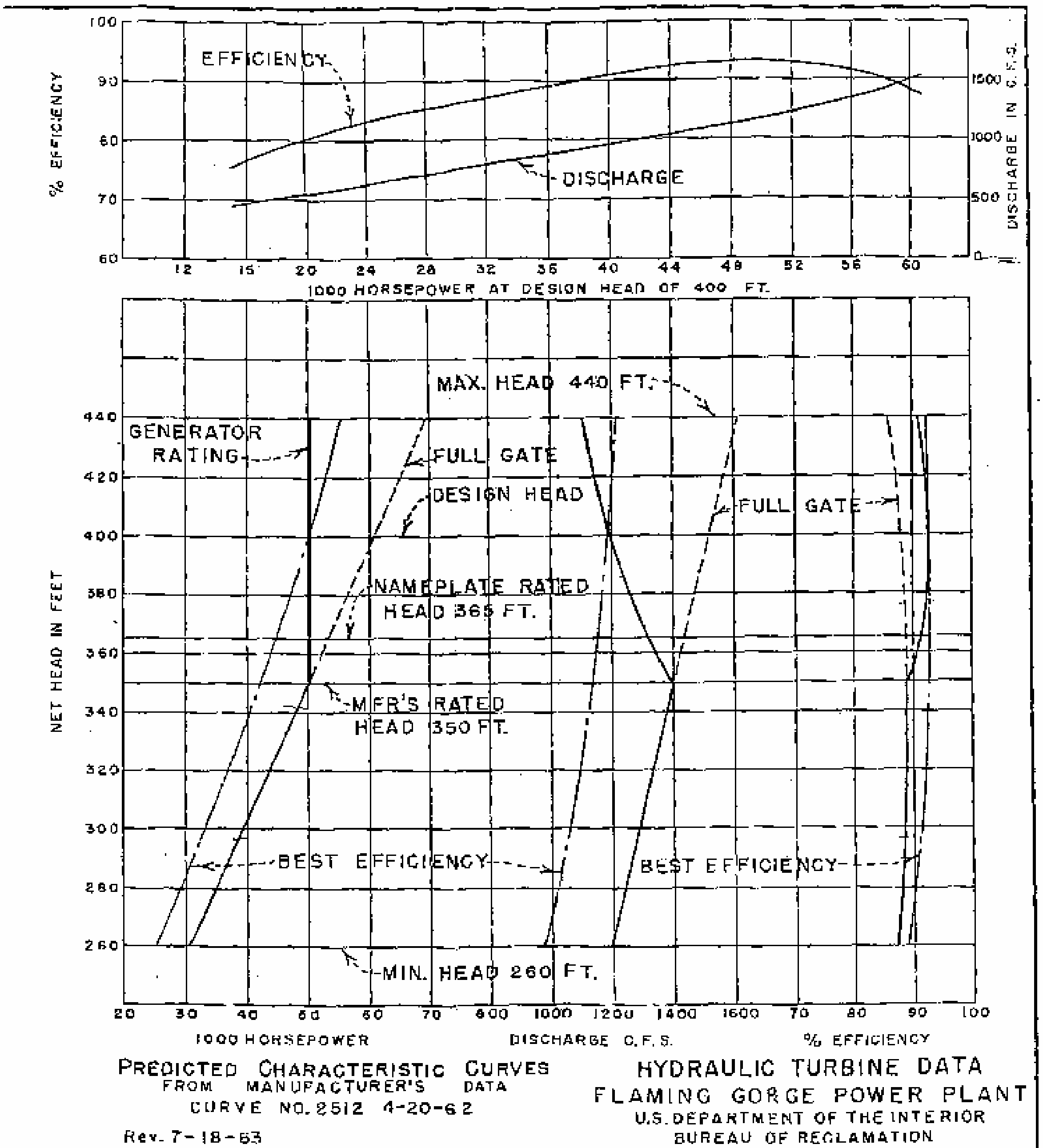


Figure A.2. Predicted Characteristic Curves and Hydraulic Turbine Data for the Flaming Gorge Powerplant.

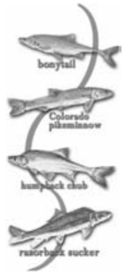
Operation of
Flaming Gorge Dam
Final Environmental
Impact Statement

Cultural Resources Technical Appendix

CULTURAL RESOURCES TECHNICAL APPENDIX

Page No.

Cultural Resources Technical Appendix



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August 30, 2002

Kerry Schwartz
Chief, Environmental Group
Bureau of Reclamation
302 East 1860 South
Provo, UT 84606-7317

Re: Flaming Gorge Dam Operation

Dear Ms. Schwartz

This office has reviewed the information contained in your correspondence of August 22, 2002 concerning the project listed above.

5MF605, 5MF2357.3 and 5MF2357.2 are listed in the National Register of Historic Places. 5MF2399 and 5MF2388 have officially been determined not eligible to the National Register.

We concur that sites 5MF3668, 5MF1238, 5MF3669 and 5MF1230 are not eligible due to the lack of subsurface deposits, diagnostic artifacts and features. 5MF1233, an historic trash scatter, could not be relocated and is therefore not eligible.

5MF1234, 5MF840 and 5MF67 need additional data in order to make a determination of eligibility. The only information we have in house on site 5MF67 is a 1965 form. This site needs to be recorded according to today's standards.

We concur that rock art sites 5MF2964, 5MF2966 and 5MF2968 are eligible to the National Register.

The proposed work at sites 5MF605, 5MF688, 5MF840, 5MF1232 and 5MF1234 is adequate. We would also recommend that recording 5MF67 be added to the work being done for this project.

Kerry Schwartz
Page 2
August 30, 2002

If we may be of further assistance please contact Jim Green at 303-866-4674.

Sincerely,

Georgianna Contiguglia
State Historic Preservation Officer

GC/WJG

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March 28, 2003

Beverley Hefferman
Chief, Environmental Group
Bureau of Reclamation
302 East 1860 South
Provo, UT 84606-7317

Re: Flaming Gorge Dam Operation EIS, Browns Park Area

Dear Ms. Hefferman:

This office has reviewed your March 24, 2003 correspondence and the cultural resource report prepared by Alpine Archaeological Consultants for the testing of six sites in the Flaming Gorge Dam flow study, Browns Park National Wildlife Refuge.

Fort Davey Crockett, 5MF605, was listed on the National Register of Historic Places in 1977. Despite impacts from the river, testing determined that buried cultural deposits exist that may increase our knowledge of the Fort and the people who inhabited the region.

5MF688 a rock art site, was determined eligible on August 30, 2002.

Testing at 5MF1232, an early homestead site, turned up a living surface. Further work on the site may yield information on early homesteading in the region.

5MF1234, 5MF3668 and 5MF840 are not eligible. 5MF3668 and 5MF680 no longer exist and 5MF1234 will yield no further information important to history.

It is apparent that wave action from the Green River is severely impacting 5MF605 and in a lesser way 5MF1232. We look forward to working with the agencies involved in this project to formulate a mitigation plan for these sites.

If we may be of further assistance please contact Jim Green at 303-866-4674.

Sincerely,

Georgianna Contiguglia
State Historic Preservation Officer

GC/WJG

cc: Rhoda Lewis, F&WS
Mary Barger, WAPA

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State of Utah
Department of Community and Economic Development
Division of State History
Utah State Historical Society

chael O. Leavitt
Governor
Max J. Evans
Director

300 Rio Grande
Salt Lake City, Utah 84101-1182
(801) 533-3500 FAX: 533-3503 TDD: 533-3502
ushs@history.state.ut.us http://history.utah.org

December 10, 2002

Peter Crookston
Acting Chief, Environmental Group
Bureau of Reclamation
Upper Colorado Region – Provo Area Office
302 East 1860 South
Provo UT 84606-7317

RE: Consultation Regarding Determinations of Eligibility and Effect for Flaming Gorge Dam Operation Environmental Impact Statement

In Reply Please Refer to Case No. 02-1790

Dear Mr. Crookston:

The Utah State Historic Preservation Office received the referenced information on December 5, 2002. After consideration of the consultation request in behalf of the Bureau of Reclamation, the Utah Preservation Office provides the following comments per §36CFR800.

1. Eligibility of Sites Within the Reservoir Area of Potential Effects, Table 1: USHPO preservation Office concurs with the determination that Table 1 sites are **Not Eligible, [17 NP]**.

2. Eligibility of Sites in the Reservoir, Table 2, APE Indirectly Affected by the Proposed Undertaking; USHPO concurs with the determination that DA 15 is **Not Eligible** and that DA 11, 12 and 16 are **Eligible**. In addition, USHPO recommends that DA 17 and 497 be considered eligible until evaluation is completed of the sites. **[DOEx5, NPx1]**.

3. Eligibility of Sties in the Downstream Area of Potential Effects, Table 3: USHPO concurs with the determinations that DA 394, 196 are **Eligible**. The site numbers for the Uintah County sites are incomplete in the version of the table our office received, so our office cannot complete consultation without the complete site numbers. For the sites undetermined, USHPO recommends that they be treated as eligible until evaluation is completed of the sites. **[DOEx7]**.

Preserving and Sharing Utah's Past for the Present and Future

4. Eligibility of Sites Downstream Indirectly Affect by River Flows, Table 4: USHPO concurs with the determinations that DA 337, 562, 40, 485, 30, 668; UN 1746, 265, 267 and 271 are **Eligible**. USHPO concurs with the determination that DA 338, 204, 225, 339, 341, 661, 750, 751, 332; UN 1563, 65, and 1600 are **Not Eligible**. For the sites undetermined, USHPO recommends that they be treated as eligible until evaluation is completed of the sites. **[DOEx13, NPx12]**.

5. After review of the site forms in consideration for testing, USHPO understands that a limited testing program for eligibility is considered for DA 203, 342, 488 and 564. Concerning DA 342, unless there has been significant disturbance since recording appears to be eligible with well defined site location, USHPO recommends not testing this site.

6. Assessment of Effects for the Reservoir APE: Table 1, concur **No Historic Properties Affected,** Table 2, concur **No Historic Properties Affected**.

7. Assessment of Effects for the Downstream APE: concur with limited testing for eligibility and potential to be included in the area of potential effect. Concur **No Adverse Effect**.

8. Ethnographic Report: the report will be removed as of 12.16.02 from the public compliance record and put in my files until the document is released by BOR.

This information is provided to assist with Section 106 responsibilities as per §36CFR800. My email address is: jdykman@utah.gov

As ever,

James L. Dykmann
Deputy State Historic
Preservation Officer - Archaeology

JLD:02-1790 BOR/NPx31/DOEx32/NPAx24/NAEx7

c: SWCA Environmental Consultants, 230 South 500 East, Suite 380,
Salt Lake City UT 84102-2015

c: Mary Barger, Western Area Power Administration, 12155 West Alameda Parkway
P. O. Box 281213, Lakewood CO 80228-8213

c: Blaine Phillips, Archaeologist, Bureau of Land Management, Vernal Field Office
170 South 500 East, Vernal UT 84078-2799

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Department of Community and Economic Development

DAVID HARMER
Executive Director

Division of State History / Utah State Historical Society

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December 29, 2003

Barbara Blackshear
Bureau of Reclamation
302 East 1860 South
Provo UT 84606-7317

RE: Extension of the Analysis Area for the Operation of Flaming Gorge Dam EIS`

In Reply Please Refer to Case No. 02-1790

Dear Ms. Blackshear:

The Utah State Historic Preservation Office received the referenced information on December 19, 2003. After consideration of the consultation request in behalf of the Bureau of Reclamation, the Utah Preservation Office provides the following comments per §36CFR800.

Consultation; concur eligibility determinations, [Table 1, 12.16.2003 consultation letter] and effect determination, No Historic Properties Affected.

This information is provided to assist with Section 106 responsibilities as per §36CFR800. My email address is: jdykman@utah.gov

As ever,

James L. Dykmann
Deputy State Historic
Preservation Officer - Archaeology

JLD:02-1790 OFR/DOEx11/NPx11/NPAx22

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January 13, 2004

Barbara Blackshear
Bureau of Reclamation
302 East 1860 South
Provo UT 84606-7317

RE: Archaeological Determination, Testing and Assessment of Four Sites for the Operation of Flaming Gorge Dam Environmental Impact Statement

In Reply Please Refer to Case No. 02-1790

Dear Ms. Blackshear:

The Utah State Historic Preservation Office received the referenced information on January 7, 2004. After consideration of the consultation request in behalf of the Bureau of Reclamation, the Utah Preservation Office provides the following comments per §36CFR800.

Consultation; concur No Adverse Effect.

This information is provided to assist with Section 106 responsibilities as per §36CFR800. My email address is: jdykman@utah.gov

As ever,

James L. Dykmann
Deputy State Historic
Preservation Officer - Archaeology

JLD:02-1790 OFRNAE

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May 5, 2004

Barbara Blackshear
Bureau of Reclamation
302 East 1860 South
Provo UT 84606-7317

RE: Flaming Gorge EIS - Effects on Desolation Canyon National Historic Landmark

In Reply Please Refer to Case No. 02-1790

Dear Ms. Blackshear:

The Utah State Historic Preservation Office received the referenced information on April 29, 2004. After consideration of the consultation request in behalf of the Bureau of Reclamation, the Utah Preservation Office provides the following comments per §36CFR800.

Section 106 Consultation; Concur No Historic Properties Affected, 36 CFR §800.10 Consultation, National Landmark.

This information is provided on request to assist with Section 106 responsibilities as specified in §36CFR800. My email address is: jdykman@utah.gov

As ever,

James L. Dykmann
Deputy State Historic
Preservation Officer - Archaeology

JLD:02-1790 BOR

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DEPARTMENT OF STATE PARKS & CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE

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Barrett Building
2301 Central Ave.
Cheyenne, WY 82002

(307) 777-7697
FAX (307) 777-6421

Nov 19, 2002

Ms. Beverley Heffernan
Acting Chief, Environmental Group
Provo Area Office
Bureau of Reclamation
302 East 1860 South
Provo, Utah 84606-7317

Re: Flaming Gorge Dam Operation Environmental Impact Statement (SHPO File # 0902SES016)

Dear Ms Heffernan:

Sara Sheen of our staff has received information concerning the aforementioned project. Thank you for allowing us the opportunity to comment.

We have reviewed the project report and find the documentation meets the Secretary of the Interior's Standards for Archaeology and Historic Preservation (48 FR 44716-42).

We concur that the proposed action will have no effect on the historic porperties located at or near (one-quarter mile or less) of the high elevation of Flaming Gorge Reservoir as your office does no expect there to be any changes in the fluctuations of the water levels from what has been considered normal. However, we recognize there is potential for unusual drawdowns on Flaming Gorge to occur which would potentially affect cultural properties located at or near the shoreline of the Reservoir. We recommend that the Bureau of Reclamation conduct an annual monitor of the historic properties listed by your office as located near the high elevation of the Reservoir. We also recommend an annual report, due by December 31 of each year, be submitted to our office documenting the results of the monitor.

We recommend the Bureau of Reclamation allow the project to proceed in accordance with state and federal laws subject to the conditions stipulated in this letter and the request for comment and the standard stipulation that if any cultural materials are discovered during the proposed action, work in the area should halt immediately and the Bureau of Reclamation staff and SHPO staff must be contacted. Work in the area may not resume until the materials have been evaluated and adequate measures for their protection have been taken.

This letter should be retained in your files as documentation of our conditional determination that no historic properties will be affected by this project.

Jim Geringer, Governor   John T. Keck, Director

Please refer to SHPO project control number 0902SES016 on any future correspondence dealing with this project. If you have any questions, contact Sara Sheen at 307-777-7498 or me at 307-777-6311.

Sincerely,

Judy K. Wolf
Review and Compliance Program Manager

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United States Department of the Interior
NATIONAL PARK SERVICE
INTERMOUNTAIN REGION
Intermountain Support Office
12795 West Alameda Parkway
PO Box 25287
Denver, Colorado 80225-0287

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Memorandum

To: Beverly C. Heffernan, Chief, Environmental Group, Bureau of Land Management, Provo Area Office, 302 East 1860 South, Provo, Utah 84606-7317

From: Lysa Wegman-French, Historian, National Park Service, Heritage Partnership Program

Subject: Consultation on Desolation Canyon for Operations of Flaming Gorge Dam Environmental Impact Statement (EIS)

Thank you for providing us with the material on the proposed implementation of the Action Alternative described in the above referenced EIS, which is an undertaking in relation to Desolation Canyon National Historic Landmark (NHL). As stated in 36 CFR Part 800.10 (c), federal agencies are required to notify the Secretary of the Interior (delegated to the National Park Service) of any consultation involving an undertaking at a National Historic Landmark.

That same paragraph in Code of Federal Regulations specifies that the agency will invite the Secretary to participate in the consultation where there may be an adverse effect. Based on your letter, and the letter that you enclosed from the Utah State Historic Preservation Office (SHPO), your agencies concur that the undertaking will not result in an adverse effect.

Your letter also asks us to concur with the finding of no adverse effect, or no effect, on the NHL. It is not within the statutory authority of the National Park Service to concur on effects.

As a result of these two points, we have no comments on the proposal.

Thank you for informing us about this undertaking, and we appreciate your interest in preserving our nation's historic resources. If you have any questions, please contact call me at (303) 969-2842.

Sincerely,

for Thomas G. Keohan

~~Lysa~~ Wegman-French, Historian
Heritage Partnerships

cc:
Bureau of Land Management, Attn: Garth Portillo, Post Office Box 45155, Salt Lake City, Utah 84145-0155
Utah State Historic Preservation Office, Salt Lake City

TAKE PRIDE IN AMERICA

Attachment #9

THE HOPI TRIBE

C... GINAL COPY

Wayne Taylor, Jr.
CHAIRMAN

Phillip R. Quochytewa, Sr.
VICE-CHAIRMAN

July 17, 2000

Bruce C. Barrett, Area Manager
Bureau of Reclamation
Upper Colorado Region
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Dear Mr. Barrett,

This letter is in response to your correspondence dated July 10, 2000 regarding the Bureau of Reclamation publication of a notice of intent to draft a Flaming Gorge Dam Operations Environmental Impact Statement. The Hopi Tribe appreciates your solicitation of our input and your efforts to address our concerns.

Without waiving our rights under the National Historic Preservation Act, the Native American Graves Protection and Repatriation Act, and all other relevant legislation and executive orders, the Hopi Tribe defers consultation on this proposed project to the Unitah and Ute Nations, whose lands lie within the potential project area, and other interested American Indian tribes.

Thank you for your consideration

Respectfully,

Leigh J. Kuwanwisiwma, Director
Cultural Preservation Office

P.O. BOX 123 — KYKOTSMOVI, AZ. — 86039 — (520) 734-3000

ORIGINAL

Kaibab Band of Paiute Indians

Attachment #7

August 29, 2000

Mr. Bruce C. Barrett, Area Manager
U.S. Department of the Interior
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Re: Flaming Gorge EIS

Dear Mr. Barrett:

We are in receipt of the correspondence and maps of the Flaming Gorge Environmental Impact Statement and want to express to you that in matters related to the Inadvertent Discovery of Human Remains, and Cultural Resource concerns, we will be satisfied that the Uintah/Ouray Ute Tribe take the lead in monitoring and deciding what course of action to take in these matters. Thus, with the Ute Tribe taking the lead, the government-to-government relationship and consultation, will be completed in a timely manner.

Thank you for notifying us and considering our participation.

Sincerely,

VJake

VIVIENNE-CARON JAKE
Director, Environmental Program

cc: File

Tribal Affairs

HC 65 Box 2
Pipe Spring, Arizona 86022

Phone (520) 643-7245
Fax (520) 643-7260

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The Great Seal of The Ute Indian Tribe
Uintah and Ouray Reservation

UTE INDIAN TRIBE
P.O. Box 190
Fort Duchesne, Utah 84026
Phone: (435) 722-5141 • Fax: (435) 722-5072

May 24, 2004

Mr. Peter Crookston
Environmental Protection Specialist
Flaming Gorge EIS Manager
302 E. 1860 South
Provo, Utah 84606

RE: Flaming Gorge PD EIS Draft

Dear Peter:

Upon review of the Comment Analysis and our meeting on April 27, 2004 regarding the Flaming Gorge EIS draft we find there would not be a significant impact on Tribal lands.

Advance notice of peak flows from Reclamation would resolve our issues of oil and gas well development and access. It is our understanding Reclamation will monitor the Yampa River and the Green River for timing of peak flows, and we will given a three day notice prior to peak flows. This advance notice is imperative to curtail any oil and gas activity in the area and also to relocate any cattle in the area.

Contact information:

UTE INDIAN TRIBE

Energy & Minerals
Lynn Becker, Land Manager EMD 435-725-4072,
email address lynnb@utetribe.com
Energy & Minerals Department 435-725-4040,
email address energy_minerals@utetribe.com
Fax # 435-722-9270

Fish and Wildlife
Everett Manning, Director, 435-722-5511, ext. 402, email address emanning@ubta.com
Conrad Reed, Sr., Livestock Manager 453-722-5511, ext. 435, he does not have an email address

Business Committee
Roland McCook, Tribal Business Committee Member, 435-722-4005,
email address rolandm@utetribe.com

BIA
Environment Protection Specialist – will need to contact the BIA for this information

If you need any further information, please call me at 435-725-4072.

Sincerely,

Lynn Becker
Land Manager

cc: Fish and Game
Business Committee

UTE INDIAN TRIBE
UINTAH AND OURAY AGENCY
P.O. Box 190
Fort Duchesne, Utah 84026
Phone (435) 722-5141
Fax (435) 722-5072

TRI - UTE LEADER'S SUMMIT
GRAND JUNCTION, COLORADO
SEPTEMBER 22, 2000

AGENDA

9:00 A.M. COFFEE, JUICES, ROLLS, FRUIT

OPENING:

Welcoming - O. Roland McCook, Sr.
Opening Prayer

SOUTHERN UTE INDIAN TRIBE

Update ***John E. Baker, Jr., Chair***

UTE MOUNTAIN UTE INDIAN TRIBE

Update ***Ernest House, Sr., Chair***

UTE INDIAN TRIBE

Update ***O. Roland McCook, Sr., Chair***

OTHER ITEMS

Dale Bassett - Concern with Council Tree

Barbara Blackshears - Bureau of Reclamation

ORIGINAL COPY

PUEBLO OF ZUNI

HERITAGE AND HISTORIC PRESERVATION OFFICE

P.O. BOX 339
ZUNI
NEW MEXICO 87327

TEL: 505-782-4814
782-5558
FAX: 505 782-2393

PRO OFFICIAL FILE COPY
RECEIVED

Attachment # 8

August 1, 2000

Mr. Kerry Schwartz
Co-NEPA Manager
United States Department of the Interior
Bureau of Reclamation
Upper Colorado Region, Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Dear Mr. Schwartz:

Pursuant to your request dated 30 June 2000 regarding the draft environmental impact statement (EIS) on the operation of Flaming Gorge Dam, located on the Green River in northeastern Utah, the Zuni Heritage and Historic Preservation Office (ZHHPO) provides the following information with regards to cultural properties. The Zuni Tribe, federally recognized as the Pueblo of Zuni, ascribes cultural and religious significance to historic properties that may be affected by the proposed undertaking

Prior to amendments of the National Historic Preservation Act and other federal laws enacted to protect historic properties, archaeological resources, traditional cultural properties, and places of significance of Native American Tribes, many properties with immense cultural and religious significance were knowingly and unknowingly destroyed. This destruction occurred in areas of ancestral occupations along ancestral migration routes, within aboriginal lands, and even within the current boundaries of Indian reservations through federally assisted undertakings.

While federal laws have been strengthened to provide for the preservation and protection of properties and places as described above, the Zuni Tribe continues to witness such destruction and desecration in areas where it claims affiliation to cultural resources.

The land that will be impacted by this undertaking is outside the boundaries of the Zuni aboriginal land claims. The Zuni Tribe claims cultural affiliation to ancestral Puebloan, and pre-Puebloan archaeological sites, trails, shrines, and other historic properties. Many of these properties should be treated as Traditional Cultural Properties because of their significance to the cultural history of the Zuni Tribe.

The Zuni Tribe also claims cultural affiliation to all Puebloan and pre-Puebloan ancestral burials and associated funerary objects under the provisions of the Native American Graves Protection and Repatriation Act (NAGPRA) of 1990 (Public Law 101-601).

Since it would be impossible to consult with every group of Zuni religious leaders for this undertaking, it is recommended that all historic and traditional cultural properties be avoided. If avoidance cannot be accomplished, it is recommended that comprehensive archaeological and ethnographic studies be implemented to identify affected properties that are important to the Zuni Tribe, and to determine how any impact to the properties may be mitigated. If further consultation is deemed necessary, we will be happy to work with you in establishing the necessary protocol.

Although we acknowledge that according to 36 CFR 800.2 (c) (3), the Pueblo of Zuni is a *consulting party* for properties that may be affected by the proposed undertaking, we do not wish at this time to participate as a consulting party. Please keep us informed of information regarding properties with traditional, cultural, and religious significance that may be affiliated to the Zuni Tribe and which may be of consideration in planning this particular project.

On behalf of the Zuni Tribe and the Pueblo of Zuni, we thank you for providing an opportunity to comment on the undertaking. Should you require additional information, please call 505-782-4814.

Sincerely,

Jonathan E. Damp
Director, ZHHPO

Malcolm B. Bowekaty
Governor, Pueblo of Zuni

Operation of
Flaming Gorge Dam
Final Environmental
Impact Statement

Recreation Visitation and Valuation Analysis Technical Appendix

RECREATION VISITATION AND VALUATION ANALYSIS TECHNICAL APPENDIX

Page No.

Recreation Visitation and Valuation Analysis Technical Appendix

1.0 INTRODUCTION

This technical appendix (TA) presents information on the Flaming Gorge EIS recreation analysis. The TA is broken down into two primary sections: affected environment and environmental consequences. The affected environment section describes the geographic impact area where the majority of the recreation effects are anticipated to occur as well as current recreation conditions within the impact area. The environmental consequences section presents a detailed discussion of the various methodologies applied as well as the results of the analysis for each alternative.

2.0 AFFECTED ENVIRONMENT

The affected environment section consists of two subsections: geographic impact area and current conditions. The geographic impact area section provides background on the location and management jurisdiction of the potentially affected lands within the impact area as well as the rationale for defining the impact area. The current conditions section presents information on current conditions in terms of reservoir water levels/river flows, recreation visitation, and recreation economic value.

2.1 Geographic Impact Area

The Bureau of Reclamation (Reclamation) constructed and currently operates Flaming Gorge Dam located on the Green River in northeast Utah. Flaming Gorge Reservoir and the Green River for approximately 12 miles downstream of the dam comprise the Flaming Gorge National Recreation Area (FGNRA) which is managed by the Ashley National Forest, USDA Forest Service (FS). After exiting the FGNRA, the Green River flows across U.S. Bureau of Land Management (BLM) and State of Utah lands for approximately 18 miles before entering the U. S. Fish and Wildlife Service (USFWS) managed Browns Park National Wildlife Refuge along the Utah/Colorado border 30 miles downstream of the dam. Immediately downstream of the refuge, approximately 47 miles downstream of the dam, lies Dinosaur National Monument (NM) managed by the U.S. National Park Service (NPS). The upper portion of Dinosaur NM, upstream of the confluence with the Yampa River, reflects the end of Reach 1 of the study area.

The recreation analysis conducted for the Flaming Gorge EIS addresses impacts to both Flaming Gorge Reservoir and the Green River downstream of Flaming Gorge Dam. Despite the series of Federal and State managed public lands along the river downstream of the dam, the analysis focuses upon recreation effects within Reach 1 and specifically within the FGNRA because that is where the majority of the potentially impacted water based recreation occurs. Relatively little of the river oriented recreation activity within the region (mainly scenic floating via raft/kayak, shoreline and boat based fishing, and camping) initiates within the 35-mile stretch of the river between the FGNRA and Dinosaur NM. In Dinosaur NM, water-based recreation is dominated by rafting activities. Rafting within the monument is managed via a permit system that covers both the Green and Yampa Rivers. If flow conditions deteriorated on the Green River to the point of adversely impacting rafting activity, there exists the possibility of shifting activity to the Yampa River. While NPS constrains the total number of permits for both commercial and private rafting parties across both rivers to 600 a year, and the number of launches from either river to 4 per day, there still exists the potential for rafting substitution between the rivers. In addition, the majority of commercial and private rafting trips are scheduled well ahead of time. Commercial rafting operations are popular and early reservations are often required since space on these trips tends to fill up quickly. Private rafting permits are limited to one per person annually and must be obtained via a lottery system months prior to the actual trip date. Given the degree of planning and financial commitment required for these rafting trips, there exists a fairly strong incentive to take trips even when flow conditions are less than ideal. To substantiate this discussion, attempts were made to model the impact of average monthly flows on rafting visitation within Dinosaur (see Dinosaur NM Rafting Methodology section 3.1.1.1.2). Separate models were estimated for commercial and private rafting activity. These models either resulted in insignificant flow variables (commercial model) or significant flow variables with relatively minor impacts on rafting activity (private model). As a result, the assumption was made that rafting activity within Dinosaur NM would not vary substantially with the fluctuations in Green River flows associated with the EIS alternatives. Finally, changes in water-based recreation activity within Reaches 2 and 3 based on the EIS alternatives were also assumed to be relatively minor either due to low levels of recreation use or the overriding effect of the combined flows from the numerous tributaries (e.g., Yampa, Duchesne, White, etc.) as compared to dam releases. Given all of the above, the decision was made to focus the recreation visitation and value analysis on water-based effects primarily within the Flaming Gorge National Recreation Area.

The Green River portion of the FGNRA is located entirely within Daggett County Utah, found in the northeast corner of the state. The southernmost portions of the reservoir are also found within Daggett County. This part of the reservoir is relatively narrow given the water is impounded via a series of canyons. The reservoir widens as one travels northward out of the canyons and toward the Utah/Wyoming border. The Wyoming portion of the reservoir, located entirely within Sweetwater County, is relatively wide and extends northward for many miles before narrowing at the confluence of the Green and Blacks Fork Rivers.

Potentially affected recreation facilities within the FGNRA along both the Green River and Flaming Gorge Reservoir include the following:

Green River:

1. Boat ramps at the Flaming Gorge Dam spillway and at the Little Hole recreation complex
2. Little Hole National Recreation Trail (from the spillway of Flaming Gorge Dam to the Little Hole recreation complex)
3. Fishing pier at the Little Hole recreation complex
4. 18 riverside campgrounds (7 are on BLM lands outside FGNRA)

Flaming Gorge Reservoir:

1. 11 boat ramps (4 associated with marinas)
2. 3 marinas
3. 3 boat based campgrounds
4. 4 swimming beaches
5. Cut Through - Horseshoe Canyon Bypass (not evaluated within the recreation analysis since it has only minor impacts on recreation use)

While the Green River recreation analysis emphasizes impacts within the upper portion of Reach 1, primarily within Flaming Gorge National Recreation Area, consideration is also given to recreation facilities downstream, all the way to the confluence with the Colorado River. After passing out of Reach 1 within Dinosaur National Monument, the Green River flows across private lands, State of Utah lands, Federal lands (BLM, USFWS including Ouray National Wildlife Refuge), and Ute Indian tribal lands within Reach 2. Very few recreational facilities are found in this reach. Reach 3 of the Green River starts at the confluence with the White River and ends at the Colorado River. This long stretch of river includes Ute Indian tribal lands (including Desolation Canyon), State of Utah lands (including Green River State Park), Federal lands (BLM, NPS including Canyonlands National Park), and private lands. Numerous recreational facilities are located within Reach 3. The following represents a list of recreational facilities found along the Green River downstream of Flaming Gorge National Recreation Area within Reaches 1, 2, and 3.

Green River – Reach 1 (downstream of Flaming Gorge National Recreation Area):

BLM:	1. Three boat ramps (Indian Crossing, Bridge Hollow, and Swallow Canyon – a fourth ramp at the pipeline crossing below Jarvies Ranch, is being phased out).
	2. Twenty campgrounds, of which only one (at Bridge Hollow) may be impacted. Six of these are administered by the FS for BLM.
State of Utah:	3. One boat ramp (Bridge Port Camp)
	4. Five campgrounds (Gorge Creek, Little Davenport, Bridge Port, Elm Grove, and Burned Tree)

USFWS (Browns Park NWR):	5.	Two boat ramps (Swinging Bridge, Crook)
	6.	Two campgrounds (Swinging Bridge, Crook)
	7.	Fishing Pier
NPS (Dinosaur NM):	8.	Three boat ramps (Lodore, Deerlodge, and Split Mountain)
(Note: Facilities located downstream of the Yampa are technically Reach 2 (e.g., Split Mountain))	9.	Five riverside campgrounds (Lodore, Deerlodge, Echo Park, Split Mountain, and Green River)
	10.	One riverside picnic area (Split Mountain)

Green River – Reach 2 (Yampa River to White River):

USFWS (Ouray NWR):	1. One boat launch site

Green River – Reach 3 (White River to Colorado River):

BLM:	1.	Five boat ramps/launch sites (Sand Wash, Swasey's Beach ramp, Nefertiti, Butler Rapid, and Mineral Bottom)
	2.	One riverside campground (Swasey's Beach)
State of Utah (Green River S.P.):	3.	One boat ramp
	4.	One campground
Private:	5.	One boat launch site (Ruby Ranch)
NPS (Canyonlands N.P.):	6.	Eight campsites

2.2 Current Conditions

This section describes current conditions within the geographic impact area in terms of Green River flows and Flaming Gorge Reservoir water levels, recreation visitation, and economic value. Given the recreation analyses linked hydrologic river flows and reservoir water levels to recreation visitation and economic value to estimate impacts, this current condition information should provide some perspective when considering the impacts presented under the environmental consequences section.

Recreation visitation is measured in terms of the number of recreation trips or visits by recreation activity. A recreation trip or visit reflects a round trip excursion from a recreator's primary residence for the main purpose of recreation. Recreation value reflects the sum of individual recreator benefits aggregated across users of a site. Recreator value is represented by consumer surplus which is measured by estimating recreator willingness-to-pay in excess of per visit costs.

The current condition information and recreation analysis results are presented separately for the Green River and Flaming Gorge Reservoir due to differences in methodology. When referring to current conditions, we describe information which formed the basis or starting point of the two applied analyses: facility availability approach for reservoir visitation and the linear interpolation approach for all other analyses (i.e., river visitation, river valuation, and reservoir valuation). This perspective was selected instead of simply choosing to gather data for the most recent time period because in many cases, recent data does not exist. Furthermore, since current information was used as a data point in the survey based interpolation analysis, it was important to link the current period to the survey period (see section 3.1.1 for more on the recreation survey).

Recreation activities studied were generally water based, implying they require the use of water for participation. Water influenced activities, which do not require water access but typically benefit from the presence of water (such as picnicking, sightseeing), were generally insignificant compared to the water based activities at both these water oriented sites. Activities studied on the Green River include scenic floating, guide boat fishing, private boat fishing, shoreline fishing/trail use, and boat based camping. These activities more or less cover the gamut of activities pursued on the river. Activities studied on Flaming Gorge Reservoir focused on power boating/waterskiing, boat fishing, boat based camping, and swimming/waterplay. These water based activities represent nearly 80 percent of the total visitation at the reservoir. In both cases, the camping activity was considered a water based activity since the studied campsites were accessed from the water.

2.2.1 Current Hydrology

As will be discussed in more detail under the environmental consequences methodology section, the recreation analyses in this appendix relate recreation visitation and value to hydrologic Green River flows (measured in cubic feet per second (cfs)) and Flaming Gorge Reservoir water levels (measured in feet above mean sea level (msl)).

2.2.1.1 Current Green River Flows

To get some perspective on current Green River recreation visitation, it is necessary to have information on current river flows. The difficulty lies in defining what should be considered current. Since the Green River recreation analysis is tied to the results generated from a recreation survey conducted from May to September 2001, and the survey asked recreators about their activity over the past 12 months, it was necessary to gather flow data from June 2000 to September 2001 to estimate current survey oriented monthly flows.

Current monthly flow was calculated from March through October given visitation data, obtained from the FS, was only available for those months. While visitation information was not gathered from November through February, loss of those months was not considered significant.

Calculating current average monthly flows relevant to the survey data was complicated by the fact that depending on when a recreator was contacted during the May through September 2001 survey sampling period, a different annual and monthly perspective could result. For example, when considering June flows, someone contacted about their recreation activity over the past 12 months in May 2001 would visualize June 2000 flows, whereas all others would be visualizing June 2001 flows. To calculate current flows for months with this dual year situation (basically June - September), actual average monthly flows for 2000 and 2001 were weighted by the percent of the sample contacted in each month (May = 11.3%, June = 20.5%, July = 29.2%, August = 15.4%, and September = 23.6%). For the other months (March, April, May, and October), all recreators would be referencing the same months implying no timing conflicts in estimating average monthly flows. Using this weighting procedure, current average monthly

Green River flows were estimated as follows:

	Current Monthly Flows (cfs)
March	1,036
April	1,145
May	2,478
June	1,215
July	1,007
August	1,122
September	1,118
October	1,024

The analysis of economic values was also conducted monthly, but the actual calculation used annual flow information by activity as a reference point. The survey asked recreators for their current value by recreation activity based on activity pursued across the past 12 months. As a result, the current flows associated with the current economic values by activity were based on average annual (technically high season) flows for the months of March to October using data from the June 2000 through September 2001 survey orientation period. The average annual flow for each activity took into consideration both when a recreator was contacted during the sampling period (weighting based on sampling percentage by month as described above) and the percent of visitation by month associated with each activity. The weighted average current annual flows for the five studied Green River recreational activities are as follows:

	Current Annual Flows (cfs)
Scenic Floating	1,097
Guide Boat Fishing	1,359
Private Boat Fishing	1,373
Trail Use/Shoreline Fishing	1,299
Camping	1,115

2.2.1.2 Current Flaming Gorge Reservoir Water Levels

Whereas the Green River recreation analysis used the interpolation approach for both the visitation and value analysis, lack of visitation data for the relevant survey period from June 2000 through September 2001 resulted in the use of a facilities availability approach for estimating reservoir visitation. The interpolation approach was used to estimate economic values by reservoir recreation activity as with the river analysis.

The two different analyses for developing reservoir visitation and value estimates create different perspectives for estimating current reservoir water levels. The visitation analysis is based on information collected during fiscal year 1997 (October 1996–September 1997), whereas the value analysis stems from survey data referring to the June 2000–September 2001 period. Fortunately, regardless of whether one focuses on hydrology from fiscal year 1997 or weighted average water levels during the 2000-2001 survey period, facility availability and associated visitation turns out the same. In both cases, all water based facilities were available, which implies the same visitation estimate using the facility availability approach. Given it doesn't matter which time frame is selected for the visitation analysis and it does for the value analysis, it makes the most sense to simply refer to the current water levels as those represented by the survey period. Table 1 reflects end of month water levels at Flaming Gorge reservoir for both fiscal year 1997 and the survey period.

As with the river economic value analysis, the reservoir value analysis keys into the current weighted average annual water levels by activity as presented in table 1. Note that warm water activities are defined as power boating/waterskiing, boat fishing, swimming and cool water activities are defined as camping.

2.2.2 Current Recreation Visitation

Recreation visits have been counted by FS contractors from March to October on an annual basis since the early 1990's on the Green River portion of the FGNRA. Visitation counts on the reservoir have been more infrequent with the most recent estimates made for fiscal year 1997 (October 1996 to September 1997).

Table 1: Flaming Gorge Reservoir Current Water Level Data (feet above msl)

Month	Fiscal Year 1997	Current Water Levels (Survey Period)
January	6027	6020.3
February	6026	6020.4
March	6024.9	6020.7
April	6023.6	6021.5
May	6023	6021.8
June	6027.7	6021.3
July	6031.5	6021.3
August	6031.3	6020.9
September	6030.5	6020.6
October	6029.6	6020.4
November	6028.5	6020.6
December	6027.4	6020.4
Weighted Average for Warm Water Activities:		6021.2
Weighted Average for Cooler Water Activities:		6021.1

2.2.2.1 Current Green River Visitation

As mentioned above and described in more detail below under the recreation methodology section located under environmental consequences, the Green River analysis was based on interpolation of results obtained from a recreation survey conducted from May to September 2001. Current visitation was one of the data points used in the interpolation analysis. Current visitation was calculated on a monthly basis from March through October based on the FS data. To allow for use in the interpolations, current visitation estimates needed to be consistent with the time period of the recreation data collection.
FS monthly visitation data by recreation activity were weighted, using the monthly sampling percentage approach described above, to come up with the estimates of current monthly visitation by activity.

Summing the current weighted average monthly visitation estimates by activity across the March through October months provided an estimate of current annual visitation. While the FS data was not gathered across the November through February months, the exclusion of these months was not considered significant from the perspective of missing data given these are very low use months. Table 2 presents the current estimates of visitation by activity and month.

Reviewing the data in table 4 indicates that shoreline fishing/trail use (mainly shoreline fishing), scenic floating, and private boat fishing are the top three activities on the Green River portion of FGNRA combining for slightly over 85 percent of the river visitation. The top three high use months are as expected June, July, and August with over 60 percent of the river visitation.

Table 2: Current Green River Visitation Estimates by Activity and Month

Month	Scenic Floating	Guide Boat Fishing	Private Boat Fishing	Shoreline Fishing/ Trail Use	Camping	Total	Percent
March	42	280	1,265	1,774	0	3,361	3.6
April	217	1,560	3,214	5,892	0	10,883	11.8
May	99	2,018	3,549	4,942	0	10,608	11.5
June	5,527	2,099	1,767	5,976	668	16,037	17.3
July	11,063	1,781	1,520	7,708	655	22,727	24.6
August	7,749	1,814	1,457	5,462	600	17,082	18.5
September	62	1,530	4,827	2,935	352	9,707	10.5
October	9	318	932	793	6	2,058	2.2
Total:	24,768	11,400	18,531	35,482	2,281	92,461	100
Percent:	26.8	12.3	20.0	38.4	2.5	100	

2.2.2.2 Current Flaming Gorge Reservoir Visitation

The most recent visitation estimates developed for Flaming Gorge Reservoir were collected by the FS during fiscal year 1997. This data was gathered by recreation activity and reservoir site (i.e., marina, boat ramp, swimming beach, campground). To allow for analysis of monthly facility availability, this annual FS data needed to be converted into monthly estimates. Fortunately, the State of Utah has periodically gathered monthly fishing data for boat fishing, shore fishing, and ice fishing. The boat fishing monthly percentages were used to allocate warm water recreation activities across months, specifically power boating, waterskiing, boat fishing, and swimming/waterplay. The shore fishing monthly percentages were used to allocate cooler month activities across months, specifically camping. While not directly tied to the activities of interest in some cases, the State of Utah percentages were believed to be representative of all warm and cool month activities.

Table 3 presents the current estimates of Flaming Gorge Reservoir visitation by activity, site, and month. The estimates of visitation could be linked to the individual facilities at each site based on the different recreation activities (i.e., power boating/waterskiing/boat fishing were linked to the boat ramps and marinas, boat camping was linked to the boat camp sites, and swimming/waterplay was linked to the swimming beaches).

Reviewing the data in table 3 indicates that the heaviest used reservoir sites from a water based activity perspective are Lucerne Valley (52.8%), Buckboard Crossing (15.8%), and Cedar Springs (15.8%). These three sites combine for nearly 85 percent of the reservoir's water based activity (recall that the water based activities represent nearly 80 percent of the total activity at the reservoir). Of the water based activities, power boating/waterskiing (62.8%) and boat fishing (31.7%) are dominant accounting for nearly 95 percent of the total water based reservoir visitation. Finally, from a monthly perspective, the months of May through August reflect nearly 75 percent of water based visitation, with over 95 percent occurring between April and October.

2.2.3 Current Recreation Valuation

The current total value estimates by activity were developed by simply multiplying the current value estimates per visit by activity, as obtained from the recreation survey, by the estimates of total current visitation by activity, as obtained from manipulating the FS visitation data. All value estimates were developed using a conservative, but frequently applied approach of assuming survey nonrespondents had a value of zero. River camping and reservoir swimming values were most affected by the nonresponse adjustment due to the large number of nonresponses for those activities.

2.2.3.1 Current Green River Valuation

Table 4 presents the estimates of Green River total current value by recreation activity. It is interesting to note the differences when comparing the percent of total visits by activity to the percent of total value by activity. The percent of total value by activity takes into account both the visitation and value per visit. While shore fishing/trail use reflects 38.4 percent of the visitation, it represents only 17.4 percent of the value due to the relatively low value per visit. Conversely, guide boat fishing reflects only 12.3 percent of the visitation, but 43.5 percent of the value due to the high value per visit.

2.2.3.2 Current Flaming Gorge Reservoir Valuation

Table 5 presents the estimates of Flaming Gorge Reservoir total current value by recreation activity. The differences between the reservoir visitation and valuation percentages are less dramatic compared to those of the river. The largest differentials are for power boating/waterskiing and swimming/waterplay. Power boating shows an increasing percentage under value compared to visitation, whereas swimming shows a decreasing percentage.

3.0 ENVIRONMENTAL CONSEQUENCES

This section is broken down into two primary subsections, methodology and results. The methodology section presents detailed information on the various approaches applied to estimate impacts. The results section presents and compares results across alternatives in terms of reservoir water levels/river flows, recreation visitation, recreation economic value, and recreation facility availability.

Table 3: Current Flaming Gorge Reservoir Visitation by Site, Activity, and Month

Site/ Activity	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total/Percent	
Antelope Flat:	24	0	117	928	2489	3356	3654	2121	1216	1094	286	185	15469	2.7
Power Boating:	8	0	38	300	805	1085	1181	686	393	353	92	60	5001	
Boat Fishing:	6	0	30	240	643	868	945	548	314	283	74	48	3999	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	10	0	49	388	1041	1403	1528	887	509	458	120	77	6469	
Anvil Draw:	5	0	21	168	450	607	661	384	220	198	52	33	2800	0.5
Power Boating:	2	0	9	72	193	260	283	165	94	85	22	14	1200	
Boat Fishing:	3	0	12	96	257	347	378	219	126	113	30	19	1600	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Buckboard Crossing Marina:	66	0	304	2427	6515	8786	9567	5554	3185	2866	748	482	40500	7.1
Power Boating:	49	0	225	1798	4826	6508	7087	4114	2359	2123	554	357	30000	
Boat Fishing:	17	0	79	629	1689	2278	2480	1440	826	743	194	125	10500	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Buckboard Crossing Boat Ramp:	81	0	371	2967	7963	10738	11693	6788	3892	3503	914	589	49500	8.7
Power Boating:	49	0	225	1798	4826	6508	7087	4114	2359	2123	554	357	30000	
Boat Fishing:	32	0	146	1169	3137	4230	4606	2674	1533	1380	360	232	19500	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cedar Springs Marina:	66	0	304	2427	6515	8786	9567	5554	3185	2866	748	482	40500	7.1
Power Boating:	49	0	225	1798	4826	6508	7087	4114	2359	2123	554	357	30000	
Boat Fishing:	17	0	79	629	1689	2278	2480	1440	826	743	194	125	10500	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Cedar Springs Boat Ramp:	81	0	371	2967	7963	10738	11693	6788	3892	3503	914	589	49500	8.7
Power Boating:	49	0	225	1798	4826	6508	7087	4114	2359	2123	554	357	30000	
Boat Fishing:	32	0	146	1169	3137	4230	4606	2674	1533	1380	360	232	19500	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Firehole:	13	0	61	482	1294	1744	1898	1102	632	570	148	96	8037	1.4
Power Boating:	4	0	20	156	420	566	616	358	205	185	48	31	2608	
Boat Fishing:	3	0	15	120	322	434	472	274	157	142	37	24	2000	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	6	0	26	206	552	744	810	470	270	243	63	41	3429	

Gooseneck:	1	0	15	52	75	101	98	64	34	34	15	10	500	0.1
Power Boating:	0	0	1	12	32	43	47	27	16	14	4	2	200	
Boat Fishing:	0	0	1	6	16	22	24	14	8	7	2	1	100	
Boat Camping:	1	0	13	34	27	36	27	23	10	13	9	7	200	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hideout:	91	0	717	2466	3624	4881	4738	3082	1645	1652	707	497	24100	4.2
Power Boating:	14	0	66	527	1415	1909	2079	1207	692	623	163	105	8800	
Boat Fishing:	8	0	37	300	804	1085	1181	686	393	354	92	60	5000	
Boat Camping:	67	0	607	1579	1244	1670	1242	1052	481	604	434	320	9300	
Swimming:	2	0	7	60	161	217	236	137	79	71	18	12	1000	
Jarvies Canyon:	5	0	39	137	198	268	259	169	90	91	39	28	1325	0.2
Power Boating:	1	0	3	27	72	98	106	62	35	32	8	5	450	
Boat Fishing:	0	0	2	18	48	65	71	41	24	21	6	4	300	
Boat Camping:	4	0	34	89	70	94	70	59	27	34	24	18	525	
Swimming:	0	0	0	3	8	11	12	7	4	4	1	1	50	
Kingfisher Island:	3	0	26	87	122	165	158	104	55	56	25	17	820	0.1
Power Boating:	0	0	2	16	43	59	64	37	21	19	5	3	270	
Boat Fishing:	0	0	1	12	32	43	47	27	16	14	4	2	200	
Boat Camping:	3	0	23	59	47	63	47	40	18	23	16	12	350	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Lucerne Valley Marina:	227	0	1045	8354	22420	30239	32926	19116	10960	9865	2577	1660	139387	24.4
Power Boating:	164	0	756	6041	16214	21868	23811	13824	7926	7134	1863	1200	100800	
Boat Fishing:	54	0	249	1993	5348	7213	7854	4560	2614	2353	615	396	33250	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	9	0	40	320	858	1158	1261	732	420	378	99	64	5337	
Lucerne Valley Boat Ramp:	264	0	1219	9742	26147	35264	38398	22293	12781	11504	3004	1935	162550	28.4
Power Boating:	164	0	756	6041	16214	21868	23811	13824	7926	7134	1863	1200	100800	
Boat Fishing:	100	0	463	3701	9933	13396	14587	8469	4855	4370	1141	735	61750	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Mustang Ridge:	17	0	82	660	1769	2387	2599	1509	865	778	203	131	11000	1.9
Power Boating:	11	0	52	420	1126	1519	1654	960	550	495	129	83	7000	
Boat Fishing:	6	0	30	240	643	868	945	549	315	283	74	48	4000	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sheep Creek:	34	0	157	1258	3378	4556	4961	2880	1652	1486	388	250	21000	3.7
Power Boating:	19	0	90	719	1930	2603	2835	1646	944	849	222	143	12000	
Boat Fishing:	15	0	67	539	1448	1953	2126	1234	708	637	166	107	9000	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	

Squaw Hollow:	0	0	2	12	32	44	48	28	16	14	4	2	200	0.0
Power Boating:	0	0	1	6	16	22	24	14	8	7	2	1	100	
Boat Fishing:	0	0	1	6	16	22	24	14	8	7	2	1	100	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Sunny Cove Swim Beach:	8	0	37	300	804	1085	1181	686	393	354	92	60	5000	0.9
Power Boating:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Boat Fishing:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	8	0	37	300	804	1085	1181	686	393	354	92	60	5000	
Upper Marsh Creek:	0	0	0	6	16	22	24	14	8	8	2	2	100	0.0
Power Boating:	0	0	0	3	8	11	12	7	4	4	1	1	50	
Boat Fishing:	0	0	0	3	8	11	12	7	4	4	1	1	50	
Boat Camping:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Swimming:	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total:	986	0	4888	35440	91774	123767	134123	78236	44721	40442	10866	7048	572291	100
Percent:	0.2	0	0.9	6.2	16.0	21.6	23.4	13.7	7.8	7.1	1.9	1.2	100	
Power Boating:	583	0	2694	21532	57792	77943	84871	49273	28250	25426	6638	4276	359278	62.8
Boat Fishing:	293	0	1358	10870	29170	39343	42838	24870	14260	12834	3352	2160	181348	31.7
Boat Camping:	75	0	677	1761	1388	1863	1386	1174	536	674	483	357	10374	1.8
Swimming:	35	0	159	1277	3424	4618	5028	2919	1675	1508	393	255	21291	3.7

Table 4: Current Green River Value Estimates by Activity								
Recreation Activity	Original Value per Visit (Survey)	Number of Responses	Full Sample	Revised Current Value per Visit	Current Number of Total Visits	% of Total Visits	Current Total Value	Percent of Total Value
Scenic Floating	80.05	38	65	$ 46.80	24,768	26.8	$ 1,159,154	24.2
Guide Boat Fishing	296.19	21	34	$ 182.94	11,400	12.3	$ 2,085,497	43.5
Private Boat Fishing	85.00	37	84	$ 37.44	18,531	20.0	$ 693,786	14.5
Shoreline Fishing/ Trail Use	33.55	105	150	$ 23.49	35,482	38.4	$ 833,469	17.4
Camping	24.55	8	59	$ 10.78	2,281	2.5	$ 24,588	.5
Total:					92,461	100	$ 4,796,494	100

Table 5: Current Flaming Gorge Reservoir Value Estimates by Activity								
Recreation Activity	Original Value per Visit (Survey)	Number of Responses	Full Sample	Revised Current Value per Visit	Current Number of Total Visits	Percent of Total Visits	Current Total Value	Percent of Total Value
Power Boating/ Waterskiing	$ 50.60	62	122	$ 25.71	359,278	62.8	$9,237,038	66.1
Boat Fishing	$ 57.30	55	125	$ 25.21	181,348	31.7	$4,571,785	32.7
Boat Camping	$ 30.10	46	106	$ 13.06	10,374	1.8	$35,484	1.0
Swimming/ Waterplay	$ 35.00	4	97	$ 1.44	21,291	3.7	$30,659	.2
Total:					572,291	100	$13,974,966	100

3.1 Methodology

This section describes the methodology used to analyze recreation impacts both on Flaming Gorge Reservoir and the Green River. The recreation analyses evaluate effects in terms of visitation, economic value, and facility availability.

3.1.1 Recreation Visitation, Economic Value, and Facility Availability Methodology

The recreation visitation and value analysis compares estimates of visitation and value by recreation activity for the action alternative to those of the no action alternative. The driving force behind the analyses is changes in visitation and value stemming from variations in alternative specific hydrology as measured by reservoir water levels and river instream flows. Recreation visitation is measured in terms of recreation visits which reflect an individual's round-trip recreation excursions typically from their primary residence. Recreation value, measured in terms of per visit willingness-to-pay minus actual per visit costs, reflects the increment in benefits a recreator experiences in excess of what they actually pay. Multiplying and summing hydrology influenced visits and values by recreation activity for each alternative provide estimates of total recreation value by alternative. The gain or loss in recreation visitation and value, compared to the no action alternative, provides one measure of an alternative's effect on recreation.

Initially, attempts were made to gather and apply existing information in the development of the visitation and value analyses. Existing information was sought in terms of recreation visitation and recreation values per visit by activity, as well as how these measures might be affected by changing reservoir water levels and river flows. Some visitation information existed for both the river and reservoir, but very little value information was available. Attempts were made to model statistical relationships between reservoir visitation and water levels and river visitation and instream flows. For various reasons, these modeling efforts proved unsuccessful. Even if they had been successful, the results for the reservoir in particular would still have been insufficient given data was only available for fishing activities. As a result, the FS, one of the EIS's cooperating agencies, contracted with Colorado State University to gather additional recreation information.

The contractor conducted a survey at both Flaming Gorge Reservoir and the Green River within the FGNRA during the summer of 2001. Recreators were contacted on-site from May 2001 through September 2001 and asked a series of questions about their recreation activity over the past year. The survey provided information by recreation activity in terms of visitation and value for both current and preferred reservoir water level and river flow conditions. In many cases, survey responses were adjusted downward using a conservative, but frequently applied approach of assuming nonrespondents equal to zero. As a result, differences exist between certain estimates used in the analysis and those presented in the survey report. In addition, information was also obtained on the water levels and flows where recreators would stop participating due to low or high water level/flow conditions. Detailed information on survey methods and results are presented in Aukerman and Schuster (2002).

3.1.1.1 Green River Visitation and Valuation Analysis Methodology

As noted in the affected environment section, the Green River recreation analysis looked at visitation impacts at both the Flaming Gorge National Recreation Area and Dinosaur NM.

3.1.1.1.1 Flaming Gorge National Recreation Area Analysis Methodology – Using existing data along with information gathered by the contractor, estimates of recreation use and economic value were developed by recreation activity for both current and preferred flow conditions. Combining that information with the high and low flow thresholds by activity where visitation and economic value go to zero, provides four flow oriented data points of visitation and value. These four data points sketch out an inverted U-shaped distribution which was used to estimate Green River visitation and value through a process of linear interpolation.

Typically, the current conditions data point fell between the low end threshold and preferred conditions data points (except for current river flows during May which fell between the preferred flow and high end threshold). To provide a more symmetric distribution and to avoid problems associated rapid drop offs after exceeding the preferred condition, a high end kink data point was estimated. The high end kink (and in May, a low end kink) was developed to be proportional with the location of the current conditions data point. If the current conditions data point fell 75 percent of the way between the low end threshold and the preferred condition, the high end kink was estimated to fall 75 percent of the way between the preferred condition and the high end threshold. Since the location of the high end kink was based on a proportional calculation, the actual distance from the preferred condition of the high end kink and current condition data points would vary in terms of flows, but not percentages. Since the difference between the low and high end thresholds and the preferred condition varies in terms of flow, the same proportional location for the current condition and high end kink would imply different flows. Therefore, the high end kink and the current conditions flows will not be the same distance from the preferred flow condition in terms of flows, but they will be the same distance in terms of percentage.

Combining the high end kink with the other four data points provides five data points for performing the interpolation to estimate recreation visitation and value. The five data points reflect information on river flows, visitation by activity, and values by activity. The linear interpolation starts by evaluating where monthly flows for each alternative and hydrologic condition (i.e., average, wet (90% exceedence), and dry (10% exceedence)) fall within the range of flows of the five data points: low end threshold, current conditions, preferred conditions, high end kink, and high end threshold data points. Once an alternative's monthly flows are located within the range of data points, the calculation progresses to deriving the visitation or value estimate by determining the percentage distance between the two flow data points and applying that percentage to the two relevant visitation or value data points. For example, let's assume that a given monthly flow for the No Action Alternative average condition falls 60 percent of the way between the current conditions and preferred flow data points. The resulting visitation or value estimate would also be estimated at 60 percent of the way between the current conditions and preferred flow visitation or value data points. This linear interpolation procedure was used to develop all the monthly visitation and value estimates by activity for each Green River alternative and hydrologic condition.

Since the five data points in terms of flow, visitation, and value are critical to the entire Green River recreation analysis, it is important to understand how each of these data point was derived. The following presents a discussion of the calculation procedures for each of the data points with respect to flows, visits, and values.

A) Flow Data Points:

1) Low End Threshold Flow: The low end threshold flow for each activity reflects the point were visitation for that recreation activity is assumed to go to zero due to low flows. This flow level was obtained from the survey and represents the average flow where recreators pursuing that activity indicated they would stop participating.

Low end threshold flows by recreation activity were based on recreator rankings in terms of physical descriptions of Green River flows. A range of physical descriptions, from very low to very high flows, were used in each flow oriented survey question. River experts were used to convert the physical description oriented recreator rankings into actual flow estimates (river expert opinions: very low = 800, low = 1,000, medium = 2,000, high = 3,000, very high = 5,000).

	Low End Flow (cfs) Threshold
Scenic Floating:	953
Guide Boat Fishing:	854
Private Boat Fishing:	879
Shoreline Fishing/Trail Use:	825
Camping:	836

2) Current Flow (Monthly or Annually): Current flows, either monthly or annually, needed to be based on the time period associated with the recreation survey. The recreation survey was conducted from May to September 2001, but asked recreators about their activity over the past 12 months, implying it was necessary to gather flow data from June 2000 to September 2001 to estimate current flows.

Current monthly flows were calculated from March through October given visitation data was only available for those months. Calculating current monthly flows relevant to the survey data was complicated by the fact that depending on when a recreator was contacted during the May through September 2001 survey sampling period, a different monthly perspective could result. For example, when considering June flows, someone contacted in May 2001 about their recreation activity over the past 12 months would visualize June 2000 flows, whereas recreators contacted in June, July August, or September 2001 would be visualizing June 2001 flows. To calculate current flows for months with this dual year situation (June–September), actual average monthly flows for 2000 and 2001 were weighted by the percent of the sample contacted in each month (May = 11.3%, June = 20.5%, July = 29.2%, August = 15.4%, and September = 23.6%). For the other months (March, April, May, and October), all recreators would be referencing the same months implying no timing conflicts in estimating average monthly flows. Using this weighting procedure, current average monthly Green River flows relevant for all activities were estimated as follows (measured in cfs):

	Current Flows	Calculation
March	1,036	1,036 (March 2001) across entire sample
April	1,145	1,145 (April 2001) across entire sample
May	2,478	2,478 (May 2001) across entire sample
June	1,215	(2,292*.113 + .887*1,078), 2,292 = 6/2000, 1,078 = 6/2001
July	1,007	(1,408*.318 + .682*820), 1,408 = 7/2000, 820 = 7/2001
August	1,122	(1,311*.61 + .39*827), 1,311 = 8/2000, 827 = 8/2001
September	1,118	(1,203*.764 + .236*843), 1,203 = 9/2000, 843 = 9/2001
October	1,024	1,024 (October 2000) across entire sample

It should be emphasized that the hydrologic data used in the analysis reflects average monthly flows. Regardless of whether the discussion focuses on average, wet, or dry conditions, the underlying hydrologic data is measured in terms of average monthly flows. So even in the extreme hydrologic conditions of wet and dry, the 90% and 10% flow levels still represent average flows (i.e., the highest 90% of average flows and the lowest 10% of average flows for a particular month). This average monthly flow measure was assumed to adequately reflect hydrologic conditions during any given month. This introduces some error into the analysis given the potential variation in flows across the month. In some cases, average monthly flows for a given alternative and hydrologic condition, fall above or below the high and low end flow thresholds for a given recreation activity. As a result, the interpolation analysis predicts zero visitation for that activity and month. Given the average flow may imply that for part of the month, flows may not fall below or exceed the threshold, use of the average flow may somewhat overstate the impact. Perhaps a better approach would be to use a shorter time step, such as a day, but unfortunately the rest of the data for the analysis was not available to such detail. Therefore, the monthly orientation does provide a certain degree of embedded error, but given the analyses were conducted similarly across alternatives, the results are still comparable.

The analysis of economic values was also conducted monthly, but the actual calculation used annual flow information by activity as the current flow reference point. When estimating per trip values, it makes no difference whether the flow reference point is daily, weekly, monthly, or annually. The survey asked recreators for their current value by recreation activity based on activity pursued across the past 12 months (the survey did not ask about values per activity by month since that would be overly complicated). As a result, the current flows associated with the current economic values by activity were based on average annual flows reflected by the high use months from March to October based on data from the June 2000 through September 2001 survey orientation period. The average annual flow for each activity took into consideration both when a recreator was contacted during the sampling period (weighting based on sampling percentage by month) and the percent of visitation by month associated with each activity. Table 6 presents the annual average flow calculation for scenic floating.

Table 6: Scenic Floating Current Average Annual Flows (cfs)

Month	Scenic Floating Current Visits	Percent	Monthly Visits Required Weighting by Sampling %?	Current Flows	Weighted Average Flow
March	42	.2	No	1,036	2.1
April	217	.9	No	1,145	10.3
May	99	.4	No	2,478	9.9
June	5,527	22.3	Yes	1,215	270.9
July	11,063	44.7	Yes	1,007	450.1
August	7,749	31.3	Yes	1,122	351.2
September	62	.3	Yes	1,118	3.3
October	9	0	No	1,024	0
Total:	24,768				1,097

The weighted average current annual flows for the five studied Green River recreational activities are as follows:

	Wtd. Average
Scenic Floating:	1,097
Guide Boat Fishing:	1,359
Private Boat Fishing:	1,373
Trail Use/Shoreline Fishing:	1,299
Camping:	1,115

3) Preferred Flow: The preferred flow for each activity reflects the point were visitation for that recreation activity is assumed to be at the maximum. This flow level was obtained from the survey and represents the average flow where recreators pursuing that activity indicated they would participate the most.

As with the low end threshold flows, preferred flows by recreation activity were based on recreator rankings of physical descriptions of Green River flows combined with expert opinion of what those physical descriptions represent in terms of flow levels.

	Preferred Flow (cfs)
Scenic Floating:	2,170
Guide Boat Fishing:	1,837
Private Boat Fishing:	1,808
Shoreline Fishing/Trail Use:	1,624
Camping:	2,000

4) High End (Low End) Kink Flow: Calculation of the high end kink flow was discussed above. Note that for the river visitation analysis, current monthly flow varies by month, but not by activity. However, since the preferred and low/high threshold flows vary by activity, the monthly high (low) end kink by activity for the visitation analysis varies by month and activity. See table 14 for the various monthly high end kink flows for each activity used in the visitation analysis.

The high end kink of the valuation analysis is based on the current annual flow by activity. The current annual flow varies by activity, but since it is annual, it doesn't vary by month. Therefore, for the valuation analysis, the five data points vary by activity, but not by month. The high end kink flows used in the valuation analysis are as follows:

	"Value Analysis" High End Kink Flow
Scenic Floating:	3,699.9
Guide Boat Fishing:	2,757.9
Private Boat Fishing:	2,672.7
Shoreline Fishing/Trail Use:	2,473.1
Camping:	3,168.7

5) High End Threshold Flow: The high end threshold flow for each activity reflects the point were visitation for that recreation activity is assumed to go to zero due to high flows. This flow level was obtained from the survey and represents the average flow where recreators pursuing that activity indicated they would stop participating.

As with the low end threshold and preferred flows, high end threshold flows by recreation activity were based on recreator rankings of physical descriptions of Green River flows combined with expert opinion of what those physical descriptions represent in terms of flow levels.

	High End Flow Threshold (cfs)
Scenic Floating:	3,905
Guide Boat Fishing:	3,731
Private Boat Fishing:	3,656
Shoreline Fishing/Trail Use:	3,709
Camping:	3,538

B) Visitation Data Points:

1) Low End Visitation: Assumed to be zero by definition.

2) Current Visitation: Current visitation by activity was based on data collected by the FS from June 2000 through September 2001. As discussed throughout this technical appendix, current visitation estimates needed to be tied into the survey period. The recreation survey was conducted from May to September 2001, but asked recreators about their activity over the past 12 months, implying it was necessary to gather visitation data from June 2000 to September 2001 to estimate current visitation. Current monthly visitation was calculated from March through October given visitation data was only available for those months. Calculating current monthly visitation relevant to the survey data was complicated by the fact that depending on when a recreator was contacted during the May through September 2001 sampling period, a different annual and monthly perspective could result. For example, when considering current June visitation, someone contacted in May 2001 about their recreation activity over the past 12 months would be visualize June 2000 visitation, whereas recreators contacted in June, July August, or September 2001 would be visualizing June 2001 visitation. To calculate current visitation for months with this dual year situation (June–September), actual average monthly visitation for 2000 and 2001 were weighted by the percent of the sample contacted in each month (May = 11.3%, June = 20.5%, July = 29.2%, August = 15.4%, and September = 23.6%). For the other months (March, April, May, and October), all recreators would be referencing the same months implying no timing conflicts in estimating average monthly visitation. Using this weighting procedure, current average monthly Green River visitation by activity was estimated as presented in table 2 under Affected Environment current conditions.

3) Preferred Visitation: The survey asked a contingent behavior question to estimate how many more visits by activity recreators would take if flows were at the recreator's preferred level. The survey additional visit responses were averaged by activity and divided by the average current visits by activity (also obtained from the survey) to estimate a percentage change compared to current visitation. The additional visits by activity were revised downward using the conservative, but frequently applied adjustment of assuming nonrespondents equal to zero. Table 7 shows the percentage increase in visits per year under preferred conditions.

Table 7: Preferred (Upper Bound) Green River Visitation Estimates by Activity

Recreation Activity	Additional Visits per Year (Survey)	Number of Responses	Full Sample	Revised Additional Visits per Year	Current Visits per Year	% Increase Visits per Year under Preferred Conditions
Scenic Floating	2.417	18	65	.67	2.765	24.2
Guide Boat Fishing	2.133	15	34	.94	4.875	19.3
Private Boat Fishing	3.563	24	84	1.02	6.137	16.6
Shoreline Fishing/ Trail Use	3.143	70	150	1.47	3.401	43.2
Camping	2.885	13	123	.3	3.074	9.8

The percentage increase by activity (from the survey) was then applied to the current monthly visitation estimates (based on the FS data) to derive the preferred flow monthly visitation estimates.

Given the percentage changes varied by activity, and the current visitation estimates varied by activity and month, the preferred visitation estimates ended up varying by activity and month. Table 8 presents estimates of preferred visitation by activity and month. The estimates of preferred visits reflect an upper bound for potential visitation.

Table 8: Preferred (Upper Bound) Green River Visitation Estimates by Activity and Month

Month	Scenic Floating	Guide Boat Fishing	Private Boat Fishing	Shoreline Fishing/ Trail Use	Camping	Total	Percent
March	52	334	1,475	2,541	0	4,402	3.7
April	270	1,861	3,748	8,439	0	14,318	12.0
May	123	2,407	4,139	7,078	0	13,747	11.5
June	6,867	2,504	2,060	8,559	733	20,723	17.4
July	13,744	2,124	1,773	11,039	719	29,399	24.6
August	9,626	2,163	1,699	7,823	659	21,970	18.4
September	77	1,826	5,629	4,204	386	12,122	10.2
October	11	379	1,087	1,136	7	2,620	2.2
Total:	30,770	13,598	21,610	50,819	2,504	119,301	100
Percent:	25.8	11.4	18.1	42.6	2.1	100	

While the percentage change by activity refers to annual visitation, the decision was made to assume the percentages also held on a monthly basis to allow for monthly analysis. The monthly analysis was seen as a significant improvement over an annual analysis since it allowed for a more thorough evaluation of the month-to-month consequences of each alternative.

4) High End (Low End) Kink Visitation: Since the high end kink data point was analogous to the current conditions data point, visitation for the high end kink was assumed to be the same as current visitation as presented in table 2 under Affected Environment current conditions.

5) High End Visitation: Assumed to be zero by definition.

C) Value per Visit Data Points:

1) Low End Values: Assumed to be zero by definition.

2) Current Values: Current value estimates were obtained by activity from the survey. All value estimates were developed using the conservative, but frequently applied approach of assuming nonrespondents have a value of zero. River camping values were most affected by the nonresponse adjustments due to the large number of nonresponses. Table 4 under Affected Environment current conditions presents the estimates of current value per visit by recreation activity for the Green River.

3) Preferred Values per Visit: As with the preferred visitation estimates, the survey asked a contingent valuation question to estimate how much more value per visit by activity recreators would expect if flows were at the recreator's preferred level. The survey additional value per visit responses were averaged by activity and revised downward using the conservative, but frequently applied adjustment of assuming nonrespondents equal to zero. The revised additional values per

visit by activity were added to the current revised values per visit by activity to estimate preferred values per visit by activity. The preferred values per visit vary by activity, but not by month. Table 9 presents estimates of preferred values per visit by activity. The estimates of preferred values per visit reflect an upper bound.

Table 9: Preferred (Upper Bound) Green River Values per Visit by Activity

Recreation Activity	Additional Value per Visit (Survey)	No. of Responses	Full Sample	Revised Additional Value per Visit	Revised Current Value per Visit	Preferred Value per Visit
Scenic Floating	$ 64.39	48	65	$ 47.55	$ 46.80	$ 94.35
Guide Boat Fishing	$ 71.37	27	34	$ 56.68	$ 182.94	$ 239.62
Private Boat Fishing	$ 55.66	49	84	$ 32.47	$ 37.44	$ 69.91
Shoreline Fishing/Trail Use	$ 13.53	118	150	$ 10.64	$ 23.49	$ 34.13
Camping	$ 9.36	44	123	$ 3.35	$ 10.78	$ 14.13

4) High End (Low End) Kink Value per Visit: Since the high end kink data point was analogous to the current conditions data point, value per visit for the high end kink was assumed to be the same as current value per visit. Table 4 under Affected Environment current conditions presents the estimates of current value per visit by recreation activity for the Green River.

5) High End Value per Visit: Assumed to be zero by definition.

3.1.1.1.2 Dinosaur National Monument Analysis Methodology – Based on conversations with Dinosaur NM staff (personal communications with Christy Wright), there was uncertainty over whether Green River flows would have a significant impact on rafting visitation within Dinosaur. As noted in the affected environment section, given the potential for substitution of rafting activity between the Green and Yampa Rivers and the fact that most rafting trips are scheduled well ahead of time and, thereby, involve both time and financial commitments, the general hypothesis was that changing Green River flows would not have a significant impact on rafting activity.

To test this hypothesis, monthly data on both private and commercial rafting visitation and average Green River flows was gathered over an 11-year period (1993-2003). Annual population data for the States of Colorado, Utah, and Wyoming was also gathered over this period. Using this data, the following models were attempted.

Rafting visits = f (Green River Flows, Green River Flows^2, Population, School)

Dependent Variables:

Private Visits = Number of monthly visitors on private rafting trips
Commercial Visits = Number of monthly visitors on commercial rafting trips

Explanatory Variables:

Green River Flows = Average monthly Green River flows as obtained from the USGS.
Expected sign: +

Green River Flows^2 = Average monthly Green River flows squared. Provides the often assumed quadratic (inverted U-shaped) distribution. Expected sign: -

Population = Annual population of Colorado, Utah, Wyoming. Reflects trend variable. Expected sign: +

School = Qualitative variable reflecting 1 when school is out of session (months of June, July, August) and 0 when in session. Expected sign: +

Private Rafting Model Results:

Variables	Constant	Flows	Flows^2	Population	School	Adjusted R^2
Constant	-609.469	.3998	-3.855E-05	8.11E-05	856.811	.656
t Statistic	-.941	4.445	-2.973	.919	11.042	

Interestingly, the flow variable in the private model proved to be statistically significant implying that changes in average flows do influence changes in private rafting visitation. However, when plugging the average monthly flows (along with the other variables) associated with both the No Action and Action Alternatives into the model, the estimated visitation differences weren't considered substantial. On average, Action Alternative rafting visits were estimated to increase by less than 8 percent compared to the No Action Alternative. In wet and dry conditions, which each only occur about 10 percent of the time, the change in visitation associated with the Action Alternative was +11% and -5%, respectively.

	Average Conditions	Wet Conditions	Dry Conditions
No Action Alternative Visits	6,750	7,665	4,961
Action Alternative Visits	7,284 (+7.9%)	8,510 (+11.0%)	4,715 (-5.0%)

Commercial Rafting Model Results: In the initial regression, we tested the relationship between commercial rafting visits and average monthly flow only. Given this relationship did not prove significant, we went no further with the commercial rafting analysis.

Bottom line, since the private model indicated fairly minor changes in rafting visitation between the two alternatives and the commercial rafting model showed no statistical relationship between flows and visitation, the assumption was made that rafting in Dinosaur would not be substantially affected by the EIS alternative and, therefore, a detailed analysis of Dinosaur NM rafting would not be included in the EIS.

3.1.1.2 Flaming Gorge Reservoir Visitation and Valuation Analysis Methodology

Whereas the Green River recreation analysis used the interpolation approach for both the visitation and value analyses, lack of visitation data for the relevant survey period from June 2000 through September 2001 precluded use of an interpolation analysis to estimate Flaming Gorge Reservoir visitation. Instead, a facilities availability approach was used to estimate reservoir visitation. However, the interpolation approach was used to estimate economic values by reservoir recreation activity as with the Green River analysis.

3.1.1.2.1 Facility Availability Approach to Flaming Gorge Reservoir Visitation – The facility availability approach to estimating recreation visitation focuses purely on the influence of water access on recreation activity. Water access is determined by the availability of recreation facilities as reservoir water levels fluctuate. The basic concept that recreation visitation varies with availability of facilities is well founded, but it obviously only applies to water based activities. In addition, by focusing purely on access, the approach fails to consider other influential factors such as aesthetics and safety concerns. Nevertheless, facilities availability approaches are often used to estimate changes in visitation.

Step 1: The first step in developing a facility availability analysis is to gather information on the high and low end usability thresholds associated with each potentially affected facility. Usability thresholds, measured in feet above mean sea level (msl), represent the point where each facility would no longer be usable due to either high or low water. For the Flaming Gorge analysis, high end thresholds were of little concern and were not included in the analysis. Table 10 presents a list of sites, facilities, and low end usability thresholds.

Table 10: Flaming Gorge Reservoir Facility List

Site	Facility Type	Low End Threshold (feet above msl)
Antelope Flat	Boat Ramp Swim Beach	6015 6012
Anvil Draw[1]	Boat Ramp	6020
Buckboard Crossing	Marina Boat Ramp	6015 6000
Cedar Springs	Marina Boat Ramp	6018 6018
Firehole	Boat Ramp Swim Beach	6019 6012
Hideout	Boat Camp	6014
Jarvies Canyon	Boat Camp	6012
Kingfisher Island	Boat Camp	6010
Lucerne Valley	Marina Two Boat Ramps Swim Beach	6010 5994 6014
Mustang Ridge	Boat Ramp	6000
Sheep Creek	Boat Ramp	6015
Squaw Hollow	Boat Ramp	6015
Sunny Cove	Swim Beach	6018
Upper Marsh Creek	Boat Ramp	6000

[1] The Anvil Draw boat ramp was extended in 2003 such that the low end threshold changed from 6020 to 6015. This change is not reflected in the analysis because it would not substantially affect the results (impacts only this low use ramp during dry conditions).

Step 2: The next step involves obtaining visitation estimates by activity linked to each of the recreation facilities. The latest, most reliable visitation estimates for the reservoir were gathered by the FS in fiscal year 1997 (October 1996–September 1997). This data was gathered by recreation activity, site, and facility. This annual visitation data needed to be converted into monthly estimates allow for use of the facility availability approach. Fortunately, the State of Utah has periodically gathered monthly data for boat, shore, and ice fishing from which monthly percentages were estimated. The boat fishing monthly percentages were used to allocate warm water recreation activities across months. Warm water activities were defined as power boating, waterskiing, boat fishing, and swimming/waterplay. The shore fishing monthly percentages were used to allocate cooler month activities across months. The only cool water activity of interest was boat camping. While not directly targeted toward each of our activities of interest, the State of Utah percentages were seen as representative of the various warm and cool water activities.

Fishing data from the State of Utah was available for 1993-4, 1988-9, and 1982. Given there was not much variation in these percentages over time, which helped justify their use, it mattered little which set of data was applied. Data from 1988-9, as presented in table 11, was selected as most representative since the reservoir water levels of 1988-9 matched the visitation oriented 1996-7 water levels the closest.

Table 11: Flaming Gorge Reservoir Monthly Percentages by Activity Type

Month	Monthly Percentages for Warm Water Activities	Monthly Percentages for Cool Water Activities
January	.002	.007
February	.000	.000
March	.007	.065
April	.060	.170
May	.161	.134
June	.217	.180
July	.236	.134
August	.137	.113
September	.079	.052
October	.071	.065
November	.018	.047
December	.012	.034

Step 3: The next step in the analysis was to look at the actual availability of the facilities under current conditions and conditions associated with each alternative. As noted in the Affected Environment discussion of current reservoir water levels, use of both a facility availability approach and an interpolation approach to estimate visitation and value respectively within the reservoir recreation analysis complicates the definition of current flows to some extent. Fortunately, regardless of whether one defines current conditions in terms of water levels for fiscal year 1997 (based on visitation data) or water levels from June 2000 through September 2001 (based on survey value data), the current visitation estimate derived from the facility availability approach would be the same. Under both perspectives, all facilities are available in all months. The current visitation estimate is presented in table 3 under Affected Environment current conditions.

The current visitation estimate was used as the starting point for estimating visitation for the No Action and Action Alternatives. End of month reservoir water levels were obtained from the hydrologists for each alternative under a series of conditions ranging from dry (10% exceedence) to wet (90% exceedence). Monthly availability of facilities was evaluated for dry, average, and wet conditions. An implicit assumption is made that end of month water levels are representative of water levels throughout the month. Monthly water level data was used for each alternative since that time step was consistent with the lowest level of detail available for the visitation data as well as the historical water level data.

Step 4: Based on the availability of facilities under each alternative and hydrologic scenario, estimates of visitation were developed. As facilities became unusable, the level of visitation associated with that facility was assumed lost under the initial analysis run. Full loss of visitation as facilities become unusable is a worst case scenario since it fails to address potential substitution of visitation to other facilities along the reservoir. After developing the initial, worst case loss estimates, the results were presented to on-site recreation managers for their opinions as to the potential degree of facility substitution. The final monthly visitation estimates by recreation activity, alternative, and hydrologic condition therefore take into account facility substitution based on the professional judgement of recreation management.

3.1.1.2.2 Interpolation Approach to Flaming Gorge Reservoir Valuation – The linear interpolation approach was also used to estimate monthly recreation values by activity. The approach used was the same as that presented above to estimate Green River values. The following reflects details of the interpolation data points for Flaming Gorge Reservoir water levels and values.

A) Water Level Data Points:

1) Low End Water Level Thresholds: The low end threshold water level for each activity reflects the point were value for that recreation activity is assumed to go to zero due to low flows. This flow level was obtained from the survey and represents the average flow where recreators pursuing that activity indicated they would stop participating.

As with Green River flows, low end threshold water levels by recreation activity were based on recreator rankings in terms of physical descriptions of Flaming Gorge Reservoir water levels. A range of physical descriptions, from very low to very high water levels, were used in each water level oriented survey question. Reservoir experts were used to convert the physical description oriented recreator rankings into actual water level estimates (reservoir expert opinions: very low = 6015, low = 6022, medium = 6028, high = 6030, very high = 6040).

	Low End Water Level Threshold
Power Boating/WaterSkiing:	6016.7
Boat Fishing:	6017.3
Boat Camping:	6017.1
Swimming/Waterplay:	6017.4

2) Current Water Levels: The analysis of economic values was conducted by month and alternative, but the actual calculation used annual water level information by activity as the current flow reference point. When estimating per visit values, it makes no difference whether the water level reference point is daily, weekly, monthly, or annually. The survey asked recreators for their current value by recreation activity based on activities pursued across the past 12 months (the survey did not ask about values per activity by month since that would be overly complicated). As a result, the current water levels associated with the current economic values by activity were based on average annual water levels from the June 2000 through September 2001 survey orientation period. The average annual water level for each activity took into consideration both when a recreator was contacted during the sampling period (weighting based on sampling percentage by month) and the percent of visitation by month associated with each activity.

The weighted average current annual water levels for the four studied Flaming Gorge Reservoir recreational activities hardly varied and are as follows:

	Low End Water Level Threshold
Power Boating/WaterSkiing:	6021.2
Boat Fishing:	6021.2
Boat Camping:	6021.1
Swimming/Waterplay:	6021.2

3) Preferred Water Levels: The preferred water level for each activity reflects the point were visitation for that recreation activity is assumed to be at the maximum. This water level was obtained from the survey and represents the average water level where recreators pursuing that activity indicated they would participate the most.

As with the low end threshold reservoir water levels, preferred water levels by recreation activity were based on recreator rankings of physical descriptions of Flaming Gorge Reservoir water levels combined with expert opinion of what those physical descriptions represent in terms of water levels.

	Preferred Water Levels
Power Boating/WaterSkiing:	6029.0
Boat Fishing:	6029.1
Boat Camping:	6028.9
Swimming/Waterplay:	6028.9

3) High End Kink Water Levels: Calculation of the high end kink water level was discussed above under the Green River section. Note that for the reservoir valuation analysis, current annual water levels (and all data points for that matter) vary by activity, but not by month. As a result, the high end kink water level also varies by activity, but not month. Also note that in all months, this data point reflects a high end kink and never a low end kink.

	High End Kink Water Levels
Power Boating/WaterSkiing:	6021.2
Boat Fishing:	6021.2
Boat Camping:	6021.1
Swimming/Waterplay:	6021.2

4) High End Threshold Water Levels: The high end threshold water level for each activity reflects the point were value for that recreation activity is assumed to go to zero due to high water levels. This water level was obtained from the survey and represents the average water level where recreators pursuing that activity indicated they would stop participating.

As with the low end threshold and preferred reservoir water levels, high end threshold water levels by recreation activity were based on recreator rankings of physical descriptions of Flaming Gorge Reservoir water levels combined with expert opinion of what those physical descriptions represent in terms of water levels.

	High End K Water Level Threshold
Power Boating/WaterSkiing:	6036.8
Boat Fishing:	6037.5
Boat Camping:	6036.7
Swimming/Waterplay:	6036.7

B) Visitation Data Points: Not relevant since the reservoir visitation analysis is based on the facility availability approach as opposed to the interpolation approach.

C) Value per Visit Data Points:

1) Low End Values: Assumed to be zero by definition.

2) Current Values: Current value estimates were obtained by activity from the survey. All value estimates were developed using the conservative, but frequently applied approach of assuming nonrespondents have a value of zero. All activities were significantly affected by this adjustment. Table 5 under Affected Environment current conditions presents the estimates of current value per visit by recreation activity for the reservoir.

3) Preferred Values per Visit: The survey asked a contingent value question to estimate how much more value per visit by activity recreators would expect if water levels were at the recreator's preferred level. The survey additional value per visit responses were averaged by activity and revised downward using the conservative nonrespondent adjustment. The revised additional values per visit by activity were added to the current revised values per visit by activity to estimate preferred values per visit by activity. The preferred values per visit vary by activity, but not by month. Table 12 presents estimates of preferred values per visit by activity. The estimates of preferred values per visit reflect an upper bound.

Table 12: Preferred (Upper Bound) Flaming Gorge Reservoir Values per Visit by Activity

Recreation Activity	Additional Value per Visit (Survey)	Number of Responses	Full Sample	Revised Additional Value per Visit	Revised Current Value per Visit	Preferred Value per Visit
Power Boating/ Waterskiing	$ 41.71	60	122	$ 20.51	$ 25.71	$ 46.22
Boat Fishing	$ 33.79	47	125	$ 12.71	$ 25.21	$ 37.92
Boat Camping	$ 40.52	24	8106	$ 9.17	$ 13.06	$ 22.23
Swimming/ Waterplay	$ 36.25	24	97	$ 8.97	$ 1.44	$ 10.41

4) High End (Low End) Kink Value per Visit: Since the high end kink data point was analogous to the current conditions data point, value per visit for the high end kink was assumed to be the same as current value per visit. See current values per visit in table 12 directly above.

5) High End Value per Visit: Assumed to be zero by definition.

Monthly values by alternative and hydrologic condition were multiplied by monthly visitation estimates by alternative and hydrologic condition to estimate total value by alternative and hydrologic condition.

3.1.1.3 Green River Facility Availability Analysis Methodology

In addition to the visitation and economic value analysis, evaluations were also made as to the availability of recreation facilities for each alternative. As noted above, facility availability provided the basis for estimating visitation effects for the reservoir. Although not used to estimate the visitation effects on the Green River, facility availability was also reviewed on the Green River downstream of the dam, all the way to the confluence with the Colorado River. As with the reservoir visitation analysis, high and low end usability thresholds were obtained for each facility from the various managing entities (i.e., FS, BLM, State of Utah, USFWS, NPS). Average, wet (90^{th} percentile), and dry (10^{th} percentile) flows from the hydrology model for each alternative were compared to the high and low end usability thresholds for each facility to determine availability. In addition, the raw hydrologic output data was searched to determine the percent of time each usability threshold was exceeded for each alternative. This facility availability information is presented for each alternative along with the visitation and valuation information. For consistency with the reservoir analysis, the results of the Green River facility availability analysis are presented within the visitation sections.

The following summarizes information obtained from discussions with the various managing entities. Note that as a result of these discussions, many of the recreation facilities identified in the affected environment section were assumed to be unaffected by river flows given their historical use across a wide range of flow conditions. Table 13 presents the high and low end usability thresholds for each potentially impacted facility on the Green River.

Reach 1: Flaming Gorge Dam to the confluence with the Yampa River

USDA Forest Service: The FS manages two boat ramps (Spillway and Little Hole), a fishing pier, a hiking trail, and 18 riverside campgrounds along the Green River within FGNRA. Use of both boat ramps and the fishing pier become difficult as flows fall below 600 cfs. Significant impacts occur to nine of the eighteen campgrounds as flows exceed 5,000 cfs. The Spillway ramp, the fishing pier, and the hiking trail become unusable or significantly impacted as flows rise above 6,000 cfs. Finally, the Little Hole boat ramp becomes inaccessible as flows exceed 8,000 cfs.

Bureau of Land Management: The BLM manages numerous recreational facilities between FGNRA and Browns Park NWR including three boat ramps and approximately 20 campsites. The boat ramps are found at Indian Crossing, Bridge Hollow, and Swallow Canyon (an additional ramp at Pipeline is being phased out). These ramps have remained usable at very high flows, and therefore no information exists as to high end flow thresholds where the ramps become unusable. However, these ramps do become difficult to use below 800 cfs. The only campsite which may experience flooding is the Bridge Hollow camp. The group campsites at Bridge Hollow have flooded at about 10,000 cfs in the past.

State of Utah: The State manages one boat ramp (Bridge Port Camp) and five campgrounds (Gorge Creek, Little Davenport, Bridge Port, Elm Grove, and Burned Tree) between FGNRA and Browns Park NWR. The boat ramp remains usable at very high flows so no high end flow threshold was assumed, but becomes unusable below 800 cfs. The campgrounds are far enough away from the water that they would be unaffected by high flows.

Table 13. Green River Facility Usability Thresholds				
Site Name	Facility Type	Managing Entity	Low End Usability Threshold (cfs)	High End Usability Threshold (cfs)
Green River – Reach 1 (Dam to Confluence With Yampa River):				
Spillway	Boat Ramp	FS	600	6,000
Little Hole	Boat Ramp	FS	600	8,000
	Fishing Pier	FS	600	6,000
	Trail	FS	n/a	6,000
	9 of 18 Campgrounds	FS	n/a	5,000
Indian Crossing	Boat Ramp	BLM	800	None
Bridge Hollow	Boat Ramp	BLM	800	None
	Campground	BLM	n/a	10,000
Swallow Canyon	Boat Ramp	BLM	800	None
Bridge Port Camp	Boat Ramp	State of Utah – Wildlife Resources	800	None
Green River – Reach 2 (Yampa River to confluence with White River):				
Ouray NWR	Boat Ramp	USFWS	None	25,000
Green River – Reach 3 (White River to confluence with Colorado River):				
Sand Wash	Boat Ramp	BLM	800	50,000
Swasey's Beach	Boat Ramp	BLM	2,000	50,000
Nefertiti	Boat Ramp	BLM	800	[1]27,000
Butler Rapid	Boat Ramp	BLM	800	[1]27,000
Mineral Bottom	Boat Ramp	BLM	800	[1]30,000
Green River State Park	Boat Ramp	State of Utah	800	25,000
	Campground	State of Utah	None	25,000
	Golf Course	State of Utah	None	19,000

[1] Access road to the facility becomes inundated, not the facility itself.

National Park Service (Dinosaur National Monument): Dinosaur NM has three primary boat ramp facilities: Lodore, Deerlodge, and Split Mountain. Generally speaking, these facilities have been usable across all flow levels and hence high and low end usability thresholds are unknown. The likely continued operation of recreation facilities across a wide range of flow levels also holds for the riverside campgrounds (i.e., Lodore, Deerlodge, Echo Park, Split Mountain, and Green River) and picnic areas (i.e., Split Mountain).

Reach 2: Yampa River to the confluence with the White River

U.S. Fish and Wildlife Service (Ouray National Wildlife Refuge): While there is a primitive boat ramp, very little boating activity occurs within the refuge. Site management estimates that use of this ramp becomes difficult at about 25,000 cfs. There are no riverside campgrounds within the refuge.

Reach 3: White River to the confluence with the Colorado River

Bureau of Land Management: The BLM oversees a considerable amount of land within Reach 3 from the confluence with the White River to the northern border of Canyonlands National Park. The agency maintains five boat ramps/launches (Sand Wash, Swasey's Beach, Nefertiti, Butler Rapid, and Mineral Bottom) within this river stretch. Swasey's Beach is the only developed concrete ramp, with the other sites being primitive. Sand Wash is usable at virtually all flow levels, with impacts occurring at the low end below 800 cfs and at the high end above 50,000 cfs. Swasey's Beach ramp becomes unusable below 2,000 cfs due to rocks and at very high flows in excess of 50,000 cfs. The launch sites at Nefertiti and Butler Rapid remain accessible at virtually all flow levels, but the access road to these facilities floods at about 27,000 cfs. At Mineral Bottom, use of the site becomes difficult below 800 cfs. As with Nefertiti and Butler Rapid, the site remains accessible at high flows, but the access road floods at about 30,000 cfs. Finally, three sites at the campground at Swasey's Beach get inundated at about 26,000 cfs, but this is not a significant enough effect to close the campground.

State of Utah (Green River State Park): The park has a developed boat ramp, a 42 unit campground, and a golf course all located along the Green River. At 19,000 cfs the golf course begins to see significant impacts. At 25,000 cfs, impacts begin at both the campground and boat ramp. While these facilities may still be usable at these flow levels, impacts become readily apparent.

Private Lands: A primitive boat launch site exists on private lands at Ruby Ranch upstream of Canyonlands National Park. No information was readily available on high or low end usability thresholds.

National Park Service (Canyonlands National Park): Given there are no boat ramps within the park, Green River boaters within Canyonlands use boat ramps outside the park on BLM, State, or private lands. Boaters use undeveloped, undesignated campsites throughout the park available at all flow levels. Usability thresholds for 8 minimally developed road-accessible campsites along the river are unknown. Above about 30,000 cfs, a portion of the access road from the north becomes inundated, but access is still possible from the south or east.

3.2 Results

This section presents the results of the recreation visitation and value analyses. Results are presented by alternative within each section with the Action Alternative results compared to the No Action Alternative results.

3.2.1 Recreation Visitation and Valuation Results

This section presents the results of the recreation visitation and valuation analysis by alternative starting with the No Action Alternative. Under each alternative, separate sections are presented for hydrology, visitation, and value. Within each hydrology, visitation, and value subsection, a further division is made between the Green River and Flaming Gorge Reservoir analyses, but the visitation and value results are ultimately combined across both sites. Finally, information presented for the Action Alternative will be compared to the No Action Alternative to evaluate the effects of the Action Alternative.

3.2.1.1 No Action Alternative

Within a Federal environmental document, such as this Flaming Gorge EIS, the No Action Alternative reflects the baseline from which to compare all other alternatives.

3.2.1.1.1 Hydrologic Conditions –

A) Green River Flows:

Monthly average Green River flows were obtained from the hydrology models for each project alternative. Within the recreation analysis, comparisons were made of recreation effects between alternatives under average, wet, and dry hydrologic conditions. The monthly average flows under average conditions simply reflects the average flows for that particular month across all years within the hydrologic output. As a result, average flows do not necessarily equate to information related to average water year types presented within the context of the Green River flow recommendations. Similarly, the wet and dry flows used in the recreation analysis are not based on information by water year type, but reflect the 90 percent and 10 percent thresholds associated with the output from the hydrologic models. The dry flows represent the lowest 10% flow level whereas the wet flows represent the highest 90% flow level. Table 14 presents the average, wet, and dry flows by month for the No Action Alternative. Also included in the table are the five flow data points used in the interpolations. Comparing the alternative flows to the data points provides an idea as to where the alternative flow falls within the inverted U-shaped flow distribution. For example, the No Action Alternative average condition flow for scenic floating for March of 1,484 falls between the current flow data point (1,036) and the preferred flows data point (2,170). The visitation and value interpolation for the No Action Alternative scenic floating March average condition would therefore also result in estimates falling between the current and preferred visit and value data points.

Note that the Green River recreation analysis evaluated the months of March through October given visitation data was only available for those months. In addition, as described under affected environment, the river recreation analysis focused on the Flaming Gorge NRA which is found in Reach 1. Reach 1 of the Green River is defined within this EIS as the stretch of river from Flaming Gorge Dam to the confluence of the Green and Yampa Rivers.

B) Flaming Gorge Reservoir Water Levels:

End of month Flaming Gorge Reservoir water levels were also obtained from the hydrology models for each alternative. As with the river hydrology, reservoir water levels were obtained by alternative for average, wet, and dry hydrologic conditions. The end of month (EOM) water levels under average conditions simply reflects the average water levels for that particular month across all years within the hydrologic output. As a result, average water levels do not necessarily equate to information related to average water year types presented within the context of the Green River flow recommendations. Similarly, the wet and dry water levels used in the recreation analysis are not based on information by water year type, but reflect the 90 percent and 10 percent thresholds associated with the output from the hydrologic models. The dry water levels represent the lowest 10% water level whereas the wet water levels represent the highest 90% water level. Table 15 presents the average, wet, and dry water levels by month for the No Action Alternative. Note that the Flaming Gorge Reservoir recreation analysis evaluated across all months, and not only March through October as was the river analysis.

Table 14: No Action Alternative, Green River Reach 1 Average Monthly Flows (cfs) by Hydrologic Condition									
		Interpolation Data Points					No Action Alternative		
Month	Recreation Activity	Low End Threshold Flow	Current Flow	Preferred Flow	High End Kink Flow	High End Threshold Flow	Average	Wet	Dry
		Monthly Oriented Flow Data Points for Visitation Analysis Interpolation							
March	Scenic Floating	953	1036.0	2170	3786.7	3905	1484	1898	800
	Guide Boat Fishing	854	" "	1837	3380.3	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	3343.7	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	3158.4	3709	" "	" "	" "
	Camping	836	" "	2000	3273.7	3538	" "	" "	" "
April	Scenic Floating	953	1145.0	2170	3631.3	3905	2207	3290	800
	Guide Boat Fishing	854	" "	1837	3170.3	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	3126.9	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	2874.0	3709	" "	" "	" "
	Camping	836	" "	2000	3129.7	3538	" "	" "	" "
May	Scenic Floating	953	1954.0	2170	2478.0	3905	3463	5100	1400
	Guide Boat Fishing	854	1504.3	1837	" "	3731	" "	" "	" "
	Private Boat Fishing	879	1471.2	1808	" "	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	1296.7	1624	" "	3709	" "	" "	" "
	Camping	836	1638.2	2000	" "	3538	" "	" "	" "
June	Scenic Floating	953	1215.2	2170	3531.2	3905	2710	5917	800
	Guide Boat Fishing	854	" "	1837	3035.1	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	2987.3	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	2690.8	3709	" "	" "	" "
	Camping	836	" "	2000	3037.0	3538	" "	" "	" "
July	Scenic Floating	953	1007.0	2170	3828.0	3905	983	1200	800
	Guide Boat Fishing	854	" "	1837	3436.2	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	3401.4	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	3234.1	3709	" "	" "	" "
	Camping	836	" "	2000	3312.1	3538	" "	" "	" "
Aug	Scenic Floating	953	1122.2	2170	3663.7	3905	1251	1531	931
	Guide Boat Fishing	854	" "	1837	3214.2	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	3172.1	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	2933.3	3709	" "	" "	" "
	Camping	836	" "	2000	3159.8	3538	" "	" "	" "
Sept	Scenic Floating	953	1118.0	2170	3669.7	3905	1374	1639	1039
	Guide Boat Fishing	854	" "	1837	3222.3	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	3180.5	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	2944.3	3709	" "	" "	" "
	Camping	836	" "	2000	3165.3	3538	" "	" "	" "
Oct	Scenic Floating	953	1024.0	2170	3803.8	3905	1654	2075	1039
	Guide Boat Fishing	854	" "	1837	3403.5	3731	" "	" "	" "
	Private Boat Fishing	879	" "	1808	3367.6	3656	" "	" "	" "
	Shore Fishing/Trail Use	825	" "	1624	3189.7	3709	" "	" "	" "
	Camping	836	" "	2000	3289.6	3538	" "	" "	" "
		Annually Oriented Flow Data Points for Valuation Analysis Interpolation							
		Low End Threshold Flow	Annual Current Flow	Preferred Flow	Annual High End Kink Flow	High End Threshold Flow			
All Months	Scenic Floating	953	1096.9	2170	3699.8	3905	Monthly flows are as above		
	Guide Boat Fishing	854	1359.0	1837	2757.9	3731			
	Private Boat Fishing	879	1373.3	1808	2672.7	3656			
	Shore Fishing/Trail Use	825	1298.6	1624	2473.1	3709			
	Camping	836	1115.5	2000	3168.7	3538			

Table 15: No Action Alternative, Flaming Gorge Reservoir Average End of Month Water Levels (feet above msl) by Hydrologic Condition

		Annually Oriented Water Level (WL) Data Points for Valuation Analysis Interpolation					No Action Alternative Water Levels		
Month	Recreation Activity	Low End Threshold WL	Annual Current WL	Preferred WL	Annual High End Kink WL	High End Threshold WL	Average	Wet	Dry
January	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6024.3	6028.1	6017.4
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
February	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6024.0	6026.8	6017.8
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
March	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6024.0	6027.9	6019.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
April	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6024.1	6028.5	6020.1
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
May	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6023.8	6029.4	6017.6
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
June	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.6	6031.7	6018.5
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
July	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6029.1	6035.5	6019.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
August	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6028.9	6036.0	6018.5
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
September	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6028.3	6035.5	6017.9
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
October	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6027.5	6034.9	6017.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
November	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.3	6032.9	6017.5
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			
December	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.1	6030.3	6017.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5			
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7			
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7			

3.2.1.1.2 Annual Recreation Visitation and Infrastructure Impacts – Based on the methods described above, visitation estimates by recreation activity for both the Green River and Flaming Gorge Reservoir are presented below for the No Action Alternative under average, wet, and dry hydrologic conditions. In addition, impacts to recreation facilities are also presented by alternative and hydrologic condition.

A) Green River Visitation:

Table 16 presents the Green River visitation estimates for the No Action Alternative. The five data points for the interpolation are included in the table as well as the visitation estimates. Note that the data points and visitation estimates vary by recreation activity and month. Visitation estimates were summed across the March through October time period to provide an estimate of annual water based visitation.

No Action Alternative visitation under average conditions was estimated at nearly 83,500 or about 9,000 visits (9.7%) less than current 2000-2001 conditions. The estimated decline in visitation affected all activities due primarily to the high flows in May (3,463 cfs) and low flows in July (983 cfs).

The wet condition was estimated at nearly 69,700 visits. This reflects a drop of about 13,800 visits (16.5%) compared to the No Action Alternative average condition. While certain months were expected to generate more visitation under wet conditions compared to average conditions, the loss of May and June visitation due to flows (5,100 and 5,917 respectively) averaging in excess of the high end thresholds for all activities resulted in the lower visitation estimate. The loss was expected to occur across all activities.

The dry condition was estimated to generate only about 22,300 visits reflecting a 61,200 visit (73.3%) decline compared to average conditions. These declines held for all activities and stemmed mainly from the complete loss of visitation which is expected during the months of March, April, June, and July. Visitation was expected to drop to zero for these months due to the monthly average flows of 800 cfs.

Although unrelated to the interpolation based Green River visitation analysis, an analysis of facility availability was also conducted for Green River recreation facilities. As shown in table 17, within Reach 1, all river facilities were expected to be available based on average monthly flows across all months under No Action Alternative average and dry conditions. However, under No Action Alternative wet conditions, 9 of the 18 riverside campgrounds were expected to be unavailable in May and June due to high flows. Looking across all years, the unavailability percentage, due exclusively to high flows, ranges from 0 to 15.5 percent (or from virtually never to once every 6.5 years). It should be noted that facility unavailability due to low water levels on the reservoir implies little damage to the facilities whereas facility unavailability on the river due to high flows can imply substantial damage. River facility unavailability was based on the point where significant impacts were expected to occur. However, in most cases, erosion damage begins prior to the significant impact flow level (e.g., impacts begin at: 4,200 cfs to Little Hole ramp foundations, 5,000 cfs to trail tread/boardwalk footings and campground banks and vegetation, and 6,000 cfs to Spillway boat ramp protective riprap and foundations).

Within Reach 2, the boat ramp at Ouray National Wildlife Refuge remains available under average, dry, and wet conditions across all months for the No Action Alternative. Looking across all years, unavailability is expected to occur in May and June, but only about 2 percent of the time.

Within Reach 3, all facilities remain available under average conditions for the No Action Alternative. However, under dry conditions, the Swasey's Beach boat ramp would be unavailable during the months of January, February, and July through December. Under wet conditions, the facilities at Green River State Park would be affected during May and June (golf course during both May and June, and the campground and boat ramp during June). Looking across all years, again the Swasey's Beach boat ramp and the Green River State Park facilities show the most dramatic effects. The unavailability percentages displayed in table 17 need to be looked at with some skepticism given the uncertainty associated with the Reach 3 hydrology model.

Table 16: No Action Alternative, Green River Reach 1 Average Monthly Visitation by Hydrologic Condition									
		Interpolation Data Points					No Action Alternative Visits		
Month	Recreation Activity	Low End Threshold Visits	Current Visits	Preferred Visits	High End Kink Visits	High End Threshold Visits	Average	Wet	Dry
March	Scenic Floating	0	42	52	42	0	46	50	0
	Guide Boat Fishing	0	280	334	280	0	310	332	0
	Private Boat Fishing	0	1,265	1,475	1,265	0	1,387	1,463	0
	Shore Fishing/Trail Use	0	1,774	2,541	1,774	0	2,358	2,404	0
	Camping	0	0	0	0	0	0	0	0
	Total:	0	3,361	4,402	3,361	0	4,101	4,249	0
April	Scenic Floating	0	217	270	217	0	269	229	0
	Guide Boat Fishing	0	1,560	1,861	1,560	0	1,777	1,227	0
	Private Boat Fishing	0	3,214	3,748	3,214	0	3,586	2,223	0
	Shore Fishing/Trail Use	0	5,892	8,439	5,892	0	7,251	2,956	0
	Camping	0	0	0	0	0	0	0	0
	Total:	0	10,883	14,318	10,883	0	12,883	6,635	0
May	Scenic Floating	0	99	123	99	0	31	0	44
	Guide Boat Fishing	0	2,018	2,407	2,018	0	432	0	1,694
	Private Boat Fishing	0	3,549	4,139	3,549	0	581	0	3,122
	Shore Fishing/Trail Use	0	4,942	7,078	4,942	0	988	0	5,616
	Camping	0	0	0	0	0	0	0	0
	Total:	0	10,608	13,747	10,608	0	2,032	0	10,476
June	Scenic Floating	0	5,527	6,867	5,527	0	6,336	0	0
	Guide Boat Fishing	0	2,099	2,504	2,099	0	2,209	0	0
	Private Boat Fishing	0	1,767	5,060	1,767	0	1,836	0	0
	Shore Fishing/Trail Use	0	5,976	8,559	5,976	0	5,864	0	0
	Camping	0	668	733	668	0	688	0	0
	Total:	0	16,037	20,723	16,037	0	16,933	0	0
July	Scenic Floating	0	11,063	13,744	11,063	0	6,148	11,508	0
	Guide Boat Fishing	0	1,781	2,124	1,781	0	1,502	1,861	0
	Private Boat Fishing	0	1,520	1,773	1,520	0	1,235	1,581	0
	Shore Fishing/Trail Use	0	7,708	11,039	7,708	0	6,692	8,750	0
	Camping	0	655	719	655	0	563	667	0
	Total:	0	22,727	29,399	22,727	0	16,140	24,367	0
Aug	Scenic Floating	0	7,749	9,626	7,749	0	7,979	8,481	0
	Guide Boat Fishing	0	1,814	2,163	1,814	0	1,877	2,013	521
	Private Boat Fishing	0	1,457	1,699	1,457	0	1,503	1,601	312
	Shore Fishing/Trail Use	0	5,462	7,823	5,462	0	6,068	7,385	1,948
	Camping	0	600	659	600	0	609	628	199
	Total:	0	17,082	21,970	17,082	0	18,036	20,108	2,980
Sept	Scenic Floating	0	62	77	62	0	66	70	32
	Guide Boat Fishing	0	1,530	1,826	1,530	0	1,636	1,745	1,072
	Private Boat Fishing	0	4,827	5,629	4,827	0	5,124	5,432	3,231
	Shore Fishing/Trail Use	0	2,935	4,204	2,935	0	3,577	4,190	2,143
	Camping	0	352	386	352	0	362	372	253
	Total:	0	9,707	12,122	9,707	0	10,765	11,809	6,731
Oct	Scenic Floating	0	9	11	9	0	10	11	9
	Guide Boat Fishing	0	318	379	318	0	365	370	319
	Private Boat Fishing	0	932	1,087	932	0	1,057	1,060	935
	Shore Fishing/Trail Use	0	793	1,136	793	0	1,129	1,037	802
	Camping	0	6	7	6	0	7	7	6
	Total:	0	2,058	2,620	2,058	0	2,568	2,485	2,071
Total	Scenic Floating	0	24,768	30,770	24,768	0	20,885	20,349	85
	Guide Boat Fishing	0	11,400	13,598	11,400	0	10,108	7,548	3,606
	Private Boat Fishing	0	18,531	21,610	18,531	0	16,309	13,360	7,600
	Shore Fishing/Trail Use	0	35,482	50,819	35,482	0	33,927	26,722	10,509
	Camping	0	2,281	2,504	2,281	0	2,229	1,674	458
	Total:	0	9,2461	119,301	92,461	0	83,458	69,653	22,258

Table 17: No Action Alternative, Green River Facility Availability by Site and Hydrologic Condition (Facility Availability: Yes = available, No = unavailable)

Agency	Site	Facility	Low End Thres-hold	High End Thres-hold	Hydrologic Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Reach 1: Flaming Gorge Dam to the Yampa River																	
No Action Alternative, Reach 1, Average Flows:						1,721	1,432	1,484	2,207	3,463	2,710	983	1,251	1,374	1,654	1,969	1,895
USFS	Spillway	Boat Ramp	600	6,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Little Hole	Boat Ramp	600	8,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fishing Pier	600	6,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Trail	n/a	6,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		9 of 18 Campgrounds	n/a	5,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BLM	Indian Crossing	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bridge Hollow	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	None	10,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swallow Canyon	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Bridge Port Camp	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No Action Alternative, Reach 1, Dry Flows:						800	800	800	800	1,400	800	800	931	1,039	1,039	800	800
USFS	Spillway	Boat Ramp	600	6,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Little Hole	Boat Ramp	600	8,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fishing Pier	600	6,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Trail	n/a	6,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		9 of 18 Campgrounds	n/a	5,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BLM	Indian Crossing	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bridge Hollow	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	None	10,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swallow Canyon	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Bridge Port Camp	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

No Action Alternative, Reach 1, Wet Flows:						3,212	2,895	1,898	3,290	5,100	5,917	1,200	1,531	1,639	2,075	3,389	3,337
USFS	Spillway	Boat Ramp	600	6,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Little Hole	Boat Ramp	600	8,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fishing Pier	600	6,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Trail	n/a	6,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		9 of 18 Campgrounds	n/a	5,000	Wet	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
BLM	Indian Crossing	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bridge Hollow	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	None	10,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swallow Canyon	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Bridge Port Camp	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
						Percent of Time, Across All Years, Facilities Are Unavailable											
USFS	Spillway	Boat Ramp	600	6,000	All Years	0	0	0	0	6.3	9.9	0	0	0	0	0	0
	Little Hole	Boat Ramp	600	8,000	All Years	0	0	0	0	2.8	4.0	0	0	0	0	0	0
		Fishing Pier	600	6,000	All Years	0	0	0	0	6.3	9.9	0	0	0	0	0	0
		Trail	n/a	6,000	All Years	0	0	0	0	6.3	9.9	0	0	0	0	0	0
		9 of 18 Campgrounds	n/a	5,000	All Years	0	0	0	0	10.3	15.5	0.1	0	0	0	0	0
BLM	Indian Crossing	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
	Bridge Hollow	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
		Campground	None	10,000	All Years	0	0	0	0	.7	1.1	0	0	0	0	0	0
	Swallow Canyon	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
State of Utah	Bridge Port Camp	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0

						Reach 2: Yampa River to the White River											
No Action Alternative, Reach 2, Average Flows:						2,078	1,884	2,521	5,956	12,429	10,366	2,662	1,702	1,646	2,107	2,409	2,295
FWS	Ouray NWR	Boat Ramp	None	25,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No Action Alternative, Reach 2, Dry Flows:						1,050	1,085	1,501	2,655	5,975	3,349	1,109	1,097	1,132	1,288	1,119	1,080
FWS	Ouray NWR	Boat Ramp	None	25,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No Action Alternative, Reach 2, Extremely Wet Flows:						3,638	3,389	3,584	10,013	19,670	18,113	4,993	2,234	2,081	2,748	3,881	3,821
FWS	Ouray NWR	Boat Ramp	None	25,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
						Percent of Time, Across All Years, Facilities Are Unavailable											
FWS	Ouray NWR	Boat Ramp	None	25,000	All Years	0	0	0	0	2.2	2.4	0	0	0	0	0	0
						Reach 3: White River to the Colorado River											
No Action Alternative, Reach 3, Average Flows:						2,841	3,030	4,163	6,646	14,292	15,189	4,494	2,636	2,487	3,099	3,411	3,076
BLM	Sand Wash	Boat Ramp	800	50,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swasey Beach	Boat Ramp	2000	50,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Nefertiti	Boat Ramp	800	27,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Butler Rapid	Boat Ramp	800	27,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Mineral Bottom	Boat Ramp	800	30,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Green River State Park	Boat Ramp	800	25,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	n/a	25,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Golf Course	n/a	19,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No Action Alternative, Reach 3, Dry Flows:						1,520	1,727	2,266	3,151	6,140	4,819	1,326	1,366	1,520	1,751	1,819	1,441
BLM	Sand Wash	Boat Ramp	800	50,000	Critically Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swasey Beach	Boat Ramp	2000	50,000	Critically Dry	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No
	Nefertiti	Boat Ramp	800	27,000	Critically Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Butler Rapid	Boat Ramp	800	27,000	Critically Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Mineral Bottom	Boat Ramp	800	30,000	Critically Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

State of Utah	Green River State Park	Boat Ramp	800	25,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	n/a	25,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Golf Course	n/a	19,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No Action Alternative, Reach 3, Wet Flows:						4,328	4,770	6,420	11,478	23,500	25,688	9,383	4,450	3,911	4,785	5,076	4,791
BLM	Sand Wash	Boat Ramp	800	50,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swasey Beach	Boat Ramp	2000	50,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Nefertiti	Boat Ramp	800	27,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Butler Rapid	Boat Ramp	800	27,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Mineral Bottom	Boat Ramp	800	30,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Green River State Park	Boat Ramp	800	25,000	Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	n/a	25,000	Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
		Golf Course	n/a	19,000	Wet	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
						Percent of Time, Across All Years, Facilities Are Unavailable											
BLM	Sand Wash	Boat Ramp	800	50,000	All Years	0.3	0.8	0.7	0.1	0	0	1.6	0.8	1.0	0.1	0.2	1.2
	Swasey Beach	Boat Ramp	2000	50,000	All Years	29.4	18.1	4.8	0.7	0	1.2	24.7	34.7	35.9	16.2	15.8	24.5
	Nefertiti	Boat Ramp	800	27,000	All Years	0.3	0.8	0.8	0.1	5.1	7.7	1.8	0.8	1.0	0.1	0.2	1.2
	Butler Rapid	Boat Ramp	800	27,000	All Years	0.3	0.8	0.8	0.1	5.1	7.7	1.8	0.8	1.0	0.1	0.2	1.2
	Mineral Bottom	Boat Ramp	800	30,000	All Years	0.3	0.8	0.8	0.1	2.9	4.6	1.8	0.8	1.0	0.1	0.2	1.2
State of Utah	Green River State Park	Boat Ramp	800	25,000	All Years	0.3	0.8	0.8	0.2	7.6	11.4	1.8	0.8	1.0	0.1	0.2	1.2
		Campground	n/a	25,000	All Years	0	0	0.1	0	7.6	11.4	0.2	0	0	0	0	0
		Golf Course	n/a	19,000	All Years	0	0.2	0.3	0.7	23.6	31.8	1.0	0	0.1	0	0	0

B) Flaming Gorge Visitation:

As noted under methodology, visitation estimates by recreation activity and month at Flaming Gorge Reservoir were developed using a facility availability approach as opposed to the interpolation approach. Table 18 presents facility availability for the No Action Alternative average, wet, and dry conditions by site and facility (while not comparable to the rest of the analysis, table 18 also presents the percent of time each facility is unavailable by month across all years). Comparing end of month water levels by hydrologic condition from table 15 to the low end usability thresholds for each facility provides an estimate of monthly facility availability.

All facilities were expected to be available based on end of month water levels across all months under No Action Alternative average and wet conditions. However, under No Action Alternative dry conditions, several facilities are expected to be unusable. The Anvil Draw boat ramp has a low end usability threshold of 6020 and becomes unusable on average for all months except April during dry conditions. The Cedar Springs marina and boat ramp are expected to experience problems under dry conditions during January, February, May, and September through December. The Firehole boat ramp would only be available under dry conditions during March, April, and July. Finally, the Sunny Cove swim beach follows at pattern similar to Cedar Springs during dry conditions experiencing problems in January, February, May, and September through December.

Table 19, which immediately follows the facility availability table, presents results of a preliminary analysis on visitation for the No Action Alternative dry condition conducted without taking into consideration the potential for recreators moving or substituting to other facilities around the reservoir. The 533,940 visitation estimate reflects a lower bound given it assumes loss of a facility implies a complete loss of visitation from that facility. This information is not the focus of the analysis, but is presented as an indicator of the worst case scenario.

Table 20 presents the results of the with facility substitution analysis for the No Action Alternative dry condition. The No Action Alternative average and wet conditions indicated facility availability in all months such that visitation estimates would be equal to current conditions (572,290 visits). The facility substitution effects were developed based on discussions with Flaming Gorge Reservoir recreation managers (see notes at the end of the table). The table emphasizes changes at the four affected sites: Anvil Draw, Cedar Springs, Firehole, and Sunny Cove. Affected sites are defined as those that suffered some level of facility unavailability under the dry condition. For each recreation activity at each affected site and facility, the table presents visitation estimates by month which continue to occur at the facility, visitation estimates which substitute to other facilities along the reservoir, and the total visitation. The total visitation is simply at the site visitation plus the visitation which moves to other sites, so technically it does not apply only to the site in question. Given the site managers only indicated what percent of visitation lost at a given facility would substitute to all other available facilities, the analysis could not actually estimate total visitation at each site and facility. However, the information provided allowed for the development of visitation estimates by recreation activity across all sites. These estimates were considered to be sufficient for comparison between alternatives.

In addition to the affected site visitation estimates, visitation estimates for the unaffected sites are also included in table 20 to allow for calculation of total visitation across all sites and activities. The term "unaffected sites" is somewhat of a misnomer since several of these sites (i.e., Lucerne Valley, Squaw Hollow, Mustang Ridge, Buckboard Crossing) would probably be affected by the substitution from the "affected sites." The No Action Alternative dry condition visitation estimate is approximately 28,300 below that of current conditions (572,290) or a 4.9-percent decline. Nearly all of the loss (99%) occurred

Table 18: No Action Alternative, Flaming Gorge Reservoir Facility Availability by Site and Hydrologic Condition

Site	Facility	Low End Usability Threshold	Hydrologic Condition	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Antelope Flat	Boat Ramp Swim Beach	6015 6012	Average	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Anvil Draw	Boat Ramp	6020	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buckboard Crossing	Marina Boat Ramp	6015 6000	Average	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Cedar Springs	Marina Boat Ramp	6018 6018	Average	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Firehole	Boat Ramp Swim Beach	6019 6012	Average	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Hideout	Boat Camp	6014	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jarvies Canyon	Boat Camp	6012	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kingfisher Island	Boat Camp	6010	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	Average	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes
Mustang Ridge	Boat Ramp	6000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sheep Creek	Boat Ramp	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squaw Hollow	Boat Ramp	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sunny Cove	Swim Beach	6018	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Upper Marsh Creek	Boat Ramp	6000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUT Through	Boat Channel	6022	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Antelope Flat	Boat Ramp Swim Beach	6015 6012	Wet	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Anvil Draw	Boat Ramp	6020	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buckboard Crossing	Marina Boat Ramp	6015 6000	Wet	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Cedar Springs	Marina Boat Ramp	6018 6018	Wet	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Firehole	Boat Ramp Swim Beach	6019 6012	Wet	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Hideout	Boat Camp	6014	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jarvies Canyon	Boat Camp	6012	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kingfisher Island	Boat Camp	6010	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	Wet	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes

Mustang Ridge	Boat Ramp	6000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sheep Creek	Boat Ramp	6015	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squaw Hollow	Boat Ramp	6015	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sunny Cove	Swim Beach	6018	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Upper Marsh Creek	Boat Ramp	6000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUT Through	Boat Channel	6022	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Antelope Flat	Boat Ramp Swim Beach	6015 6012	Dry	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Anvil Draw	Boat Ramp	6020	Dry	No	No	No	Yes	No	No	No	No	No	No	No	No
Buckboard Crossing	Marina Boat Ramp	6015 6000	Dry	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Cedar Springs	Marina Boat Ramp	6018 6018	Dry	No No	No No	Yes Yes	Yes Yes	No No	Yes Yes	Yes Yes	Yes Yes	No No	No No	No No	No No
Firehole	Boat Ramp Swim Beach	6019 6012	Dry	No Yes	No Yes	Yes Yes	Yes Yes	No Yes	No Yes	Yes Yes	No Yes	No Yes	No Yes	No Yes	No Yes
Hideout	Boat Camp	6014	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jarvies Canyon	Boat Camp	6012	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kingfisher Island	Boat Camp	6010	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	Dry	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes
Mustang Ridge	Boat Ramp	6000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sheep Creek	Boat Ramp	6015	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squaw Hollow	Boat Ramp	6015	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sunny Cove	Swim Beach	6018	Dry	No	No	Yes	Yes	No	Yes	Yes	Yes	No	No	No	No
Upper Marsh Creek	Boat Ramp	6000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUT Through	Boat Channel	6022	Dry	No	No	No	No	No	No	No	No	No	No	No	No
				Percent of Time below Low End Threshold											
Antelope Flat	Boat Ramp Swim Beach	6015 6012	All Years	8.9 7.4	7.8 7.4	7.4 5.5	6.0 3.3	4.8 3.3	2.1 1.5	4.7 1.5	7.1 1.6	9.1 3.3	9.1 4.9	9.1 5.4	9.1 6.8
Anvil Draw	Boat Ramp	6020	All Years	12.2	12.2	12.3	9.7	15.9	11.2	12.7	12.6	12.6	12.7	12.5	12.5
Buckboard Crossing	Marina Boat Ramp	6015 6000	All Years	8.9 0.0	7.8 0.1	7.4 0.0	6.0 0.0	4.8 0.1	2.1 0.0	4.7 0.0	7.1 0.0	9.1 0.0	9.1 0.0	9.1 0.0	9.1 0.0
Cedar Springs	Marina Boat Ramp	6018 6018	All Years	10.4 10.4	10.4 10.4	8.1 8.1	7.4 7.4	10.5 10.5	8.2 8.2	9.2 9.2	9.2 9.2	10.5 10.5	10.7 10.7	10.7 10.7	10.7 10.7
Firehole	Boat Ramp Swim Beach	6019 6012	All Years	10.9 7.4	10.8 7.4	10.0 5.5	7.9 3.3	12.0 3.3	10.6 1.5	9.4 1.5	11.1 1.6	11.6 3.3	12.2 4.9	11.4 5.4	11.4 6.8
Hideout	Boat Camp	6014	All Years	7.9	7.6	7.4	5.1	4.4	1.6	2.1	5.0	7.9	9.1	8.5	8.2
Jarvies Canyon	Boat Camp	6012	All Years	7.4	7.4	5.5	3.3	3.3	1.5	1.5	1.6	3.3	4.9	5.4	6.8

Kingfisher Island	Boat Camp	6010	All Years	3.2	3.7	3.2	2.9	2.1	1.5	1.5	1.5	1.6	3.0	3.0	3.2
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	All Years	3.2 0.0 7.9	3.7 0.0 7.6	3.2 0.0 7.4	2.9 0.0 5.1	2.1 0.0 4.4	1.5 0.0 1.6	1.5 0.0 2.1	1.5 0.0 5.0	1.6 0.0 7.9	3.0 0.0 9.1	3.0 0.0 8.5	3.2 0.0 8.2
Mustang Ridge	Boat Ramp	6000	All Years	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sheep Creek	**Boat Ramp**	**6015**	**All Years**	**8.9**	**7.8**	**7.4**	**6.0**	**4.8**	**2.1**	**4.7**	**7.1**	**9.1**	**9.1**	**9.1**	**9.1**
Squaw Hollow	Boat Ramp	6015	All Years	8.9	7.8	7.4	6.0	4.8	2.1	4.7	7.1	9.1	9.1	9.1	9.1
Sunny Cove	Swim Beach	6018	All Years	10.4	10.4	8.1	7.4	10.5	8.2	9.2	9.2	10.5	10.7	10.7	10.7
Upper Marsh Creek	Boat Ramp	6000	All Years	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUT Through	Boat Channel	6022	All Years	15.8	15.2	15.0	13.4	32.8	23.0	15.9	18.2	18.5	17.8	17.2	17.1

Table 19: No Action Alternative –Dry Condition, Flaming Gorge Reservoir Visitation by Affected Site and Recreation Activity Without Facility Substitution							
Without Facility Substitution Analysis:							
Site	Facility	Month	Power Boating/ Waterskiing	Boat Fishing	Camping	Swimming and Waterplay	Total
Anvil Draw	Boat Ramp	Jan	0	0		0	0
		Feb	0	0		0	0
		Mar	0	0		0	0
		Apr	72	96		0	168
		May	0	0		0	0
		June	0	0		0	0
		July	0	0		0	0
		Aug	0	0		0	0
		Sept	0	0		0	0
		Oct	0	0		0	0
		Nov	0	0		0	0
		Dec	0	0		0	0
		Total:	72	96		0	168
Cedar Springs	Marina	Jan	0	0			0
		Feb	0	0			0
		Mar	225	79			304
		Apr	1,798	629			2,427
		May	0	0			0
		June	6,508	2,278			8,786
		July	7,087	2,480			9,567
		Aug	4,114	1,440			5,554
		Sept	0	0			0
		Oct	0	0			0
		Nov	0	0			0
		Dec	0	0			0
		Total:	19,732	6,906			26,638
Cedar Springs	Boat Ramp	Jan	0	0			0
		Feb	0	0			0
		Mar	225	146			371
		Apr	1,798	1,169			2,967
		May	0	0			0
		June	6,508	4,230			10,738
		July	7,087	4,606			11,693
		Aug	4,114	2,674			6,788
		Sept	0	0			0
		Oct	0	0			0
		Nov	0	0			0
		Dec	0	0			0
		Total:	19,732	12,825			32,557
Firehole	Boat Ramp	Jan	0	0		6	6
		Feb	0	0		0	0
		Mar	20	15		26	61
		Apr	156	120		206	482
		May	0	0		552	552
		June	0	0		744	744
		July	616	472		810	1,898
		Aug	0	0		470	470
		Sept	0	0		270	270
		Oct	0	0		243	243
		Nov	0	0		63	63
		Dec	0	0		41	41
		Total:	792	607		3,431	4,830

Table 19: No Action Alternative –Dry Condition, Flaming Gorge Reservoir Visitation by Affected Site and Recreation Activity Without Facility Substitution (continued)							
Without Facility Substitution Analysis:							
Site	Facility	Month	Power Boating/ Waterskiing	Boat Fishing	Camping	Swimming and Waterplay	Total
Sunny Cove	Swim Beach	Jan				0	0
		Feb				0	0
		Mar				37	37
		Apr				300	300
		May				0	0
		June				1,085	1,085
		July				1,181	1,181
		Aug				686	686
		Sept				0	0
		Oct				0	0
		Nov				0	0
		Dec				0	0
		Total:				3,289	3,289
Total for All Affected Sites:		Jan	0	0	0	6	6
		Feb	0	0	0	0	0
		Mar	470	240	0	63	773
		Apr	3,824	2,014	0	506	6,344
		May	0	0	0	552	552
		June	13,016	6,508	0	1,829	21,353
		July	14,790	7,558	0	1,991	24,339
		Aug	8,228	4,114	0	1,156	13,498
		Sept	0	0	0	270	270
		Oct	0	0	0	243	243
		Nov	0	0	0	63	63
		Dec	0	0	0	41	41
		Total:	40,328	20,434	0	6,720	67,482
Total for All Unaffected Sites:		Jan	479	238	75	21	813
		Feb	0	0	0	0	0
		Mar	2,215	1,106	677	96	4,094
		Apr	17,708	8,856	1,761	771	29,096
		May	47,527	23,765	1,388	2,068	74,748
		June	64,101	32,054	1,863	2,789	100,807
		July	69,798	34,902	1,386	3,037	109,123
		Aug	40,522	20,263	1,174	1,763	63,722
		Sept	23,233	11,618	536	1,012	36,399
		Oct	20,910	10,456	674	911	32,951
		Nov	5,460	2,731	483	238	8,912
		Dec	3,517	1,760	357	154	5,788
		Total:	295,470	147,749	10,374	12,860	466,453
Overall Total :		Jan	479	238	75	27	819
		Feb	0	0	0	0	0
		Mar	2,685	1,346	677	159	4,867
		Apr	21,532	10,870	1,761	1,277	35,440
		May	47,527	23,765	1,388	2,620	75,300
		June	77,117	38,562	1,863	4,618	122,160
		July	84,588	42,460	1,386	5,028	133,462
		Aug	48,750	24,377	1,174	2,919	77,220
		Sept	23,233	11,618	536	1,282	36,669
		Oct	20,910	10,456	674	1,154	33,194
		Nov	5,460	2,731	483	301	8,975
		Dec	3,517	1,760	357	195	5,829
		Total:	335,798	168,183	10,374	19,580	533,935

Table 20: No Action Alternative - Dry Condition, Flaming Gorge Reservoir Visitation by Affected Site and Recreation Activity With Facility Substitution

With Facility Substitution Results:

Site	Facility	Month	Power Boating/ Waterskiing			Boat Fishing			Camping			Swimming and Waterplay			Total
			At Site	Substituted to Other Facilities	Total	At Site	Substituted to Other Facilities	Total	At Site	Substituted to Other Facilities	Total	At Site	Substituted to Other Facilities	Total	
Anvil Draw	Boat Ramp	Jan		2	2		3	3	0	0	0	0	0	0	5
		Feb		0	0		0	0	0	0	0	0	0	0	0
		Mar		9	9		12	12	0	0	0	0	0	0	21
		Apr	72		72	96		96	0	0	0	0	0	0	168
		May		193	193		257	257	0	0	0	0	0	0	450
		June		260	260		347	347	0	0	0	0	0	0	607
		July		283	283		378	378	0	0	0	0	0	0	661
		Aug		165	165		219	219	0	0	0	0	0	0	384
		Sept		94	94		126	126	0	0	0	0	0	0	220
		Oct		85	85		113	113	0	0	0	0	0	0	198
		Nov		22	22		30	30	0	0	0	0	0	0	52
		Dec		14	14		19	19	0	0	0	0	0	0	33
		Total:	72	1,128	1,200	96	1,504	1,600	0	0	0	0	0	0	2,800
Cedar Springs	Marina	Jan		5	5		2	2	0	0	0	0	0	0	7
		Feb	0		0	0		0	0	0	0	0	0	0	0
		Mar	225		225	79		79	0	0	0	0	0	0	304
		Apr	1798		1798	629		629	0	0	0	0	0	0	2,427
		May		483	483		169	169	0	0	0	0	0	0	652
		June	6508		6508	2278		2278	0	0	0	0	0	0	8,786
		July	7087		7087	2480		2480	0	0	0	0	0	0	9,567
		Aug	4114		4114	1440		1440	0	0	0	0	0	0	5,554
		Sept		236	236		83	83	0	0	0	0	0	0	319
		Oct		212	212		74	74	0	0	0	0	0	0	286
		Nov		55	55		19	19	0	0	0	0	0	0	74
		Dec		36	36		13	13	0	0	0	0	0	0	49
		Total:	19732	1027	20759	6906	360	7266	0	0	0	0	0	0	28,025
Cedar Springs	Boat Ramp	Jan		5	5		3	3	0	0	0	0	0	0	8
		Feb	0		0	0		0	0	0	0	0	0	0	0
		Mar	225		225	146		146	0	0	0	0	0	0	371
		Apr	1798		1798	1169		1169	0	0	0	0	0	0	2,967
		May		483	483		314	314	0	0	0	0	0	0	797
		June	6508		6508	4230		4230	0	0	0	0	0	0	10,738
		July	7087		7087	4606		4606	0	0	0	0	0	0	11,693
		Aug	4114		4114	2674		2674	0	0	0	0	0	0	6,788
		Sept		236	236		153	153	0	0	0	0	0	0	389
		Oct		212	212		138	138	0	0	0	0	0	0	350
		Nov		55	55		36	36	0	0	0	0	0	0	91
		Dec		36	36		23	23	0	0	0	0	0	0	59
		Total:	19732	1027	20759	12825	667	13492	0	0	0	0	0	0	34,251

Firehole	Boat Ramp	Jan		4	4		3	3	0	0	0	0	0	0	7
		Feb		0	0		0	0	0	0	0	0	0	0	0
		Mar	20		20	15		15	0	0	0	0	0	0	35
		Apr	156		156	120		120	0	0	0	0	0	0	276
		May		378	378		290	290	0	0	0	0	0	0	668
		June		509	509		391	391	0	0	0	0	0	0	900
		July	616		616	472		472	0	0	0	0	0	0	1,088
		Aug		322	322		247	247	0	0	0	0	0	0	569
		Sept		185	185		141	141	0	0	0	0	0	0	326
		Oct		167	167		128	128	0	0	0	0	0	0	295
		Nov		43	43		33	33	0	0	0	0	0	0	76
		Dec		30	30		22	22	0	0	0	0	0	0	50
		Total:	792	1,638	2,430	607	1,255	1,862	0	0	0	0	0	0	4,290
Sunny Cove	Swim Beach	Jan	0	0	0	0	0	0	0	0	0		7	7	7
		Feb	0	0	0	0	0	0	0	0	0		0	0	0
		Mar	0	0	0	0	0	0	0	0	0	37		37	37
		Apr	0	0	0	0	0	0	0	0	0	300		300	300
		May	0	0	0	0	0	0	0	0	0		683	683	683
		June	0	0	0	0	0	0	0	0	0	1,085		1,085	1,085
		July	0	0	0	0	0	0	0	0	0	1,181		1,181	1,181
		Aug	0	0	0	0	0	0	0	0	0	686		686	686
		Sept	0	0	0	0	0	0	0	0	0		334	334	334
		Oct	0	0	0	0	0	0	0	0	0		301	301	301
		Nov	0	0	0	0	0	0	0	0	0		78	78	78
		Dec	0	0	0	0	0	0	0	0	0		51	51	51
		Total:	0	0	0	0	0	0	0	0	0	3,289	1,454	4,743	4,743
Total for All Affected Sites:		Jan			16			11			0			7	34
		Feb			0			0			0			0	0
		Mar			479			252			0			37	768
		Apr			3,824			2,014			0			300	6,138
		May			1,537			1,030			0			683	3,250
		June			13,785			7,246			0			1,085	22,116
		July			15,073			7,936			0			1,181	24,190
		Aug			8,715			4,580			0			686	13,981
		Sept			751			503			0			334	1,588
		Oct			676			453			0			301	1,430
		Nov			175			118			0			78	371
		Dec			114			77			0			51	242
		Total:			45,145			24,220			0			4,743	74,108

Total for All Unaffected Sites:		Jan			479			238			75			27	819
		Feb			0			0			0			0	0
		Mar			2,215			1,106			677			122	4,120
		Apr			17,708			8,856			1,761			977	29,302
		May			47,527			23,765			1,388			2,620	75,300
		June			64,101			32,054			1,863			3,533	101,551
		July			69,798			34,902			1,386			3,847	109,933
		Aug			40,522			20,263			1,174			2,233	64,192
		Sept			23,233			11,618			536			1,282	36,669
		Oct			20,910			10,456			674			1,154	33,194
		Nov			5,460			2,731			483			201	8,975
		Dec			3,517			1,760			357			195	5,829
		Total:			29,5470			147,749			10,374			16,291	469,884
Overall Total:		Jan			495			249			75			34	853
		Feb			0			0			0			0	0
		Mar			2,694			1,358			677			159	4888
		Apr			21,532			10,870			1761			1277	35440
		May			49,064			24,795			1388			3303	78550
		June			77,886			39,300			1863			4618	123667
		July			84,871			42,838			1386			5028	134123
		Aug			49,237			24,843			1174			2919	78173
		Sept			23,984			12,121			536			1616	38257
		Oct			21,586			10,909			674			1455	34624
		Nov			5,635			2,849			483			379	9346
		Dec			3,631			1,837			357			246	6071
		Total:			340,615			171,969			10374			21034	543992

Notes:

1) Anvil Draw Boat Ramp: All visitation losses at Anvil Draw could be completely absorbed by Lucerne Valley and Squaw Hollow boat ramps. Therefore, the loss identified via the without facility substitution analysis would not materialize. True Loss: 0%

2) Cedar Springs Marina and Boat Ramp: Lucerne Valley and Mustang Ridge could absorb only about 10% of the losses at Cedar Springs. Ninety percent of the without facility substitution losses would likely move to another reservoir. True Loss: 90%

3) Firehole Boat Ramp: Antelope Flat, Buckboard Crossing, and Lucerne Valley would likely absorb 90% of the losses at Firehole as identified in the without substitution analysis. True Loss: 10%

4) Sunny Cove Swim Beach: Even when water drops below the edge of the sand at Sunny Cove, most swimmers would cross the mud flats or use other beach such that the swimming loss would not be severe. True Loss: 15%

to power boating (18,660 lost visits) and boat fishing (9,380 lost visits). Comparing the total visitation estimates across activities with facility substitution (approximately 543,990) to those without facility substitution (approximately 533,940) indicates that only about 10,055 visits would substitute to other facilities along the reservoir. The amount of substitution reflects only about 26 percent of the total without facility substitution loss. Nearly all (98%) of the unabsorbed visitation losses stem from the Cedar Springs facilities.

C) Total River and Reservoir Visitation:

Table 21 presents information on water based visitation combined for both the Green River and Flaming Gorge Reservoir for the No Action Alternative under average, wet, and dry conditions. Reservoir visitation accounts for anywhere from 86.1 to 96.1 percent of the total depending on the hydrologic condition. The average condition is slightly less than current visitation (-9000 visits or 1.4%). The percentage loss in total water based visitation compared to average conditions is 2.1% for the wet condition and 13.7% for the dry condition. The Green River losses account for 100% of the difference during wet conditions and 68.4% of the losses during dry conditions. So despite reflecting only a relatively small percent of total water based visitation, Green River losses account for the majority of the impact compared to the average condition.

Table 21: Total Water Based Visitation for Green River and Flaming Gorge Reservoir for No Action Alternative

			Visitation by Hydrologic Condition						
			Average	Wet			Dry		
					Change from Average Condition			Change from Average Condition	
Site	Recreation Activity	Current Visits	Visits	Visits	Visits	%	Visits	Visits	%
Green River	Scenic Floating	24,768	20,885	20,349	-536	-2.6	85	-20,800	-99.6
	Guide Boat Fishing	11,400	10,108	7,548	-2,560	-25.3	3,606	–6,502	-64.3
	Private Boat Fishing	18,531	16,309	13,360	-2,949	-18.1	7,600	-8,709	-53.4
	Shoreline Fishing/Trail Use	35,482	33,927	26,722	-7,205	-21.2	10,509	-23,418	-69.0
	Boat Based Camping	2,281	2,229	1,674	-555	-24.9	458	-1,771	-79.5
	Total:	92,461	83,458	69,653	-13,805	-16.5	22,258	-61,200	-73.3
Flaming Gorge Reservoir	Power Boating/ Waterskiing	359,278	359,278	359,278	0	0	340,615	-18,663	-5.2
	Boat Fishing	181,348	181,348	181,348	0	0	171,969	-9,379	-5.2
	Boat Based Camping	10,374	10,374	10,374	0	0	10,374	0	0
	Swimming/ Waterplay	21,291	21,291	21,291	0	0	21,034	-257	-1.2
	Total:	572,291	572,291	572,291	0	0	543,992	-28,299	-4.9
Both Sites	Combined Total:	664,752	655,749	641,944	-13,805	-2.1	566,250	-89,499	-13.7

3.2.1.1.3 Recreation Value –

A) Green River Valuation:

Table 22 presents value per visit and total value by month and activity for the No Action Alternative under average, wet, and dry conditions. Determining where monthly No Action Alternative flows by hydrologic condition fall within the range of data points allows for interpolation of the per visit value by activity. For example, looking at table 14, compare average condition flows for March to the annual flow oriented data points for the valuation analysis at the bottom of the table. The 1,484 average condition flow falls between the valuation analysis data point current flow and preferred flow levels. As a result, the value per visit for No Action Alternative March average condition in table 22 also falls between current and preferred values per visit. The percentage of the distance the No Action March average flows fall between preferred and current flows is used to calculate the value per visit. Applying the values per visit to the visitation estimates in table 16 results in the total value estimates.

The No Action Alternative average condition total valuation is estimated at nearly $ 4 million ($3,965.7 thousand). This reflects a decline of about $830 million or 17.3 percent compared to current conditions. wet conditions imply a further $206 million or 5.2 percent decline compared to average conditions. Finally, No Action Alternative dry conditions result in a dramatic decline of more than $3.1 million or nearly 80 percent compared to average conditions.

B) Flaming Gorge Valuation:

The Flaming Gorge Reservoir valuation analysis used a similar interpolation approach as the Green River valuation analysis. As a result, the reservoir valuation analysis applies value per visit estimates by activity derived from interpolation to visitation estimates by activity derived from a facility availability approach.

As indicated in table 23, the No Action Alternative average condition value of nearly $21.4 million exceeds current condition values by over $7.4 million or 53 percent. Current water levels for the survey period (table 1) fall in the 6020 to 6021 range, whereas the No Action Alternative flows for the average condition (table 15) fall in the 6024 to 6029 range. The facility availability approach indicates no difference in average condition visitation since all facilities were available in all months in both cases. Herein lies a disadvantage of the facility availability approach, when facilities are available under two varying scenarios, the approach fails to detect potential increases in visitation as water levels rise. The interpolation based valuation analysis is more sensitive to water level changes thereby resulting in the differential.

Compared to the average condition, the No Action Alternative wet and dry conditions both result in declining values. Wet conditions result in nearly a $5.2 million loss (24.1%), whereas dry conditions result in a $16.4 million loss (76.6% decline) compared to average conditions.

C) Total River and Reservoir Valuation:

Table 24 presents information on water based valuation combined for both the Green River and Flaming Gorge Reservoir for the No Action Alternative under average, wet, and dry conditions. Reservoir valuation accounts for anywhere from 81.2 to 86.2 percent of total value depending on the hydrologic condition. The average condition is significantly greater than current valuation (increase of nearly

Table 22: No Action Alternative, Green River Reach 1 Average Monthly Value per Visit by Hydrologic Condition

		Interpolation Data Points					No Action Alternative Values					
							Per Visit			Total ($1,000s)		
Month	Recreation Activity	Low End Threshold Values	Current Values	Preferred Values	High End Kink Values	High End Threshold Values	Average	Wet	Dry	Average	Wet	Dry
March	Scenic Floating	0	46.8	94.35	46.8	0	63.95	82.30	0	2.9	4.1	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	197.76	235.87	0	61.3	78.3	0
	Private Boat Fishing	0	37.44	69.91	37.44	0	45.71	66.53	0	63.4	97.3	0
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	29.55	30.70	0	69.7	73.8	0
	Camping	0	10.78	14.13	10.78	0	12.18	13.74	0	0	0	0
	Total:									197.3	253.6	0
April	Scenic Floating	0	46.8	94.35	46.8	0	93.20	59.54	0	25.1	13.6	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	216.85	82.91	0	385.3	101.7	0
	Private Boat Fishing	0	37.44	69.91	37.44	0	54.93	13.94	0	197.0	31.0	0
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	26.82	7.96	0	194.5	23.5	0
	Camping	0	10.78	14.13	10.78	0	13.54	7.24	0	0	0	0
	Total:									801.9	169.9	0
May	Scenic Floating	0	46.8	94.35	46.8	0	54.16	0	60.23	1.7	0	2.7
	Guide Boat Fishing	0	182.94	239.62	182.94	0	50.38	0	187.80	21.8	0	318.1
	Private Boat Fishing	0	37.44	69.91	37.44	0	7.35	0	39.43	4.3	0	123.1
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	4.68	0	26.81	4.6	0	150.6
	Camping	0	10.78	14.13	10.78	0	2.19	0	11.86	0	0	0
	Total:									32.3	0	594.5
June	Scenic Floating	0	46.8	94.35	46.8	0	77.57	0	0	491.5	0	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	185.89	0	0	410.6	0	0
	Private Boat Fishing	0	37.44	69.91	37.44	0	36.02	0	0	66.1	0	0
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	18.99	0	0	111.4	0	0
	Camping	0	10.78	14.13	10.78	0	12.09	0	0	8.3	0	0
	Total:									1,087.9	0	0
July	Scenic Floating	0	46.8	94.35	46.8	0	9.75	51.37	0	59.9	591.2	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	46.73	125.33	0	70.2	233.2	0
	Private Boat Fishing	0	37.44	69.91	37.44	0	7.88	24.31	0	9.7	38.4	0
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	7.84	18.60	0	52.5	162.8	0
	Camping	0	10.78	14.13	10.78	0	5.67	11.10	0	3.2	7.4	0
	Total:									195.5	1,033.0	0

Aug	Scenic Floating	0	46.8	94.35	46.8	0	53.63	66.03	0	427.9	560.0	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	143.81	203.33	27.89	269.9	409.3	14.5
	Private Boat Fishing	0	37.44	69.91	37.44	0	28.17	49.22	3.94	42.3	78.8	1.2
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	21.13	31.09	5.26	128.2	229.6	10.2
	Camping	0	10.78	14.13	10.78	0	11.29	12.35	3.66	6.9	7.8	.7
	Total:									875.3	1,285.5	26.7
Sept	Scenic Floating	0	46.8	94.35	46.8	0	59.08	70.82	27.96	3.9	5.0	.9
	Guide Boat Fishing	0	182.94	239.62	182.94	0	184.71	216.14	67.01	302.2	377.2	71.8
	Private Boat Fishing	0	37.44	69.91	37.44	0	37.49	57.29	12.12	192.1	311.2	39.2
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	25.96	33.94	10.61	92.9	142.2	22.7
	Camping	0	10.78	14.13	10.78	0	11.76	12.76	7.83	4.3	4.7	2.0
	Total:									595.3	840.3	136.6
Oct	Scenic Floating	0	46.8	94.35	46.8	0	71.49	90.14	27.96	.7	1.0	.3
	Guide Boat Fishing	0	182.94	239.62	182.94	0	217.92	224.97	67.01	79.5	83.2	21.4
	Private Boat Fishing	0	37.44	69.91	37.44	0	58.41	59.88	12.12	61.7	63.5	11.3
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	33.75	28.48	10.61	38.1	29.5	8.5
	Camping	0	10.78	14.13	10.78	0	12.82	13.92	7.83	0	0	0
	Total:									180.2	177.3	41.5
Total	Scenic Floating									1,013.6	1,174.9	3.8
	Guide Boat Fishing									1,600.9	1,283.0	425.9
	Private Boat Fishing									636.7	620.2	174.8
	Shore Fishing/Trail Use									691.8	661.4	192.1
	Camping									22.7	20.0	2.8
	Total:									3,965.7	3,759.5	799.3

Table 23: No Action Alternative, Flaming Gorge Reservoir Monthly Values per Visit by Hydrologic Condition

		Interpolation Data Points					No Action Alternative Values					
							Per Visit			Total ($1,000s)		
Month	Recreation Activity	Low End Threshold Values	Current Values	Preferred Values	High End Kink Values	High End Threshold Values	Average	Wet	Dry	Average	Wet	Dry
Jan	Power Boating/Skiing	0	25.71	46.22	25.71	0	33.89	43.86	4.02	19.8	25.6	2.0
	Boat Fishing	0	25.21	37.92	25.21	0	30.22	36.31	0.65	8.9	10.6	.2
	Boat Camping	0	13.06	22.23	13.06	0	16.79	21.28	0.97	1.3	1.6	.1
	Swimming/Waterplay	0	1.44	10.41	1.44	0	5.06	9.48	0	.2	.3	0
	Total:									30.0	38.1	2.2
Feb	Power Boating/Skiing	0	25.71	46.22	25.71	0	33.10	40.45	6.31	0	0	0
	Boat Fishing	0	25.21	37.92	25.21	0	29.73	34.23	3.25	0	0	0
	Boat Camping	0	13.06	22.23	13.06	0	16.43	19.75	2.26	0	0	0
	Swimming/Waterplay	0	1.44	10.41	1.44	0	4.72	7.97	0.15	0	0	0
	Total:									0	0	0
March	Power Boating/Skiing	0	25.71	46.22	25.71	0	33.10	43.33	13.19	89.2	116.7	35.5
	Boat Fishing	0	25.21	37.92	25.21	0	29.73	35.99	11.04	40.4	48.9	15.0
	Boat Camping	0	13.06	22.23	13.06	0	16.43	21.05	6.13	11.1	14.3	4.2
	Swimming/Waterplay	0	1.44	10.41	1.44	0	4.72	9.25	0.61	.8	1.5	.1
	Total:									141.4	181.3	54.8
April	Power Boating/Skiing	0	25.71	46.22	25.71	0	33.37	44.91	19.50	718.5	967.0	419.9
	Boat Fishing	0	25.21	37.92	25.21	0	29.89	36.96	18.18	324.9	401.8	197.6
	Boat Camping	0	13.06	22.23	13.06	0	16.55	21.76	9.68	29.1	38.3	17.0
	Swimming/Waterplay	0	1.44	10.41	1.44	0	4.83	9.95	1.03	6.2	12.7	1.3
	Total:									1,078.7	1,419.8	635.9
May	Power Boating/Skiing	0	25.71	46.22	25.71	0	32.58	44.90	5.16	1,882.9	2,594.9	253.2
	Boat Fishing	0	25.21	37.92	25.21	0	29.41	37.24	1.95	858.0	1,086.3	48.4
	Boat Camping	0	13.06	22.23	13.06	0	16.20	21.33	1.61	22.5	29.6	2.2
	Swimming/Waterplay	0	1.44	10.41	1.44	0	4.48	9.55	0.08	15.3	32.7	.3
	Total:									2,778.6	3,743.5	304.0
June	Power Boating/Skiing	0	25.71	46.22	25.71	0	39.92	37.29	10.33	3,111.5	2,906.5	804.6
	Boat Fishing	0	25.21	37.92	25.21	0	33.91	32.02	7.79	1,334.1	1,259.8	306.2
	Boat Camping	0	13.06	22.23	13.06	0	19.51	17.2	4.52	36.3	32.0	8.4
	Swimming/Waterplay	0	1.44	10.41	1.44	0	7.74	5.58	0.42	35.7	25.8	1.9
	Total:									4,517.7	4,224.1	1,121.1

July	Power Boating/Skiing	0	25.71	46.22	25.71	0	45.89	23.57	14.92	3894.7	2000.4	1266.3
	Boat Fishing	0	25.21	37.92	25.21	0	37.92	18.01	12.99	1624.4	771.5	556.5
	Boat Camping	0	13.06	22.23	13.06	0	21.87	5.80	7.10	30.3	8.0	9.8
	Swimming/Waterplay	0	1.44	10.41	1.44	0	10.06	0.66	0.72	50.6	3.3	3.6
	Total:									5600.0	2783.3	1836.2
Aug	Power Boating/Skiing	0	25.71	46.22	25.71	0	45.96	20.00	10.33	2264.6	985.5	508.6
	Boat Fishing	0	25.21	37.92	25.21	0	37.60	13.51	7.79	935.1	336.0	193.5
	Boat Camping	0	13.06	22.23	13.06	0	22.23	3.39	4.52	26.1	4.0	5.3
	Swimming/Waterplay	0	1.44	10.41	1.44	0	10.41	0.39	0.42	30.4	1.1	1.2
	Total:									3256.2	1326.6	708.7
Sept	Power Boating/Skiing	0	25.71	46.22	25.71	0	44.38	23.57	6.88	1253.7	665.9	165.0
	Boat Fishing	0	25.21	37.92	25.21	0	36.64	18.01	3.90	522.5	256.8	47.3
	Boat Camping	0	13.06	22.23	13.06	0	21.52	5.80	2.58	11.5	3.1	1.4
	Swimming/Waterplay	0	1.44	10.41	1.44	0	9.71	0.66	0.19	16.3	1.1	.3
	Total:									1804.0	926.9	214.0
Oct	Power Boating/Skiing	0	25.71	46.22	25.71	0	42.28	26.70	3.44	1075.0	678.9	74.3
	Boat Fishing	0	25.21	37.92	25.21	0	35.35	23.41	0	453.7	300.4	0
	Boat Camping	0	13.06	22.23	13.06	0	20.57	8.71	0.65	13.9	5.9	.4
	Swimming/Waterplay	0	1.44	10.41	1.44	0	8.78	1.00	0	13.2	1.5	0
	Total:									1555.8	986.7	74.7
Nov	Power Boating/Skiing	0	25.71	46.22	25.71	0	39.14	33.32	4.59	259.8	221.2	25.9
	Boat Fishing	0	25.21	37.92	25.21	0	33.43	29.3	1.30	112.1	98.2	3.7
	Boat Camping	0	13.06	22.23	13.06	0	19.15	15.04	1.29	9.2	7.3	.6
	Swimming/Waterplay	0	1.44	10.41	1.44	0	7.39	3.51	0.04	2.9	1.4	0
	Total:									384.0	328.0	30.2
Dec	Power Boating/Skiing	0	25.71	46.22	25.71	0	35.99	41.92	3.44	153.9	179.3	12.5
	Boat Fishing	0	25.21	37.92	25.21	0	31.50	35.20	0	68.0	76.0	0
	Boat Camping	0	13.06	22.23	13.06	0	17.74	19.71	0.65	6.3	7.0	.2
	Swimming/Waterplay	0	1.44	10.41	1.44	0	5.99	7.99	0	1.5	2.0	0
	Total:									229.8	264.4	12.7
Total	Power Boating/Skiing									14723.6	11341.7	3567.6
	Boat Fishing									6281.9	4646.3	1368.2
	Boat Camping									197.8	151.1	49.7
	Swimming/Waterplay									173.1	83.5	8.8
	Total:									21376.3	16222.6	4994.4

Table 24: Total Water Based Valuation for Green River and Flaming Gorge Reservoir for No Action Alternative									
			Valuation by Hydrologic Condition						
			Average	Wet			Dry		
					Change from Average Condition			Change from Average Condition	
Site	Recreation Activity	Current Values	Values	Values	Values	%	Values	Values	%
Green River	Scenic Floating	1,159.2	1,013.6	1,174.9	161.3	15.9	3.8	-1,009.8	-99.6
	Guide Boat Fishing	2,085.5	1,600.9	1,283.0	-317.9	-19.9	425.9	-1,175.0	-73.4
	Private Boat Fishing	693.8	636.7	620.2	-16.5	-2.6	174.8	-461.9	-72.6
	Shoreline Fishing/ Trail Use	833.5	691.8	661.4	-30.4	-4.4	192.1	-499.7	-72.2
	Boat Based Camping	24.6	22.7	20.0	-2.7	-11.9	2.8	-19.9	-87.7
	Total:	4,796.5	3,965.7	3,759.5	-206.2	-5.2	799.3	-3,166.4	-79.8
Flaming Gorge Reservoir	Power Boating/ Waterskiing	9,237.0	14,723.6	11,341.7	-3,381.9	-23.0	3,567.6	-11,156.0	-75.8
	Boat Fishing	4,571.8	6,281.9	4,646.3	-1,635.6	-26.0	1,368.2	-4,913.7	-78.2
	Boat Based Camping	135.5	197.8	151.1	-46.7	-23.6	49.7	-148.1	-74.9
	Swimming/ Waterplay	30.7	173.1	83.5	-89.6	-51.8	8.8	-164.3	-94.9
	Total:	13,975.0	21,376.3	16,222.6	-5,153.7	-24.1	4,994.4	-16,381.9	-76.6
Both Sites	Combined Total:	18,771.5	25,342.0	19,982.1	-5,359.9	-21.2	5,793.7	-19,548.3	-77.1

$6.6 million or 25.9%), whereas wet and dry conditions fall below the average condition. The percentage loss in total water based valuation compared to average conditions is 21.2% for the wet condition and 77% for the dry condition. Losses at Flaming Gorge Reservoir account for about 96% and 84% of the differential from average conditions for wet and dry conditions respectively.

3.2.1.2 Action Alternative

The Flaming Gorge EIS has one action alternative based on the flows suggested in the 2000 Flow and Temperature Recommendation Report (Muth et al., 2000).

3.2.1.2.1 Hydrologic Conditions –

A) Green River Flows

Table 25 presents average flows by month for the Action Alternative under average, wet, and dry hydrologic conditions as obtained from the hydrology model. Information is also presented on the difference between the Action and No Action Alternatives in terms of flows (cfs) and percentages. Also included in the table are the five flow data points used in the interpolations.

Table 25: Action Alternative Green River Reach One Flows by Hydrologic Condition and Month

Month	Recreation Activity	Interpolation Data Points					Action Alternative								
							Average Condition			Wet Condition			Dry Condition		
		Low End Threshold Flows	Current Flows	Preferred Flows	High End Kink Flows	High End Threshold Flows	Average Monthly Flows	Change from No Action		Average Monthly Flows	Change from No Action		Average Monthly Flows	Change from No Action	
								Cfs	%		Cfs	%		Cfs	%
		Monthly Oriented Flow Data Points for Visitation Analysis Interpolation													
March	Scenic Floating	953	1036.0	2170	3786.7	3905	1270	-214	-14.4	2030	132	7.0	800	0	0
	Guide Boat Fishing	854	"	1837	3380.3	3731	"			"			"		
	Private Boat Fishing	879	"	1808	3343.7	3656	"			"			"		
	Shore Fishing/Trail Use	825	"	1624	3158.4	3709	"			"			"		
	Camping	836	"	2000	3273.7	3538	"			"			"		
April	Scenic Floating	953	1145.0	2170	3631.3	3905	1904	-303	-13.7	3981	691	21.0	800	0	0
	Guide Boat Fishing	854	"	1837	3170.3	3731	"			"			"		
	Private Boat Fishing	879	"	1808	3126.9	3656	"			"			"		
	Shore Fishing/Trail Use	825	"	1624	2874.0	3709	"			"			"		
	Camping	836	"	2000	3129.7	3538	"			"			"		
May	Scenic Floating	953	1954.0	2170	2478.0	3905	3233	-230	-6.7	5537	437	8.6	800	-600	-42.9
	Guide Boat Fishing	854	1504.3	1837	"	3731	"			"			"		
	Private Boat Fishing	879	1471.2	1808	"	3656	"			"			"		
	Shore Fishing/Trail Use	825	1296.7	1624	"	3709	"			"			"		
	Camping	836	1638.2	2000	"	3538	"			"			"		
June	Scenic Floating	953	1215.2	2170	3531.2	3905	3862	1152	42.5	7038	1121	19.0	893	93	11.6
	Guide Boat Fishing	854	"	1837	3035.1	3731	"			"			"		
	Private Boat Fishing	879	"	1808	2987.3	3656	"			"			"		
	Shore Fishing/Trail Use	825	"	1624	2690.8	3709	"			"			"		
	Camping	836	"	2000	3037.0	3538	"			"			"		
July	Scenic Floating	953	1007.0	2170	3828.0	3905	2185	1202	122.2	4600	3400	283.3	893	93	11.6
	Guide Boat Fishing	854	"	1837	3436.2	3731	"			"			"		
	Private Boat Fishing	879	"	1808	3401.4	3656	"			"			"		
	Shore Fishing/Trail Use	825	"	1624	3234.1	3709	"			"			"		
	Camping	836	"	2000	3312.1	3538	"			"			"		
Aug	Scenic Floating	953	1122.2	2170	3663.7	3905	1626	375	29.9	2131	600	39.2	906	-25	-2.7
	Guide Boat Fishing	854	"	1837	3214.2	3731	"			"			"		
	Private Boat Fishing	879	"	1808	3172.1	3656	"			"			"		
	Shore Fishing/Trail Use	825	"	1624	2933.3	3709	"			"			"		
	Camping	836	"	2000	3159.8	3538	"			"			"		

Sept	Scenic Floating	953	1118.0	2170	3669.7	3905	1639	265	19.3	2239	600	36.6	939	-100	-9.6
	Guide Boat Fishing	854	" "	1837	3222.3	3731	" "			" "			" "		
	Private Boat Fishing	879	" "	1808	3180.5	3656	" "			" "			" "		
	Shore Fishing/Trail Use	825	" "	1624	2944.3	3709	" "			" "			" "		
	Camping	836	" "	2000	3165.3	3538	" "			" "			" "		
Oct	Scenic Floating	953	1024.0	2170	3803.8	3905	1487	-167	-10.1	2172	97	4.7	800	-239	-23.0
	Guide Boat Fishing	854	" "	1837	3403.5	3731	" "			" "			" "		
	Private Boat Fishing	879	" "	1808	3367.6	3656	" "			" "			" "		
	Shore Fishing/Trail Use	825	" "	1624	3189.7	3709	" "			" "			" "		
	Camping	836	" "	2000	3289.6	3538	" "			" "			" "		
		Annually Oriented Flow Data Points for Valuation Analysis Interpolation													
		Low End Threshold Flow	Annual Current Flow	Preferred Flow	Annual High End Kink Flow	High End Threshold Flow									
All Months	Scenic Floating	953	1096.9	2170	3699.8	3905	Monthly Flow Information as above.								
	Guide Boat Fishing	854	1359.0	1837	2757.9	3731									
	Private Boat Fishing	879	1373.3	1808	2678.7	3656									
	Shore Fishing/Trail Use	825	1298.6	1624	2473.1	3709									
	Camping	836	1115.5	2000	3168.7	3538									

Comparing the alternative flows to the data points indicates where the alternative flow falls within the inverted U-shaped flow distribution. For example, the Action Alternative average condition flow for March of 1,270 falls between the current flow data point (1,036 or 1,096.9) and the preferred flow data point (2,170) for scenic floating. The scenic floating visitation and value interpolation for the Action Alternative March average condition would therefore also result in estimates falling between the current and preferred visit and value data points. Also note that the Action Alternative March average condition flow is 214 cfs less than the No Action Alternative. This implies that the Action Alternative March average condition visitation and value estimates will be less than those of the No Action Alternative since No Action Alternative March flows are closer to the preferred flow. Generally speaking, the closer an alternative's flow is to the preferred flow, the higher the visitation and value estimate.

Comparing the average condition flows between the Action and No Action Alternatives indicates that from June through September, Action Alternative average flows exceed No Action flows. The largest differences occur in June and July where the Action Alternative flow exceeds the No Action Alternative flow by more than 1,000 cfs.

During wet conditions, Action Alternative flows exceed No Action Alternative flows across the entire March through October period. The largest difference occurs in July where the Action Alternative exceeds the No Action Alternative by 3,400 cfs or 283 percent.

During dry conditions, the difference between the alternatives is less severe in terms of both cfs and percentage. In 4 of the 8 studied months (May, August, September, October), No Action Alternative average monthly flows exceed those of the action alternative. The largest difference (-600 cfs, -42.9%) occurs in May.

B) Flaming Gorge Reservoir Water Levels:

Table 26 presents end of month water levels for the Action Alternative under average, wet, and dry hydrologic conditions as obtained from the hydrology model. Information is also presented on the difference between the Action and No Action Alternatives in terms of water levels.

Comparing average condition end of month water levels between the Action and No Action alternatives indicates very little difference between the two alternatives. The largest difference occurs in May with the Action Alternative only 2 feet higher than the No Action.

Water levels under wet conditions were not evaluated within the recreation visitation analysis since they do not create any problems in terms of recreation access on the reservoir. However, water level differences were evaluated via the interpolation procedure in the reservoir valuation analysis. Action Alternative water levels fell below those of the No Action Alternative in 8 of 12 months, with the most significant differences being in July through November.

Under dry conditions, Action Alternative water levels exceed those of the No Action across all months. The differences between the alternatives range from a low of 2.9 feet to a high of 6.0 feet. These differences are substantially greater than those seen under average conditions and may be more significant given the lower water levels.

Table 26: Action Alternative Flaming Gorge Reservoir Water Levels by Hydrologic Condition and Month

		Annually Oriented Water Level (WL) Data Points for Valuation Analysis Interpolation					Action Alternative Water Levels					
							Average Condition		Wet Condition		Dry Condition	
Month	Recreation Activity	Low End Threshold WL	Annual Current WL	Preferred WL	Annual High End Kink WL	High End Threshold WL	Average Monthly Water Levels	Change from No Action (Feet)	Average Monthly Water Levels	Change from No Action (Feet)	Average Monthly Water Levels	Change from No Action (Feet)
January	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.8	1.5	6028.4	.3	6023.4	6.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
February	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.7	1.7	6028.0	1.2	6023.7	5.9
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
March	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.8	1.8	6027.9	0	6023.5	4.5
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
April	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.0	1.9	6028.5	0	6023.0	2.9
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
May	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6025.8	2.0	6029.2	-.2	6022.8	5.2
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
June	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6027.8	1.2	6030.3	-1.4	6024.5	6.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
July	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6029.2	.1	6030.7	-4.8	6024.7	5.4
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
August	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6028.4	-.5	6030.5	-5.5	6023.8	5.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						

September	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6027.4	-.9	6030.0	-5.5	6023.2	5.3
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
October	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.8	-.7	6029.8	-5.1	6023.1	5.8
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
November	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.5	.2	6029.5	-3.4	6023.3	5.8
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						
December	Power Boating/Skiing	6016.7	6021.2	6029.0	6035.2	6038.8	6026.1	1.0	6029.1	-1.2	6023.3	6.0
	Boat Fishing	6017.3	6021.2	6029.1	6034.7	6037.5						
	Boat Camping	6017.1	6021.1	6028.9	6034.0	6036.7						
	Swimming/Waterplay	6017.4	6021.2	6028.9	6034.1	6036.7						

3.2.1.2.2 Annual Recreation Visitation and Infrastructure Impacts –

A) Green River Visitation:

Table 27 presents the results of the Green River visitation analysis for the Action Alternative. Visitation estimates were developed for the Action Alternative by month and recreation activity. In addition, a comparative analysis is made to the No Action Alternative in terms changes in number of visits and percentage.

For the Action Alternative average condition, the 85.200 plus visitation estimate is slightly above the No Action Alternative average condition estimate by 1.770 visits or 2.1 percent. Looking at the individual activities, the gains in visitation for scenic floating and shoreline fishing/trail use somewhat outweigh the losses in guide boat fishing, private boat fishing, and camping.

Within the interpolation analysis, the closer a flow is to the preferred flow level (in percentage terms), the higher the visitation estimate. Comparing the average condition Action Alternative flows (table 25) and the average condition No Action Alternative flows (table 14, also derivable from table 25) to the visitation analysis oriented data points across the various months, it becomes evident that in some months the Action Alternative average condition is clearly an improvement over the No Action while in other months the reverse is true. For example, the months of May, August, and September have Action Alternative average monthly flows which are clearly closer to the preferred flow for all activities compared to the No Action Alternative. Conversely, the months of March, June, and October are clearly closer to the preferred flow under No Action average conditions. The months of April and July are ambiguous because the flows fall on either side of the preferred level (e.g., the April No Action flow of 2,207 falls above the preferred flow of 2,170 whereas the Action Alternative April flow of 1,904 falls below the preferred flow). The formula calculates visitation based on the percentage of the distance between data points, in April it turns out that the No Action Alternative average condition flow of 2,207 is closer on a percentage basis than the Action Alternative flow of 1,904. While one could guess that the 2,207 was closer to the preferred flow based simply on the numeric difference (2,207-2,170 = 37 versus 2,170-1,904 = 266), the assumption that the closer the numeric difference implies a higher the visitation estimate does not always hold since we are working with percentages. Hypothetically, let's say that the difference between the preferred flow and the high end kink was only 100 cfs, but the difference between the preferred flow and the current flow was 1,000 cfs. Note that widely divergent locations for the high end kink and current conditions did result in some cases from the survey data. In such a case, the Action Alternative flow would be closer to the preferred flow on a percentage basis (37/100 = 37% versus 226/1,000 = 22.6%). The fact that 5 months resulted in gains and three months resulted losses lead to slightly positive difference for the Action Alternative average condition over the No Action Alternative. The months of May, July, and August were relatively large gainers and the month of June a large loser for the Action Alternative compared to the No Action. When considering changes in visitation between the alternatives, obviously the flow differentials play a significant role, but so does the baseline visitation estimates for each month. Looking at the preferred visitation estimates, note that the heaviest use months are June, July, and August with visitation tailing off as one approaches the edges of the high recreation season in March and October. Therefore, a smaller flow differential during the highest use months could result in a larger impact compared to a larger flow differential during the lower use months.

Under Action Alternative wet conditions, Green River visitation drops significantly compared to the No Action Alternative. Total visitation drops to under 39,000 visits, a decline of over 31,000 visits and

Table 27: Action Alternative, Green River Reach One Average Monthly Visitation by Hydrologic Condition

		Interpolation Data Points					Action Alternative								
							Average Condition			Wet Condition			Dry Condition		
		Low End Threshold	Current	Preferred	High End	High End Threshold	Average Monthly	Change from No Action		Average Monthly	Change from No Action		Average Monthly	Change from No Action	
Month	Recreation Activity	Visits	Visits	Visits	Kink Visits	Visits	Visits	Visits	%	Visits	Visits	%	Visits	Visits	%
March	Scenic Floating	0	42	52	42	0	44	-2	-4.3	51	1	2.0	0	0	0
	Guide Boat Fishing	0	280	334	280	0	296	-14	-4.5	327	-5	-1.5	0	0	0
	Private Boat Fishing	0	1,265	1,475	1,265	0	1,329	-58	-4.2	1,445	-18	-1.2	0	0	0
	Shore Fishing/Trail Use	0	1,774	2,541	1,774	0	2,079	-279	-11.8	2,338	-66	-2.7	0	0	0
	Camping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	0	3,361	4,402	3,361	0	3,748	-353	-8.6	4,161	-88	-2.1	0	0	0
April	Scenic Floating	0	217	270	217	0	256	-13	-4.8	0	-229	-100	0	0	0
	Guide Boat Fishing	0	1,560	1,861	1,560	0	1,846	69	3.9	0	-1,227	-100	0	0	0
	Private Boat Fishing	0	3,214	3,748	3,214	0	3,709	123	3.4	0	-2,223	-100	0	0	0
	Shore Fishing/Trail Use	0	5,892	8,439	5,892	0	7,868	617	8.5	0	-2,956	-100	0	0	0
	Camping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	0	10,883	14,318	10,883	0	13,679	796	6.2	0	-6,635	-100	0	0	0
May	Scenic Floating	0	99	123	99	0	47	16	51.6	0	0	0	0	-44	-100
	Guide Boat Fishing	0	2,018	2,407	2,018	0	802	370	85.6	0	0	0	0	-1,694	-100
	Private Boat Fishing	0	3,549	4,139	3,549	0	1,274	693	119.3	0	0	0	0	-3,122	-100
	Shore Fishing/Trail Use	0	4,942	7,078	4,942	0	1,911	923	93.4	0	0	0	0	-5,616	-100
	Camping	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total:	0	10,608	13,747	10,608	0	4,034	2,002	98.5	0	0	0	0	-10,476	-100
June	Scenic Floating	0	5,527	6,867	5,527	0	636	-5,700	-90	0	0	0	0	0	n/a
	Guide Boat Fishing	0	2,099	2,504	2,099	0	0	-2,209	-100	0	0	0	227	227	n/a
	Private Boat Fishing	0	1,767	2,060	1,767	0	0	-1,836	-100	0	0	0	74	74	n/a
	Shore Fishing/Trail Use	0	5,976	8,559	5,976	0	0	-5,864	-100	0	0	0	1,042	1,042	n/a
	Camping	0	668	733	668	0	0	-688	-100	0	0	0	100	100	n/a
	Total:	0	16,037	20,723	16,037	0	636	-16,297	-96.2	0	0	0	1,443	1,443	n/a
July	Scenic Floating	0	11,063	13,744	11,063	0	13,720	7,572	123.2	0	-11,508	-100	0	0	n/a
	Guide Boat Fishing	0	1,781	2,124	1,781	0	2,049	547	36.4	0	-1,861	-100	454	454	n/a
	Private Boat Fishing	0	1,520	1,773	1,520	0	1,713	478	38.7	0	-1,581	-100	166	166	n/a
	Shore Fishing/Trail Use	0	7,708	11,039	7,708	0	9,878	3,186	47.6	0	-8,750	-100	2,880	2,880	n/a
	Camping	0	655	719	655	0	710	147	26.1	0	-667	-100	218	218	n/a
	Total:	0	22,727	29,399	22,727	0	28,070	11,930	73.9	0	-24,367	-100	3,718	3,718	n/a

Aug	Scenic Floating	0	7,749	9,626	7,749	0	8,651	672	8.4	9,556	1,075	12.7	0	0	0
	Guide Boat Fishing	0	1,814	2,163	1,814	0	2,060	183	9.7	2,088	75	3.7	352	-169	-32.4
	Private Boat Fishing	0	1,457	1,699	1,457	0	1,635	132	8.8	1,642	41	2.6	162	-150	-48.1
	Shore Fishing/Trail Use	0	5,462	7,823	5,462	0	7,819	1,751	28.9	6,909	-476	-6.4	1,488	-460	-23.6
	Camping	0	600	659	600	0	634	25	4.1	652	24	3.8	147	-52	-26.1
	Total:	0	17,082	21,970	17,082	0	20,799	2,763	15.3	20,847	739	3.7	2149	-831	-27.9
Sept	Scenic Floating	0	62	77	62	0	70	4	6.1	76	6	8.6	0	-32	-100
	Guide Boat Fishing	0	1,530	1,826	1,530	0	1,745	109	6.7	1,740	-5	-0.3	493	-579	-54.0
	Private Boat Fishing	0	4,827	5,629	4,827	0	5,432	308	6.0	5,377	-55	-1.0	1,212	-2,019	-62.5
	Shore Fishing/Trail Use	0	2,935	4,204	2,935	0	4,190	613	17.1	3,613	-577	-13.8	1,142	-1,001	-46.7
	Camping	0	352	386	352	0	372	10	2.8	379	7	-1.9	129	-124	-49.0
	Total:	0	9,707	12,122	9,707	0	11,809	1,044	9.7	11,185	-624	-5.3	2,976	-3,755	-55.8
Oct	Scenic Floating	0	9	11	9	0	10	0	0	11	0	0	0	-9	-100
	Guide Boat Fishing	0	318	379	318	0	353	-12	-3.3	366	-4	-1.1	0	-319	-100
	Private Boat Fishing	0	932	1,087	932	0	1,024	-33	-3.1	1,051	-9	-0.8	0	-935	-100
	Shore Fishing/Trail Use	0	793	1,136	793	0	1,058	-71	-6.3	1,016	-21	-2.0	0	-802	-100
	Camping	0	6	7	6	0	6	-1	-14.3	7	0	0	0	-6	-100
	Total:	0	2,058	2,620	2,058	0	2,451	-117	-4.6	2,451	-34	-1.4	0	-2,071	-100
Total:	Scenic Floating	0	24,768	30,770	24,768	0	23,434	2,549	12.2	9,694	-10,655	-52.4	0	-85	-100
	Guide Boat Fishing	0	11,400	13,598	11,400	0	9,151	-957	-9.5	4,521	-3,027	-40.1	1,526	-2,080	-57.7
	Private Boat Fishing	0	18,531	21,610	18,531	0	16,116	-193	-1.2	9,515	-3,845	-28.8	1,614	-5,986	-78.8
	Shore Fishing/Trail Use	0	35,482	50,819	35,482	0	34,803	876	2.6	13,876	-12,846	-48.1	6,552	-3,957	-37.7
	Camping	0	2,281	2,504	2,281	0	1,722	-507	-22.7	1,038	-636	-38.0	594	136	29.7
	Total:	0	92,461	119,301	92,461	0	85,226	1,768	2.1	38,644	-31,009	-44.5	10,286	-11,972	-53.8

44 percent. All activities experienced significant losses. Every month with changes in visitation (note May and June resulted in no change), except for August, resulted in lost visitation for the Action Alternative wet condition compared to the No Action. The months with the largest losses were April and July, where July accounts for nearly 80% of the total loss. In April, Action Alternative flows of 3,981 exceed the high end threshold flow for all activities resulting in an estimate of zero visits. Conversely, the No Action flow of 3,290 generally falls just beyond the high end kink flow, well below the high end threshold. In July the same situation occurs, but the impact is more severe since the No Action flow of 1,200 cfs actually falls between current and preferred flows (i.e., it is even closer to preferred flows than in April) and the base level of visitation is higher.

Under Action Alternative dry conditions, visitation drops to slightly under 10,300 visits, a decline of nearly 12,000 visits or almost 54 percent compared to the No Action Alternative. The decline is experienced for all activities except camping. The Action Alternative dry condition resulted in four months of losses and two months of gains (and 2 months of zero impact) compared to the No Action Alternative. The months with gains were relatively insignificant resulting in the 12,000 visit loss. The months of May, September, and October were the largest losers with May accounting for about 88% of the overall loss. The dry May flow of 800 cfs for the Action Alternative falls below the low end threshold for all activities resulting in a zero visitation estimate. Conversely, the 1,400 cfs May flow for the No Action Alternative falls above the low end threshold and in the case of shoreline fishing/trail use, the 1,440 cfs flow falls above the low end kink. As a result, a nearly 10,500 visit loss is predicted for the month of April for the Action Alternative dry condition compared to the No Action Alternative.

Although unrelated to the visitation and value analysis, as noted previously, an analysis of facility availability was also conducted for Green River recreation facilities. As shown in table 28, within Reach 1, all river facilities were expected to be available based on average monthly flows across all months under Action Alternative average and dry conditions. However, under wet conditions, the following Forest Service facilities are expected to be unavailable in June due to high flows: the spillway boat ramps, fishing pier, hiking trail, and 9 of 18 riverside campgrounds. In addition, 9 of the 18 riverside campgrounds are also expected to be unavailable in May under wet conditions. The June unavailability of the Spillway ramp, the Little Hole fishing pier, and the recreation trail reflect additional facility unavailability compared to the No Action Alternative. Looking across all years, the unavailability percentage, due exclusively to high flows, ranges from 0 to 27.2 percent (or from virtually never to once every 3.7 years). Across all years, the percentage difference between Action and No Action Alternatives is generally minor, with the largest differences occurring during June (Forest Service campgrounds, +11.7%) and July (spillway ramp, pier, and trail; +7%). Erosion of river facilities is similar to that discussed under the No Action Alternative, but occurs to a greater degree due to higher flows.

Within Reach 2, the boat ramp at Ouray National Wildlife Refuge remains available under average, dry, and wet conditions across all months for the Action Alternative. This implies no change in facility availability within Reach 2 between the alternatives during those hydrologic conditions. Looking across all years, unavailability is expected to occur in May and June, but only about 1.5 to 2 percent of the time. This implies virtually no change in reach two facility availability between the alternatives.

Within Reach 3, all facilities remain available under average conditions for the Action Alternative. However, under dry conditions, the Swasey's Beach boat ramp would be unavailable during the months of January, February, and July through December. Under wet conditions, the facilities at Green River State Park would be affected during May and June (golf course during both May and June, and the campground and boat ramp during June). The facility unavailability for the Action Alternative within Reach 3 mirrors that of the No Action Alternative, implying no change in facility availability between the alternatives within Reach 3 under these conditions. Looking across all years, again the Swasey's Beach

Table 28: Action Alternative, Green River Facility Availability by Site and Hydrologic Condition (Facility Availability: Yes = available, No = unavailable)

Agency	Site	Facility	Low End Thres-hold	High End Threshold	Hydrologic Condition	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Reach 1: Flaming Gorge Dam to the Yampa River																	
Action Alternative, Reach 1, Average Flows:						1,243	1,118	1,270	1,904	3,233	3,862	2,185	1,626	1,639	1,487	1,402	1,331
USFS	Spillway	Boat Ramp	600	6,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Little Hole	Boat Ramp	600	8,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fishing Pier	600	6,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Trail	n/a	6,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		9 of 18 Campgrounds	n/a	5,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BLM	Indian Crossing	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bridge Hollow	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	None	10,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swallow Canyon	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Bridge Port Camp	Boat Ramp	800	None	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Alternative, Reach 1, Dry Flows:						800	800	800	800	800	893	893	906	939	800	800	800
USFS	Spillway	Boat Ramp	600	6,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Little Hole	Boat Ramp	600	8,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fishing Pier	600	6,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Trail	n/a	6,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		9 of 18 Campgrounds	n/a	5,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
BLM	Indian Crossing	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bridge Hollow	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	None	10,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swallow Canyon	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Bridge Port Camp	Boat Ramp	800	None	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Action Alternative, Reach 1, Wet Flows:						2,086	1,968	2,030	3,981	5,537	7,038	4,600	2,131	2,239	2,172	2,243	2,214
USFS	Spillway	Boat Ramp	600	6,000	Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
	Little Hole	Boat Ramp	600	8,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Fishing Pier	600	6,000	Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
		Trail	n/a	6,000	Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
		9 of 18 Campgrounds	n/a	5,000	Wet	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
BLM	Indian Crossing	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Bridge Hollow	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	None	10,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swallow Canyon	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Bridge Port Camp	Boat Ramp	800	None	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
						Percent of Time, Across All Years, Facilities Are Unavailable											
USFS	Spillway	Boat Ramp	600	6,000	All Years	0	0	0	0	7.5	14.6	7.0	0	0	0	0	0
	Little Hole	Boat Ramp	600	8,000	All Years	0	0	0	0	4.2	8.5	1.2	0	0	0	0	0
		Fishing Pier	600	6,000	All Years	0	0	0	0	7.5	14.6	7.0	0	0	0	0	0
		Trail	n/a	6,000	All Years	0	0	0	0	7.5	14.6	7.0	0	0	0	0	0
		9 of 18 Campgrounds	n/a	5,000	All Years	0	0	0	0	13.0	27.2	2.8	0	0	0	0	0
BLM	Indian Crossing	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
	Bridge Hollow	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
		Campground	None	10,000	All Years	0	0	0	0	1.9	4.1	0	0	0	0	0	0
	Swallow Canyon	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
State of Utah	Bridge Port Camp	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0

						Change in Percent of Time, Across All Years, Facilities Are Unavailable (Action minus No Action)											
USFS	Spillway	Boat Ramp	600	6,000	All Years	0	0	0	0	1.2	4.7	7.0	0	0	0	0	0
	Little Hole	Boat Ramp	600	8,000	All Years	0	0	0	0	1.4	4.5	1.2	0	0	0	0	0
		Fishing Pier	600	6,000	All Years	0	0	0	0	1.2	4.7	7.0	0	0	0	0	0
		Trail	n/a	6,000	All Years	0	0	0	0	1.2	4.7	7.0	0	0	0	0	0
		9 of 18 Campgrounds	n/a	5,000	All Years	0	0	0	0	2.7	11.7	2.8	0	0	0	0	0
BLM	Indian Crossing	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
	Bridge Hollow	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
		Campground	None	10,000	All Years	0	0	0	0	1.1	2.9	0	0	0	0	0	0
	Swallow Canyon	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
State of Utah	Bridge Port Camp	Boat Ramp	800	None	All Years	0	0	0	0	0	0	0	0	0	0	0	0
Reach 2: Yampa River to the White River																	
Action Alternative, Reach 2, Average Flows:						1,606	1,567	2,300	5,600	12,111	11,548	3,955	2,085	1,941	1,939	1,862	1,729
FWS	Ouray NWR	Boat Ramp	None	25,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Alternative, Reach 2, Dry Flows:						1,040	1,080	1,350	2,205	5,320	3,943	1,206	1,170	1,036	1,100	1,115	1,060
FWS	Ouray NWR	Boat Ramp	None	25,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Alternative, Reach 2, Wet Flows:						2,665	2,642	3,650	9,625	20,310	20,160	7,949	2,884	2,818	2,837	2,747	2,776
FWS	Ouray NWR	Boat Ramp	None	25,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
						Percent of Time, Across All Years, Facilities Are Unavailable											
FWS	Ouray NWR	Boat Ramp	None	25,000	All Years	0	0	0	0	1.95	1.64	0	0	0	0	0	0
						Change in Percent of Time, Across All Years, Facilities Are Unavailable (Action minus No Action)											
FWS	Ouray NWR	Boat Ramp	None	25,000	All Years	0	0	0	0	-0.24	-0.73	0	0	0	0	0	0

Reach 3: White River to the Colorado River																	
Action Alternative, Reach 3, Average Flows:						2,347	2,681	3,934	6,390	13,882	16,201	5,825	3,028	2,799	2,990	2,877	2,476
BLM	Sand Wash	Boat Ramp	800	50,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swasey Beach	Boat Ramp	2,000	50,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Nefertiti	Boat Ramp	800	27,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Butler Rapid	Boat Ramp	800	27,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Mineral Bottom	Boat Ramp	800	30,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Green River State Park	Boat Ramp	800	25,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	n/a	25,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Golf Course	n/a	19,000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Alternative, Reach 3, Dry Flows:						1,470	1,610	2,120	2,783	5,243	5,499	1,494	1,475	1,460	1,591	1,770	1,327
BLM	Sand Wash	Boat Ramp	800	50,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swasey Beach	Boat Ramp	2,000	50,000	Dry	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No
	Nefertiti	Boat Ramp	800	27,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Butler Rapid	Boat Ramp	800	27,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Mineral Bottom	Boat Ramp	800	30,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State of Utah	Green River State Park	Boat Ramp	800	25,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	n/a	25,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
		Golf Course	n/a	19,000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Action Alternative, Reach 3, Wet Flows:						3,438	3,995	6,256	11,507	23,690	26,730	11,880	4,967	4,333	4,692	4,149	3,769
BLM	Sand Wash	Boat Ramp	800	50,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swasey Beach	Boat Ramp	2,000	50,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Nefertiti	Boat Ramp	800	27,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Butler Rapid	Boat Ramp	800	27,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Mineral Bottom	Boat Ramp	800	30,000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

State of Utah	Green River State Park	Boat Ramp	800	25,000	Extremely Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
		Campground	n/a	25,000	Extremely Wet	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
		Golf Course	n/a	19,000	Extremely Wet	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
						Percent of Time, Across All Years, Facilities Are Unavailable											
BLM	Sand Wash	Boat Ramp	800	50,000	All Years	0.9	1.1	0.9	0.2	0	0	0.6	0.4	0.6	0.1	0.3	2.0
	Swasey Beach	Boat Ramp	2,000	50,000	All Years	37.4	24.8	7.4	1.8	0.1	1.4	18.5	23.5	26.5	21.7	18.9	33.9
	Nefertiti	Boat Ramp	800	27,000	All Years	0.9	1.1	0.9	0.2	5.6	9.6	1	0.4	0.6	0.1	0.3	2.0
	Butler Rapid	Boat Ramp	800	27,000	All Years	0.9	1.1	0.9	0.2	5.6	9.6	1	0.4	0.6	0.1	0.3	2.0
	Mineral Bottom	Boat Ramp	800	30,000	All Years	0.9	1.1	0.9	0.2	3.5	5.3	0.8	0.4	0.6	0.1	0.3	2.0
State of Utah	Green River State Park	Boat Ramp	800	25,000	All Years	0.9	1.1	0.9	0.2	8.1	15.2	1.4	0.4	0.6	0.1	0.3	2.0
		Campground	n/a	25,000	All Years	0	0	0	0	8.1	15.2	0.7	0	0	0	0	0
		Golf Course	n/a	19,000	All Years	0	0.2	0.4	0.9	22.8	37.1	2.2	0	0	0	0	0
						Change in Percent of Time, Across All Years, Facilities Are Unavailable (Action minus No Action)											
BLM	Sand Wash	Boat Ramp	800	50,000	All Years	0.6	0.3	0.1	0.1	0	0	-1.0	0	-0.3	0	0.1	0.8
	Swasey Beach	Boat Ramp	2,000	50,000	All Years	8.1	6.7	2.6	1.1	0	0.1	-6.2	-11.2	-9.4	5.5	3.2	9.4
	Nefertiti	Boat Ramp	800	27,000	All Years	0.6	0.3	0.1	0.1	0.6	1.9	-0.8	0	-0.3	0	0.1	0.8
	Butler Rapid	Boat Ramp	800	27,000	All Years	0.6	0.3	0.1	0.1	0.6	1.9	-0.8	0	-0.3	0	0.1	0.8
	Mineral Bottom	Boat Ramp	800	30,000	All Years	0.6	0.3	0.1	0.1	0.6	0.8	-1.0	0	-0.3	0	0.1	0.8
State of Utah	Green River State Park	Boat Ramp	800	25,000	All Years	0.6	0.3	0.1	0.1	0.5	3.8	-0.5	0	-0.3	0	0.1	0.8
		Campground	n/a	25,000	All Years	0	0	-0.1	0	0.5	3.8	0.5	0	0	0	0	0
		Golf Course	n/a	19,000	All Years	0	0	0.1	0.3	-0.8	5.3	1.2	0	0	0	0	0

boat ramp and the Green River State Park facilities show the most dramatic effects. The unavailability percentages displayed in table 28 need to be looked at with some skepticism given the uncertainty associated with the reach three hydrology model. As a result, it makes sense to focus more on the differences in the unavailability percentages between the alternatives as compared to the percentages themselves. For the most part, the differences in the percentages between the alternatives are fairly minor. The largest differences (both + and -) occur with the Swasey's Beach boat ramp. The difference exceeds 5% for 7 of the months, although 3 of those months show a reduction in unavailability for the Action Alternative. In only one other month (June), did a facility (Green River State Park golf course) experience a 5% difference between alternatives?

B) Flaming Gorge Visitation:

Table 29 presents the Flaming Gorge Reservoir facility availability for the Action Alternative under average, wet, and dry conditions (while not comparable to the rest of the analysis, table 18 also presents the percent of time each facility is unavailable by month across all years). Under all three hydrologic conditions, all the facilities are available based on end of month water levels provided by the hydrologic models (table 26). The highest low end usability threshold is for the Anvil Draw boat ramp at 6020. Even under dry conditions, end of month water levels were not expected to decline below that level. As a result, reservoir visitation estimates for the Action Alternative under average, wet, and dry conditions are all estimated at the nearly 572,300 level. Visitation was also estimated at this level for the No Action Alternative average and wet conditions, therefore the only situation where a visitation difference results between alternatives is for the dry condition.

Under the No Action Alternative dry condition, losses in facility availability imply the Action Alternative dry condition results in a gain in visitation compared to the No Action Alternative. Table 30 presents information on visitation for the Action Alternative under dry conditions by activity, month, and affected site. Bottomline, the majority of the gain in visitation during dry conditions compared to No Action occurs due to the availability of the Cedar Springs marina and boat ramp. Virtually all of the gain accrues to power boating and boat fishing activities. The 28,300 visit gain reflects a 5.2 percent increase compared to No Action Alternative. Nearly 47 percent of the gain occurs in May, with 90 percent occurring across May, September, and October.

C) Total River and Reservoir Visitation:

Table 31 presents information on water based visitation combined for both the Green River and Flaming Gorge Reservoir for the Action Alternative under average, wet, and dry conditions. Reservoir visitation accounts for anywhere from 87.0 to 98.2 percent of the total depending on the hydrologic condition. For information on what these changes in recreation visitation mean in terms of expenditures, jobs, and other measures of regional economic activity, see the socioeconomic section.

For the Action Alternative average condition, the combined visitation barely changes from the No Action Alternative average condition. The Action Alternative's approximately 1,770 additional visits represent less than a 1 percent change compared to No Action. This change in visitation from the No Action Alternative was not considered significant. Since the facility availability approach indicated no visitation changes on the reservoir, the gains in visitation are completely attributable to the river. Gains in scenic floating and shoreline fishing/trail use in July and August slightly outweigh losses to guide boat fishing, private boat fishing, and boat based camping which occur primarily in June.

Table 29: Action Alternative, Flaming Gorge Reservoir Facility Availability by Site and Hydrologic Condition

Site	Facility	Low End Usability Threshold	Hydrologic Condition	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Antelope Flat	Boat Ramp	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swim Beach	6012		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Anvil Draw	Boat Ramp	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buckboard Crossing	Marina	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Boat Ramp	6000		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cedar Springs	Marina	6018	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Boat Ramp	6018		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firehole	Boat Ramp	6019	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swim Beach	6012		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hideout	Boat Camp	6014	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jarvies Canyon	Boat Camp	6012	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kingfisher Island	Boat Camp	6010	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lucerne Valley	Marina	6010	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Boat Ramps	5994		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swim Beach	6014		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mustang Ridge	Boat Ramp	6000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sheep Creek	Boat Ramp	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squaw Hollow	Boat Ramp	6015	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sunny Cove	Swim Beach	6018	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Upper Marsh Creek	Boat Ramp	6000	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUT Through	Boat Channel	6022	Average	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Antelope Flat	Boat Ramp	6015	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Swim Beach	6012		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Anvil Draw	Boat Ramp	6020	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buckboard Crossing	Marina	6015	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Boat Ramp	6000		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cedar Springs	Marina	6018	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Boat Ramp	6018		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Firehole	Boat Ramp Swim Beach	6019 6012	Wet	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Hideout	Boat Camp	6014	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jarvies Canyon	Boat Camp	6012	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kingfisher Island	Boat Camp	6010	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	Wet	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes
Mustang Ridge	Boat Ramp	6000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sheep Creek	Boat Ramp	6015	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squaw Hollow	Boat Ramp	6015	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sunny Cove	Swim Beach	6018	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Upper Marsh Creek	Boat Ramp	6000	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUT Through	Boat Channel	6022	Wet	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Antelope Flat	Boat Ramp Swim Beach	6015 6012	Dry	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Anvil Draw	Boat Ramp	6020	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buckboard Crossing	Marina Boat Ramp	6015 6000	Dry	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Cedar Springs	Marina Boat Ramp	6018 6018	Dry	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Firehole	Boat Ramp Swim Beach	6019 6012	Dry	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes	Yes Yes
Hideout	Boat Camp	6014	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jarvies Canyon	Boat Camp	6012	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kingfisher Island	Boat Camp	6010	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	Dry	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes	Yes Yes Yes
Mustang Ridge	Boat Ramp	6000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sheep Creek	Boat Ramp	6015	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Squaw Hollow	Boat Ramp	6015	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Sunny Cove	Swim Beach	6018	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Upper Marsh Creek	Boat Ramp	6000	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CUT Through	Boat Channel	6022	Dry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
				Percent of Time Unavailable by Month											
Antelope Flat	Boat Ramp Swim Beach	6015 6012	All Years	1.1 0.1	1.7 0.2	2.1 0.3	1.5 0.2	1.5 0.6	0.4 0.0	0.2 0.0	0.2 0.0	0.4 0.0	0.5 0.0	0.7 0.0	1.0 0.1
Anvil Draw	Boat Ramp	6020	All Years	6.6	6.7	5.0	2.9	3.2	3.0	1.9	2.3	3.8	5.4	6.2	6.6
Buckboard Crossing	Marina Boat Ramp	6015 6000	All Years	1.2 0.0	1.7 0.0	2.1 0.0	1.5 0.0	1.5 0.0	.4 0.0	.2 0.0	.2 0.0	.4 0.0	.5 0.0	.7 0.0	1.0 0.0
Cedar Springs	Marina Boat Ramp	6018 6018	All Years	3.9 3.9	4.5 4.5	3.0 3.0	2.0 2.0	2.5 2.5	1.9 1.9	1.2 1.2	1.5 1.5	1.8 1.8	2.1 2.1	3.0 3.0	3.1 3.1
Firehole	Boat Ramp Swim Beach	6019 6012	All Years	5.0 0.1	5.1 0.2	4.3 0.3	2.4 0.2	3.0 0.6	1.9 0.0	1.5 0.0	1.7 0.0	2.4 0.0	3.2 0.0	3.4 0.0	4.9 0.1
Hideout	Boat Camp	6014	All Years	0.6	0.9	1.0	1.1	1.5	0.2	0.0	0.1	0.2	0.3	0.3	0.6
Jarvies Canyon	Boat Camp	6012	All Years	0.1	0.2	0.3	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Kingfisher Island	Boat Camp	6010	All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lucerne Valley	Marina Boat Ramps Swim Beach	6010 5994 6014	All Years	0.0 0.0 0.6	0.0 0.0 0.9	0.0 0.0 1.0	0.0 0.0 1.1	0.0 0.0 1.5	0.0 0.0 0.2	0.0 0.0 0.0	0.0 0.0 0.1	0.0 0.0 0.2	0.0 0.0 0.3	0.0 0.0 0.3	0.0 0.0 0.6
Mustang Ridge	Boat Ramp	6000	All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sheep Creek	Boat Ramp	6015	All Years	1.1	1.7	2.1	1.5	1.5	0.4	0.2	0.2	0.4	0.5	0.7	1.0
Squaw Hollow	Boat Ramp	6015	All Years	1.1	1.7	2.1	1.5	1.5	0.4	0.2	0.2	0.4	0.5	0.7	1.0
Sunny Cove	Swim Beach	6018	All Years	3.9	4.5	3.0	2.0	2.5	1.9	1.2	1.5	1.8	2.1	3.0	3.1
Upper Marsh Creek	Boat Ramp	6000	All Years	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUT Through	Boat Channel	6022	All Years	7.8	7.8	7.8	6.6	7.3	3.4	3.6	6.6	8.0	7.9	7.3	8.1

Table 30: Action Alternative - Dry Condition, Flaming Gorge Reservoir Visitation by Affected Site, Activity and Month (Accounts for Facility Substitution)

			Action Alternative Visitation					Change from No Action Alternative									
								Power Boating/ Waterskiing		Boat Fishing		Camping		Swimming and Waterplay		Total	
Site	Facility	Month	Power Boating/ Water-skiing	Boat Fishing	Camping	Swimming & Waterplay	Total	Visits	%	Visits	%	Visits	%	Visits	%	Visits	%
Anvil Draw	Boat	Jan	2	3	0	0	5	0		0		0		0		0	
	Ramp	Feb	0	0	0	0	0	0		0		0		0		0	
(affected,		Mar	9	12	0	0	21	0		0		0		0		0	
but losses		Apr	72	96	0	0	168	0		0		0		0		0	
completely		May	193	257	0	0	450	0		0		0		0		0	
absorbed		June	260	347	0	0	607	0		0		0		0		0	
by other		July	283	378	0	0	661	0		0		0		0		0	
sites)		Aug	165	219	0	0	384	0		0		0		0		0	
		Sept	94	126	0	0	220	0		0		0		0		0	
		Oct	85	113	0	0	198	0		0		0		0		0	
		Nov	22	30	0	0	52	0		0		0		0		0	
		Dec	14	19	0	0	33	0		0		0		0		0	
		Total:	1,200	1,600	0	0	2,800	0	0	0	0	0	0	0	0	0	0
Cedar	Marina	Jan	49	17	0	0	66	44		15		0		0		59	
Springs		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	225	79	0	0	304	0		0		0		0		0	
		Apr	1,798	629	0	0	2,427	0		0		0		0		0	
		May	4,826	1,689	0	0	6,515	4,343		1,520		0		0		5,863	
		June	6,508	2,278	0	0	8,786	0		0		0		0		0	
		July	7,087	2,480	0	0	9,567	0		0		0		0		0	
		Aug	4,114	1,440	0	0	5,554	0		0		0		0		0	
		Sept	2,359	826	0	0	3,185	2,123		743		0		0		2,866	
		Oct	2,123	743	0	0	2,866	1,911		669		0		0		2,580	
		Nov	554	194	0	0	748	499		175		0		0		674	
		Dec	357	125	0	0	482	321		113		0		0		434	
		Total:	30,000	10,500	0	0	40,500	9,241	44.5	3,234	44.5	0	0	0	0	12,475	44.5

Cedar Springs	Boat Ramp	Jan	49	32	0	0	81	44		29		0		0		73	
		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	225	146	0	0	371	0		0		0		0		0	
		Apr	1,798	1,169	0	0	2,967	0		0		0		0		0	
		May	4,826	3,137	0	0	7,963	4,343		2,823		0		0		7,166	
		June	6,508	4,230	0	0	10,738	0		0		0		0		0	
		July	7,087	4,606	0	0	11,693	0		0		0		0		0	
		Aug	4,114	2,674	0	0	6,788	0		0		0		0		0	
		Sept	2,359	1,533	0	0	3,892	2,123		1,380		0		0		3,503	
		Oct	2,123	1,380	0	0	3,503	1,911		1,242		0		0		3,153	
		Nov	554	360	0	0	914	499		324		0		0		823	
		Dec	357	232	0	0	589	321		209		0		0		530	
		Total:	30,000	19,500	0	0	49,500	9,241	44.5	6,008	44.5	0	0	0	0	15,249	44.5
Firehole	Boat Ramp	Jan	4	3	0	0	7	0		0		0		0		0	
		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	20	15	0	0	35	0		0		0		0		0	
		Apr	156	120	0	0	276	0		0		0		0		0	
		May	420	322	0	0	742	42		32		0		0		74	
		June	566	434	0	0	1,000	57		43		0		0		100	
		July	616	472	0	0	1,088	0		0		0		0		0	
		Aug	358	274	0	0	632	36		27		0		0		63	
		Sept	205	157	0	0	362	21		16		0		0		37	
		Oct	185	142	0	0	327	19		14		0		0		33	
		Nov	48	37	0	0	85	5		4		0		0		9	
		Dec	31	24	0	0	55	3		2		0		0		5	
		Total:	2,608	2,000	0	0	4,608	178	7.3	138	7.4	0	0	0	0	316	7.4
Sunny Cove	Swim Beach	Jan	0	0	0	8	8	0		0		0		1		1	
		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	0	0	0	37	37	0		0		0		0		0	
		Apr	0	0	0	300	300	0		0		0		0		0	
		May	0	0	0	804	804	0		0		0		121		121	
		June	0	0	0	1,085	1,085	0		0		0		0		0	
		July	0	0	0	1,181	1,181	0		0		0		0		0	
		Aug	0	0	0	686	686	0		0		0		0		0	
		Sept	0	0	0	393	393	0		0		0		59		59	
		Oct	0	0	0	354	354	0		0		0		53		53	
		Nov	0	0	0	92	92	0		0		0		14		14	
		Dec	0	0	0	60	60	0		0		0		9		9	
		Total:	0	0	0	5,000	5,000	0	0	0	0	0	0	257	5.4	257	5.4

Total for Affected Sites:		Jan	98	49	0	8	155	88		44		0		1		133	
		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	450	225	0	37	712	0		0		0		0		0	
		Apr	3,596	1,798	0	300	5,694	0		0		0		0		0	
		May	9,652	4,826	0	804	15,282	8,728		4,375		0		121		13,224	
		June	13,016	6,508	0	1,085	20,609	57		43		0		0		100	
		July	14,174	7,087	0	1,181	22,442	0		0		0		0		0	
		Aug	8,228	4,114	0	686	13,028	36		27		0		0		63	
		Sept	4,718	2,359	0	393	7,470	4,267		2,139		0		59		6,465	
		Oct	4,246	2,123	0	354	6,723	3,841		1,925		0		53		5,819	
		Nov	1,108	554	0	92	1,754	1,003		503		0		14		1,520	
		Dec	714	357	0	60	1,131	645		324		0		9		978	
		Total:	60,000	30,000	0	5,000	95,000	18,660	41.3	9,380	38.7	0	0	257	5.4	28,297	38.2
Total for Unaffected Sites:		Jan	485	244	75	27	831	0		0		0		0		0	
		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	2,244	1,133	677	122	4,176	0		0		0		0		0	
		Apr	17,936	9,072	1,761	977	29,746	0		0		0		0		0	
		May	48,140	24,344	1,388	2,620	76,492	0		0		0		0		0	
		June	64,927	32,835	1,863	3,533	103,158	0		0		0		0		0	
		July	70,697	35,751	1,386	3,847	11,681	0		0		0		0		0	
		Aug	41,045	20,756	1,174	2,233	65,208	0		0		0		0		0	
		Sept	23,532	11,901	536	1,282	37,251	0		0		0		0		0	
		Oct	21,180	10,711	674	1,154	33,719	0		0		0		0		0	
		Nov	5,530	2,798	483	301	9,112	0		0		0		0		0	
		Dec	3,562	1,803	357	195	5,917	0		0		0		0		0	
		Total:	299,278	151,348	10,374	16,291	477,291	0	0	0	0	0	0	0	0	0	0
Overall Total:		Jan	583	293	75	35	986	88		44		0		1		133	
		Feb	0	0	0	0	0	0		0		0		0		0	
		Mar	2,694	1,358	677	159	4,888	0		0		0		0		0	
		Apr	21,532	10,870	1,761	1,277	35,440	0		0		0		0		0	
		May	57,792	29,170	1,388	3,424	91,774	8,728		4,375		0		121		13,224	
		June	77,943	39,343	1,863	4,618	123,767	57		43		0		0		100	
		July	84,871	42,838	1,386	5,028	134,123	0		0		0		0		0	
		Aug	49,273	24,870	1,174	2,919	78,236	36		27		0		0		63	
		Sept	28,250	14,260	536	1,675	44,721	4,267		2,139		0		59		6,465	
		Oct	25,426	12,834	674	1,508	40,442	3,841		1,925		0		53		5,819	
		Nov	6,638	3,352	483	393	10,866	1,003		503		0		14		1,520	
		Dec	4,276	2,160	357	255	7,048	645		324		0		9		978	
		Total:	359,278	181,348	10,374	21,291	572,291	18,660	5.5	9,380	5.5	0	0	257	1.2	28,297	5.2

Table 31: Total Water Based Visitation for Green River and Flaming Gorge Reservoir for Action Alternative

Site	Recreation Activity	Action Alternative Visitation by Hydrologic Condition								
		Average			Wet			Dry		
		Visits	Change from No Action Average Condition		Visits	Change from No Action Wet Condition		Visits	Change from No Action Dry Condition	
			Visits	%		Visits	%		Visits	%
Green River	Scenic Floating	23,434	2,549	12.2	9,694	-10,655	-52.4	0	-85	-100
	Guide Boat Fishing	9,151	-957	-9.5	4,521	-3,027	-40.1	1,526	-2,080	-57.7
	Private Boat Fishing	16,116	-193	-1.2	9,515	-3,845	-28.8	1,614	-5,986	-78.8
	Shoreline Fishing/ Trail Use	34,803	876	2.6	1,3876	-12,846	-48.1	6,552	-3,957	-37.7
	Boat Based Camping	1,772	-507	-22.7	1,038	-636	-38.0	5,94	136	29.7
	Total:	85,226	1,768	2.1	38,644	-31,009	-44.5	10,286	-11,972	-53.8
Flaming Gorge Reservoir	Power Boating/ Waterskiing	35,9278	0	0	359,278	0	0	359,278	18,663	5.5
	Boat Fishing	18,1348	0	0	181,348	0	0	181,348	9,379	5.5
	Boat Based Camping	10,374	0	0	10,374	0	0	10,374	0	0
	Swimming/ Waterplay	21,291	0	0	21,291	0	0	21,291	257	1.2
	Total:	572,291	0	0	572,291	0	0	57,291	28,299	5.2
Both Sites	Combined Total:	657,517	1,768	.3	610,935	-31,009	-4.8	582,577	16,327	2.9

For the Action Alternative wet condition, combined visitation declines about 31,000 or nearly 5 percent compared to the No Action Alternative wet condition. This change in visitation from the No Action Alternative was not considered significant especially given that wet conditions occur only 10 percent of the time. Since the facility availability approach indicated no visitation changes on the reservoir, all of this decline stems from losses experienced on the river. All river activities were estimated to experience losses compared to No Action with the majority of the losses (over 75%) accruing to scenic floating and shoreline fishing/trail use during April and July.

For the Action Alternative dry condition, combined visitation is estimated to increase by over 16,300 visits or just under 3 percent compared to the No Action Alternative dry condition. This change in visitation from the No Action Alternative was not considered significant especially given that conditions occur only 10 percent of the time. Visitation on the reservoir is estimated to increase by about 28,300 visits whereas visitation on the river is estimated to decline by nearly 12,000 visits. The largest gains are expected for reservoir power boating and boat fishing during the months of May, September, and October, and the largest losses are expected for river private boat fishing and shoreline fishing/trail use during the month of May.

3.2.1.2.3 Recreation Value – This section presents the results of the valuation analysis for the Action Alternative for both the Green River and Flaming Gorge Reservoir.

A) Green River Valuation:

Table 32 presents the results of the Green River value per visit interpolations for the Action Alternative under average, wet, and dry conditions. The five value data points used in the interpolation are presented should one be interested in comparing the values per visit to the flows and flow data points from table 25 (note that the flow data points used in the valuation analysis are those at the bottom of table 25). Zero values are the result of flows either below the low end threshold or above the high end threshold.

Table 32 also includes a comparison of values per visit by activity, month, and hydrologic condition between the Action and No Action Alternatives. Generally speaking, since the value interpolations are based on the same average monthly flows as the visitation analysis, months which provided visitation gains (losses) compared to the No Action Alternative would also provide valuation gains (losses). The magnitude or percentage change for the same month within the visitation and valuation analysis would vary because differential flow oriented interpolation data points were used in the visitation (monthly oriented data) and valuation (annually oriented data) analyses. In comparing the impacts for both the visitation and valuation analyses, the results are consistent. See the flow related discussion under the visitation section for more elaboration as to gains and losses by month.

As with the visitation analysis, Action Alternative average conditions results in gains compared to No Action Alternative average conditions in 5 of the 8 months. The largest gains in value per visit appear to occur in July and August with the largest loss in June.

Under Action Alternative wet conditions, all months with changed values (note that May and June showed no change) except August, generated predominately lower values compared to the No Action Alternative. The largest losses appear to occur in April and July.

Finally, under the Action Alternative dry condition, four months indicated losses, two months indicated gains, and two months showed no change. The months with the most significant losses appear to be May, September and October.

Table 33 presents the results of applying the values per visit from table 32 to the visitation estimates from table 27. Values are measured in thousands of dollars for the Action Alternative under average, wet, and dry conditions. Changes from the No Action Alternative for the same hydrologic condition are presented in dollar and percentage terms. The impacts by month generally align between the visitation and valuation analyses; however the magnitude of the change within the two analyses varies due to the different flow data points used in the interpolations.

For the Action Alternative average condition, total river recreation value is estimated at $5.7 million. This reflects nearly a $1.75 million or 44 percent increase over No Action Alternative average conditions. All activities, except camping, show gains in value with over 50 percent of the gain stemming from scenic floating. Five of the eights months indicate gains in value with the largest gains seen in July through September.

For the Action Alternative wet condition, total river recreation value is estimated at $2.8 million. This reflects over a $940 thousand or 25 percent loss in value compared to No Action Alternative wet conditions. All activities are estimated to result in losses compared to No Action with the largest losses due to guide boat fishing, shoreline fishing/trail use, and scenic floating. The vast majority of the loss in value occurs in July.

Table 32: Action Alternative, Green River Reach One Average Monthly Value per Visit by Hydrologic Condition

Month	Recreation Activity	Interpolation Data Points: Low End Threshold Values	Current Values	Preferred Values	High End Kink Values	High End Threshold Values	Action Alternative Values: Average Values	Change from No Action Average: $	%	Wet Values	Change from No Action Wet: $	%	Dry Values	Change from No Action Dry: $	%
March	Scenic Floating	0	46.8	94.35	46.8	0	54.47	-9.48	-14.8	88.15	5.85	7.1	0	0	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	150.69	-47.07	-23.8	227.74	-8.13	-3.4	0	0	0
	Private Boat Fishing	0	37.44	69.91	37.44	0	29.61	-16.10	-35.2	61.57	-4.96	-7.5	0	0	0
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	22.07	-7.48	-25.3	29.04	-1.66	-5.4	0	0	0
	Camping	0	10.78	14.13	10.78	0	11.37	-0.81	-6.7	14.04	0.30	2.2	0	0	0
April	Scenic Floating	0	46.8	94.35	46.8	0	82.56	-10.64	-11.4	0	-59.54	-100	0	0	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	235.50	18.65	8.6	0	-82.91	-100	0	0	0
	Private Boat Fishing	0	37.44	69.91	37.44	0	66.30	11.37	20.7	0	-13.94	-100	0	0	0
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	30.62	3.80	14.2	0	-7.96	-100	0	0	0
	Camping	0	10.78	14.13	10.78	0	13.77	0.23	1.7	0	-7.24	-100	0	0	0
May	Scenic Floating	0	46.8	94.35	46.8	0	61.31	7.15	13.2	0	0	0	0	-60.23	-100
	Guide Boat Fishing	0	182.94	239.62	182.94	0	93.62	43.24	85.8	0	0	0	0	-187.80	-100
	Private Boat Fishing	0	37.44	69.91	37.44	0	16.11	8.76	119.2	0	0	0	0	-39.43	-100
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	9.05	4.37	93.4	0	0	0	0	-26.81	-100
	Camping	0	10.78	14.13	10.78	0	8.90	6.71	306.4	0	0	0	0	-11.86	-100
June	Scenic Floating	0	46.8	94.35	46.8	0	9.81	-67.76	-87.4	0	0	0	0	0	n/a
	Guide Boat Fishing	0	182.94	239.62	182.94	0	0	-185.89	-100	0	0	0	14.13	14.13	n/a
	Private Boat Fishing	0	37.44	69.91	37.44	0	0	-36.02	-100	0	0	0	1.06	1.06	n/a
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	0	-18.99	-100	0	0	0	3.37	3.37	n/a
	Camping	0	10.78	14.13	10.78	0	0	-12.09	-100	0	0	0	2.20	2.20	n/a
July	Scenic Floating	0	46.8	94.35	46.8	0	93.88	84.13	862.9	0	-51.37	-100	0	0	n/a
	Guide Boat Fishing	0	182.94	239.62	182.94	0	218.20	171.47	366.9	0	-125.33	-100	14.13	14.13	n/a
	Private Boat Fishing	0	37.44	69.91	37.44	0	55.75	47.87	607.5	0	-24.31	-100	1.06	1.06	n/a
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	27.10	19.26	245.7	0	-18.60	-100	3.37	3.37	n/a
	Camping	0	10.78	14.13	10.78	0	13.60	7.93	139.9	0	-11.10	-100	2.20	2.20	n/a
Aug	Scenic Floating	0	46.8	94.35	46.8	0	70.24	16.61	31.0	92.62	26.59	40.3	0	0	0
	Guide Boat Fishing	0	182.94	239.62	182.94	0	214.60	70.79	49.2	221.53	18.20	9.0	18.84	-9.05	-32.4
	Private Boat Fishing	0	37.44	69.91	37.44	0	56.31	28.14	99.9	57.78	8.56	17.4	2.04	-1.90	-48.2
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	34.10	12.97	61.4	27.78	-3.31	-10.6	4.02	-1.24	-23.6
	Camping	0	10.78	14.13	10.78	0	12.71	1.42	12.6	13.75	1.40	11.3	2.70	-0.96	-26.2
Sept	Scenic Floating	0	46.8	94.35	46.8	0	70.82	11.74	19.9	92.21	21.39	30.2	0	-27.96	-100
	Guide Boat Fishing	0	182.94	239.62	182.94	0	216.14	34.43	17.0	214.88	-1.26	-0.6	30.79	-36.22	-54.1
	Private Boat Fishing	0	37.44	69.91	37.44	0	57.29	19.80	52.8	53.73	-3.56	-6.2	4.54	-7.58	-62.5
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	33.94	7.98	30.7	26.42	-7.52	-22.2	5.65	-4.96	-46.7
	Camping	0	10.78	14.13	10.78	0	12.76	1.00	8.5	13.44	0.68	5.3	3.97	-3.86	-49.3
Oct	Scenic Floating	0	46.8	94.35	46.8	0	64.08	-7.41	-10.4	94.29	4.15	4.6	0	-27.96	-100
	Guide Boat Fishing	0	182.94	239.62	182.94	0	198.11	-19.81	-9.1	219.00	-5.97	-2.7	0	-67.01	-100
	Private Boat Fishing	0	37.44	69.91	37.44	0	45.93	-12.48	-21.4	56.24	-3.64	-6.1	0	-12.12	-100
	Shore Fishing/Trail Use	0	23.49	34.13	23.49	0	29.65	-4.10	-12.1	27.26	-1.22	-4.3	0	-10.61	-100
	Camping	0	10.78	14.13	10.78	0	12.19	-0.63	-4.9	13.64	-0.28	-2.0	0	-7.83	-100

Table 33: Action Alternative, Green River Reach 1 Average Monthly Total Values by Hydrologic Condition ($1,000s)											
		Action Alternative Total Values			Change from No Action						
					Average		Wet		Dry		
Month	Recreation Activity	Average	Wet	Dry	$	%	$	%	$	%
March	Scenic Floating	2.3	4.5	0	-.5	-18.5	.4	9.3	0	0
	Guide Boat Fishing	44.6	74.5	0	-16.7	-27.2	-3.8	-4.9	0	0
	Private Boat Fishing	39.4	89.0	0	-24.1	-37.9	-8.4	-8.6	0	0
	Shore Fishing/Trail Use	45.9	68.0	0	-23.8	-34.2	-5.9	-8.0	0	0
	Camping	0	0	0	0	0	0	0	0	0
	Total:	132.2	235.8	0	-65.1	-33.0	-17.7	-7.0	0	0
April	Scenic Floating	21.1	0	0	-3.9	-15.7	-13.6	-100	0	0
	Guide Boat Fishing	434.7	0	0	49.4	12.8	-101.7	-100	0	0
	Private Boat Fishing	245.9	0	0	48.9	24.8	-31.0	-100	0	0
	Shore Fishing/Trail Use	240.9	0	0	46.4	23.9	-23.5	-100	0	0
	Camping	0	0	0	0	0	0	0	0	0
	Total:	942.7	0	0	140.8	17.6	-169.9	-100	0	0
May	Scenic Floating	2.9	0	0	1.2	71.6	0	0	-2.7	-100
	Guide Boat Fishing	75.1	0	0	53.3	245.0	0	0	-318.1	-100
	Private Boat Fishing	20.5	0	0	16.3	380.6	0	0	-123.1	-100
	Shore Fishing/Trail Use	17.3	0	0	12.7	274.0	0	0	-150.6	-100
	Camping	0	0	0	0	0	0	0	0	0
	Total:	115.8	0	0	83.4	258.0	0	0	-594.5	-100
June	Scenic Floating	6.2	0	0	-485.2	-98.7	0	0	0	0
	Guide Boat Fishing	0	0	3.2	-410.6	-100	0	0	3.2	n/a
	Private Boat Fishing	0	0	0	-66.1	-100	0	0	0	0
	Shore Fishing/Trail Use	0	0	3.5	-111.4	-100	0	0	3.5	n/a
	Camping	0	0	.2	-8.3	-100	0	0	.2	n/a
	Total:	6.2	0	7.0	-1,081.7	-99.4	0	0	7.0	n/a
July	Scenic Floating	1,288.0	0	0	1,228.1	2,048.8	-591.2	-100	0	0
	Guide Boat Fishing	447.1	0	6.4	376.9	537.0	-233.2	-100	6.4	n/a
	Private Boat Fishing	95.5	0	.2	85.8	881.3	-38.4	-100	.2	n/a
	Shore Fishing/Trail Use	267.7	0	9.7	215.2	410.2	-162.8	-100	9.7	n/a
	Camping	9.7	0	.5	6.5	202.5	-7.4	-100	.5	n/a
	Total:	2,108.0	0	16.8	1,912.5	978.1	- 1,033.0	-100	16.8	n/a
Aug	Scenic Floating	607.6	885.1	0	179.7	42.0	325.1	58.0	0	0
	Guide Boat Fishing	442.1	462.6	6.6	172.1	63.8	53.3	13.0	-7.9	-54.4
	Private Boat Fishing	92.1	94.9	.3	49.7	117.4	16.1	20.4	-.9	-73.1
	Shore Fishing/Trail Use	266.6	191.9	6.0	138.4	108.0	-37.7	-16.4	-4.3	-41.6
	Camping	8.1	9.0	.4	1.2	17.2	1.2	15.6	-.3	-45.5
	Total:	1,416.5	1,643.4	13.3	541.2	61.8	357.9	27.8	-13.4	-50.1
Sept	Scenic Floating	5.0	7.0	0	1.1	27.1	2.1	41.4	-.9	-100
	Guide Boat Fishing	377.2	373.9	15.2	75.0	24.8	-3.3	-.9	-56.7	-78.9
	Private Boat Fishing	311.2	288.9	5.5	119.1	62.0	-22.3	-7.2	-33.7	-85.9
	Shore Fishing/Trail Use	142.2	95.4	6.4	49.4	53.1	-46.8	-32.9	-16.3	-71.6
	Camping	4.7	5.1	.5	.5	11.5	.3	7.3	-1.5	-74.1
	Total:	840.3	770.4	27.6	245.0	41.2	-69.9	-8.3	-109.0	-79.8
Oct	Scenic Floating	.6	1.0	0	-.1	-10.4	0	4.6	-.3	-100
	Guide Boat Fishing	69.9	80.2	0	-9.6	-12.1	-3.1	-3.7	-21.4	-100
	Private Boat Fishing	47.0	59.1	0	-14.7	-23.8	-4.4	-6.9	-11.3	-100
	Shore Fishing/Trail Use	31.4	27.7	0	-6.7	-17.7	-1.8	-6.2	-8.5	-100
	Camping	.1	.1	0	0	-18.5	0	-2.0	0	-100
	Total:	149.1	168.1	0	-31.1	-17.3	-9.2	-5.2	-41.5	-100
Total	Scenic Floating	1,933.9	897.6	0	920.3	90.8	-277.2	-23.6	-3.8	-100
	Guide Boat Fishing	1,890.9	991.1	31.4	289.8	18.1	-291.9	-22.8	-394.4	-92.6
	Private Boat Fishing	851.6	531.9	6.1	214.9	33.8	-88.4	-14.2	-168.7	-96.5
	Shore Fishing/Trail Use	1,012.0	383.0	25.7	320.2	46.3	-278.4	-42.1	-166.4	-86.6
	Camping	22.5	14.2	1.6	-.2	-.9	-5.8	-29.2	-1.1	-41.6
	Total:	5,710.7	2,817.7	64.8	1745.0	44.0	-941.8	-25.1	-734.5	-91.9

For the Action Alternative dry condition, total river recreation valuation was estimated at only $65 thousand. This reflects a loss of nearly $735 thousand or 92 percent compared to No Action Alternative dry conditions. All activities are estimated to experience losses with the largest associated with guide boat fishing, private boat fishing, and shoreline fishing/trail use. The majority of the losses occur during May and September with over 80 percent of the loss occurring in May.

B) Flaming Gorge Valuation:

Table 34 presents the results of the Flaming Gorge Reservoir value per visit interpolations for the Action Alternative under average, wet, and dry conditions. The five value data points used in the interpolation are presented should one be interested in comparing the values per visit to the water levels and data points from table 26. The table also includes a comparison of Action Alternative values by hydrologic condition to those of the No Action Alternative in terms of both dollars and percent.

For the Action Alternative average condition, water levels were closer to preferred conditions during 8 of the 12 months. The months with the largest gains appear to be February through May where the largest differentials in water levels between the alternatives also occur. Given these months are associated with relatively low visitation, the gain in value is not particularly large.

For the Action Alternative wet condition, 10 of the 12 months indicated gains in values per visit compared to No Action Alternative wet conditions. The other 2 months (March and April) showed no change. The largest increases in value per visit appear to occur in July through November where the largest differentials in water levels between the two alternatives also occur.

For the Action Alternative dry condition, all months resulted in sizable gains in values per visit compared to the No Action Alternative. The increase in water level associated with the Action Alternative dry condition over that of the No Action Alternative ranged from a low of 2.9 feet to a high of 6 feet (averaging 5.3 feet).

Table 35 presents the results of applying the values per visit from table 34 to the visitation estimates from table 30. Values are measured in thousands of dollars for the Action Alternative under average, wet, and dry conditions. Changes from the No Action Alternative for the same hydrologic condition are presented in dollar and percentage terms.

For the Action Alternative average condition, total reservoir recreation value is estimated at over $22 million. This reflects about a $650 thousand or 3.0 percent increase over No Action Alternative average conditions. All activities show gains in value with nearly 97 percent of the gain stemming from power boating/waterskiing and boat fishing. Gains in value were estimated for 7 of the 12 months with the largest gains seen in April through June. All of the gain in value is attributable to the gain in values per visit obtained from the interpolation analysis since visitation was estimated via the facility availability approach to be the same under both Action and No Action Alternative average conditions at the reservoir. Recall that the facility availability approach is less sensitive to changes in water levels compared to the interpolation approach. Gains in value per trip were estimated via the interpolation approach and applied to current visitation (given the facility availability approach estimated no change in visitation) to obtain the overall gain in valuation. It is interesting to note that the months with the largest estimated gains in values per visit were not the months with the largest total value gains. This was because several of the months with large gains in values per visit were low visitation months.

For the Action Alternative wet condition, total reservoir recreation value is estimated at $22.2 million. This reflects over a $5.9 million or 36.6 percent increase in value compared to No Action Alternative wet

Table 34: Action Alternative, Flaming Gorge Reservoir Monthly Value per Visit by Hydrologic Condition

		Interpolation Data Points					Action Alternative Values									
								Change from No Action Average			Change from No Action Wet			Change from No Action Dry	
Month	Recreation Activity	Low End Threshold Values	Current Values	Preferred Values	High End Kink Values	High End Threshold Values	Average Values	$	%	Wet Values	$	%	Dry Values	$	%
Jan	Power Boating/Skiing	0	25.71	46.22	25.71	0	37.83	3.94	11.6	44.65	.79	1.8	31.53	27.51	684.3
	Boat Fishing	0	25.21	37.92	25.21	0	32.62	2.40	7.9	36.80	.49	1.3	28.77	28.12	4,326.2
	Boat Camping	0	13.06	22.23	13.06	0	18.56	1.77	10.5	21.64	.36	1.7	15.72	14.75	1,520.6
	Swimming/Waterplay	0	1.44	10.41	1.44	0	6.81	1.75	34.6	9.83	.35	3.7	4.02	4.02	N/A
Feb	Power Boating/Skiing	0	25.71	46.22	25.71	0	37.56	4.46	13.5	43.60	3.15	7.8	32.32	26.01	412.2
	Boat Fishing	0	25.21	37.92	25.21	0	32.46	2.73	9.2	36.15	1.92	5.6	29.25	26.00	800.0
	Boat Camping	0	13.06	22.23	13.06	0	18.45	2.02	12.3	21.17	1.42	7.2	16.08	13.82	611.5
	Swimming/Waterplay	0	1.44	10.41	1.44	0	6.69	1.97	41.7	9.36	1.39	17.4	4.37	4.22	2,813.3
March	Power Boating/Skiing	0	25.71	46.22	25.71	0	37.83	4.73	14.3	43.33	0	0	31.79	18.6	141.0
	Boat Fishing	0	25.21	37.92	25.21	0	32.62	2.89	9.7	35.99	0	0	28.93	17.89	162.0
	Boat Camping	0	13.06	22.23	13.06	0	18.56	2.13	13.0	21.05	0	0	15.84	9.71	158.4
	Swimming/Waterplay	0	1.44	10.41	1.44	0	6.81	2.09	44.3	9.25	0	0	4.13	3.52	577.0
April	Power Boating/Skiing	0	25.71	46.22	25.71	0	38.35	4.98	14.9	44.91	0	0	30.48	10.98	56.3
	Boat Fishing	0	25.21	37.92	25.21	0	32.94	3.05	10.2	36.96	0	0	28.13	9.95	54.7
	Boat Camping	0	13.06	22.23	13.06	0	18.80	2.25	13.6	21.76	0	0	15.25	5.57	57.5
	Swimming/Waterplay	0	1.44	10.41	1.44	0	7.04	2.21	45.8	9.95	0	0	3.55	2.52	244.7
May	Power Boating/Skiing	0	25.71	46.22	25.71	0	37.83	5.25	16.1	45.56	0.66	1.5	29.96	24.8	480.6
	Boat Fishing	0	25.21	37.92	25.21	0	32.62	3.21	10.9	37.69	0.45	1.2	27.81	25.86	1,326.2
	Boat Camping	0	13.06	22.23	13.06	0	18.56	2.36	14.6	21.69	0.36	1.7	15.02	13.41	832.9
	Swimming/Waterplay	0	1.44	10.41	1.44	0	6.81	2.33	52.0	9.89	0.34	3.6	3.32	3.24	4,050.0
June	Power Boating/Skiing	0	25.71	46.22	25.71	0	43.07	3.15	7.9	41.92	4.63	12.4	34.41	24.08	233.1
	Boat Fishing	0	25.21	37.92	25.21	0	35.83	1.92	5.7	35.20	3.18	9.9	30.54	22.75	292.0
	Boat Camping	0	13.06	22.23	13.06	0	20.93	1.42	7.3	19.71	2.51	14.6	17.03	12.51	276.8
	Swimming/Waterplay	0	1.44	10.41	1.44	0	9.13	1.39	18.0	7.99	2.41	43.2	5.30	4.88	1,161.9
July	Power Boating/Skiing	0	25.71	46.22	25.71	0	45.56	-0.33	-0.7	40.60	17.03	72.3	34.94	20.02	134.2
	Boat Fishing	0	25.21	37.92	25.21	0	37.69	-0.23	-0.6	34.29	16.28	90.4	30.86	17.87	137.6
	Boat Camping	0	13.06	22.23	13.06	0	21.69	-0.18	-0.8	18.99	13.19	227.4	17.26	10.16	143.1
	Swimming/Waterplay	0	1.44	10.41	1.44	0	9.89	-0.17	-1.7	7.31	6.65	1,000.6	5.53	4.81	668.1
Aug	Power Boating/Skiing	0	25.71	46.22	25.71	0	44.65	-1.31	-2.9	41.26	21.26	106.3	32.58	22.25	215.4
	Boat Fishing	0	25.21	37.92	25.21	0	36.80	-0.80	-2.1	34.74	21.23	157.1	29.41	21.62	277.5
	Boat Camping	0	13.06	22.23	13.06	0	21.64	-0.59	-2.7	19.35	15.96	470.8	16.20	11.68	258.4
	Swimming/Waterplay	0	1.44	10.41	1.44	0	9.83	-0.58	-5.6	7.65	7.26	1,861.5	4.48	4.06	966.7
Sept	Power Boating/Skiing	0	25.71	46.22	25.71	0	42.02	-2.36	-5.3	42.91	19.34	82.1	31.00	24.12	350.6
	Boat Fishing	0	25.21	37.92	25.21	0	35.19	-1.45	-4.0	35.88	17.87	99.2	28.45	24.55	629.5
	Boat Camping	0	13.06	22.23	13.06	0	20.46	-1.06	-4.9	20.25	14.45	249.1	15.49	12.91	500.4
	Swimming/Waterplay	0	1.44	10.41	1.44	0	8.67	-1.04	-10.7	8.51	7.85	1,189.4	3.79	3.60	1,894.7
Oct	Power Boating/Skiing	0	25.71	46.22	25.71	0	40.45	-1.83	-4.3	43.57	16.87	63.2	30.74	27.3	793.6
	Boat Fishing	0	25.21	37.92	25.21	0	34.23	-1.12	-3.2	36.33	12.92	55.2	28.29	28.29	N/A
	Boat Camping	0	13.06	22.23	13.06	0	19.75	-0.82	-4.0	20.61	11.90	136.6	15.37	14.72	2,264.6
	Swimming/Waterplay	0	1.44	10.41	1.44	0	7.97	-0.81	-9.2	8.86	7.86	786.0	3.67	3.67	N/A
Nov	Power Boating/Skiing	0	25.71	46.22	25.71	0	39.66	0.52	1.3	44.57	11.25	33.8	31.27	26.68	581.3
	Boat Fishing	0	25.21	37.92	25.21	0	33.75	0.32	1.0	37.01	7.71	26.3	28.61	27.31	2,100.8
	Boat Camping	0	13.06	22.23	13.06	0	19.39	0.24	1.3	21.15	6.11	40.6	15.61	14.32	1110.1
	Swimming/Waterplay	0	1.44	10.41	1.44	0	7.62	0.23	3.1	9.37	5.86	167.0	3.90	3.86	9,650.0
Dec	Power Boating/Skiing	0	25.71	46.22	25.71	0	38.61	2.62	7.3	45.89	3.97	9.5	31.27	27.83	809.0
	Boat Fishing	0	25.21	37.92	25.21	0	33.10	1.60	5.1	37.92	2.72	7.7	28.61	28.61	N/A
	Boat Camping	0	13.06	22.23	13.06	0	18.92	1.18	6.7	21.87	2.16	11.0	15.61	14.96	2,301.5
	Swimming/Waterplay	0	1.44	10.41	1.44	0	7.16	1.17	19.5	10.06	2.07	25.9	3.90	3.9	N/A

Table 35: Action Alternative, Flaming Gorge Reservoir Monthly Total Values by Hydrologic Condition ($1,000s)

Month	Recreation Activity	Average Values	Change from No Action Average Condition		Wet Values	Change from No Action Wet Condition		Dry Values	Change from No Action Dry Condition	
			$	%		$	%		$	%
Jan	Power Boating/Skiing	22.1	2.3		26.0	.5		18.4	16.4	
	Boat Fishing	9.6	.7		10.8	.1		8.4	8.3	
	Boat Camping	1.4	.1		1.6	0		1.2	1.1	
	Swimming/Waterplay	.2	.1		.3	0		.1	.1	
	Total:	33.2	3.2	10.6	38.8	.6	1.7	28.1	25.9	1,164.4
Feb	Power Boating/Skiing	0	0		0	0		0	0	
	Boat Fishing	0	0		0	0		0	0	
	Boat Camping	0	0		0	0		0	0	
	Swimming/Waterplay	0	0		0	0		0	0	
	Total:	0	0	0	0	0	0	0	0	0
March	Power Boating/Skiing	101.9	12.7		116.7	0		85.6	50.1	
	Boat Fishing	44.3	3.9		48.9	0		39.3	24.3	
	Boat Camping	12.6	1.4		14.3	0		10.7	6.6	
	Swimming/Waterplay	1.1	.3		1.5	0		.7	.6	
	Total:	159.9	18.4	13.0	181.3	0	0	136.3	81.5	148.9
April	Power Boating/Skiing	825.8	107.3		967.0	0		656.3	236.4	
	Boat Fishing	358.1	33.2		401.8	0		305.8	108.2	
	Boat Camping	33.1	4.0		38.3	0		26.9	9.8	
	Swimming/Waterplay	9.0	2.8		12.7	0		4.5	3.2	
	Total:	1,225.9	147.2	13.6	1,419.8	0	0	993.5	357.6	56.2
May	Power Boating/Skiing	2,186.3	303.4		2,633.0	38.1		1,731.5	1,478.3	
	Boat Fishing	951.5	93.6		1,099.4	13.1		811.2	762.9	
	Boat Camping	25.8	3.3		30.1	.5		20.8	18.6	
	Swimming/Waterplay	23.3	8.0		33.9	1.1		11.4	11.1	
	Total:	3,186.9	408.3	17.9	3,796.4	52.9	1.4	2,574.9	2,270.9	747.0
June	Power Boating/Skiing	3,357.0	245.5		3,267.4	360.9		2,682.0	1,877.5	
	Boat Fishing	1,409.7	75.5		1,384.9	125.1		1,201.5	895.4	
	Boat Camping	39.0	2.6		36.7	4.7		31.7	23.3	
	Swimming/Waterplay	42.2	6.4		36.9	11.1		24.5	22.5	
	Total:	4,847.8	330.1	7.3	4,725.9	501.8	11.9	3,939.8	2,818.7	251.4
July	Power Boating/Skiing	3,866.7	-28.0		3,445.8	1,445.4		2,965.4	1,699.1	
	Boat Fishing	1,614.6	-9.9		1,468.9	697.4		1,322.0	765.5	
	Boat Camping	30.1	-0.3		26.3	18.3		23.9	14.1	
	Swimming/Waterplay	49.7	-0.9		36.8	33.4		27.8	24.2	
	Total:	5,561.1	-39.0	-0.7	4,977.8	2,194.5	78.8	4,339.1	2,502.9	136.3
Aug	Power Boating/Skiing	2,200.0	-64.5		2,033.0	1,047.5		1,605.3	1,096.7	
	Boat Fishing	915.2	-19.9		864.0	528.0		731.4	537.9	
	Boat Camping	25.4	-.7		22.7	18.7		19.0	13.7	
	Swimming/Waterplay	28.7	-1.7		22.3	21.2		13.1	11.9	
	Total:	3,169.4	-86.8	-2.7	2,942.0	1,615.5	121.8	2,368.8	1,660.2	234.3
Sept	Power Boating/Skiing	1,187.1	-66.7		1,212.2	546.4		875.8	710.7	
	Boat Fishing	501.8	-20.7		511.6	254.8		405.7	358.4	
	Boat Camping	11.0	-.6		10.9	7.7		8.3	6.9	
	Swimming/Waterplay	14.5	-1.7		14.3	13.1		6.3	6.0	
	Total:	1,714.4	-89.7	-5.0	1,749.0	822.1	88.7	1,296.1	1,082.1	505.8
Oct	Power Boating/Skiing	1,028.5	-46.5		1,107.8	428.9		781.6	707.3	
	Boat Fishing	439.3	-14.4		466.3	165.8		363.1	363.1	
	Boat Camping	13.3	-.6		13.9	8.0		10.4	9.9	
	Swimming/Waterplay	12.0	-1.2		13.4	11.9		5.5	5.5	
	Total:	1,493.1	-62.7	-4.0	1,601.3	614.6	62.3	1,160.6	1,085.9	1,453.8
Nov	Power Boating/Skiing	263.3	3.5		295.9	74.7		207.6	181.7	
	Boat Fishing	113.1	1.1		124.1	25.8		95.9	92.2	
	Boat Camping	9.4	.1		10.2	3.0		7.5	6.9	
	Swimming/Waterplay	3.0	.1		3.7	2.3		1.5	1.5	
	Total:	388.8	4.7	1.2	433.8	105.8	32.3	312.5	282.3	934.7
Dec	Power Boating/Skiing	165.1	11.2		196.2	17.0		133.7	121.2	
	Boat Fishing	71.5	3.5		81.9	5.9		61.8	61.8	
	Boat Camping	6.8	.4		7.8	.8		5.6	5.3	
	Swimming/Waterplay	1.8	.3		2.6	.5		1.0	1.0	
	Total:	245.2	15.4	6.7	288.5	24.2	9.1	202.1	189.4	1,488.3
Total	Power Boating/Skiing	15,203.7	480.1	3.3	15,301.0	3,959.3	34.9	11,743.1	8,175.5	229.2
	Boat Fishing	6,428.6	146.7	2.3	6,462.5	1,816.1	39.1	5,346.1	3,977.9	290.7
	Boat Camping	207.7	9.9	5.0	212.8	61.7	40.8	166.0	116.3	233.8
	Swimming/Waterplay	185.6	12.5	7.2	178.2	94.8	113.6	96.5	87.7	998.2
	Total:	22,025.5	649.2	3.0	22,154.5	5,931.9	36.6	17,351.8	12,357.4	247.4

conditions. All activities are estimated to result in gains compared to No Action with the largest gain due to power boating/waterskiing and boat fishing. Nearly 97 percent of the gain occurs in the months of June through October. As with the average condition, all gains in total value under wet conditions stem from gains in value per visit since visitation was estimated to be the same under both the Action and No Action Alternatives.

For the Action Alternative dry condition, total reservoir recreation valuation was estimated at nearly $17.4 million. This reflects a substantial gain of nearly $12.4 million or 247 percent compared to No Action Alternative dry conditions. All activities are estimated to experience gains with the largest associated with power boating/waterskiing and boat fishing. Gains are expected in virtually all months with the largest accruing from May through October. The Action Alternative dry condition gains are driven by gains in both visitation and value per visit compared to No Action.

C) Total Valuation:

Table 36 presents the sum of the Green River and Flaming Gorge Reservoir recreation values for the Action Alternative under average, wet, and dry conditions. The table displays the Green River values, the Flaming Gorge Reservoir values, and the combined total across both sites. In addition to the total values

Table 36: Total Water Based Activity Valuation for Green River and Flaming Gorge Reservoir for Action Alternative

		Action Alternative Valuation by Hydrologic Condition								
		Average			Wet			Dry		
			Change from No Action Average Condition			Change from No Action Wet Condition			Change from No Action Dry Condition	
Site	Recreation Activity	Total Value	Value	%	Total Values	Value	%	Total Value	Value	%
Green River	Scenic Floating	1,933.9	920.3	90.8	897.6	-277.2	-23.6	0	-3.8	-100
	Guide Boat Fishing	1,890.9	289.8	18.1	991.1	-291.9	-22.8	31.4	-394.4	-92.6
	Private Boat Fishing	851.6	214.9	33.8	531.9	-88.4	-14.2	6.1	-168.7	-96.5
	Shoreline Fishing/ Trail Use	1,012.0	320.2	46.3	383.0	-278.4	-42.1	25.7	-166.4	-86.6
	Boat Based Camping	22.5	-.2	-.9	14.2	-5.8	-29.2	1.6	-1.1	-41.6
	Total:	5,710.7	1,745.0	44.0	2,817.7	-941.8	-25.1	64.8	-734.5	-91.9
Flaming Gorge Reservoir	Power Boating/ Waterskiing	15,203.7	480.1	3.3	15,301.0	3,959.3	34.9	11,743.1	8,175.5	229.2
	Boat Fishing	6,428.6	146.7	2.3	6462.5	1816.1	39.1	5,346.1	3,977.9	290.7
	Boat Based Camping	207.7	9.9	5.0	212.8	61.7	40.8	166.0	116.3	233.8
	Swimming/ Waterplay	185.6	12.5	7.2	178.2	94.8	113.6	96.5	87.7	998.2
	Total:	22,025.5	649.2	3.0	22,154.5	5,931.9	36.6	17,351.8	12,357.4	247.4
Both Sites	Combined Total:	27,736.2	2,394.2	9.5	24,972.2	4,990.1	25.0	17,416.6	11,622.9	200.6

by hydrologic condition, the table also presents the change from the No Action Alternative both in terms of values and percentage. Reservoir valuation accounts for anywhere from 79.4 to 99.6 percent of the total depending on the hydrologic condition.

For the Action Alternative average condition, the combined valuation was estimated at $27.7 million. This reflects nearly a $2.4 million or 10 percent increase from the No Action Alternative average condition. Gains in value occur on both the river and reservoir with the largest gains accruing to scenic floating on the river and power boating/waterskiing on the reservoir. Given the insignificant increase in visitation for the Action Alternative average condition, virtually all of the increase in value stems from increases in value per visit. The majority of the gains on the river occur from July through September and on the reservoir from April through June.

Note that total values for the Action Alternative average condition increased compared to the No Action Alternative for both guide boat and private boat fishing on the river despite the losses in visitation displayed in table 31. This result stemmed from the fact that the annual loss in visitation included certain months with gains (mainly July, August, and September) as well as the months with losses (mainly June). As it turns out, the losses in visitation were associated with months of relatively low value per visit and the gains with months of high value per visit. Recall that values per visit increase the closer flows come to the preferred flow level for each activity. When combined, the influence of the higher values per visit outweighed the influence of the lost visitation.

For the Action Alternative wet condition, combined valuation was estimated at nearly $25 million. This reflects an increase of almost $5 million or 25 percent compared to the No Action Alternative wet condition. The $5.9 million of increased value for the reservoir outweighs the $940 thousand of lost value on the river. Power boating/waterskiing and boat fishing on the reservoir account for the majority of the increase in value. The largest gains on the reservoir occur in the months of June through October, and the largest losses on the river occur in July. Keep in mind that wet conditions are expected only about 10 percent of the time.

For the Action Alternative dry condition, combined valuation is estimated at $17.4 million. This reflects an increase of over $11.6 million or 200 percent compared to the No Action Alternative dry condition. The nearly $12.4 million of increased value for the reservoir outweighs the $735 thousand of lost value on the river. Power boating/waterskiing and boat fishing on the reservoir account for the majority of the increase in value. The largest gains in value occur on the reservoir in the months of May through October. Losses on the river are seen across all activities with the majority occurring in the month of May. Keep in mind that dry conditions are expected only about 10 percent of the time.

4.0 REFERENCES

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Socioeconomics Technical Appendix

SOCIOECONOMICS TECHNICAL APPENDIX

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Socioeconomics Technical Appendix

1.0 INTRODUCTION

This technical appendix reviews the current economic environment that could be affected by implementation of either the No Action or Action Alternatives, discusses regional economic methods, and provides detailed results of the regional analysis. Under affected environment, a brief discussion of the geographic impact area is followed by a description of current conditions. Under environmental consequences, a methodology discussion is followed by regional economic impact results for each alternative, along with comparisons of the Action Alternative to the No Action Alternative.

This EIS presents two types of economic analyses, one measuring economic benefits and the other regional economic impacts. Regional economic impacts for this study have been developed based on recreation effects and are presented in the EIS under socioeconomics. Economic benefits have been estimated separately for agriculture, hydropower, and recreation and are presented within each relevant EIS section.

Regional economic impacts attempt to measure changes in total economic activity within a specified geographic region stemming from changes in within region expenditures. Regional economic impacts are typically described using such general indicators as output, income, and employment. Conversely, economic benefits attempt to measure changes in societal or national welfare based on a net value concept.[1] Theoretically, nationally oriented economic benefit analyses attempt to provide a broader geographic focus compared to regional economic impact analyses. Unfortunately, in practice, the geographic difference between the analyses may be less pronounced given the difficulty in evaluating national implications of an action. If an action is relatively small from a national perspective, repercussions outside the directly impacted area may be insignificant. If the opposite is true, nationwide displacement or substitution effects may need to be taken into consideration. The difficultly lies in trying to estimate these substitution effects. For this analysis, the changes in economic benefits within the directly affected areas were assumed to be small enough so as not to create significant changes in national benefits. As a result, evaluation of nationwide substitution effects was deemed unnecessary.

One way to visualize the difference between regional economic impacts and economic benefits is to consider how each reacts to increases in regional expenditures. Regional economic impacts typically increase as in-region expenditures increase, whereas consumer surplus/profitability benefits tend to decrease as costs or expenditures alone increase. It should be noted that regional economic impacts and benefits often move in unison since they both typically rise or fall with levels of production (including recreation visitation). On the benefit side, as production changes, so do both production costs/expenditures and revenues/total consumer benefits, the net effect is that benefits generally move in the same direction as production changes. Nevertheless, there are many situations where changes in benefits and economic impacts diverge. This potential for divergence, along with the fact that different user groups are often interested in different economic measures, creates a need for both analyses.

Given the above discussion, the basic objective of the regional economic analysis is to measure changes in total economic activity within the affected region for the Action Alternative as compared to the No Action Alternative. The proposed Action Alternative potentially affects regional economic activity mainly through changes in: 1) costs of agricultural production due to flooding effects on irrigated acreage, 2) recreational expenditures due to the effects of changes in reservoir water levels and river flows on recreation visitation, and 3) costs of electricity as the timing and production of hydropower varies with the fluctuation in releases from Flaming Gorge Dam. Flooding effects upon agricultural lands along the Green River proved to be relatively minor and were consequently dropped from the regional analysis. Regional impacts due to losses in hydropower generation were also deemed to be relatively insignificant locally given any increased costs of power generation would be distributed across thousands of power users throughout the Western United States. Also, given this EIS is primarily a reservoir re-operation study, the lack of structural adjustments to the dam implies that construction costs would be minimal. Other typically encountered project purposes, such as municipal and industrial uses, were either not applicable or not significantly affected. Bottomline, the only factor used to evaluate changes in regional economic activity were the changes in recreation expenditures.

Regional economic impacts were measured using input-output (I-O) analysis. I-O estimates regional economic impacts based on a region's inter-industry trade linkages. The analyses present changes in total economic impact as measured by the sum of direct effects (impacts to

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[1] For consumers, economic welfare reflects the value of goods and services consumed above what is actually paid for them. Such consumer welfare estimates are measured in terms of willingness-to-pay (WTP) in excess of cost, otherwise referred to as consumer surplus. This is the approach used in the recreation and hydropower analyses. While the hydropower analysis does not go through the process of estimating WTP, by focusing on differences in the replacement cost of power which are passed along to consumers, the resulting benefit measure is essentially the same. For producers or businesses, economic welfare is generally reflected in terms of gross revenues minus operating costs, otherwise referred to as profitability. This later approach is used in the agriculture analysis.

initially affected industries), indirect effects (impacts to industries providing inputs to directly impacted industries, i.e., backward linkages), and induced effects (impacts from employees spending wages within the region) all caused by the initial change in demand. For example, if $1,000 in agricultural product is lost from irrigated acreage idled by flooding (direct effect), and the farmer buys $500 less in seed and fertilizer from the local store (indirect effect), and the farm workers spend $100 less for household goods and services within the region (induced effect), then the total loss in output from regional agriculture is $1,000, but the total regional output loss is $1,600.

Three measures of regional economic activity provide the basis of the evaluation: total industry output, total labor income, and employment.

- ❖ Total Industry Output: Dollar value of production (sales revenues and gross receipts) from all industries in the region. Total industry output includes the value of inter-industry trade of intermediate goods prior to final manufacture and sale.
- ❖ Total Labor Income: Employment income derived at the workplace including wages and benefits (employee compensation) plus self-employed income (proprietary income).
- ❖ Employment: Total of hourly wage, salary, and self-employed jobs (part-time and full-time), measured in terms of number of jobs, not full-time equivalents.

The majority of the regional analysis discussion is based on the results of a regional modeling effort. In addition, information is presented at the end of the Action Alternative section on the results of surveys conducted with commercial guide operators on both the Green River and Flaming Gorge Reservoir. It was anticipated that commercial guide operators, particularly those on the Green River, may be adversely affected by the Action Alternative. Given the regional analysis focused on a three-county area, impacts to commercial guide operators would not be directly discernible. As a result, surveys of commercial guide operators were conducted to try and identify impacts. Other tourist oriented sectors, such as lodging and restaurants, were not anticipated to be as adversely affected since they cater to both river and reservoir recreators.

2.0 AFFECTED ENVIRONMENT

This section includes a brief discussion of the geographic impact area followed by descriptions of current conditions.

2.1 Geographic Impact Area (Region)

As described under the recreation section, the recreation analysis focuses on effects at Flaming Gorge Reservoir and along the Green River primarily within the Flaming Gorge NRA. Flaming Gorge Reservoir is located within Sweetwater County, Wyoming and Daggett County, Utah. The relevant portions of the Green River are located within Daggett County, Utah. Access to the northern portions of the reservoir would likely involve economic activity in the Wyoming towns of Green River and Rock Springs. Conversely, access to the southern reaches of the reservoir and the Green River may involve economic activity in more southern communities. Since Daggett County has little by way of significantly sized communities, the decision was made to include

Uintah County, Utah, within the impact region due to the influence of the town of Vernal. As a result, the geographic impact area for both the reservoir and river recreation analyses includes all three counties.

2.2 Current Conditions

The latest available data for the IMPLAN regional input-output model used in the analysis reflects regional economic activity for calendar year 1999 (for information on the IMPLAN model, see section 3.1 on Regional Economic Impact Analysis Methodology). Table 1 presents "current" base year 1999 conditions from the IMPLAN three-county model for total industry output, employment, and labor income. The table is broken down by major aggregated industry as well as the eight most directly impacted recreation oriented economic sectors identified in the analysis. The eight directly impacted sectors are shown separately, but under their associated major industry (e.g., "air transportation" is presented separately, but under transportation). Adding the separately presented directly impacted sectors with their associated major industry provides an estimate of the total for that industry (e.g., adding "air transportation" with "other transportation estimates total transportation).

Reviewing the percentages in table 1, the most important industries vary depending on the measure. From an output perspective, the top five industries include mining (33.8 percent [%]), transportation (12.0%), services (9.7%), construction (8.4%), and manufacturing (8.1%). Conversely, from an employment perspective, the top five industries include services (20.9%), retail trade (17.6%), government (17.3%), mining (10.8%), and manufacturing (8.3%). Comparing services and mining under these two perspectives indicates that the service industry is relatively more labor intensive that the mining industry. Similarly, the government sector appears to involve a fairly significant work force, but a relatively low level of marketable output. Finally, the top five industries from the perspective of labor income includes mining (22.1%), government (16.1%), transportation (14.8%), services (13.1%), and construction (8.7%). Comparing these percentages to the employment percentages provides an indication as to the relatively high and low paying industries. Mining and transportation appear to be high paying industries given they reflect only 10.8 and 7.6% of employment, but 22.1 and 14.8% of labor income respectively. The opposite appears to be true for the retail trade and service industries.

The eight directly impacted sectors, from a recreation expenditure perspective, combined to provide 5.4% of total industry output, 16.6% of employment, and 7.3% of labor income. These directly impacted sectors are fairly significant contributors to regional employment, but are relatively insignificant in terms of output and income. Food stores, automobile dealers and service stations, eating and drinking establishments, miscellaneous retail stores, and hotels and lodging places in particular combine for 16.1% of total regional employment.

3.0 ENVIRONMENTAL CONSEQUENCES

This section describes the regional economic impact methodology as well as the results of the analyses.

Table 1: Current Conditions Data Year: 1999		(Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)					
		Total Industry Output		Employment		Labor Income	
Primary Industries/Sectors	IMPLAN Industry Number	Millions of Dollars ($M)	% of Total	No. of Jobs	% of Total	Millions of Dollars ($M)	% of Total
Agriculture, Forestry, Fishing	1-27	50.8	1.3	1,340	3.5	15.9	1.2
Mining	28-47, 57	1,349.7	33.8	4,146	10.8	283.9	22.1
Construction	48-56	335.5	8.4	3,210	8.3	111.3	8.7
Manufacturing	58-432	322.1	8.1	1,728	4.5	85.4	6.7
Other Transportation	433-436, 438-440	471.8	11.8	2,899	7.5	187.4	14.6
- Air Transportation:	437	6.4	0.2	74	0.1	2.7	0.2
Communications	441-442	45.7	1.1	194	0.5	11.1	0.9
Utilities	443-446	285.2	7.1	625	1.6	45.4	3.5
Wholesale Trade	447	89.3	2.2	1,074	2.8	36.9	2.9
Other Retail Trade	448-449, 452-453	52.9	1.3	1,579	4.1	25.8	2.0
- Food Stores:	450	32.2	0.8	882	2.3	18.9	1.5
- Automotive Dealers & Service Stations:	451	55.4	1.4	1,076	2.8	25.3	2.0
- Eating & Drinking:	454	66.5	1.7	2,292	6.0	22.6	1.8
- Miscellaneous Retail:	455	17.1	0.4	921	2.4	8.4	0.7
Finance, Insurance, & Real Estate (FIRE)	456-462	206.2	5.2	1,769	4.6	27.2	2.1
Other Services	464-476, 478-487, 489-509	345.7	8.7	6,891	17.9	152.1	11.9
- Hotels and Lodging Places:	463	36.1	0.9	1,004	2.6	14.4	1.1
- Automobile Rental and Leasing:	477	.4	0.0	13	0.0	0.1	0.0
- Amusement and Recreation Services:	488	3.2	0.1	149	0.4	1.4	0.1
Federal, State, and Local Government	510-515, 519-523	261.7	6.6	6,659	17.3	207.1	16.1
TOTAL:		3,993.7	100	38,523	100	1,283.3	100
MOST AFFECTED SECTORS:		217.3	5.4	6,410	16.6	93.8	7.3

3.1 Regional Economic Impact Analysis Methodology

The majority of the regional analysis discussion is based on the results of a regional modeling effort. In addition to the regional modeling results, a brief discussion is presented at the end of the Action Alternative section on the results of surveys conducted with commercial operators on both the Green River and Flaming Gorge Reservoir.

3.1.1 Regional Modeling Methodology

The regional economic impact analysis involves running alternative specific estimates of recreation expenditures through the IMPLAN input output model of the three-county regional economies. The IMPLAN (IMpact analysis for PLANning) model was originally developed by the U.S. Department of Agriculture Forest Service to assist in land and resource planning. This personal computer based software is widely used for the development of regional economic analyses.

Input-output analysis is a procedure for examining relationships both between businesses and between businesses and consumers. The analysis captures all the monetary market transactions within a specified region for a given period of time via the inter-industry transaction table. The resulting mathematical formulas allow for examination of the effects of a change in one or more economic activities upon the overall regional economy (Minnesota IMPLAN Group, Inc., 2000).

Regional economic effects stemming from river and reservoir recreational activities within the three-county Utah/Wyoming area are driven by levels of within region recreation expenditures. The recreation analysis developed visitation results by month and activity for each alternative and hydrologic condition (i.e., average, dry, and wet water conditions). This information, combined with estimates of recreational expenditures per visit by month and activity for each alternative and hydrologic condition allowed for calculation of total within region recreational expenditures by alternative and hydrologic condition. Changes in recreational expenditures for the Action Alternative compared to the No Action Alternative for each hydrologic condition were entered into the IMPLAN model. The resulting differences in regional economic activity between the Action Alternative and No Action Alternative for each hydrologic condition provide a measure of the regional economic impacts associated with the Action Alternative.

As described under the affected environment current conditions section, the latest available IMPLAN data reflects regional economic activity during 1999. While the total recreation expenditure information reflects visitation and expenditures per visit during 2000-2001, the difference in years was considered insignificant enough to assume the 1999 version of the regional economy was reflective of the No Action Alternative. Given that 1999 was a wet year for both the river and reservoir, the underlying picture of the economy was considered analogous to the No Action Alternative wet condition. To estimate regional economic conditions for the No Action Alternative under average and dry conditions, differences in recreation expenditures for the No Action average and dry conditions were estimated as compared to No Action wet conditions. The expenditure differences were entered into IMPLAN to calculate regional economic activity under No Action average and dry conditions. The differences in Action Alternative expenditures compared to No Action expenditures under average, wet, and dry conditions were also run through IMPLAN to estimate impacts for the Action Alternative.

Typically, a recreation oriented regional analysis focuses on the expenditures made by nonlocal recreators, defined as recreators who do not reside in the region of interest. The logic is that increases or decreases in within region recreational expenditures by local residents would likely represent a wash to the regional economy since those expenditures would displace other within region expenditures. For example, if we anticipate that a local recreator will take more rafting trips and spend more money recreating on the Green River as a result of an alternative, the standard logic assumes that individual would reduce within region expenditures for other items, not necessarily recreational items, by an equal amount. The resulting implication is this transfer of within region spending would have very little effect upon regional economic activity. While this assumption sounds reasonable, it is often faulty for several reasons. First, it is possible that additional within region recreational expenditures may displace recreational spending outside the region, implying substitution of recreation visits between sites. In this case, the additional spending would reflect a true gain for the region. Secondly, even if the additional within region recreational expenditures did displace other within region expenditures, differences in the types or size of expenditures could affect the level of regional economic activity. If within region recreation expenditures for gas, food, etc. associated with the additional recreation visitation displaced within region expenditures for going to the movies or some other within region activity, the fact that the expenditures are incurred within different economic sectors would imply different regional effects. As a result, the decision was made to evaluate regional economic impacts based on all recreation expenditures, not just those expenditures generated by nonlocal residents. No attempt was made to estimate the level of offset in recreational expenditures for local residents given the inherently speculative nature of such an analysis. As a result, the regional impacts for recreation may be somewhat overstated.

Average per visit current total recreation expenditures by activity within the region were obtained from the recreation survey described within the recreation section. Information was also gathered from the survey as to the breakdown of expenditures by expenditure category. Expenditure categories include camping fees, lodging, restaurants, groceries and liquor, gasoline, recreation supplies, guide services, car rental, other rentals, public transportation, and other. Expenditure categories varied somewhat by activity. For example, guide boat fishing was the only activity which included guide services.

In addition to the current recreation expenditure information, the survey also asked if the recreator's length of visit might increase under preferred river flow and reservoir water level conditions. The results of this preferred conditions length of trip question were adjusted downward using the conservative, but often applied approach of assuming nonrespondent responses would be equal to zero. The preferred conditions length of visit was divided by the current average length of visit to estimate a percentage increase in length of visit under preferred conditions for each recreation activity. These activity specific percentage increases were applied to current per visit expenditures to estimate per visit expenditures by activity under preferred conditions.

As with the recreation analysis, current and preferred conditions were used to develop recreation expenditures per visit by activity for each alternative using an interpolation approach. Assuming length of stay per visit, and consequently expenditures per visit, peak under preferred conditions, an inverted U-shaped distribution was assumed to hold for recreation expenditures as it did for recreation visitation and value. A high end kink expenditure estimate was developed as in the recreation analysis. The high end kink was assumed to fall at proportionally the same position as the current condition expenditure location. Low end and high end thresholds, points where river flows or reservoir water levels were so low or high as to prevent use, were also obtained from the survey. The high end kink was assumed to fall the same percentage distance from the preferred flow/WL as the current conditions data point. If current conditions falls 75% of the way between preferred conditions and the low end threshold, then the high end kink was also assumed to fall 75% of the way between preferred conditions and the high end threshold. Including the high end kink, five data points now exist for conducting a linear interpolation of per visit recreation expenditures (i.e., low end threshold, current conditions, preferred conditions, high end kink, and high end threshold).

Instead of doing an interpolation using all five data points as was done in the recreation analyses, a modified interpolation was done using only the current conditions, preferred conditions, and high end kink data points. The logic for this was that for conditions below current conditions or above high end kink conditions, the full scale interpolation would predict recreation expenditures per visit to fall below current expenditures. While this may sound reasonable, at the extremes where conditions approach the low or high end thresholds, per visit expenditures would be estimated to approach zero. While values per trip may indeed approach zero for the last few visits taken, the expenditures for those visits will obviously not decline to zero. As a result, the decision was made to only interpolate between current conditions and the high end kink. This results in expenditures per visit falling within the range of current conditions to preferred conditions (note that the expenditures for the high end kink would be equivalent to current conditions). For cases where river flows or reservoir water levels fall below current conditions or above high end kink conditions, the expenditures per visit were assumed to hold at current/high end kink levels. To the extent that actual visit length declines below current visit length, the assumption that expenditures wouldn't't drop below current expenditures per visit may somewhat overstate total expenditures. The following presents the information on the three data points used in the interpolations.

1) Current Expenditures

Current and high end kink expenditures per visit were developed separately for Green River and Flaming Gorge Reservoir recreation activities based on information obtained from the recreation survey. Given that the high end kink is analogous to current conditions from an expenditure per visit perspective, the expenditures per visit for current and high end kink conditions were assume to be the same.

A) Green River Current/High End Kink Expenditures per Visit

To calculate current expenditures per visit by recreation activity, information was gathered from two primary questions from the recreation survey. The first question asked how much the recreator spends per visit on average for each of the expenditure categories. The second question asked how much the recreator spent on average by recreation activity. Combining the two questions allows for estimation of the expenditures per visit by recreation activity and expenditure category. Instead of trying to ask complex questions about costs by expenditure category for each recreation activity, this approach gets to essentially the same information.

As with many of the recreation calculations, the conservative but often applied approach of assuming zero values for nonrespondents was again applied to calculate expenditures. Question responses from the survey were reported by Aukerman et al., 2002 in terms of the average values for those who responded to each question. For example, average public transportation costs for those that used it were calculated at $255.71 per visit. But, only 7 of 195 respondents on the river indicated that they used public transit. Instead of calculating expenditures per visit based on the averages of the respondents, we assumed nonrespondents incurred zero costs for expenditure categories they didn't respond to. The result of this adjustment was to reduce total average expenditures across all activities from $1,463.81 to $316.22 per visit.

A couple of distinctions were made between presumed camping and non-camping trips and between guide boat fishing and other activities. For recreators who identified their primary activity as camping, an assumption was made that certain expenditure categories would not be relevant (e.g., lodging, restaurants, car rental, and public transportation). With the low overall expenditures per visit for Green River camping ($80.59), this assumption leads to more reasonable expenditure estimates for the relevant expenditure categories. Similarly, guide boat fishing was separated from all other activities so that the expenditure for guide services could be included within the overall expenditure estimate.

Once these adjustments had been made, percentages were calculated for each expenditure category. Percentages by expenditure category for guide boat fishing, camping, and all other activities were applied to the current total expenditure estimates obtained from the survey for each recreation activity (scenic floating, guide boat fishing, private boat fishing, shoreline fishing/trail use, and camping) to estimate current expenditures by activity as shown in table 2.

B) Flaming Gorge Reservoir Current/High End Kink Expenditures per Visit

The approach used to estimate current/high end kink expenditures per visit for the reservoir followed closely the procedure described directly above for the river. However, a couple of differences need to be mentioned. First, given guide boat fishing is not a significant activity on

Table 2: Current and High End Kink Green River Expenditures per Visit					
Expenditure Categories	Scenic Floating	Guide Boat Fishing	Private Boat Fishing	Shoreline Fishing/ Trail Use	Camping
Camping Fees	$ 25.14	$ 20.49	$ 17.95	$ 10.53	$ 10.32
Lodging	64.00	52.14	45.68	26.80	0
Restaurants	50.00	40.73	35.69	20.94	0
Groceries and Liquor	55.75	45.42	39.80	23.35	22.89
Gasoline	54.58	44.47	38.96	22.86	22.41
Recreation Supplies	32.51	26.49	23.21	13.62	13.35
Guide Services	0	444.10	0	0	0
Car Rental	22.95	18.70	16.38	9.61	0
Other Rentals	19.33	15.75	13.80	8.10	7.94
Public Transit	9.96	8.12	7.11	4.17	0
Other	8.95	7.29	6.39	3.75	3.68
Total:	$ 343.17	$ 723.70	$ 244.97	$ 143.73	$ 80.59

the reservoir, it was dropped from the analysis. As a result, no distinction needed to be made between activities based on the incorporation of a guide services expenditure category. Second, as with the river analysis, expenditure category differences were assumed between camping and non-camping activities (e.g., lodging, restaurants, car rental, and public transportation costs were assumed irrelevant on a camping visit). For the reservoir analysis, the camping based percentages of costs by expenditure category were applied to both camping and swimming/waterplay. The swimming/waterplay total expenditure per visit estimate was so low (only $55.24) as to make it questionable to divide the cost among all expenditure categories. Survey results indicated that average length of visit for swimming visits did exceed one day suggesting that we could not assume swimming visits were day trips. Given the low expenditures per visit, the assumption was made that swimmers typically camped. The resulting current/high end kink expenditures per visit by activity are presented in table 3.

2) Preferred Expenditures:

A) Green River Preferred Expenditures per Visit:

Similar to the river visitation calculation described under the recreation section, a survey question asked if recreators by activity would extend the length of their visits under preferred flow conditions. Average increased length of visit by activity was again adjusted downward assuming nonrespondents would not extend their visits. The adjusted increase in length of stay was divided by the average current length of stay to estimate a percentage increase in length of stay by recreation activity. The percentage increase in length of stay was applied to the current expenditures per visit by activity to estimate the expenditures per visit by activity under preferred flow conditions as presented in table 4.

Table 3: Current and High End Kink Flaming Gorge Reservoir Expenditures per Visit				
Expenditure Categories	Power Boating/ Waterskiing	Boat Fishing	Boat Camping	Swimming/ Waterplay
Camping Fees	$ 15.74	$ 10.28	$ 17.42	6.99
Lodging	14.15	9.25	0	0
Restaurants	19.85	12.97	0	0
Groceries and Liquor	32.24	21.06	35.68	14.31
Gasoline	48.42	31.64	53.59	21.50
Recreation Supplies	10.17	6.64	11.25	4.51
Other Rentals	5.22	4.41	5.78	2.32
Other	12.64	8.26	13.99	5.61
Total:	$ 158.43	$ 103.51	$ 137.71	$ 55.24

Table 4: Preferred Conditions Green River Expenditures per Visit					
Expenditure Categories	Scenic Floating	Guide Boat Fishing	Private Boat Fishing	Shoreline Fishing/ Trail Use	Camping
Camping Fees	$ 32.49	$ 29.73	$ 26.43	$ 15.67	$ 11.78
Lodging	82.72	75.65	67.25	39.92	0
Restaurants	64.63	59.10	52.55	31.19	0
Groceries and Liquor	72.06	65.90	58.60	34.78	26.14
Gasoline	70.55	64.52	57.36	34.05	25.59
Recreation Supplies	42.02	38.43	34.17	20.29	15.24
Guide Services	0	644.35	0	0	0
Car Rental	29.66	27.13	24.12	14.31	0
Other Rentals	24.98	22.85	20.32	12.06	9.07
Public Transit	12.87	11.78	10.47	6.21	0
Other	11.57	10.58	9.41	5.59	4.20
Total:	$ 443.55	$ 1,050.02	$ 360.68	$ 214.08	$ 92.02

B) Flaming Gorge Reservoir Preferred Expenditures per Visit:

The procedure described directly above for the river was also applied to estimate the preferred Flaming Gorge Reservoir expenditures per visit as presented in table 5.

Table 5: Preferred Conditions Flaming Gorge Reservoir Expenditures per Visit

Expenditure Categories	Power Boating/ Waterskiing	Boat Fishing	Boat Camping	Swimming/ Waterplay
Camping Fees	$ 27.98	$ 14.94	$ 20.78	$ 8.21
Lodging	25.16	13.44	0	0
Restaurants	35.29	18.85	0	0
Groceries and Liquor	57.32	30.61	42.57	16.81
Gasoline	86.08	45.99	63.94	25.26
Recreation Supplies	18.08	9.65	13.42	5.30
Other Rentals	9.28	4.96	6.90	2.73
Other	22.47	12.01	16.69	6.59
Total:	$ 281.66	$ 150.45	$ 164.30	$ 64.90

These three recreation expenditure data points (current expenditures, preferred expenditures, and high end kink expenditures), for both the river and reservoir, provided the basis for the per visit expenditure interpolations. As with the recreation visitation and valuation analyses, expenditures per visit were estimated by activity, month, alternative and hydrologic condition based on the associated river flows and reservoir water levels. The expenditures per visit by activity, month, alternative and hydrologic condition were applied to similar estimates of recreation visitation to calculate total expenditures by alternative and hydrologic condition. The changes in total expenditures by expenditure category for the Action Alternative compared to the No Action Alternative, were entered into the IMPLAN model to generate impact estimates associated with the Action Alternative.

3.1.2 Commercial Operator Survey Methodology

Given the regional analysis focused on a three-county area, and lack of county specific expenditure data precluded the development of county level regional economic impact models, anticipated adverse impacts to commercial guide operators concentrated within Daggett County would not be directly discernible. As a result, surveys of commercial guide operators were conducted to try and identify impacts.

The results of the surveys of both Green River and Flaming Gorge Reservoir recreational commercial operators is presented at the end of the Action Alternative subsection in terms of: 1) average visitation and revenue, 2) high end, low end, and preferred flows/water levels, and 3) preferred flow/water level visitation and revenue. Unfortunately, the survey data did not provide enough information to estimate impacts by alternative. However, the high end, low end, and preferred flows/water levels obtained from the survey were compared to flows and water levels from March to October for each alternative under average, wet, and dry conditions. Attempts were made to evaluate which alternative would be preferred for each commercially supported recreation activity.

3.2 Regional Economic Impact Results

This section presents the results of the recreation expenditure based regional economic analysis. The results are presented by alternative, starting with the No Action Alternative.

3.2.1 No Action Alternative

Given the large volume of recreation expenditure estimates (estimates calculated for each of the eleven expenditure categories, for each recreation activity, for each month, for each alternative and hydrologic condition), the individual monthly estimates are not presented. Instead, information on No Action Alternative total recreation expenditures by expenditure category, hydrologic condition, site (river versus reservoir), and recreation activity are presented in table 6. These estimates portray the product of recreation visits from the recreation analysis times the expenditures per visit from the expenditure interpolations.

As mentioned above under methodology, given the IMPLAN 1999 base data is considered reflective of No Action Alternative wet conditions, table 6 also includes estimates of the differences in No Action average and dry expenditures as compared to No Action wet conditions. The gain in No Action Alternative average condition expenditures compared to No Action Alternative wet condition expenditures of $23.6 million reflects almost a 20% increase. The decline in No Action dry expenditures compared to No Action wet expenditures of $39.1 million reflects a 32.6%drop in recreation expenditures.

These expenditure differences were run through the IMPLAN model to estimate regional economic conditions under No Action average and dry hydrologic conditions. As presented in table 7, differences in the overall three-county regional economy were insignificant between No Action Alternative average, wet, and dry conditions. Looking at employment, the most volatile regional economic measure on a percentage basis, indicates that the 330 and 908 job declines compared to average conditions under wet and dry conditions respectively, reflect only a 0.9 and 2.3% reduction in overall employment.

Focusing in on the overall economy is important, but can gloss over industry by industry changes. To address this issue, reviews were also made of the eight most affected economic sectors, those sectors directly impacted by changing recreational expenditures. Table 8 describes the linkage from each recreation expenditure category to Standard Industrial Classification (SIC) industry codes to IMPLAN industry codes. Based on this table, the most directly affected IMPLAN industries are as follows: air transportation (#437), food stores (#450), automotive dealers and service stations (#451), eating and drinking (#454), miscellaneous retail (#455), hotels and lodging places (#463), automobile rental and leasing (#477), and amusement and recreation services (#488).

Comparing employment for the No Action Alternative under average and wet conditions shows a minor decline of 294 jobs (-4.4%) between these eight most affected sectors. The 805 job loss from average to dry conditions for these sectors was more noticeable reflecting a 12.0% drop. The nearly 44% decline in recreation expenditures under dry conditions compared to average conditions generated a much less severe decline in regional economic activity, even for the eight most affected sectors, implying that a significant share of recreation

Table 6: No Action Alternative Recreation Expenditures ($1,000s) 2000-2001 $ (Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)

Hydrologic Condition	Site	Recreation Activity	Expenditures Categories: Camping Fees	Lodging	Restaurants	Groceries	Gas	Supplies	Guides	Car Rental	Other Rentals	Public Transit	Other	Total
Average	Green River	Scenic Floating	565.9	1,440.6	1,125.5	1,254.9	1,228.5	731.8	0	516.5	435.1	224.2	201.5	7,724.4
		Guide Boat Fishing	221.3	563.1	439.9	490.6	480.3	286.1	4,796.5	202.0	170.1	87.7	78.7	7,816.2
		Private Boat Fishing	318.0	809.2	632.2	705.0	690.1	411.1	0	290.2	244.5	126.0	113.2	4,339.5
		Shoreline Fishing/Trail Use	385.7	981.8	767.1	855.4	837.5	499.0	0	352.0	296.7	152.8	137.4	5,265.6
		Boat Based Camping	23.7	0	0	52.6	51.5	30.7	0	0	18.2	0	8.4	185.0
		Total:	1,514.6	3,794.7	2,964.8	3,358.4	3,287.9	1,958.7	4,796.5	1,360.7	1,164.6	590.6	539.3	25,330.7
	Flaming Gorge Reservoir	Power Boating/Waterskiing	8,928.7	8,029.1	11,261.9	18,292.6	27,470.6	5,769.5	0	0	2,961.1	0	7,170.2	89,883.7
		Boat Fishing	2,491.3	2,241.3	3,143.0	5,104.1	7,668.6	1,609.2	0	0	826.8	0	2,002.7	25,087.0
		Boat Camping	203.5	0	0	416.9	626.2	131.4	0	0	67.6	0	163.5	1,609.2
		Swimming/Waterplay	168.2	0	0	344.4	517.5	108.6	0	0	55.9	0	135.0	1,329.6
		Total:	11,791.7	10,270.4	14,404.9	24,158.1	36,282.9	7,618.7	0	0	3,911.4	0	9,471.4	117,909.4
		FGNRA Total:	13,306.3	14,065.1	17,369.7	27,516.5	39,570.8	9,577.4	4,796.5	1,360.7	5,076.0	590.6	10,010.7	143,240.1
		Change from No Action Extremely Wet:	+2200.6	+2185.4	+2846.9	+4534.4	+6643.2	+1514.7	+977.7	+125.8	+792.4	+54.6	+1703.1	+23,578.3
Wet	Green River	Scenic Floating	546.0	1,389.9	1,086.0	1,210.8	1,185.3	706.0	0	498.3	419.8	216.3	194.4	7,453.0
		Guide Boat Fishing	176.2	448.3	350.2	390.6	382.4	227.8	3,818.8	160.8	135.4	69.8	62.7	6,223.1
		Private Boat Fishing	290.2	738.5	577.0	643.5	629.9	375.3	0	264.8	223.2	114.9	103.4	3,960.6
		Shoreline Fishing/Trail Use	340.7	867.1	677.5	755.4	739.6	440.7	0	310.9	262.0	134.9	121.4	4,650.1
		Boat Based Camping	18.1	0	0	40.2	39.4	23.5	0	0	14.0	0	6.5	141.6
		Total:	1,371.2	3,443.9	2,690.7	3,040.5	2,976.6	1,773.2	3,818.8	1,234.9	1,054.4	536.0	488.2	22,428.4
	Flaming Gorge Reservoir	Power Boating/Waterskiing	7,223.2	6,494.8	9,110.0	14,796.4	22,221.2	4,667.5	0	0	2,395.7	0	5,801.1	72,709.9
		Boat Fishing	2,157.6	1,941.0	2,722.1	4,420.2	6,640.7	1,393.5	0	0	716.0	0	1,734.0	21,725.1
		Boat Camping	196.8	0	0	403.1	605.5	127.1	0	0	65.3	0	158.1	1,555.8
		Swimming/Waterplay	157.2	0	0	321.9	483.7	101.4	0	0	52.2	0	126.2	1,242.6
		Total:	9,734.8	8,435.8	11,832.1	19,941.6	29,951.0	6,289.5	0	0	3,229.2	0	7,819.4	97,233.4
		FGNRA Total:	11,106.0	11,879.7	14,522.8	22,982.1	32,927.6	8,062.7	3,818.8	1,234.9	4,283.6	536.0	8,307.6	119,661.8
Dry	Green River	Scenic Floating	2.2	5.7	4.4	4.9	4.8	2.9	0	2.0	1.7	.9	.8	30.4
		Guide Boat Fishing	75.2	191.4	149.5	166.8	163.3	97.3	1,630.5	68.7	57.8	29.8	26.8	2,657.0
		Private Boat Fishing	138.0	351.3	274.5	306.1	299.6	178.5	0	126.0	106.1	54.7	49.2	1,883.9
		Shoreline Fishing/Trail Use	119.6	304.6	238.0	265.4	259.8	154.8	0	109.2	92.0	47.4	42.6	1,633.5
		Boat Based Camping	4.7	0	0	10.5	10.2	6.1	0	0	3.6	0	1.7	36.9
		Total:	339.9	853.0	666.4	753.6	737.8	439.5	1,630.5	305.8	261.3	132.8	121.0	6,241.7
	Flaming Gorge Reservoir	Power Boating/Waterskiing	5,361.2	4,819.7	6,761.2	10,981.4	16,492.5	3,464.0	0	0	1,778.0	0	4,305.3	53,963.3
		Boat Fishing	1,767.8	1,590.7	2,230.4	3,621.6	5,441.1	1,141.9	0	0	586.4	0	1,420.5	17,800.4
		Boat Camping	180.7	0	0	370.1	555.9	116.7	0	0	60.0	0	145.1	1,428.6
		Swimming/Waterplay	147.0	0	0	301.0	452.2	94.9	0	0	48.8	0	118.0	1,161.9
		Total:	7,456.8	6,410.4	8,991.6	15,274.1	22,941.7	4,817.5	0	0	2,473.2	0	5,988.9	74,354.3
		FGNRA Total:	7,796.7	7,263.4	9,658.0	16,027.7	23,679.5	5,257.0	1,630.5	305.8	2,734.5	132.8	6,109.9	80,596.0
		Change from No Action Extremely Wet:	-3,309.3	-4,616.3	-4,864.8	-6,954.4	-9,248.1	-2,805.7	-2,188.3	-929.1	-1,549.1	-403.2	-2,197.7	-39,065.8

Table 7: No Action Alternative — Data Year: 1999 — (Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)

Primary Industries/Sectors	IMPLAN Industry Number	Average Condition Total Industry Output ($M)	Average Condition Employment (Jobs)	Average Condition Labor Income ($M)	Wet Condition Total Industry Output ($M)	Wet Condition Employment (Jobs)	Wet Condition Labor Income ($M)	Dry Condition Total Industry Output ($M)	Dry Condition Employment (Jobs)	Dry Condition Labor Income ($M)
Agriculture, Forestry, Fishing	1-27	50.8	1,340	15.9	50.8	1,340	15.9	50.8	1,338	15.9
Mining	28-47, 57	1349.8	4,146	283.9	1,349.7	4,146	283.9	1,349.6	4,145	283.9
Construction	48-56	335.6	3,212	111.3	335.5	3,210	111.3	335.2	3,205	111.1
Manufacturing	58-432	322.2	1,729	85.4	322.1	728	85.4	322.0	1,727	85.4
Other Transportation	433-436, 438-440	472.0	2,901	187.5	471.8	2,899	187.4	471.5	2,892	187.3
- Air Transportation:	437	6.4	74	2.7	6.4	74	2.7	6.3	72	2.7
Communications	441-442	45.9	195	11.1	45.7	194	11.1	45.4	192	11.0
Utilities	443-446	285.4	626	45.4	285.2	625	45.4	284.8	623	45.3
Wholesale Trade	447	89.4	1,076	36.9	89.3	1,074	36.9	89.0	1,069	36.7
Other Retail Trade	448-449, 452-453	53.0	1,582	25.9	52.9	1,579	25.8	52.7	1,572	25.7
- Food Stores:	450	33.4	914	19.6	32.2	882	18.9	30.4	814	17.5
- Automotive Dealers & Service Stations:	451	56.8	1,103	25.9	55.4	1,076	25.3	53.5	1,021	24.0
- Eating & Drinking:	454	69.0	2,382	23.5	66.5	2,292	22.6	62.0	2,085	20.6
- Miscellaneous Retail:	455	17.5	945	8.7	17.1	921	8.4	16.4	867	8.0
Finance, Insurance, & Real Estate (FIRE)	456-462	206.8	1,776	27.3	206.2	1,769	27.2	205.0	1,750	27.0
Other Services	464-476, 478-487, 489-509	346.4	6,907	152.4	345.7	6,891	152.1	344.6	6,854	151.3
- Hotels and Lodging Places:	463	39.4	1,096	15.7	36.1	1,004	14.4	30.2	784	11.2
- Automobile Rental and Leasing:	477	0.5	14	0.1	.435	13	0.1	0.2	5	0.0
- Amusement and Recreation Services:	488	3.8	177	1.6	3.2	149	1.4	1.9	84	0.8
Federal, State, and Local Government	510-515, 519-523	261.8	6,660	207.2	261.7	6,659	207.1	21.5	6,656	207.0
TOTAL:		4008.8	38,853	1,288.2	3,993.7	38,523	1,283.3	3,966.4	37,757	1,272.3
Change from Average Condition ($M, Jobs):					-15.1	-330	-4.9	-42.4	-1096	-15.9
(Percent):					-0.4	-0.9	-0.4	-1.1	-2.8	-1.2
MOST AFFECTED SECTORS:		226.9	6,704	97.8	217.3	6,410	93.8	200.8	5,733	84.7
Change from Average Condition ($M, Jobs):					-9.6	-294	-4.0	-26.1	-971	-13.1
(Percent):					-4.2	-4.4	-4.1	-11.5	-14.5	-13.4

Table 8: Conversion of SIC Code Industries to IMPLAN Industries					
Recreation Expenditure Category	SIC Industry Code Number	SIC Industry Name	Industry Description	IMPLAN Industry Number	IMPLAN Industry Name
Camping Fees	7033	Recreational Vehicle Parks and Campsites		463	Hotels and Lodging Places
Lodging	7011	Hotels and Motels		463	Hotels and Lodging Places
Restaurants	5812	Eating Places		454	Eating and Drinking
Groceries	5411	Grocery Stores		450 (retail)	Food Stores
Gasoline	5541	Gasoline Service Stations	Includes gasoline service stations, boat dealers, and recreation vehicle dealers	451 (retail)	Automotive Dealers and Service Stations
Recreation Supplies (fishing)	5941	Sporting Goods Stores and Bike Stops	Includes bait and tackle, fishing equipment.	455 (retail)	Miscellaneous Retail
Guide Services	7999	Amusement and Recreation Services, not elsewhere classified	Includes hunting and tourist guides	488	Amusement & Recreation Services, NEC
Car Rental	7514	Passenger Car Rental		477	Automobile Rental and Leasing
Other Rentals (boats)	7999	Amusement and Recreation Services, not elsewhere classified	Includes boat and canoe rental	488	Amusement and Recreation Services, NEC
Public Transit (airlines)	4512	Air Transportation, scheduled		437	Air Transportation
Other	5946 5947	Camera and Photographic Supply stores Gift, Novelty, and Souvenir Shops	Includes drug stores, liquor stores, sporting goods, camera and photographic supply stores, gift and souvenir shops	455 (retail)	Miscellaneous Retail

expenditures must pass through the economy without creating much impact. This is not surprising since the three-county economy has a relatively small manufacturing base suggesting much of the inputs to the most affected sectors likely come from outside the region.

3.2.2 Action Alternative

This section describes changes in regional economic activity associated with implementing the Action Alternative under average, wet, and dry conditions. For each hydrologic condition, changes in recreation expenditures compared to the No Action Alternative for the same hydrologic condition were run through the IMPLAN model. As a result, impacts are measured for the Action Alternative compared to the No Action Alternative within the context of the same hydrologic condition. In no instances are impacts measured across hydrologic conditions.

Table 9 presents recreation expenditures by category, recreation activity, site, and hydrologic condition for the Action Alternative. The table presents total expenditures as well as changes compared to the No Action Alternative in both dollar and percentage terms. Under all three hydrologic conditions, total Action Alternative expenditures are higher than those of the No Action Alternative. The gain in expenditures is about 5.6% under average conditions, 13.7% under wet conditions, and 22.7% under dry conditions.

While the overall change in expenditures is positive, this doesn't imply consistent expenditure gains on both the river and reservoir. The change in Action Alternative expenditures for the Green River follow the direction of the change in visitation—positive for the average condition and negative for the wet and dry conditions. Losses in river recreation expenditures were estimated at 38% and 60% compared to the No Action Alternative under wet and dry conditions, respectively. Conversely, changes in Action Alternative expenditures for Flaming Gorge Reservoir were positive under each hydrologic condition despite the lack of visitation change under average and wet conditions.

The facility availability approach, used to measure changes in reservoir visitation, is less sensitive than the interpolation approach for measuring gains in visitation as water levels rise. As a result, no changes in visitation were estimated for the reservoir under average and wet conditions. However, recreation expenditures are estimated based on both visitation and expenditures per trip. Since expenditures per trip are based on an interpolation, increases in expenditures per trip, due to increased length of stay associated with higher water levels, when applied to existing visitation levels, results in gains in recreation expenditures at the reservoir under both average and wet conditions. Under wet conditions, these gains in reservoir expenditures exceeded the losses in river expenditures leading to the odd situation of an estimated overall loss in visitation coupled with an overall gain in expenditures. Under dry conditions, gains in reservoir visitation and expenditures out weigh losses on the river.

While the overall level of expenditures shows gains compared to the No Action Alternative, the individual expenditure categories include both gains and losses. This is because expenditure categories vary by recreation activity and the visitation by activity varies by month, alternative, and hydrologic condition. Some activities may post gains while others show losses. The potential for both gains and losses in recreation visitation and recreation expenditures per trip across activities and months creates the possibility of both positive and negative expenditures. For example, losses in recreation expenditures for river guides under wet and dry conditions are not offset because they are applicable only to the guide boat fishing activity.

Table 9: Action Alternative Recreation Expenditures ($1,000s) 2000-2001 $ (Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)

Hydrologic Conditions	Site	Recreation Activity	Camping Fees	Lodging	Restaurants	Groceries	Gas	Supplies	Guides	Car Rental	Other Rentals	Public Transit	Other	Total
			Expenditures Categories											
Average	Green River	Scenic Floating	722.2	1,838.7	1,436.6	1,601.7	1,568.1	934.1	0	659.2	555.2	286.0	257.1	9,858.9
		Guide Boat Fishing	236.0	600.6	469.2	523.2	512.3	305.1	5,116.0	215.4	181.4	93.5	84.0	8,337.0
		Private Boat Fishing	363.9	926.0	723.6	806.9	789.9	470.5	0	332.1	279.8	144.2	129.6	4,966.4
		Shoreline Fishing/Trail Use	475.5	1,210.2	945.7	1,054.4	1,032.3	615.0	0	433.9	365.6	188.3	169.4	6,490.3
		Boat Based Camping	19.5	0	0	43.3	42.4	25.2	0	0	15.0	0	7.0	152.3
		Total:	1,817.1	4,575.7	3,575.0	4,029.5	3,944.9	2,350.0	5,116.0	1,640.6	1,397.1	712.0	647.0	29,805.0
	Flaming Gorge Reservoir	Power Boating/Waterskiing	9,216.0	8,286.3	11,623.3	18,878.6	28,351.9	5,954.2	0	0	3,057.0	0	7,400.8	92,768.1
		Boat Fishing	2,545.3	2,289.7	3,211.3	5,214.7	7,834.2	1,644.3	0	0	844.8	0	2,045.6	25,629.9
		Boat Camping	207.2	0	0	424.4	637.4	133.8	0	0	68.8	0	166.4	1,637.9
		Swimming/Waterplay	169.9	0	0	347.9	522.7	109.7	0	0	56.5	0	136.4	1,343.0
		Total:	12,138.4	10,575.9	14,834.6	24,865.6	37,346.2	7,841.9	0	0	4,027.0	0	9,749.2	121,378.9
		FGNRA Total:	13,955.5	15,151.6	18,409.6	28,895.1	41,291.1	10,191.9	5,116.0	1,640.6	5,424.1	712.0	10,396.2	151,183.9
	Change from No Action Alternative:	$:	649.2	1,086.5	1,039.9	1,378.6	1,720.3	614.5	319.5	279.9	348.1	121.4	385.5	7,943.8
		%:	4.9	7.7	6.0	5.0	4.4	6.4	6.7	20.6	6.9	20.6	3.9	5.6
Wet	Green River	Scenic Floating	312.3	795.2	621.3	692.7	678.2	403.9	0	285.2	240.1	123.7	111.2	4,263.8
		Guide Boat Fishing	119.4	303.7	237.3	264.6	259.1	154.3	2,587.1	108.9	91.7	47.3	42.5	4,216.0
		Private Boat Fishing	216.6	551.3	430.8	480.4	470.2	280.1	0	197.7	166.6	85.8	77.1	2,956.7
		Shoreline Fishing/Trail Use	173.7	442.2	345.5	385.3	377.2	224.8	0	158.5	133.6	68.8	61.9	2,371.6
		Boat Based Camping	12.0	0	0	26.7	26.1	15.5	0	0	9.2	0	4.3	93.8
		Total:	834.0	2,092.5	1,634.9	1,849.6	1,810.8	1,078.7	2,587.1	750.3	641.3	325.6	296.9	13,901.8
	Flaming Gorge Reservoir	Power Boating/Waterskiing	9,273.5	8,338.4	11,696.1	18,997.0	28,529.7	5,991.8	0	0	3,076.5	0	7,446.6	93,349.6
		Boat Fishing	2,557.7	2,300.7	3,227.0	5,239.7	7,872.4	1,652.2	0	0	849.1	0	2,055.9	25,754.5
		Boat Camping	209.1	0	0	428.2	643.3	135.0	0	0	69.4	0	167.9	1,652.9
		Swimming/Waterplay	169.0	0	0	345.8	519.6	109.0	0	0	56.1	0	135.6	1,335.1
		Total:	12,209.2	10,639.1	14,923.0	25,010.7	37,565.0	7,888.1	0	0	4,051.0	0	9,806.0	122,092.1
		FGNRA Total:	13,043.2	12,731.6	16,557.9	26,860.3	39,375.8	8,966.8	2,587.1	750.3	4,692.3	325.6	10,102.9	135,993.9
	Change from No Action Alternative:	$:	1,937.2	851.9	2,035.1	3,878.2	6,448.2	904.1	-1,231.7	-484.6	408.7	-210.4	1,795.3	16,332.1
		%:	17.4	7.2	14.0	16.9	19.6	11.2	-32.3	-39.2	9.5	-39.3	21.6	13.7
Dry	Green River	Scenic Floating	0	0	0	0	0	0	0	0	0	0	0	0
		Guide Boat Fishing	31.3	79.6	62.2	69.3	67.9	40.4	677.7	28.5	24.0	12.4	11.1	1,104.4
		Private Boat Fishing	29.0	73.7	57.6	64.2	62.9	37.5	0	26.4	22.3	11.5	10.3	295.4
		Shoreline Fishing/Trail Use	69.0	175.6	137.2	153.0	149.8	89.2	0	63.0	53.1	27.3	24.6	941.7
		Boat Based Camping	6.1	0	0	13.6	13.3	7.9	0	0	4.7	0	2.2	47.9
		Total:	135.4	328.9	257.0	300.1	293.8	175.1	677.7	117.9	104.1	51.2	48.2	2,489.3
	Flaming Gorge Reservoir	Power Boating/Waterskiing	7,150.4	6,428.6	9,018.6	14,647.6	21,998.2	4,620.8	0	0	2,371.6	0	5,741.7	71,977.5
		Boat Fishing	2,147.9	1,933.0	2,709.7	4,400.4	6,611.7	1,387.8	0	0	713.0	0	1,726.6	21,630.2
		Boat Camping	191.9	0	0	393.1	590.4	123.9	0	0	63.7	0	154.1	1,517.2
		Swimming/Waterplay	157.8	0	0	323.0	485.3	101.9	0	0	52.5	0	126.7	1,247.1
		Total:	9,647.9	8,361.6	11,728.3	19,764.1	29,685.7	6,234.4	0	0	3,200.8	0	7,749.1	96,371.9
		FGNRA Total:	9,783.3	8,690.5	11,985.3	20,064.2	29,979.5	6,409.5	677.7	117.9	3,304.9	51.2	7,797.3	98,861.2
	Change from No Action Alternative:	$:	1,986.6	1,427.1	2,327.3	4,036.5	6,300.0	1,152.5	-952.8	-187.9	570.4	-81.6	1,687.4	18,265.2
		%:	25.5	19.7	24.1	25.2	26.6	21.9	-58.4	-61.5	20.9	-61.5	27.6	22.7

The impacts of the Action Alternative under average, wet, and dry conditions are described in three separate tables to allow for presentation of both totals by industry and the changes compared to the No Action Alternative in terms of both dollars/jobs and percentage for all three regional economic impact measures.

Table 10 reports the effects of the Action Alternative under average conditions. The “total” columns for total industry output, employment, and labor income portray overall estimates of economic activity for each industry and for the economy as a whole. The “change from No Action” columns depict changes in both dollars/jobs and percent.

The overall change in Action Alternative total output, employment, and income compared to No Action average conditions was positive but quite small, reflecting less than a 1% change. Looking at the sum of the eight most directly affected sectors, the gains are somewhat higher in percentage terms indicating about a 1.5% change. The largest percentage change (gain) occurred in the automotive rental and leasing and the amusement and recreation services sectors, both small sectors in the three-county economy. These gains in economic activity associated with the Action Alternative under average conditions were considered insignificant from both the overall and most affected sector perspectives.

Table 11 reports the effects of the Action Alternative under wet conditions. The overall change in Action Alternative total output, employment, and income compared to No Action wet conditions was also positive but very small, again reflecting less than a 1% change. Looking at the sum of the eight most directly affected sectors, the gains were slightly higher in percentage terms indicating nearly a 3% change. The largest percentage change (loss) occurred in the automotive rental and leasing and the amusement and recreation services sectors, both small sectors in the three-county economy. These gains in economic activity associated with the Action Alternative under wet conditions were considered insignificant from both the overall and most affected sector perspectives.

Table 12 reports the effects of the Action Alternative under dry conditions. The overall change in Action Alternative total output, employment, and income compared to No Action wet conditions was again positive but very small, reflecting less than a 1% change. Looking at the sum of the eight most directly affected sectors, the gains were slightly higher in percentage terms indicating about a 3.5% change. The largest percentage change occurred in the automotive rental and leasing, hotel and lodging places, and the amusement and recreation services sectors. The hotel and lodging places sector is relatively large compared to the other two sectors. These gains in economic activity associated with the Action Alternative under dry conditions were considered insignificant from both the overall and most affected sector perspectives.

While the lack of expenditure data by county precluded county specific analyses, it is possible that certain impacts could be centered within certain counties. For example, negative impacts estimated for the amusement and recreation services sector under the Action Alternative during wet and dry conditions, stem from losses in guide boat fishing services expenditures which appear to be centered in and around the town of Dutch John in Daggett County. This loss of jobs during wet and dry conditions, while not overly apparent from a three-county perspective, could be more detrimental from the perspective of Daggett County alone and Dutch John in particular.

Table10: Action Alternative Average Condition — Data Year: 1999 — (Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output: Total ($M)	Total Industry Output: Change from No Action $M	Total Industry Output: Change from No Action Percent	Employment: Total (Jobs)	Employment: Change from No Action Jobs	Employment: Change from No Action Percent	Labor Income: Total ($M)	Labor Income: Change from No Action $M	Labor Income: Change from No Action Percent
Agriculture, Forestry, Fishing	1-27	50.8	.0058	0.0	1340	0	0	15.9	.0021	0.0
Mining	28-47, 57	1349.8	.0185	0.0	4146	0	0	284.0	.0039	0.0
Construction	48-56	335.7	.0538	0.0	3213	1	0.0	111.4	.0257	0.0
Manufacturing	58-432	322.2	.0273	0.0	1729	0	0	85.5	.0052	0.0
Other Transportation	433-436, 438-440	472.1	.0744	0.0	2902	1	0.0	187.5	.0266	0.0
- Air Transportation:	437	6.4	.0353	0.6	74	0	0	2.8	.0151	0.6
Communications	441-442	46.0	.0623	0.1	195	0	0	11.2	.0151	0.1
Utilities	443-446	285.5	.0848	0.0	626	0	0	45.5	.0158	0.0
Wholesale Trade	447	89.5	.0570	0.1	1076	1	0.1	37.0	.0235	0.1
Other Retail Trade	448-449, 452-453	53.0	.0343	0.1	1583	1	0.1	25.9	.0165	0.1
- Food Stores:	450	33.7	.3547	1.1	923	10	1.1	19.8	.2085	1.1
- Automotive Dealers & Service Stations:	451	57.2	.3713	0.7	1111	7	0.7	26.1	.1692	0.7
- Eating & Drinking:	454	70.0	.9469	1.4	2414	33	1.4	23.8	.3219	1.4
- Miscellaneous Retail:	455	17.7	.1414	0.8	952	8	0.8	8.7	.0700	0.8
Finance, Insurance, & Real Estate (FIRE)	456-462	207.1	.240	0.1	1779	3	0.2	27.3	.0320	0.1
Other Services	464-476, 478-487, 489-509	346.7	.2458	0.1	6913	6	0.1	152.5	.1155	0.1
- Hotels and Lodging Places:	463	40.7	1.303	3.3	11132	36	3.3	16.2	.5181	3.3
- Automobile Rental and Leasing:	477	.55	.0792	16.8	16	2	16.8	.2	.0229	16.8
- Amusement and Recreation Services:	488	4.0	.2212	5.9	187	10	5.9	1.7	.0945	5.9
Federal, State, and Local Government	510-515, 519-523	261.9	.0428	0.0	6660	0	0.0	207.2	.0146	0.0
TOTAL:		4014.6	5.72	0.1	38853	120	0.3	1289.9	1.7173	0.1
MOST AFFECTED SECTORS:		230.3	3.45	1.5	6810	107	1.6	99.3	1.4	1.5

Table 11: Action Alternative Wet Condition — Data Year: 1999 — (Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output			Employment			Labor Income		
		Total ($M)	Change from No Action		Total (Jobs)	Change from No Action		Total ($M)	Change from No Action	
			$M	Percent		Jobs	Percent		$M	Percent
Agriculture, Forestry, Fishing	1-27	50.8	.0098	0.0	1340	0	0	15.9	.0035	0.0
Mining	28-47, 57	1349.7	.0299	0.0	4146	0	0	283.9	.0064	0.0
Construction	48-56	335.6	.0933	0.0	3211	1	0.0	111.3	.0441	0.0
Manufacturing	58-432	322.1	.0466	0.0	1729	0	0	85.5	.0087	0.0
Other Transportation	433-436, 438-440	471.9	.1217	0.0	2900	2	0.1	187.5	.0426	0.0
- Air Transportation:	437	6.3	-.0465	-0.7	73	-1	-0.7	2.7	-.0199	-0.7
Communications	441-442	45.8	.1086	0.2	194	1	0.3	11.1	.0263	0.2
Utilities	443-446	285.4	.1505	0.1	625	0	0	45.4	.0279	0.1
Wholesale Trade	447	89.4	.1008	0.1	1075	1	0.1	36.9	.0416	0.1
Other Retail Trade	448-449, 452-453	53.0	.0624	0.1	1581	2	0.1	25.8	.0301	0.1
- Food Stores:	450	33.2	.9785	3.0	909	27	3.0	19.5	.5752	3.0
- Automotive Dealers & Service Stations:	451	56.8	1.337	2.4	1102	26	2.4	25.9	.6092	2.4
- Eating & Drinking:	454	68.3	1.846	2.8	2356	64	2.8	23.2	.6275	2.8
- Miscellaneous Retail:	455	17.5	.3703	2.2	941	20	2.2	8.6	.1832	2.2
Finance, Insurance, & Real Estate (FIRE)	456-462	206.6	.4156	0.2	1773	5	0.3	27.2	.0541	0.2
Other Services	464-476, 478-487, 489-509	346.2	.4243	0.1	6901	10	0.1	152.2	.1980	0.1
- Hotels and Lodging Places:	463	38.2	2.097	5.8	1062	58	5.8	15.2	.8336	5.8
- Automobile Rental and Leasing:	477	.3	-.1360	-31.3	9	-4	-31.3	.1	-.0393	-31.3
- Amusement and Recreation Services:	488	2.9	-.2642	-8.3	137	-12	-8.3	1.2	-.1129	-8.3
Federal, State, and Local Government	510-515, 519-523	261.8	.0797	0.0	6659	1	0	207.2	.0266	0.0
TOTAL:		4001.8	8.15	0.2	38724	201	0.5	1286.5	3.1678	0.2
MOST AFFECTED SECTORS:		223.5	6.2	2.8	6588	178	2.8	96.5	2.7	2.8

Table 12: Action Alternative Dry Condition — Data Year: 1999 — (Impact Area Counties: Daggett and Uintah, Utah, Sweetwater, Wyoming)

Primary Industries/Sectors	IMPLAN Industry Number	Total Industry Output: Total ($M)	Total Industry Output: Change from No Action $M	Total Industry Output: Change from No Action Percent	Employment: Total (Jobs)	Employment: Change from No Action Jobs	Employment: Change from No Action Percent	Labor Income: Total ($M)	Labor Income: Change from No Action $M	Labor Income: Change from No Action Percent
Agriculture, Forestry, Fishing	1-27	50.8	.0117	0.0	1,339	0	0	15.9	.0042	0.0
Mining	28-47, 57	1,349.6	.0362	0.0	4,146	0	0	283.9	.0077	0.0
Construction	48-56	335.3	.1102	0.0	3,208	2	0.1	111.2	.0523	0.1
Manufacturing	58-432	322.0	.0551	0.0	1,728	1	0.0	85.4	.0104	0.0
Other Transportation	433-436, 438-440	471.6	.1471	0.0	2,896	2	0.1	187.4	.0519	0.0
- Air Transportation:	437	6.3	-.0122	-0.2	72	0	0	2.7	-.0052	-0.2
Communications	441-442	45.5	.1277	0.1	193	1	0.3	11.1	.0309	0.3
Utilities	443-446	285.0	.1765	0.1	624	1	0.1	45.4	.0328	0.1
Wholesale Trade	447	89.1	.1184	0.1	1,072	1	0.1	36.8	.0489	0.1
Other Retail Trade	448-449, 452-453	52.8	.0725	0.1	1,576	2	0.1	25.8	.0349	0.1
- Food Stores:	450	31.5	1.0228	3.4	861	28	3.4	18.5	.6012	3.4
- Automotive Dealers & Service Stations:	451	54.8	1.3160	2.5	1,063	26	2.5	25.0	.5995	2.5
- Eating & Drinking:	454	64.1	2.1127	3.4	2,212	73	3.4	21.8	.7182	3.4
- Miscellaneous Retail:	455	16.8	.3922	2.4	904	21	2.4	8.3	.1940	2.4
Finance, Insurance, & Real Estate (FIRE)	456-462	205.5	.4913	0.2	1,760	6	0.3	27.1	.0646	0.2
Other Services	464-476, 478-487, 489-509	345.1	.5011	0.1	6,875	12	0.2	151.7	.2343	0.2
- Hotels and Lodging Places:	463	32.7	2.5646	8.5	909	71	8.5	13.0	1.0197	8.5
- Automobile Rental and Leasing:	477	.1	-.0523	-30.5	3	-2	-30.5	0	-.0151	-30.5
- Amusement and Recreation Services:	488	1.8	-.1192	-6.2	85	-6	-6.2	.8	-.0510	-6.2
Federal, State, and Local Government	510-515, 519-523	261.6	.0921	0.0	6,658	1	0.0	207.1	.0309	0.0
TOTAL:		3,976.6	10.2278	0.3	38,185	240	0.6	1278.8	3.6666	0.3
MOST AFFECTED SECTORS:		208.1	7.2	3.6	6,111	212	3.6	90.0	3.06	3.5

3.3 Commercial Operator Surveys

In addition to the recreator surveys described previously under the recreation section, surveys of both Green River and Flaming Gorge Reservoir commercial operators were also conducted during the summer of 2001 to try and identify anticipated adverse impacts not discernable from the three-county oriented regional analysis. Commercial operations on the Green River include rafting/scenic floating and boat fishing guides. Commercial operations on Flaming Gorge Reservoir include fishing guides and marinas.

The survey response rate was fairly good overall, especially for the Green River operators. Of the 12 river commercial operators, 10 returned surveys. The two that didn’t respond were small operators. As a result, the responses provided for the river are assumed to represent a census. On the reservoir, five of the nine boat guides and two of the three marinas provided responses. While not indicative of a census, the reservoir response rate was considered sufficiently representative to present the survey results.

Despite the reasonable response rates, the survey data did not provide enough information to estimate impacts by alternative since not all the respondents answered all the questions. While it would have been useful to separately identify impacts to commercial operations on both the river and reservoir, it should be noted that the regional modeling analysis incorporates (but does not strictly identify) most of the impacts to the commercial operators by addressing changes in visitation and recreation expenditures (including guide fees and marina rentals). As a result, if estimation of direct impacts to commercial operators had been possible from the survey, it would have been inappropriate to add them to the impacts already estimated via the regional model since that would have implied double counting. The difficultly with the regional modeling results are that they are aggregated by economic sector and industry and do not provide detailed impacts for specific businesses.

For both the river and reservoir, the surveys did provide some useful commercial operator information by recreation activity in terms of: 1) average visitation and revenue, 2) high end, low end, and preferred flows/water levels, and 3) preferred flow/water level visitation and revenue. The site and activity specific high end, low end, and preferred flow/water level information was compared to average flow/end of month water level information for each alternative under average, wet, and dry conditions for the months from March to October to try and evaluate alternative preferences (see tables 13 and 14).

In addition, assuming historical averages for visitation and revenue reflect No Action average conditions, the additional visitation and revenue under preferred conditions may provide an indicator of possible impacts under average conditions. In the typical case where Action Alternative flows/water levels are closer to preferred flows/water levels than No Action flows/water levels, the difference between average historical/No Action conditions and preferred conditions presented below could be used to as an upper bound on possible Action Alternative visitation and revenue impacts. The further away Action Alternative flows/water levels fall from preferred flows, the lower the impact. In cases where No Action Alternative flows/water levels are closer to preferred flows/water levels, the visitation and revenue impacts presented below would not reflect an upper bound.

In table 13, for Green River scenic floating operations, the survey indicated that preferred flows for reach 1 from the dam to the confluence of the Yampa River averaged 4,040 cubic feet per second (cfs) with a range from 2,000 to 10,000 cfs. High end and low end thresholds, depicting the points where flows are either too high or too low for rafting, averaged 15,200 and 715 cfs, respectively.

Table 13: Green River Commercial Operator Hydrology Comparisons

Recreation Activity	Flow Levels	Month	Average Conditions					Wet Conditions					Dry Conditions				
			No Action Flow	Beyond Usable Range?	Action Flow	Beyond Usable Range?	Closest to Preferred Flow	No Action Flow	Beyond Usable Range?	Action Flow	Beyond Usable Range?	Closest to Preferred Flow	No Action Flow	Beyond Usable Range?	Action Flow	Beyond Usable Range?	Closest to Preferred Flow
Scenic Floating	Preferred: 4,040	Mar	1,484	No	1,270	No	No Action	1,898	No	2,030	No	Action	800	No	800	No	Same
	High End: 15,000	Apr	2,207	No	1,904	No	No Action	3,290	No	3,981	No	Action	800	No	800	No	Same
	Low End: 715	May	3,463	No	3,233	No	No Action	5,100	No	5,537	No	No Action	1,400	No	800	No	No Action
		June	2,710	No	3,962	No	Action	5,917	No	7,038	No	No Action	800	No	893	No	Action
		July	983	No	2,185	No	Action	1,200	No	4,600	No	Action	800	No	893	No	Action
		Aug	1,251	No	1,626	No	Action	1,531	No	2,131	No	Action	931	No	906	No	No Action
		Sept	1,374	No	1,639	No	Action	1,639	No	2,239	No	Action	1,039	No	939	No	No Action
		Oct	1,654	No	1,487	No	No Action	2,075	No	2,172	No	Action	1,039	No	800	No	No Action
						Overall:	Action				Overall:	Action				Overall:	No Action
Boat Fishing	Preferred: 2,338	Mar	1,484	No	1,270	No	No Action	1,898	No	2,030	No	Action	800	No	800	No	Same
	High End: 7,530	Apr	2,207	No	1,904	No	No Action	3,290	No	3,981	No	No Action	800	No	800	No	Same
	Low End: 800	May	3,463	No	3,233	No	Action	5,100	No	5,537	No	No Action	1,400	No	800	No	No Action
		June	2,710	No	3,962	No	No Action	5,917	No	7,038	No	No Action	800	No	893	No	Action
		July	983	No	2,185	No	Action	1,200	No	4,600	No	No Action	800	No	893	No	Action
		Aug	1,251	No	1,626	No	Action	1,531	No	2,131	No	Action	931	No	906	No	No Action
		Sept	1,374	No	1,639	No	Action	1,639	No	2,239	No	Action	1,039	No	939	No	No Action
		Oct	1,654	No	1,487	No	No Action	2,075	No	2,172	No	Action	1,039	No	800	No	No Action
						Overall:	Action				Overall:	No Action				Overall:	No Action

Table 14: Flaming Gorge Reservoir Commercial Operator Hydrology Comparisons

			Average Conditions					Wet Conditions					Dry Conditions				
Recreation Activity	Flow Levels	Month	No Action Flow	Beyond Usable Range?	Action Flow	Beyond Usable Range?	Closest to Preferred Flow	No Action Flow	Beyond Usable Range?	Action Flow	Beyond Usable Range?	Closest to Preferred Flow	No Action Flow	Beyond Usable Range?	Action Flow	Beyond Usable Range?	Closest to Preferred Flow
Boat Fishing	Preferred: 6,029	Mar	,6024.0	No	6,025.8	No	Action	6,027.9	No	6,027.9	No	Same	6,019.0	No	6,023.5	No	Action
	High End: 6,040	Apr	6,024.1	No	6,026.0	No	Action	6,028.5	No	6,028.5	No	Same	6,020.1	No	6,023.0	No	Action
	Low End: 6,006	May	6,023.8	No	6,025.8	No	Action	6,029.4	No	6,029.2	No	Action	6,017.6	No	6,022.8	No	Action
		June	6,026.6	No	6,027.8	No	Action	6,031.7	No	6,030.3	No	Action	6,018.5	No	6,024.5	No	Action
		July	6,029.1	No	6,029.2	No	No Action	6,035.5	No	6,030.7	No	Action	6,019.3	No	6,024.7	No	Action
		Aug	6,028.9	No	6,028.4	No	No Action	6,036.0	No	6,030.5	No	Action	6,018.5	No	6,023.8	No	Action
		Sept	6,028.3	No	6,027.4	No	No Action	6,035.5	No	6,030.0	No	Action	6,017.9	No	6,023.2	No	Action
		Oct	6,027.5	No	6,026.8	No	No Action	6,034.9	No	6,029.8	No	Action	6,017.3	No	6,023.1	No	Action
						Overall:	Action				Overall:	Action				Overall:	Action
Marinas	Preferred: 6,031	Mar	6,024.0	No	6,025.8	No	Action	6,027.9	No	6,027.9	No	Same	6,019.0	Yes	6,023.5	No	Action
	High End: 6,035	Apr	6,024.1	No	6,026.0	No	Action	,6028.5	No	6,028.5	No	Same	6,020.1	Yes	6,023.0	No	Action
	Low End: 6,023	May	6,023.8	No	6,025.8	No	Action	6,029.4	No	6,029.2	No	No Action	6,017.6	Yes	6,022.8	Yes	Range
		June	6,026.6	No	6,027.8	No	Action	6,031.7	No	6,030.3	No	Same	6,018.5	Yes	6,024.5	No	Action
		July	6,029.1	No	6,029.2	No	Action	6,035.5	Yes	6,030.7	No	Action	6,019.3	Yes	6,024.7	No	Action
		Aug	6,028.9	No	6,028.4	No	No Action	6,036.0	Yes	6,030.5	No	Action	6,018.5	Yes	6,023.8	No	Action
		Sept	6,028.3	No	6,027.4	No	No Action	6,035.5	Yes	,6030.0	No	Action	6,017.9	Yes	6,023.2	No	Action
		Oct	6,027.5	No	6,026.8	No	No Action	6,034.9	No	6,029.8	No	Action	6,017.3	Yes	6,023.1	No	Action
						Overall:	Action				Overall:	Action				Overall:	Action

Comparing the high end/low end flow thresholds to average condition flows for both the No Action and Action Alternatives indicates that average flows for both alternatives for the March thru October months fall within the usable range. For each month, an evaluation was also made as to which alternative's flows were closer to the preferred flow (monthly comparison). Of the 8 months studied, 4 months resulted in the Action Alternative being preferred and 4 months resulted in the No Action being preferred. Finally, differences between the preferred flow level and both No Action and Action Alternative flows were calculated for each month. The absolute value of these differences was summed, and the alternative with the lowest total difference was considered preferred (seasonal comparison). The Action Alternative was judged to be preferred by commercial rafters based on this seasonal comparison.

The Action Alternative was deemed to be preferred by commercial rafting operators under wet conditions. Both alternatives fell within the usable flow ranges for all months. The results suggest the Action Alternative would be preferred under wet conditions based on both the overall seasonal flow difference as well as 6 of the 8 months studied.

Conversely, the No Action Alternative would appear to be preferred by commercial rafting operators under dry conditions. Both alternatives fell within the usable flow ranges for all months. It appears the No Action Alternative would be preferred based both on the overall seasonal flow difference as well as 4 of the 6 months studied (note that the difference from the preferred flow was the same for 2 months for both alternatives).

Rafting operators indicated an average of 40 boat trips a year with a range from 10 to 90. Note that boat trips would include multiple rafters and perhaps multiple days. Average annual revenues were estimated at about $235,000 with a range from $35,000 to $476,000. Average additional annual trips under preferred flows were estimated at about 17 trips with a range from zero to 54. Some operators noted that visitation is controlled within Dinosaur National Monument such that number of trips could not increase under preferred flows, but number of clients per trip could increase. Average additional annual revenues under preferred flows were estimated at about $39,000 (+16.6%) with a range from $0 to $90,000.

For Green River boat fishing operations, in table 13, the surveys suggest that preferred flows for the portion Reach 1 associated with boat fishing (from the dam to the Utah/Colorado State line) averaged 2,338 cfs with a range from 1,400 to 2,800 cfs. High and low end thresholds for boat fishing averaged 7,530 and 1,030 cfs, respectively. Based on comments from the Green River Outfitter and Guides Association, the low end threshold was further reduced to 800 cfs.

The Action Alternative was deemed to be preferred by commercial boat fishing operators on the Green River under average conditions based on comparisons to preferred flows since both alternatives fell within the usable range across all months. The comparisons to preferred flows resulted in the Action Alternative being preferred based on the overall seasonal flow difference. Individual monthly comparisons resulted in no obvious preference since 4 of the 8 months went to each alternative, although the lower use months of March and October showed a preference for the No Action implying the higher use months of April through September preferred the Action Alternative.

The No Action Alternative was deemed to be preferred by commercial boat fishing operators under wet conditions. Both alternatives fell within the usable flow ranges for all months. The preferred flow comparisons resulted in the No Action Alternative being preferred based on the overall seasonal flow difference, but both alternatives appear to be equally attractive based on the monthly comparisons. Looking at the higher use months of April through September, the No Action Alternative would be preferred.

Similarly, the No Action Alternative would appear to be preferred by commercial boat fishing operators under dry conditions. While both alternatives fall within the usable range in all months, the No Action would be preferred based on comparisons to preferred flow. The No Action Alternative would be preferred in 4 of the 6 months with preferred flow based differences.

Two of the four boat fishing operators who responded to the survey question indicated an average of 210 boat trips a year. Average annual revenues across all four operators were estimated at about $245,600 with a range from $32,000 to $500,000. Average additional annual trips under preferred flows was estimated at about 54 trips with a range from 23 to 108. Average additional annual revenues under preferred flows was estimated at about $17,000 (+6.9%) with a range from $7,200 to $35,000.

In table 14, for Flaming Gorge Reservoir boat fishing operations, preferred water levels averaged 6029 feet above mean sea level. High and low end thresholds averaged 6040 and 6006, respectively.

The Action Alternative was deemed to be preferred by commercial boat fishing operators on Flaming Gorge Reservoir under average conditions. Both alternatives fell within the usable water level ranges for all months. The comparisons to preferred water levels resulted in the Action Alternative being preferred based on the overall seasonal water level difference and in 4 of 8 monthly comparisons.

The Action Alternative was deemed to be preferred by commercial boat fishing operators under wet conditions. Both alternatives fell within the usable water level ranges for all months. The comparisons resulted in the Action Alternative being preferred based on the overall seasonal water level difference and in 6 of 6 months (note that 2 months resulted in the same water level differential for both alternatives).

The Action Alternative would appear to be preferred by commercial boat fishing operators under dry conditions. Both alternatives fell within the usable water level ranges for all months. The Action Alternative would be preferred based on both the overall seasonal water level difference and the monthly comparisons for all months studied.

Reservoir boat fishing operators indicated an average of 107 clients a year with a range from 20 to 220. Average annual revenues were estimated at about $12,800 with a range from $4,000 to $38,000. Average additional annual trips under preferred water levels was estimated at 5 trips with a range from zero to 18. Average additional annual revenues under preferred water levels were estimated at only $650 (5.1%) with a range from $0 to $2,250.

For Flaming Gorge Reservoir marina operations, table 14 indicates preferred water levels across all boat based activities averaged 6031 feet with a range from 6030 to 6035 depending on activity. High and low end thresholds averaged 6035 and 6023, respectively.

The Action Alternative was deemed to be preferred by commercial boat fishing operators on Flaming Gorge Reservoir under average conditions. Both alternatives fell within the usable water level ranges for all months. The comparisons to preferred water levels resulted in the Action Alternative being preferred based on the overall seasonal water level difference and in 5 of 8 monthly comparisons.

The Action Alternative was deemed to be preferred by commercial boat fishing operators under wet conditions. No Action water levels for July through September were the only months to fall outside the usable range. The comparisons resulted in the Action Alternative being preferred based on the overall seasonal water level difference and in 4 of 5 months (note that 3 months resulted in the same water level differential for both alternatives).

The Action Alternative would appear to be preferred by commercial boat fishing operators under dry conditions. This is primarily because the No Action Alternative falls outside the usable water level range in all months compared to only 1 month (May) for the Action Alternative.

Marina operators responded with an average of 97,200 clients a year. Average annual revenues were estimated at about $915,800. Average additional annual trips under preferred water levels was estimated at 10,600 trips. Average additional annual revenues under preferred water levels were estimated at $225,400 (+24.6%). These additional revenues include cost savings associated with reduced operation and maintenance (O&M) related to moving and shoring up docks, moorings, etc. under preferred water levels. In general, the cost of operating and maintaining marinas, boat ramps, and boat camps increases as water levels drop below preferred water levels. The annual O&M costs savings under preferred conditions at the two marinas averaged $46,000.

Comparing the high and low end thresholds provided by the commercial operators to those from the recreator surveys for the same recreation activity indicates that generally speaking the commercial operators were willing to pursue visits over a wider range of flows/water levels. In other words, the high end thresholds were higher and the low end thresholds were lower for the commercial operators. The preferred flows/water levels for the commercial operators were higher than those from the recreator surveys.

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Visual Analysis Specialist Report Technical Appendix

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July 19, 2002

INTRODUCTION

This report addresses the scenic resources surrounding Flaming Gorge Reservoir and the Green River Corridor. The focus is on potential visual impacts to changes in shoreline exposure resulting from fluctuating ongoing water levels and downstream water flows. Discussion will include scenic resources on the Flaming Gorge National Recreation Area (NRA) and the Green River Corridor.

The U.S. Department of Agriculture Forest Service (USDA Forest Service) and Bureau of Land Management (BLM) have developed systems for the administration of scenic qualities on Federal lands (Scenery Management System, USDA Forest Service, 1995, 1974; Visual Resource System, BLM, 1991). Both agency systems are addressed where applicable.

The Bureau of Reclamation has requested the report and is providing funding.

AFFECTED ENVIRONMENT

Flaming Gorge Reservoir is situated on the eastern slope of the scenic Uinta Mountains in Northeastern Utah. The concrete arch dam was constructed during the early 1960s. The heart of the Flaming Gorge National Recreation Area is a

91-mile long reservoir, created by Flaming Gorge Dam. There are over 300 miles of shoreline. An estimated 3,000 acres of shoreline are involved.

The Green River flows out of the dam, down through the lower reaches of Red Canyon, and into Brown's Park. The stretch of river covers approximately 20 miles. An estimated 100 acres of riverbank are involved.

Landscape Character

The landscape consists of a high plateau, about 8,000 feet in elevation, covered by Ponderosa pine, and pinyon-juniper; and is dissected by Red Canyon. The Green River flows through the deep Red Canyon beginning at Flaming Gorge, near Sheep Creek Flats and exits at Brown's Park, a broad open valley near the Utah-Colorado State line. Rock formations are prominent and soils are reddish in color. The Uinta Mountains form a high scenic backdrop to the west.

The Wyoming portion consists of a different land type, prominent grayish ledges and bluffs, where the Green River Corridor is not as deeply defined. Vegetative patterns are of a sage nature. Soils consist of a shale or clay type material. Open spaces are prominent.

Scenic Integrity

Visual qualities are perceived by those who normally recreate or spend time in a particular area who, in this case would be the Casual Forest Visitor. Much of their recreational experience relates to their concern for scenic quality and the condition of the view shed.

Scenic values and qualities within the Flaming Gorge NRA and along the Green River Corridor are high. With a background of the Uinta Mountains and distant vistas, this is the premier scenic showcase for northeastern Utah and southwestern Wyoming.

The normal goal for the USDA Forest Service and BLM would be to manage the NRA and Green River Corridor for a "Naturally Appearing" landscape character. To go back in time about 50 years, there was a river, flowing through a series of canyons, including the Firehole regions of Wyoming, Flaming Gorge, Red Canyon and Brown's Park in Utah and on into Colorado. Human intrusions were minimal, with a few occasional dirt roads and homesteads. The area was truly scenic, unaltered and natural in appearance.

During the mid-1960s, a dam was constructed in Red Canyon and backed up water for 91 miles. Along with the reservoir, a large influx of people desiring a recreational experience was anticipated. Highways were constructed. Bridges, boat ramps, campgrounds, visitor centers, restaurants, lodges, and service stations followed. A town site was constructed. Along with the dam, came power generators and transmission lines to serve distant communities. Utilities and lines, such as water, gas, sewer and electrical distribution, were needed to support the local facilities.

As anticipated, the public does visit the NRA and uses the facilities as listed above. They enjoy the "natural" scenery, camping, fishing, floating the river and hiking the trails. They truly enjoy the area. Scenic Byways extend along both sides of the NRA and Flaming Gorge Reservoir from Wyoming into Utah.

The scene has changed in the last 40 years. We now manage a "Cultural" landscape, at least on the Utah side, which has a high influence of recreational aspects. There are enough developed and dispersed overnight facilities within the NRA to accommodate over ten thousand people in any one night. The scenic values for the area still persist, as people are able to sort out and look beyond the negative scenic features.

The Recreation Opportunity Spectrum would call for this area to be managed for a Roaded-Natural or Roaded-Modified setting. The Recreation Opportunity Spectrum for the area around Flaming Gorge Dam is close to an "Urban" setting.

The Scenic Integrity Level for the southern end of the NRA, including Cedar Springs, the dam, Dutch John, Antelope Flats, and Little Hole is considered Moderate to Low, because of related service developments as mentioned above. Scenic Integrity Levels for the Wyoming portion and Green River Corridor, below Little Hole would be considered as High to Moderate. The desired condition for the entire NRA and Green River Corridor would be "Natural Appearing" and "Cultural".

Bureau of Land Management Lands along the Green River Corridor, below Little Hole have a Class II Objective, "Change is visible, but does not attract attention."

Constituent Information

Visitors to the NRA come from Utah, Wyoming, Colorado, and all over the United States. Most foreign Visitors are from England, Germany, France and Japan. They expect to view outstanding scenery, visit the dam, and catch trophy fish. The majority of recreation use occurs during the summer months, between Labor Day and Memorial Day, or approximately 100 days.

Recreational opportunities include driving for pleasure, viewing scenery, fishing, boating, floating, waterskiing, swimming, scuba diving, hunting, mountain biking and hiking. Winter activities include cross-country skiing, snowmobiling and ice fishing on the reservoir and stream fishing on the river. Facilities include visitor centers, boat ramps, campgrounds, trails, commercial lodges, service stations, and marinas.

The Green River, below the dam is classified as a Recreational River, within the Wild and Scenic Rivers Classification system. The trail from Spillway to Little Hole is classified as a National Recreation Trail. The Green River is a Blue ribbon trout fishery and is heavily fished throughout the year. Rafting is popular on the Green River from May through September. A popular Scenic Backway extends from the Utah Colorado State Line through Brown's Park and into Vernal. Attractions along the Backway include John Jarvies Historical Ranch, campgrounds and picnic facilities.

The Flaming Gorge-Uintas National Scenic Byway, US Highway 191, begins in Vernal, Utah, and extends past Dutch John and to the Wyoming state line. Included is Highway 44, from Greendale Junction with US 191 to Manila, Utah. Intrinsic qualities include Scenic, Recreational, Natural, Historical, and Cultural. The Byway Theme is "Wildlife Through the Ages."

The Flaming Gorge-Green River Basin Scenic Byway picks up at the Wyoming State line and carries northward on Highway 530 to Green River, and US Highway 191 to Rock Springs. Designated by Wyoming in 2002, this byway has Recreational and Natural intrinsic qualities. The Byway Theme carries over from the Utah neighbor, "Wildlife Through the Ages."

Landscape Visibility

Most areas within the NRA are seen by the public from one point or another. People in boats scrutinize all parts of the reservoir and shoreline from the water level. Other Forest visitors and fishermen view the reservoir from above and points around the NRA, such as Red Canyon Visitor Center, Flaming Gorge Dam and Visitor Center, campgrounds, marinas and dispersed areas.

People floating the Green River and hiking the trail have the perspective of Red Canyon at the water level. Only a few vista points along the river are available from roadways. These include views from Flaming Gorge Dam, Spillway Boat Ramp, Little Hole area, and at Brown's Park.

APPLICATION

Flaming Gorge Reservoir

The visual management inventory for the Flaming Gorge NRA (Baird, 1985) calls for the area within the Flaming Gorge NRA as "Retention" of visual quality. This visual quality objective would provide for management activities that are not visually evident.

The Scenery Management System (SMS), adopted by the USDA Forest Service in December, 1995, supercedes the Visual Management System and

USDA Forest Service directives called for future visual analyses to adopt the new Scenery Management System. Subsequent discussion for this visual analysis will use SMS.

As mentioned above, the desired visual resource management goal on the NRA would be for a “Naturally Appearing” landscape. We are in a “Cultural” setting where concentrations of people and developments exist, such as the Cedar Springs area, at Flaming Gorge Dam and the Dutch John Townsite. Several factors need to be considered here.

Although a reservoir with draw down, some local entities have renamed it “Lake Flaming Gorge.” The perception is for many people to view the reservoir as a lake. The draw down levels of 20 or 30 feet below high water line is minor to the entire scale of the reservoir, especially as viewed from any one viewpoint.

Several natural conditions exist, some as a result of man’s activities of dam construction. Man has built the dam and has caused water to back up in Red Canyon. As a result of this action, natural processes are taking place, such as a buildup of calcium bicarbonate in the water, which tends to coat rocks and other features with a white film in which it comes in contact.

Another natural process is the weather patterns for Utah and Wyoming, and more specifically, the Green River Corridor. Provided that we experience normal or wet weather patterns every year, it could be feasible to manage at the high water level within the reservoir through time. Because of dry cyclic conditions, such as we are currently experiencing, there is a natural draw down of the reservoir surface. The surface elevation will either rise or drop, according to available natural water supply.

A third natural condition, or possible act of man, is to simulate historic natural spring flooding downstream in order to maintain habitat for endangered and sensitive species. These seasonal flows seem to tax a lot of storage reserve, which adds to changing water levels during the summer recreational season.

Many of the access points to Flaming Gorge Reservoir were visited and photographed by this writer. (See photographs in this report.) The visual effect of the draw down and white mineral coating is most apparent in the lower regions of the reservoir, specifically from Red Canyon Visitor Center and the Dam Visitor Center. The view from Red Canyon Visitor Center and overlook is from a distance and height that a few miles of shore line is visible. The view from the Dam Visitor Center is at water level. The white line does not stand out as much from many other locations around the reservoir.

This author visited visitor centers and information outlets around Flaming Gorge NRA and at Brown’s Park. Facilities visited include:

1. Dam Visitor Center,
2. Red Canyon Visitor Center,
3. Flaming Gorge NRA Headquarters in Manila,
4. Dutch John USDA Forest Service Office,
5. Rock Springs Chamber of Commerce,
6. Green River Chamber of Commerce and Forest Service Office,
7. Lucerne Valley Marina,
8. Red Canyon Lodge, and
9. John Jarvie’s Historical Ranch in Brown’s Park (BLM).

At least 10 people at these information outlets were interviewed (see attachment), and most comments concerning the low water level indicated public concern about the dry climate conditions of the area and low water levels as a result. The public registers and comment forms - for the past several months were reviewed at Red Canyon Visitor Center and Dam Visitor Center. All comments entered were of a positive nature expressing the awesome scenery of the area. (See attached comment forms for the Dam Visitor Center.) Only one verbal comment concerning visual concerns was received by Bill Shane, Information Specialist at Red Canyon Visitor Center. Bill indicated that a lady asked, “Who painted the white line?”

At State Line Cove, near Manila, Utah, and at various other places in Wyoming around the reservoir, people choose to camp within the high water line of the reservoir. The lower the water level, the better it is for more places to camp and more space between units.

Many of the photographs of Flaming Gorge National Recreation Area, which have been taken by professional photographers, show the reservoir and white line. These are award winning photographs, transferred to post cards and on sale at the commercial outlets around the area. They are popular sale items and Forest visitors don't seem to hesitate to purchase them.

People do notice the draw down level of the reservoir, along with white line, but it does not detract from their overall recreational experience in the area. The low water marks and white line effects are only noticeable along some segments of the entire 300 miles of shoreline. During winter months any impacts are naturally mitigated with a covering of snow.

Visual effects are negligible as compared with the inherent scenery of the area.

The Green River

The USDA Forest Service visual management goal for the Green River Corridor would be for a "Natural Appearing Landscape Character."

The BLM has completed a Visual Resource Analysis along the Green River, downstream from the Forest Boundary to Brown's Park, which calls for Class II management. Some altering of the landscape can occur within Class II areas, but management activities and structures should not attract a viewer's attention.

In viewing the low-water stream flows along the Green River, there are few to no visual effects on the stream banks, from the perspective of the casual visitor. Some mud banks and exposed rocks stick out of the water, however they appear as a natural occurrence under low water conditions. Very few indications of white buildup are apparent on the cobble rocks or along the stream banks.

To summarize, the visual effects of low water flows along the Green River are negligible. Any effects are well within management prescriptions for the area.

ATTACHMENTS

Compilation of Visitor's Comments by Information Specialist, Brent Hanchett, 2002.

Visitor Comments at Flaming Gorge Dam. Hard Copy, 2002.

Photographs of Flaming Gorge and Green River, 2002.

ATTACHMENT 1
COMPILATION OF VISITOR'S COMMENTS, 2002

by Information Specialist
Brent Hanchett
June/July 2002

JUNE 10, 2002

Lori, Dinosaur Nature Association
Tour Guide
Flaming Gorge Dam and Visitor Center

Lori indicates there have been no questions or comments about the ring or white line around the reservoir. They bring up the fact that the reservoir presently has a 25-foot drawdown and is from drought and dry conditions. The publics concern then focuses on the drought conditions.

When asked, Lori said that people do ask about the pipeline clearing that goes over Dutch John Gap, and about fire scars in the area.

Nanette Gamble
USDA Forest Service
and two other interpreters
Flaming Gorge Dam and Visitor Center

The reservoir drawdown is an indicator of drought and weather conditions and is used by the interpreters as a discussion item.

Nanette will send comment forms from the Dam Visitor Center.

Individual from Cheyenne, Wyoming
at Dam Point Picnic Area

The water level being low is of concern, but the drawdown ring is not a problem. He has been floating the Green River and can tell a difference in low water conditions.

Bill Shane
Information Specialist
Red Canyon Visitor Center

Bill indicates that people do ask about the white line around the reservoir and why. After explanation, they are ok. One lady asked, "Who painted the white line?"

Mark Wilson
Owner/Operator
Red Canyon Lodge

Mark indicates no concern from the public that would impede recreational use of the area.

Jerry Taylor
Owner/Operator
Lucerne Valley Marina

Yes, people are concerned about the drawdown, especially Stateline Cove. Use is way down. Because of the low water, there is a large sandbar that extends out into the water that makes access difficult to the water.

Jerry also commented that people wanting to visit Flaming Gorge Reservoir have the conception of not enough water to boat on.

Bill, Information Specialist
Green River Visitor Information Center

Bill indicates that weather and dry conditions are of concern to people, but not the visual aspects of the drawdown ring.

June 27, 2002

Farah Humphrey
Frontline Receptionist
Flaming Gorge National Recreation
Headquarters
Manila, Utah.

There is no visual concern, but there is concern about the water level and weather.

July 10, 2002

Volunteer Interpreter
John Jarvies Historic Ranch
Brown's Park, Utah

People floating the Green River have not expressed concern about visual problems related to low water flows.

ATTACHMENT 2
COMPILATION OF VISITOR'S COMMENTS
HARD COPY, 2002

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: Flaming Gorge Dam Visitor Center

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
1/24/02	[illegible] Pantoja	Miami, Fla 33137	4	[illegible], cold
1/27/02	James, Lynette Fick			
	& Wyatt	#40 C.R. 4138, Aztec NM 87410	3	
1/31/02	[illegible] Anderson	Billings, MT 5910[illegible]	2	could be [illegible]!
1/31/02	HARRY DAVIS	PLEASANT GROVE, UT	1	
[illegible]/31/02	[illegible]	[illegible]	2	[illegible]
2/2/02	[illegible] Hill	Cheyenne, Wy	3	
2/4/02	Judy Ficierno	Brownsville TX-7852[illegible]		
2/8/02	[illegible] Copeland	Roosevelt, Ut 84066	2	Great
2-6-02	Ronny & Sheli Robertson	Crawfordsville, Ut	2	
2/8/02	LeRoy Family	Huntington, Utah	3	
2-9-02	Janette & Ron Decker	Cody, Wy 82414	2	Nice
2-10-02	[illegible]	Rock Springs, Wy 82901	3	where is the [illegible]
2-10-02	Carlos A. Garza	LAREDO TX 78043	7	NICE
2-10-02	Raul Madrigal	LAREDO Tx 78046	7	REAL NICE
2-10-02	Anselmo Rodriguez	Laredo Tx 78041	7	" "
2-11-02	Bon & BARB FOE	[illegible]AUKEE WI 53072	2	GOOD JOB BY ALL
2-11-02	Kathe Jackson	Green River WY 82935	3	Cool!
2-11-02	SEAN NIX	SPRINGFIELD MO	3	Sweet!
2-12-02	[illegible] Ebert	Gaylord MN	2	Great!!!
2-12-02	Ruben Ebert	" " 55334		
2-12-02	[illegible]	[illegible]	2	
2-15-02	Kim + Mari Kroening	St Charles MN	4	
	John + Maxine Hall	Plainview MN		
2-16-02	[illegible] + Vicky Morford	Chadron, NE	2	Beautiful
2-16-02	Andrea [illegible]	Pueblo West CO	2	Beautiful
2-[illegible]-02	[illegible]	Rock Springs W[illegible]	[illegible]	[illegible]
2-19-02	Michelle [illegible]	Chester IL	2	Beautiful!
2-19-02	Devona Malion	Rock Island, IL	2	GORGEOUS!
2-19-02	John + M[illegible] Bauman	Eugene Or	2	
2-19-02	Kristen Baumgarten	Vernal, Ut.	3	
2-22-02	W[illegible] + Claudette Reed	[illegible]ville, MS	4	Great
2-22-02	[illegible]	Roosevelt Ut.	2	
2-22-02	Raquel [illegible]	SONora Mex	1	

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
2-4-02	Ronald Stoltz	Dane Wis 53529		
2-4-02	Jean Meier	Dane, Wis 53529		
2-24-02	Shepherd	Rifle Co	2	
2-27-2	LARRY PORCO	P.O. BOX 1019 BX NY 10462	1	
3/5/02	Louis D Bernier	Westminster, MD 21157	1	
3/5/02	Matthew D. Goulsby	17344 E. Panila D.	1	
3/6/02	Bob & Dianne Hayward	111 Riverview Watertown WI	2	
3/7	[illegible]	[illegible] 83401	2	
3-7-02	RUTH ARTERBURN	St. PAUL, NE 68873	1	
3-10-02	Sharon Price	Caldwell Idaho	2	
3-10-02	Castle	H. R. Ut.	4	
3/16/02	Hutcheon Jack	South Jordan UT	3	
3/16/02	Hutcheon Jesse	Salt Lake City, UT	2	
3/16/02	Hutcheon, Ashly	SLC UT	1	
3/17/02	D.A. McIntyre	Birch Hills Saskatchewan	2	
3/17/02	John/Bonnie Landerdahl	Bozeman, MT	2	
3/19/02	Lisa Hotton	Munster Tx 76252	4	WOW —
3/20/02	Jerry & Nina Hansen	Robertson Wyo.	2	
3/20/02	Father Bruce Nick, CSP	Memphis, TN 38126		
3/20/02	Fr. Jay Bertrand	Vernal UT 84078		great
3/21/02	Carlo Kuttesch	Bethel OH 45106	2	beautiful
3/21/02	Carol Kopka	GWS Colorado		
3/21/02	Stewart	Topeka, KS 66609	4	
3/21/02	Wm. R. Snow	N. V. C. UT.	2	ENJOYED IT.
3/23/02	Florence Allen	Corinna, Maine	4	Awesome
3/23/02	Darrell Hunt	New whiteland, Indiana	2	Better catch some fish
3/23/02	Rachel Dohlen	LAKE CHARLES LA	1	
3-23/02	Brian Cindy, Bernadi, Lindsey	Panhandle Tx 79068	3	
3-24/02	Tom Chen	Taipei / Taiwan	5	
3/24/02	Williams Family	San Mateo Calif	9	Great View
3/25/02	Leo + Jean Bell	Killdeer ND	2	Great View
3/26/02	Monica Jones Peterson	Thermopolis Wy	2	Great Place
3/26/02	PASSIG	Las Vegas NV	2	Wonderful
"	Rockefeller	Gloucester MA	1	
3/27/02	Christy	Athens Ohio	2	
3/27/02	Lauren Roberts	Omaha, Nebraska	4	Awesome
3/27/02	Scott, Teri, Tommy, Cassidy, Cathrine, Kaiya	GRAND JUNCTION	5	BEAUTIFUL

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
3/28/02	The Barry Ankeny Family	Riverton, UT 84065	7	Awesome!
3/29/02	[illegible]	Windsor, Co	2	Great
3/30/02	[illegible]	Hattiesburg, MS.	2	Beautiful!!!
3/30/02	The [illegible]	FILLMORE UT. 84631	4	BREATH TAKING
3/30/02	POKORNEY FAMILY	NORTHFIELD MN 55057	5	
3/30/02	Bascom family	Orem UT 84058	2	Thank-you
3-30-02	Maumber family	Orem UT 84058	3	Thank you
3/30/02	Mills	Layton UT 84040	2	
3/30/02	Mark Wallis	VERNAL UT 84078	3	
3/31/02	[illegible]	[illegible]	2	
11	Vern & Lola Chase	PLEASANT VIEW UT	9	
3/31/02	[illegible]	Vernal UT	3	Beautiful
3/31/02	Hewitt's	SLC UT	4	
3/31/02	James [illegible] Family	Corpus Christi Texas	2	Wow
3/31/02	Stephen Jones	Greenville, SC	4	Beautiful
3/31/02	Curi Shepelle[illegible]	Rock Springs WY	2	Breath taking
4/1/02	Trotter	Sommerville AL 35670	2	Beautiful
4-1-02	Jim + Gail Dawson	Mpls. MN.	2	informative
4-2-02	Dane + Suzanne Luedke	SLC, UT 84106	2	Awesome
4-3-02	Traci, Tammy, Riley, Dru, Nolan	Cincinnati, Oh	3	lovely
4-2-2002	[illegible]	Bellingham WA	2	- Great -
4-3-2002	Mike Eggett	Clfd. UT 84015	3	Totally awesome
4-3-02	TERRY + PAT CALLAHAN	CLARKSVILLE, TN.	2	AWESOME
4-3-02	Timko family	Vicksburg, MI 49097	4	
4-4-02	Hunsaker Nicholas [illegible]	Lakeside Ca. 92021	2	BUENO
4-4-02	Miller + Don Silvius	Yuma Co 80759	2	
4-4-02	DAU RAHBO	STEAMBOAT CO	7	
4-4-02	Lee + Ellen Walker	Brigham city, Utah	2	Beautiful, breath taking
4-4-02	Ruth [illegible]	Pinedale, wy	4	
4-8-02	J & M. Koenderink	Cochrane AB Canada	2	Most Interesting Thank you
4-8-02	James Garrett	Huntsville AL	2	Great
4-9	Ray Kemp	Sandpoint, Id	2	
4-9	Eldon Daglets	Rigby Id.	2	

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
[illegible]	Rhonda	Happy Valley / Provo	1	
3-29	Mike Hunt	V-town	5	Say Name out loud
3-29	Chad	V-town	20	
3-29	Melinda Mccs	Sioux City / Ia / 51104	4	
3-29	Porter + Sherrie Martin	Shabbona, IL / 60550	2	
3-29	Melissa + Jake Fenson	Rock Springs Wy 82901	2	
3-29	Marty Hansen	Roy, Ut, 84067	5	Great Sites of Gorge
3-29	Chelsey Hansen	Roy, Ut 84067	6	Wonderful
3-29	Jim Alberts	Waterford, Mi	1	
4/5	Naomi Lyn Brown	Stone Mtn, GA	2	
4/5	Byland	Oh.	2	
4/5	Dan+Ashley, OHO	Omaha NE 68154	2	Great
4-5	Crundy & Shailen Shafer	Derby, KS	2	
4/6	Greg Buckley	SLC- Ut	1	
4-06-02	Rick, Rose Cherry	Saskatoon, SK Canada	2	
[illegible]	Liz Bailey	[illegible]	4	Beautiful as [illegible]
4/6/02	D+J. Williams	Oakland Pa.	2	
4-6-02	Russ+Renee Roberts	Grand Haven MI	2	
4-7-02	Kees Schot	mpls, MN	1	
4/7/02	Randy, Gwen, Amber, Crafe	[illegible] WY	3	
4/7/02				
4/7/02	Larry Hulsbey	RS Wy	2	
4/7/02	Michael & Nancy Remington	RS Wy	2	
4/7/02	IAN D. CORBETT	BLUFF UT 84512	1	
4/7/02	Tim Schmidt/Family	Rk Springs, WY		
4/7/02	David Tarng	SLC, UT	1	Beautiful
4-7-02	Olsen's	Soda Springs, ID	3	Awesome!
4-7-02	Gleason	[illegible]	4	So [illegible]
4-7-02	Paisley	Cody, Wy 82414	2	Kick Butt
4-9-02	Bob & Barb Lundy	R.S. Wy 82901	2	
4-10-02	Blair Allen	R.S. Wy 82901	1	
4-10	M. Kuechler	Steamboat, CO	2	
4-10	Roger Dignit Hammond	Hackensack, Minn	2	
4-12	R. Schultz	Golden, B.C.	2	
4-12	Norma + Andy Leigh	Houston, Tx.	2	

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ___________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
7/13	Vikki & Dave Gates	Ponte Vedra Bch, FL	3	Let's catch some
	Kevin Miller	Richland, MI	4	fish!
7/13/2002	Rob & Valley Beccu	Commerce City Co	5	Beautiful!
	[illegible] Hannah Vaughan			
	[illegible]	[illegible] CA	2	Lovely
4-14-02	[illegible]	[illegible] Wy 83[illegible]	4	
4-14-02	James & Mercedes Dewey	Kansas City Mo [illegible]	2	Very Nice
4-14-02	Lucas, Corina, Liesa, & Annie	Cedar City, Ut 84720	4	Beautiful
4-14-02	Michael [illegible]	Albany, Oregon	2	
4-15-02	Gary W Roland	Cheyenne Wy 82001	1	Great
4-15-02	[illegible]	[illegible] ID 836[illegible]	2	Spectacular
4-15-02	Mary Larson	Cass Lake MN 56633	2	"
4/16/02	Paul & Bobbie Wilson	Honolulu Hi 96825	2	"
4/16/02	[illegible]	[illegible] WA.	2	"
4/16/02	[illegible]	Darby MT	1	"
4/17/02	Jean Gilang	Angeles City	3	awesome
	Geoffrey Gilang	Philippines		
4/17/02	Jody McGuire	Gr Junction Co 81503	2	
4/18/02	[illegible] Mae [illegible]	[illegible] IL 60433	2	GREAT / BEAUTIFUL SCENE
18 Apr 02	M. STEVENS	DENVER Co 80220	1	
4-18-02	The Cogliati's	Jackson: Maple Creek, Ca	3	Im hungry for fresh fish
4/18/02	The [illegible]	Longmont Co 80501	2	Very Very nice
4-19-02	[illegible] Christensen	Orem Ut 84097	6	pretty
4-19-02	Harwards	Orem, UT 84097	7	View
4-20-02	T. LAWSON GULLETTE	Sterling, VA 20165	5	
4-20-02	Andrea Bristol	Geneseo, IL	1	went to school at U of Idaho [illegible]
4-20-02	John & JACKIE KUSH	ROCKLIN CA	2	NICE TIME TO VISIT
4-20-02	JOE & TRACY	CRAIG CO	2	SNOWING
4-20-02	Burton Family	PG. UT	4	Impressive
4-20-02	Mason Howell	Highlands Ranch CO	1	Beautiful
4-20-02	C.W. Miller	Craig	2	
4/22/02	[illegible]	[illegible] Rock AZ		[illegible]
4/24/02	Donna Skinner	[illegible] Wy	2	
4/23/02	Jim & Ruth Schutten	Big Timber MT	2	
4/24/02	WAYNE PETRY	Buffalo, TX	1	Beautiful

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
4-23	Cliff + Doris Parks	Lake Isabella CA	2	Beautiful Area
4-23	Cari Park		1	Fishermen make my [illegible]
4-24	D [illegible]	[illegible] 32220	2	
4-24	John Sawick	Shelby, IA	2	OUTSTANDING
4-24	Dick & Helen Brown	Oregon	2	
4/24	Mitchell Jan Kelly	Tremont, UT	3	Beautiful area
4/25	Chelsea Pa Hon	Colorado Springs, CO		Breathtaking
4/25	Tanis, [illegible]			
	Lisa [illegible]	Slt, Co	3	Beautiful Scenery
4-26-02	Howard & Eileen Bink	New Cumberland PA	2	
4-26	[illegible] Dick, [illegible]	[illegible], OR 97370	2	
	Lynn Earlene & Luke Perkins	Bern ID	3	Beautiful
4-26	Rod Streetman	Granby Co	1	
4-26	Bob + Lee Mueller	Westminster, CA.	5	
4.27.02	John, Dan Benedict	Colo Springs, CO	2	Cool.
4.27.02	F Winkler	Germany	3	
4/27/02	Julie Kirk	Mustellanye Lake		
	Sean Regan	Theresa, NY	2	awesome!
4-27-02	Sid [illegible]	R.S. Wyo	3	
4/27/02	Jim Mercer	Bloomington MN	3	FANTASTIC
4/26/02	Richard Harris	Smithfield UT	6	
4/28/02	John Smith	Franklin NC	2	Great
4/28/02	Marie Mitchell	Huntington WV	2	Great
4/28/02	Angela Richardson	Vernal, ut	5	Great
04/28/02	Alex Johner Kuipers	The Netherlands	2	Prachtig!
04/28/02	Sonia A.	Green River WY		Nice & Scenery
04/28/02	Erin A	Green River WY		
04/28/02	Tom A.	Green River WY		
4/30/02	Rod & Barbara Dye	Riverton UT	2	Beautiful
4/28/02	Curt & Connie Salisbury	Roy, ut.	2	Wonderful!
5/1/02	Dick Fraap	Auburn, N.H.	2	"
4/29/02	Paul & Cunion Savoye	Jamestown CA 95327	3	Peaceful!
4/29/02	Mike & Ingrid [illegible]	Elk River MN 55330	4	
4/30/02	Keith Morris	Denver CO 80231	2	Beautiful
4/30/02	Remote Area Medical	Knoxville TN 37917	13	
4/30/02	Mary Helen Frith	Spearfish, SD.	2	Nice.

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ______

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
4-30-02	Merrill & Karen [illegible]	Cheyenne WY 82009		
1-30-02	Bus-Mary Barton	Fresno CA 93725	2	Very nice
5-1-02	Hal & Sheila Hansen	[illegible], CA 95465	2	Fantastic
5-1-02	Paul & Glynda Byarley	716 N. 2nd Olsburg KS 66520	2	Great
5-1-02	JOHN & BETTY McGowan	Buffalo, WY	2	Wonderful
5-1-02	Michael & Nicole Hodge	[illegible] UT	2	Great
5/2/02	JIM/SUE REILLY	MCKINLEYVILLE 95519	2	
5/2/02	[illegible] Barbara [illegible]	Horseshoe Lake AR 72348	3	Great
5/2/02	Drone Barron	Caulfield Mo.		
5/2/02	DEBBIE & DAVID UPTON	ROY, UT 84067	2	Wonderful!
5/2/2002	Peter CASEY	Co. Cavan IRELAND	2	So Many Wheat
5/3-02	JOHN & MARGARET Johnston	ROSTOCKER OREGON	2	Beautiful
5-3-02	Bro. Roy & Janice Southern	Arcadia, LA	2	Wonderful
5/3/02	JOHN LINN	RICHMOND, VT, 05477	1	[redacted]
5/3/02	Walter Helen Skow [illegible]	Santa Monica Ca	2	
5/3/02	Leiver's - Jon & Sandy	Green River, Wy	2	
5/3/02	Leiver's - Bob & Jennie	Fargo, ND	2	
5/3/02	[illegible]	[illegible] SC [illegible]	2	[illegible]
5/4/02	NORM & DONNA Stuhlgheisz	ANOKA, MN	2	"
5/4/02	Chuck & Alice Meyer	Ashland, Virginia	2	Spectacular!
5/4/02	Bruce McGinny	[illegible]	2	
5-5-02	Ray & Audrey Gales	Ft. Dodge, IA 50501-5614	2	Excellent!
5-6-02	[illegible]	Cody WY	1	
5-6-02	Russ & Sue Jones	South Fork, Pennsylvania	2	Nice facilities / lake
	[illegible]	Bothell WA	3	Small
5.6.02	Mike Williams	Logan, Ut	4	Swell
5-6-02	Ben & Bev Love	Columbus Ohio	2	
5-7-02	Don McCullough	Yuba City CAL	2	
5-7-02	Rose Perrault	Duluth, MN	1	
5-7-02	Allen Lessa	Rock, NY	3	
5/7/2002	Mike & Diane Cooke	Concord CA	2	very nice
"	Don Schmidt	Bellevue, WA	2	
5-8-02	Bob & Mary Baine	Huntington Bch. CA	2	
5-8-02	Sadie Harvey	Basalt CO	21	windy
5-8-02	Kelsey Nygren	Glenwood Springs CO.	#8	Cold
5/8/02	Elsa Larson	Aspen CO		to Cold and windy But cool and fun!

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FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
5/8/02	Caitlin Doyle	Aspen CO	—	Windy & Cold but pretty
5/8/02	Ania Brogles	Carbondale CO	2	windy cold
5/8/02	Sadie Harvey	Basalt Co		pretty
5/8/02	Gina Fields	Glenwood Spgs CO		nice view
5/8/02	Margaret Downing	Woody Creek CO		Nice veiw.
5/8/02	[illegible]	Collbran Colo	3	great - fascinating
5/8/02	Michael & Carmen [illegible]	Germany	2	nice view
5/8/02	Wayne & Betty [illegible]	Nampa, Idaho	3	
5-8-02	Evelyn Martin	Rock Springs	1	
5-8-02	Larry, Sandy [illegible]	ARIZONA	3	beautiful
5-8-02	[illegible]	UK	1	Great place.
5-9-02	[illegible]	R.S. [illegible] Walmart	4	Great place
5-9-02	Deane	Georgetown TX	2	gorgeous
5/9/02	Butch & Rachael Scott	Sevierville TN 37862	4	beautiful
5/9/02	JAMES + SUSAN Phillip	Sevierville, TN 37876	15	
5/9/02	Richard & Shirley Dehart	Clemmons NC	2	
[illegible]	Robinson[illegible]	ATCHISON KS	2	
5-10-02	W. Krawza	Lakeville Mn	2	very impressive
5-10-02	Rich Riddle	Springfield, CO	1	nice
5-10-02	Sandy & Jim Houston	Buena Vista, CO	2	Fantastic
5/10/02	Dave Hafner	Rock Springs Wyo	7	keep coming back
5-10-02	Keith & Connie Stone	Granger In. (South Bend)	2	
5-11-02	Julie Hazlip [illegible] Beers	SLC, UT	4	
5-11-02	George Gill	[illegible] FC	2	
5-11-02	[illegible]	FT. HALL IDAHO	1	splendid
5-11-02	Art & Shirley [illegible]	St. Louis, MO 63128	2	breath-taking
5-11-02	GAIL WICKS	DORSET, ENGLAND	2	IMPRESSIVE.
5-11-02	Harald Stockwiefen	Uhlendorf, Germany	1	nice
5-11-02	Hans-Josef [illegible]	" "	1	very nice
5-12-02	Dave & Lucy Woodwell	Las Cruces N.M.	2	Nice views
5/12/02	Stephen Scott	Parker, AZ. 85344		Nice Place.
5/12/02	D. + J. Hülsebusch	Brake Germany		
5/12/02	L. Smith	Laramie, WY 82070	4	WHEEEE!!
5/12/02	Williams	15275 S. Sunset Banning Ca 92220	2	Mothers Day Delight
5/12/02	Jim & Fran CATRON	Kingsport TN. 37664	2	
5/13/02	DICK & JAN MALLETT	DURANGO CO	2	

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5/13/2002	DON/JACKIE BAILEY	DURANGO Colo 81301	2	[illegible]
5/13/02	LOGAN + PAT Miller	" "	2	
5-13-02	Bob & Gail Downs	Durango, Co	2	Nice Day, Nice View
5-13-02	Glen & Cindy Hendrickson	Int'l. Falls, mn	3	Beautiful
5-13-02	Mike Steele	Sandy Ut 84070	4	Nice
5-13-02	PAT DAHLIN	Fargo ND	BUS TOUR (45)	BEAUTIFUL
5/13/02	Betty [illegible]	[illegible] Mt.	Bus Tour	very beautiful
	[illegible]	Polson Mt	"	
5/14/02	Aubrey & Jean Johnson	Avinger Tx 75630		
5-14-02	JOHN & MARY DIVIGGIANO	CHICAGO/PALM SPGS	2	LOVE THE DAM!
5-14-02	MARY + Kathy Ankele	NEwberg / Or.	2	
5-14-02	Kenneth & Carol Buckner	Ellijay GA 30540	2	Beautiful
5-14-02	GVW. WARICK	Sequim WA 98382	2	"
14-5-02	J+D CROMPTON	LIVERPOOL. ENGLAND	2	AMAZING & BEAUTIFUL
5-14-02	Wd M. Hussong	Palmdale Ca	2	fantastic
5-14-02	Mariel Goris / Hans Kniest	Hoofddorp / Netherlands	2	beautiful!
5/14/02	Tom + Margaret Porter	Running Springs, CA	2	
5-14-02	Kendy Storie	Pendleton OR	1	
5-14-02	Thelma Lee	Silver City N.M.	1	great
5-14-02	David/Lucy [illegible]	Ocean Park, WA	2	fantastic
5-14-02	J. Masaki	Tokyo, Japan	2	Beautiful
5-14-02	Valerie Bye	Ephrata, Wa.	5	Really Pretty
5-14-02	Keri Swift	Quincy Wa	5	Really Beautiful
5-15-02	R+S. Filer	Redmond, WA 98052	2	
5-15-02	Dorothy + Rich Olson	Fargo ND	2	fantastic
5-15-02	Conrad Larson	Aspen Colo	2	Nice!
5-15-02	Gene & Brenda HAGUE	MORGAN Hill Calif.	2	Tax Dollars well spent.
5-15-02	Bob + Janice Uhman	Sonoita, Az	2	
5-15-02	[illegible]	Australia	2	
[illegible]	[illegible]	[illegible]	2	
[illegible]	[illegible]	[illegible]	2	[illegible] place!!
5-16-02	[illegible]	[illegible] CO	2	AWESOME
[illegible]	[illegible]	[illegible]	1	
5-16-02	[illegible]	[illegible]	1	

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5-16-02	Ed + Judy Sonny	Glendale, CA	2	SPECTACULAR!
[illegible]	[illegible]	[illegible]	3	[illegible]
[illegible]-02	Dan + Judy Atchison	Gilbert AZ 85234	2	[illegible]
5-16-02	[illegible] & Sarah Ketter	Corvallis OR 97330	2	[illegible]
5-16-02	Bill + Martha McGhee	Albuquerque, NM	4	GREAT!!!
5-17-02	Cliff + Bev Rohlf	Arvada Co	2	wonderful
5-17-02	[illegible]	[illegible]		[illegible] Breathtaking
5-18-02	Alan + John Scott	Denver CO	4	
5-18-02	Mike + Ann Cook	Denver CO	4	
5-18-02	Dennis Jensen	[illegible], NE	3	I love [illegible]
5-18-02	[illegible]	New York		GREAT!
5-18-02	[illegible]	Pueblo [illegible] 81007	2	
5-18-02	[illegible]	Pueblo Co. 81008	4	
5-18-02	[illegible]	Sun City, AZ	4	Beautiful!
5-19-02	[illegible]	Salt Lake City, UT	3	[illegible]
5-19-02	[illegible] Anderson	Rapid City SD	2	Beautiful
5-19-02	The Wilkinson	Chicago, IL	2	Wow!
5-19-02	The Saxtons	Geneva, ID	4	Neat!
5-19-02	Charles Maloney	Cullman, AL.	1	Great
5-19-02	Karen Martinez	Layton Utah 84052	5	Great
5-19-02	Loretta Dauphin	Houston Tx 77429	1	
5-19-02	Paul & Genevieve Breitbach	Wake Forest NC 27587	2	Advice not to pull a camper
5-19-02	Everett Kerr [illegible] and family	Rock Springs WY 82901	4	Cool - Liked [illegible]
5-19-02	Angie Anthony	Tickfaw La 70466	2	
5-19-02	Corina Hela	Hammond La 70401	1	
5-19-02	Don & Donna Sewell	Central Point OR 97502	2	
5/19/02	Debi Colbert	Ellsworth, ME	1	
5/19/02	Sam & Betty Beeler	Rio Rancho NM	2	
5-19-02	[illegible]	17 [illegible] NY	2	
5-20-02	Jay Booth	Colfax Ca	1	Awesome!
5-20-02	[illegible]	Orlando Florida	2	GREAT
5-20-02	[illegible]	Florida	2	"
5/20/02	[illegible]	Grand Junction, CO	2	Spectacular!
5/20/02	[illegible]	[illegible]	2	
5/20/02	[illegible]	[illegible]	2	

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FLAMING GORGE NATIONAL RECREATION AREA

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DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
5-20-02	[illegible]	[illegible] 95540		
5-20-02	[illegible]	[illegible], FL 34241	2	[illegible]
5-20-02	[illegible]	[illegible]	2	
5-20-02	Jim & [illegible] Roberts	Seneca, SC	2	Beautiful
5-22-02	Doug Sanden	Sedalia CO	6	Awesome
5-20-02	[illegible]	[illegible] TX	2	
5-21-02	[illegible]	Billings, MT	1	
5-20-02	[illegible]	Hayward, CA 94544	2	[illegible]
5.21.02	[illegible]	Buffalo Grove, IL	2	Great!!
5-21-02	Karl and Carol Brush	Indpls. Ind / Green Valley AZ	2	Beautiful area
5-21-02	[illegible]	[illegible] 18444	2	Very nice Area & ppl.
5-22-02	[illegible]	[illegible] TX	2	[illegible]
5-22-02	[illegible]	[illegible]	2	[illegible]!
5-22-02	[illegible]	SLC UT	4	[illegible]
5/23/02	Ryoko Yanagidaira	Sado, Niigata, Japan	2	Beautiful!
5-23-02	Jerry + Lori Priebe	Big Prairie OH 44611	5	Awesome Country
5-24-02	[illegible]	Flagstaff Az	1	
5-24-02	CLINT & JOYCE	ROCKLIN CA	2	ENJOYING
5/24/02	[illegible]	Twin Falls, ID	2	God's country
5/24/02	[illegible]	[illegible], CA	2	[illegible]!!
	DON MEEK	Topeka, Ks	3	great!!
5/24/02	Velma Castor	Fruita, CO	1	nice!
" "	Donna Meek	Fruita, CO		
5-24-02	Glenn + Jane Larson	Fountain Hills AZ	2	very interesting
5-24-02	[illegible]	Livingston, TX	2	Great!
5-24-02	[illegible]	Salt Lake City	3	Very helpful
5-24-02	[illegible]	WVC, UT	5	Nice!
5-24-02	Cathy Smith	Roy Ut. 84067	2	Great place
5-24-02	PEASE TOBY	NORFOLK, VA	2	I WANTED TO WALK ON THE DAM.
5-24-02	CARSON, ZOANNE L.	Grand Jct Co	1	friendly, [illegible]
5.24.02	LEO & GEMMA KWIECH	Platteville Wisc.	2	[illegible]
5-24-02	Nate & Nikki Robinson	Midvale, Ut. 84047	2	
5-24-02	CAL [illegible]	SYRACUSE, UT 84075	5	
5/24/02	Frank & Mary Gerlach	New Haven, Ct.	2	It's our anniversary!!
5/25/02	T & B LEY	LIVINGSTON, TX	2	VAL!
5/25/02	Don & Jean Kaye	Aurora, CO	2	

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DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
5-24-02	M.A. FARACHER	Kean West 124 N Perry 99336		
5-25-02	Darrin Mathews	Wellsville Utah 84339	4	
" "	GARY [illegible]	ABERDEEN, SCOTLAND	1	
5-25-	ANDREW HOGGATT	Houston TX	6	
5-25-02	Joe + Tami Burkholder	Green River, WY	2	
5-25-02	[illegible]	West Jordan Utah	4	
5-25-02	SHANE & SHANNON BROWN	Roy, UT	3	
5-25-02	Josh + JACINDA Hollund	Madison, OK	4	
5-25-02	Bob + Sylvia Buechler	Saskatoon, SK. Canada	4	Very Impressive
5-25-02	JOE & PAT SIMAR	FAIRVIEW, IL	2	
5-25-02	Wise family	Clearfield utah	4	WOW
5-25-02	[illegible]	[illegible], UT	3	We - Baby!
5-25-02	Tyler & Lisa Westenskow	Logan UT	2	
5-26-02	[illegible]	SLC UT	3	[illegible]
5-26-02	McClure Family	SLC UT	5	
5-26-02	Nyburn Family	N.SLC UT	2	
5-26-02	Rodger + Donna Hupen	Longmont, CO	2	
5-26-02	Brett & Cyndi morgan	Cheyenne, WY	2	Awsome Views
5-26-02	Terry Tom [illegible]	Orem	5	great
5-26-02	Marshall King	Park City, UT 84060	1	
5-26-02	The Johnson Clan	Salt Lake City Ut. 84084	11	great.
5/26/02	The Watsons	North ogden, Ut	6	good
5/26/02	[illegible] + Eliason	Salt Lake City Ut 84118	5	Great + perfect
5/26/02	Shockeys	Denver, Colorado	17	Nice.
5/26/02	The Hoths	Highlands Ranch Colorado	4	Awesome
5/26/02	Underground Company	Park city Ut 84098	2	
5-26-02	The Crocketts	Rock Springs WY 82901	3	
5-26-02	M. Hadsen	Orem, UT 84058	1	
5-25-02	F. CROMACK	Scotland UK	4	Fantastic
5/25/02	S. Wright	SLC, UT	2	Tite
5/26/02	E. Jackson	WVC, UT	2	Unlimited fuel
5-26-02	C. McKenzie	Green River, WY	2	
5-26-02	R. LEE	HEBER, UTAH	1	
5-26-02	Veronica [illegible]	UTAH SLC.	9	wow
5-26-02	McClure Family	Pleasant Grove UT	6	
5-26-02	J. Rith	Jackson, WY	2	

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5/29/02				
5/29/02	Anderson	Livingston TX	2	Enjoyed limited tour
5/29/02	Gaylord	Princeton, WI	2	Interesting
5/29/02	Reed	Imperial Beach	2	
5/29/02	M.L. MERRETT	BENBROOK, TX	1	GORGEOUS
5/29/02	MARTIN	ORLANDO FL	5	Thanks for the fish reel!
5-29-02	Smith	Springfield Missouri	2	You Made it
5-30-02	STATLER	Columbus, OHIO	4	
5-30-02	Nielsen DICK JULIE	Glendive, MT	2	Very nice
5-30-02	Doran	Trinidad, CO	4	Awesome.
5-30-02	andrew, Reed	Seymour IN.	4	Neat
5/31/02	Blaine Kadlec	Salida, CO	2	Wonderful
5/31/02	Tonja Skiiko	Vernal UT	2	Wonderful
5/31/02	BRIAN JENSEN	ANCHORAGE		NICE,
5/31/02	AMANDA JENSEN	ALASKA		WOW.
	[illegible]	Livingston TX	2	thanks!
05/31/02	[illegible]	Netherlands	2	Nice
05/31/02	Chris & Maddy Hammond	HIRAM, ME	4	Beautiful
5/31/02	Shane Woodfield	Calistoga CA	1	My first time here
6-1-02	Cliff & Jean Botford	Out BANK, MT	4	BEAUTIFUL
6-2-02	Leroy Howell	Lucedale, MS	4	Real Nice
6-2-02	Jennings	farmington, nm.	4	Beautiful & Hair Raising
6/2/02	Ray Kay Hill	Sedro Woolley, Wa	2	Love it!
6/2/02	Mel + Middy Smith	Gillespie, MT	2	Very Nice
6/2/02	JOHN + LORENA MABLNEA	SLC, UT	5	AWESOME
6/2/02	HARRY & ROSKET	IRVING IL 62051	2	
6/2/02	R + T Fortier	AL	4	
6/2/02	Judy Fitzle	Glendale, AZ, 85301	4	Interesting .....
6/2/02	Dallas Horn	Glendale, AZ, 85303	4	Cool + wet
6/2/02	Snyder	Norwood CO 81423	5	Beautiful & Cool.
6/2/02	Miller	Thomaston, GA 30286	2	
6-2-02	Jackie + Nick	Columbus, TX	2	
6-2-02	DAVE KELLOGG	SAN JOSE CA 95124	4	GREAT!
6-2-02	Jonathan Clark	Los Gatos CA 95033	1	Nice
6-2-02	SAM DANGER MULLINS	GREEN RIVER WY	1	SPIFFY!
6-3-02	Betty Gearhart	W. Covina CA	1	
6-3-02	Chuck + Geri Carling	Pleasant Lake, Michigan	2	

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DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
5/26/02	K+J Bray	Ketchum, Id.	2	
5-27-02	Bernice & Harold [illegible]	Klamath Falls, Or.	2	
5-27-02	Uni Geology Field Camp	Laramie, WY	30	
5/27/02	Norm + [illegible] Bettencourt	Sonoma, CA	2	
5/27/02	Joe & Terrie Rankin	Rifle, Co	2	
5/27/02	Mike & Chandra	Farmington, NM	5	wonderful place
5-27-02	Nelson Family	Eden, UT	5	Cool!
5-27-02	[illegible] family	Rock Springs, Wyo	2	
5/27/02	Amy Shaw	Winfield, KS	4	beautiful
5/27/02	Emily [illegible]	Tyler, TX	4	beautiful!!
5-27-02	Marty David [illegible]	Lawton, NC	6	
5/28/02	Brumfiend family	Casper, WY	6	Beautiful as always!
5/27/02	Matheson Family	Tooele UT	5	
5/Mon/02	Ron Johnson	Douglas, WY	2	
5/27/02	Eldon - Jean Swanson	Sun Lakes AZ 85248	2	
5/27/02	Bert & Vicky Knight	Siletz, Oregon	4	beautiful
5/27/02	Rose & Mike [illegible]	Woodinville, Wa.	2	5: 5 beautiful -
5/27/02	Valda Judd	Long Beach, CA 90803	2	Beautiful.
5-27-02	Stan Morrison	Jackson, WY 83002	1	Always a wonderful drive!
5-28-02	Bob & Donna Adams	Lemon Grove 91945	2	
5-28-02	J Smend	Eveleth MN	3	beautiful
5/28/02	Trista + Pat Burdick	Thornton, CO 80241	2	nice, friendly, informative rangers!
5/28/02	Tom + Carla	Bristol, England	4	Great
5/28/02	Ian Williams	Univ Wisconsin - River Falls	22	visiting geology group - v. nice!
"	Bart & Maureen [illegible]	Port Orchard, WA. 98366	2	Very Nice
	Phyllis & Forrest Wood	Tucson AZ 85749	2	
5/28	[illegible] & Barbara [illegible]	[illegible] 94565	2	Very nice
5/28	Boyd & Marlene Clark	Co. Spgs Co. 80921	2	beautiful
5/28	Frost family	Breckenridge + Grand [illegible] CO	6	beautiful
5/28	Mr + Mrs Frank [illegible]	Ocean Springs MS.	2	great
5/29	Mr & Mrs Dan [illegible]	Versailles, Mo.	2	Beautiful
5/28	Mr + Mrs R Reed	Christoval TX	2	spectacular!!!
5/28	M/M Bob Golding	Carmel CA	2	Thank you
5/29	Rie Mirazu	Sheridan, WY	1	
5/29	Rich & Nora, Elsa, Hanna Wiley	Julesburg CO 80737	4	We saw a moose!
5-29	Peter Hasselaar	Zevenaar Netherlands	1	

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6/3/02	GREGG POLIRES	LAKE OSWEGO, OR	1	NICEST DOVE
6/3/02	[illegible]	[illegible] 39641	2	VENT
6/3/02	[illegible]	[illegible] 48224	2	Special
6/3/02	[illegible]	[illegible]	2	
6/3/02	[illegible]	Eagle Grove, Iowa	2	excellent
6/3/02	Lindeen family	Lakewood CO 80227	5	awesome!
6/3/02	Tanner Family	Arlington TX 76012	2	Beautiful
6-3-02	Wells (Carlos)	USA	2	Great!
6-3-02	[illegible]	Greeley, CO	2	Good
6-3-02	Charles Brumey	Ft Collins CO	1	Nice
" "	[illegible]	[illegible] 11-711	2	[illegible]
6-3-02	[illegible]	Arizona		Cool
6/3/02	DANIEL STURGEON	FRUITA/CO/81521	1	God is Awesome!
6/3/02	DAVE BAEHR	SUTTER CK, CA 95685	2	
6/3/02	[illegible]	Oskaloosa IA	5	
6/4/02	[illegible]	Helper Utah	1	
6/4/02	John & Judy Jett	Hornbeck, LA	2	Awesome!!
6/4/02	RONNA ICE PIOTRASCHKE	FT COLLINS, CO 80525	2	
6/4/02	Karen + Ernie	Portland, OR	2	Spectacular Spectacular
6/4/02	Ray + Mary Johnson	Hemet, CA / Barron, WI	2	Very Beautiful
6/4/02	Jack + Pat [illegible]	Houston TX	2	" "
6-4-02	Stubbart's	Arvada, CO	2	Same - great
6-4-02	Anne + Leroy [illegible]	Austin TX	2	
6/4/02	[illegible]	[illegible]	2	
6-4-02	[illegible]	Vernal UT	4	
6-4-02	[illegible]	[illegible]	[illegible]	
6-4-02	[illegible]	[illegible]		
6-4-02	[illegible]	Vernal UT		
6-4-02	NATE ABNEY JR	HATFIELD PA	2	
6-4-02	William Kern	OLEY PA	2	GREAT
6-4-02	Doug + Vicki Thompson	Otho Iowa	3	
6-4-02	H + R. Beemer	CH C4/S [illegible]	2	
6-4-02	Bill & Lee Powell	Rockport, TX	2	Outstanding
6-5-02	Lindsey [illegible]	Fort Collins Co 80521	7	
6-5-02	Kevin + Jana [illegible]	Ft Collins, Co 80521	1	wonderful
6-5-02	Zack [illegible]	Ft Collins CO	[illegible]	great

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ______

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
4 5-02	Jessica Kelley	Ft. Collins Co. 80521	9	Great Bit
4-5-02	Kacey Kelley	Ft. Collins Co. 80521	9	Great (almost)
4-5-02	Megan Kelley	Ft. Collins Co.	9	Very good
6-5-02	Dave, Jeanne & M Walker	Union, Ky 41091	2	Great place to be..
6-5-02	[illegible]	[illegible]	4	[illegible]
6-6-02	C+K Herman	Washington, IL 61571	—	Beautiful
6-6	Donahue's	Phoenix AZ	2	Great
6-5-02	McGee's	Albany [illegible]	2	Impressive
6-5-02	[illegible]	Maine	2	Germany
6-5-02	Kate & [illegible]	Santa [illegible] CA	2	Great!
6-6-02	Duvenci	Woodland Park, CO	4	interesting
6/6/02	Charles & Carolyn [illegible]	Evansville, IN	2	
6/6/02	Stan & Ruth Johnson	Longwood, Fla.	3	Great
6/6/02	Blinda Lyon	St Joseph Mo 64503	3	
6-6-02	Rone LaVonne	Upland CA 91784	2	Great
"	Carrie	St. Louis, MO 63122	3	Thank You
"	Stacey	Hudson FL 34667	2	Great
	Parker, John	Boynton Beach FL 33467	2	
06-06-02	Margaret Twomey	Green River Wy	3	
6-6-02	Duane J Allen Family	Magna, UT	7	Awesome We'll be back
6-6-02	Max Bateman Family	Vernal UT	5	Welcome!
6-6-02	Lisa Moore	Steamboat Spgs CO 80477	1	Wonderful
6-6-02	Bob & Kitty Johnson	Royal Palm Bch, FL 33412	2	Beautiful
6-6-02	Sue & Marty Stahl	Cape Coral, FL	2	Beautiful.
6-6-02	Richard & [illegible] Whitley	Okmulgee, OK	6	Great
6-6-02	[illegible]	[illegible] OK	1	
6-6-02	[illegible]	Houston Tx	5	
6-7-02	[illegible]	Corsicana [illegible]	2	
6-7-02	McClury	Hudson Wy	2	
6-7-02	McC[illegible]	Lubbock TX	2	
6-7-02	Paul E M[illegible] Family	Denver Colorado	4	
6-7-02	[illegible]	[illegible]	2	
6-7-02	[illegible] Family	[illegible] 86043	4	Very Beautiful
6-7-02	[illegible]	[illegible], UT	2	
6-7-02	[illegible]	Puerto Rico	2	No words to describe it.
6-7-02	Müller H+R	Germany	2	Very Beautiful

PLEASE REGISTER

FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
6-7-02	R + K Buchmann	Germany	2	
6-7-02	[illegible] Family	Bountiful UT [illegible]	4	
7/6/02	The Gotlands	New Zealand	6.	
6/7/02	[illegible]	[illegible] TX	2	
6/7/02	VIRGINIA	Roy UT	2	
6/7/02	Cordova	CITY UT	5	
6/7/02	Bybee	Roy Ut.	7	
6/7/02	Sabine Krüger	Germany	3	
6/7/02	HAIT	Houston TX	2	
	Susan Jackson	San Francisco	2	Beautiful !
6/7/02	[illegible] Hamel	Longmont, Co.	6	
6-7-02	Kym Wilson	Bellevue Ky	2	
7/6/02	PHIL KRETSCHMER	AUSTRALIA (ADELAIDE)	2	WOW !
7/6/02	SUE ENGLAND	AUSTRALIA (ADELAIDE)		SURREAL !
6/7/02	John Chee	Houston, TX.	4	amazing
"	Michael Chee	" "	"	"
08/06/02	W.I & Hilde Verbeek	Gouda, Netherlands	2	Beautiful
6-8/02	[illegible] & Elroy Burgess	Bountiful, UT	2	
5/6/02	F. S[illegible]	TONBRIDGE ENGLAND	2	
6/8/02	J.C. O'NEILL	DEPTFORD LONDON ENGLAND	2	
6/8/02	James & Kim Mosley	Borger TX 79007	2	
6-8-02	Tim Davis	Chiefland FL 32626	3	
6-8-02	Kyle Langure	Utah	3	I wish we could go inside!
6-8-02	Carol Orchard	Baggs, WY	4	
6-8-02	Larry & Pat Brown	North Fairfield Ohio	2	☺
6-8-02	B & D [illegible]	Montrose, Co	2	WOW !
6-8-02	Arthur Flo[illegible]	Tucson, AZ	3	
	ARK			
	Annie	UT		
6-8-02	[illegible]	So. Jordan Ut	3	
6-8-02	[illegible] Hicks	WAKEFIELD W. YORKS ENGLAND	4	Beautiful
6-8-02	Laura Robinson	WAKEFIELD ENGLAND	4	Really cool
6-8-02	[illegible] Wilson	Archer City TX.		
6-8-02	Keith Cindy Dreckman	PHX AZ	6	?
6-8-02	Jessica Cassella	PHX AZ	6	?
6-8-02	Mark, Tina, [illegible] Curtis	Mexico, Co	4	

PLEASE REGISTER
FLAMING GORGE NATIONAL RECREATION AREA

LOCATION: ____________

DATE	NAME	CITY/ST/ZIP	# IN GROUP	COMMENTS
				For the cost/night
6/8/02	[illegible]	SLC UT	2	[illegible]
6-8-02	D+K CATALANO	MEDFORD, OR 97504	2	Awesome ...
6-8-02	Bendy + Michael [illegible]	SLC, UT	4	Cool - neat to see
6-8-02	Rob + Katie [illegible]	Cody, Wy	2	Beautiful
6/8/02	[illegible]	[illegible] UT	9	[illegible]
6-8-02	[illegible] Sophie	[illegible] UT	4	Great
6-8-02	[illegible]	[illegible] AZ	5	[illegible]
6-9-02	TRACY & MIRANDA	Goshen UT	2	Neat
— " —	Ed TRAUTWEIN	Billings MT	1	
6-9-02	Willie HANN	Bluebell UT	1	Great
6-9-02	[illegible]	Ocala, FL	3	
6-9-02	Richards	Ogden, UT	4	
6-9-02	[illegible]	[illegible] Id	2	
6/9/02	[illegible]	[illegible]	2	
6/9/02	IRV & Betty KENNEDY	Denver, Co	2	
	[illegible]	Toronto, Canada	2	[illegible]
6-9-02	Harold Lewis	Westminster, CO	2	
6-9-02	Andy + Mary Tisler	Roswell NM	7	
6-9-02	[illegible]	[illegible] OK	4	
6-9-02	Ken Smith family	Wheatland, WY	4	
6-9-02	[illegible] + Molly Drinker	Rock Springs WY	4	
6-9-02	[illegible]	[illegible] ID	1	
6-9-02	[illegible]	[illegible]	1	
6-9-02	Pullan family	Salt Lake City UT	4	
6-9-02	[illegible]	Punta Gorda FL	7	
6-9-02	[illegible]	[illegible] Ca	2	
6-9-02	[illegible]	Washington Iowa	2	
6/9/02	Jim + [illegible]	Woodhull IL	5	
6-9-02	Todd [illegible]	[illegible]	4	Fantastic
6-9-02	[illegible]	Ft Collins CO	3	
6-9-02	[illegible]	PA.	4	good. [illegible]
6/9/02	John & Connie DALY	California	4	
6/9/02	[illegible]	[illegible]	2	
6/9/02	J. Collier	Salt Lake City Utah	5	[illegible]

ATTACHMENT 3
PHOTOGRAPHS OF FLAMING GORGE AND GREEN RIVER, 2002

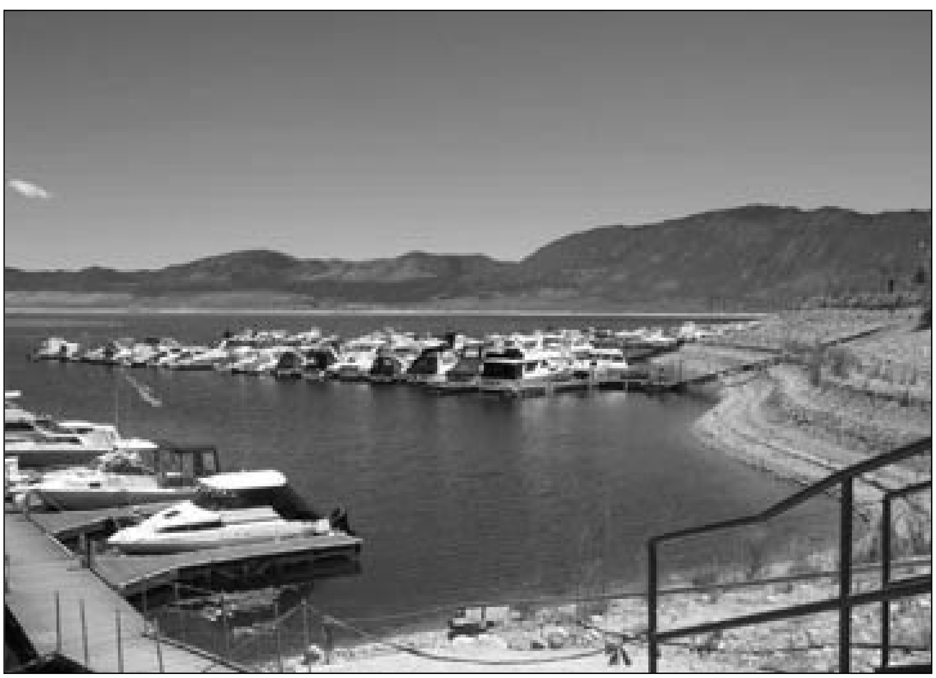
Flaming Gorge Dam

The Flaming Gorge Reservoir as viewed from the Flaming Gorge Dam.

View of Island from picnic area, next to Flaming Gorge Dam.

Red Canyon from Red Canyon Visitors Center Overlook.

Flaming Gorge from Sheep Creek Overlook.



Lucerne Valley Marina, Utah.

State Line Cove, Wyoming.

Looking West of Buckboard Marina, Wyoming.

View of Flaming Gorge Reservoir at Blacks Fork on Highway 530, Wyoming.

Looking North from Firehole Boating Site.

View of Flaming Gorge Reservoir from above Dam.

Green River

View of Flaming Gorge Dam from Spillway Launch Ramp.

View of Green River from Dam Spillway Launch Ramp.

Green River at Little Hole Boating Site.

Green River at Little Hole with John Wesley Powell historic site in middle ground.

Green River from lower Little Hole Boat Ramp.
Note recent fire activity in background.

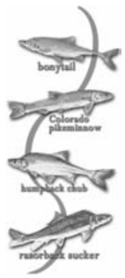
Green River at Brown's Park from John Jarvies Historical Ranch.

Looking North at Brown's Park Bridge.

Upstream from Swinging Bridge in Brown's Park.

Operation of
Flaming Gorge Dam
Final Environmental
Impact Statement

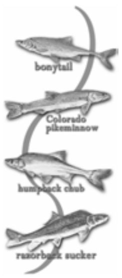
Final Biological Opinion
Technical Appendix



FINAL BIOLOGICAL OPINION
TECHNICAL APPENDIX

Page No.

Final Biological Opinion Technical Appendix



United States Department of the Interior
FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
2369 WEST ORTON CIRCLE, SUITE 50
WEST VALLEY CITY, UTAH 84119

6-UT-05-F-006
05-1380

September 6, 2005

Mr. Rick Gold, Regional Director
Upper Colorado Region
U.S. Bureau of Reclamation
125 South State Street, Room 6107
Salt Lake City, Utah 84138

Mr. Bruce Barrett, Provo Area Office Manager
U.S. Bureau of Reclamation
302 East 1860 South
Provo, Utah 84606

Mr. Brad Warren, Area Manager
Western Area Power Administration
P.O. Box 11606
Salt Lake City, Utah 84147

RE: Final Biological Opinion on the Operation of Flaming Gorge Dam
(Consultation # 6-UT-05-F-006)

Dear Sirs,

This letter transmits the enclosed Final Biological Opinion on the Preferred Alternative of the Flaming Gorge Dam Environmental Impact Statement. Reclamation proposes to modify the operations of Flaming Gorge Dam, to the extent possible, to achieve U.S. Fish and Wildlife Service flow and temperature recommendations identified in the Upper Colorado River Endangered Fish Recovery Program report "Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam" (Muth et al. 2000).

I would like to take this opportunity to commend you on your significant contributions, past and present, to the recovery of the endangered fishes of the Colorado River system. Implementation of the revised flow recommendations for Flaming Gorge Dam is the culmination of 13 years of effort by Reclamation, Western, U.S. Fish and Wildlife Service and the Recovery Program and represents a significant achievement as we seek ways to recover the endangered fishes and provide for future water development. I would also like to express my appreciation to you and your staffs for your cooperation and considerable efforts in successfully completing this consultation. If you have any questions please feel free to contact Mr. Larry Crist or myself at 801-975-3330 ext. 126 or ext. 124, respectively.

Sincerely,

Henry R. Maddux
Utah Field Supervisor

Memorandum

To: Regional Director, Bureau of Reclamation, Upper Colorado Regional Office, Salt Lake City, Utah

Area Manager, Bureau of Reclamation, Provo Area Office, Provo, Utah

Area Manager, Western Area Power Administration, Salt Lake City, Utah

From: Field Supervisor, Utah Field Office Fish and Wildlife Service
Salt Lake City, Utah

Subject: Final Biological Opinion on the Operation of Flaming Gorge Dam

In accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this transmits the Fish and Wildlife Service's (Service) final biological opinion for impacts to federally listed endangered species for Reclamation's proposed action to operate Flaming Gorge Dam to protect and assist in recovery of populations and designated critical habitat of the four endangered fishes found in the Green and Colorado River Basins. Reference is made to your February 1, 2005, correspondence (received in our Utah Field office on February 1, 2005) requesting initiation of formal consultation for the subject project. Based on the information presented in the biological assessment and the Operation of Flaming Gorge Environmental Impact Statement that you provided, I concur that the proposed action may adversely effect the threatened Ute ladies'-tresses (*Spiranthes diluvialis)* and the endangered Colorado pikeminnow *(Ptychocheilus lucius*), humpback chub (*Gila cypha*), bonytail (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*) and critical habitat.

Based on the information provided in the biological assessment, I also concur that the proposed operation of Flaming Gorge Dam may affect, but is not likely to adversely affect, the bald eagle (*Haliaeetus leucocephalus*) and southwestern willow flycatcher (*Empidonax traillii extimus*). In addition, I concur with the determination of no effect for the California condor (*Gymnogyps californiannus)*, black-footed ferret (*Mustela* nigripes) and Canada lynx (*Lynx* canadensis). The bald eagle's preferred prey are fish and waterfowl, and the proposed action involves implementation of flow recommendations that should support its prey and benefit the riparian forest that eagles use for roosting. The southwestern willow flycatcher nests in riparian corridors, islands and sandbars vegetated with willow, tamarisk and other shrubs. The species may occur in low numbers during the summer along the Green River downstream of Ouray, Utah, though subspecific identity has not been confirmed. Riparian habitats utilized by the southwestern willow flycatcher are expected to benefit from implementation of a flow recommendations for the endangered fishes that would result in a more natural flow regime. The California condor is not a resident in the Green River subbasin and would not be affected. The proposed action would also have no effect on black-footed ferret's and lynx since their upland habitats and their prey base are not affected by Flaming Gorge Dam operations.

Consultation History

Construction of Flaming Gorge Dam predates the Endangered Species Act of 1973 and as a result consultation on its construction has never been required. Consultation on operations at Flaming Gorge Dam and other Reclamation projects in the Green River subbasin first started in the late 1970s and early 1980s. The earliest link between operations at Flaming Gorge Dam and other Reclamation consultations was in November 1979 when the Service issued a jeopardy biological opinion for the Upalco Unit of the Central Utah Project and stipulated in the Reasonable and Prudent Alternative (RPA) that Flaming Gorge would compensate for depletions of the project.

On February 27, 1980, the Service requested consultation under Section 7 of the ESA for projects currently under construction in the Upper Colorado River Basin and for the continued operation of all existing Reclamation projects in the basin, including the Colorado River Storage Project (CRSP). Reclamation agreed with the request and formal consultation on the operation of Flaming Gorge Dam was initiated on March 27, 1980. Issuance of a final biological opinion by the Service for the operation of Flaming Gorge Dam was delayed until data collection and studies related to habitat requirements for the endangered fishes could be completed and used to recommend specific flows in the Green River downstream from the dam. Between 1980 and 1991 there were a series of agreements between Reclamation and the Service delaying the issuance of a biological opinion until sufficient information was collected. Existing dam operations were initially evaluated for potential effects on endangered fishes from 1979 to 1984. In 1984 the Service and Reclamation reached an interim flow agreement that constrained summer flows to benefit the endangered fishes and between 1985 and 1991 effects of the constrained summer flows were studied. Reclamation served as the lead agency for this consultation, with Western Area Power Administration (Western) becoming a party to the consultation in 1991.

During this same period, the Service issued a final biological opinion (USFWS 1980) for the Strawberry Aqueduct and Collection System (SACS), a major feature of the Central Utah Project. The SACS biological opinion determined that flow depletions from the Duchesne and Green Rivers would likely jeopardize the continued existence of the endangered Colorado pikeminnow and humpback chub. The SACS biological opinion also included a RPA that stated "Jeopardy from the Bonneville Unit, considered with the other CUP units, could be avoided by operating Flaming Gorge Dam in a more environmentally sensitive manner. Since modification of the Flaming Gorge penstock in 1978, this reservoir could be operated with much less impact on endangered fishes. Modified operations would not only compensate for effects of CUP, but also could help restore the Green River to a healthy condition for the listed fishes."

Using information collected from 1979 to 1991, the Biological Opinion on the Operation of Flaming Gorge Dam (1992 FGBO) was issued on November 25, 1992 (USFWS 1992a). The opinion stated that the then-current operation of Flaming Gorge Dam was likely to jeopardize the continued existence of the endangered fishes in the Green River. Flow recommendations in the 1992 FGBO for spring, summer, autumn, and winter were based on the best available information and professional judgment of researchers who had collected and analyzed much of the data. The recommended flows were intended to restore a more natural hydrograph and to provide a flow regime that would allow for enhancement and recovery of endangered and other native fishes in the Green River. Because of data limitations and the desire to protect areas believed to be crucial for protection of the endangered fishes, the 1992 FGBO only recommended target flows for the Green River at the U.S. Geological Survey (USGS) gage near Jensen, Utah (located 157 km, or 98 mi, downstream from the dam). The 1992 FGBO also called for refining operations so that temperature regimes, especially downstream of the confluence of the Green and Yampa Rivers, would more closely resemble historic conditions and to examine the feasibility and effects of releasing warmer water during the late spring/summer period.

The 1992 FGBO described elements of a Reasonable and Prudent Alternative (RPA) that would offset jeopardy to the endangered fishes (USFWS 1992a). The RPA included the following elements:

- Refine the operation of Flaming Gorge Dam so that flow and temperature regimes of the Green River more closely resemble historic conditions.

- Conduct a 5-year research program that includes winter and spring research flows, to allow for potential refinement of flows for these seasons.

- Determine the feasibility and effects of releasing warmer water during the late spring/summer period and investigate the feasibility of retrofitting the river bypass tubes to include power generation, thereby facilitating higher spring releases.

- Legally protect Green River flows from Flaming Gorge Dam to Lake Powell.

- Initiate discussions with the Service after conclusion of the 5-year research program to examine further refinement of flows for the endangered Colorado River fish. Under this element, results of the research program will be used to reevaluate and, if necessary, refine recommendations presented in the biological opinion.

The five-year research program concluded in 1996. At that time, the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) developed a report that summarized research and developed flow recommendations that were based on all the available information. That report (Muth et al. 2000) provided the basis for Reclamation's proposed action evaluated in their EIS and this biological opinion.

During the time that consultation for the 1992 FGBO was ongoing, other ESA related activities were occurring in the basin. In 1984, the Department of the Interior, Colorado, Wyoming, Utah, water users, and environmental groups formed a coordinating committee to discuss a process to recover the endangered fishes while new and existing water development proceeded in the Upper Colorado River Basin in compliance with Federal and State law and interstate compacts.

After 4 years of negotiations, the Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration (Western) cosigned a Cooperative Agreement on January 21-22, 1988, to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (Recovery Program). Current participants in the Recovery Program include: the Service, Reclamation, National Park Service, Western, Colorado, Utah, Wyoming, Western Resource Advocates, The Nature Conservancy, Colorado Water Congress, Utah Water Users Association, Wyoming Water Development Association, and the Colorado River Energy Distributors Association. The goal of the Recovery Program is to recover the listed species while providing for new and existing water development in the Upper Colorado River Basin. All participants agreed to cooperatively work toward the successful implementation of a recovery program that will provide for recovery of the endangered fish species, consistent with Federal law and all applicable State laws and systems for water resource development and use. Each signatory assumed certain responsibilities in implementing the Recovery Program. In particular, the refined operation of Federal reservoirs by Reclamation to reduce or eliminate impacts to endangered fish and contribute to their recovery was identified as critical to the Recovery Program. To further define and clarify processes outlined in sections 4.1.5, 4.1.6, and 5.3.4 of the Recovery Program (USFWS 1987), the *Section 7 Consultation, Sufficient Progress, and Historic Projects Agreement* (Section 7 Agreement) and *Recovery Implementation Program Recovery Action Plan* (RIPRAP) were developed in 1993 and updated yearly (USFWS 2003). The Section 7 Agreement established a framework for conducting section 7 consultations on depletion impacts related to new projects and impacts associated with existing projects in the upper basin. Procedures outlined in the Section 7 Agreement are used to determine if sufficient progress is being accomplished in the recovery of endangered fishes to enable the Recovery Program to serve as a reasonable and prudent alternative to avoid the likelihood of jeopardy and/or adverse modification of critical habitat.

Since the inception of the Recovery Program, the Service has consulted on over 700 projects depleting water from the Upper Colorado River Basin. The Recovery Program, through its implementation of the RIPRAP, has avoided the likelihood of jeopardy and/or adverse modification of critical habitat on behalf of these projects.

The RIPRAP outlines specific recovery actions, including such measures as acquiring and managing aquatic habitat and water, re-operating existing reservoirs to provide instream flows for fishes, constructing fish passage facilities, controlling nonnative fishes, and propagating and stocking listed fish species. It also stipulates which entity is responsible for taking action, when these actions would be undertaken, and how they would be funded. The RIPRAP was finalized on October 15, 1993, and has been reviewed and updated annually.

One high priority RIPRAP element under the FY 2004 Green River Action Plan: Green River above Duchesne River I.A.3.d., is to operate Flaming Gorge Dam to provide winter and spring flows and revised summer/fall flows, pursuant to the new Flaming Gorge biological opinion. Implementation of this priority RIPRAP item by Reclamation through adoption of Flow Recommendations is intended to offset in part the adverse effects of water depletions by other projects and fulfill a commitment by Reclamation to refine operations at its facilities, including

Flaming Gorge to assist in meeting instream flow requirements for endangered fishes (USFWS 1987).

Other consultations that rely on Flaming Gorge Dam as a RPA to offset their depletions include; the 1998 programmatic biological opinion for the Duchesne River Basin (447,000 af) and the 2000 Narrows Project (5,717 af). Projects covered under the programmatic biological opinion for the Duchesne River include; Strawberry Valley Project, Provo River Project, Moon Lake Project, Midview Exchange, Ute Indian Irrigation Project, and the Central Utah Project which includes the Bonneville, Uintah and Upalco Units. Consultations that received non-jeopardy biological opinions but also depend operation of Flaming Gorge Dam to meet flow recommendation as part of continued sufficient progress of the Recovery Program to offset water depletions include the Price-San Rafael Unit of the Salinity Control Program (1992) and the Programmatic Biological Opinion on the Management Plan for Endangered Fishes in the Yampa River Basin.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Scope of Biological Opinion

Emergencies

This biological opinion does not cover emergency operations at Flaming Gorge Dam. Where emergency circumstances mandate the need to consult in an expedited manner, consultation may be conducted informally through alternative procedures that are consistent with the requirements of section 7 (a)-(d) of the Act. This provision applies to situations involving acts of God, disasters, casualties, national defense or security emergencies, etc. (50 CFR 402.05). The timing and nature of emergencies are typically not predictable but at Flaming Gorge Dam they may be associated with dam safety, personal safety of individuals or groups associated with recreation or other activities on the river or power system conditions. Emergencies associated with dam safety could include unforeseen releases or operations to protect dam infrastructure. Emergencies associated with the safety of individuals or groups may be associated with river rescue or recovery operations. Types of emergency powerplant operations are discussed in Section 1.6 of the Operation of Flaming Gorge Dam Environmental Impact Statement (FGEIS) and include insufficient generation capacity, transmission (overload and voltage control), load shedding and system restoration. Emergency operations are typically of short duration as a result of emergencies occurring at the dam or within the transmission network. In the event of an emergency, Reclamation and/or Western will contact the Service in a timely manner for advice on measures to minimize the effects of the response on species and critical habitat, and formal consultation, if needed, will be conducted after the fact. This should not be interpreted to mean that an emergency response should be delayed if it is not possible to contact the Service. Spills associated with normal dam operations or to meet the proposed action are not considered emergencies and are covered in this biological opinion.

Action Area

Under the proposed action, Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in Muth et al. (2000), while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact. The flow and temperature recommendations describe the peak flows, durations, water temperatures, and base flow criteria believed by the Service to be necessary for the survival and recovery of endangered fishes. This biological opinion addresses the effects of the proposed action and associated flow regime on the endangered Colorado pikeminnow, humpback chub, bonytail and razorback sucker and the threatened Ute ladies'-tresses in the Green River downstream of Flaming Gorge Dam

The flow and temperature recommendations include specified peak and base flows (Table 1) to be achieved in the three portions of the Green River defined as follows:

- **Reach 1:** Flaming Gorge Dam to the Yampa River confluence (river kilometer [RK] 555 to 660, or river mile [RM] 345 to 410). Flow in this reach, which is measured at the USGS gage near Greendale, Utah, is almost entirely regulated by releases from Flaming Gorge Dam.

- **Reach 2:** Yampa River confluence to White River confluence (RK 396 to 555, or RM 246 to 345). Flow in this reach is measured at the USGS gage near Jensen, Utah. In this reach, tributary flows from the Yampa River combine with releases from Flaming Gorge Dam to provide a less regulated flow regime than in Reach 1.

- **Reach 3:** White River confluence to Colorado River (RK 0 to 396 or RM 0 to 246). Flow in this reach is measured at the USGS gage near Green River, Utah. In this reach, the Green River is further influenced by tributary flows from the White, Duchesne, Price, and San Rafael Rivers.

These three reaches (Figure 1) of the Green River and the adjacent 100 year floodplain constitute the action area considered in this biological opinion.

Flow and Temperature Recommendations

The proposed action would provide increased interannual variability in peak and base flows. Such variability is thought to support in-channel and floodplain geomorphic processes that would maintain the ecosystem dynamics to which the endangered fishes are adapted. Not all objectives for each species can or need to be met within each year. Different species occupy different ecological niches, and distinct life stages benefit from different specific hydrologic conditions. For all species, short-term adverse effects of high or low flows would be offset by longer-term benefits. The flow patterns of the proposed action approximate unregulated flow conditions more closely than the flow conditions required under the 1992 FGBO. The magnitude, duration, and timing of releases from Flaming Gorge Dam would be tied to the anticipated hydrologic condition in a given year. This approach would tend to mimic the natural hydrology of the Green River subbasin and provide within-year and between-year variability.

Forecasted runoff volume would be used to determine the magnitude, duration, and timing of releases from Flaming Gorge Dam to enhance downstream habitat conditions. When above-average runoff conditions are forecasted, bypass tubes or the spillway at Flaming Gorge Dam would be used to increase peak spring flows in downstream reaches. During average or drier years, spring releases would be at maximum power plant levels or greater to achieve specific target peak flows in downstream reaches. Peak releases from Flaming Gorge Dam would be timed to coincide with peak and immediate post-peak flows of the Yampa River to maximize the magnitude and duration of the peak, restore in-channel processes, inundate floodplain habitats, and extend the duration of peak flows in Reaches 2 and 3. Similar to peak flows, base flows during summer–winter would be tied to annual hydrologic conditions and would be higher in wetter years than in drier years.
Under the proposed action, hydrologic conditions in any given year would be placed in one of the following categories:

- **Wet (0–10% exceedance[1]).** Annual forecasted runoff volume is larger than almost all of the historic runoff volumes (10% probability of occurrence).

- **Moderately wet (10–30% exceedance).** Annual forecasted runoff volume is larger than most of the historic runoff volumes (20% probability of occurrence).

- **Average (30–70% exceedance).** Annual forecasted runoff volume is larger than about half of the historic runoff volumes (40% probability of occurrence).

- **Moderately dry (70–90% exceedance).** Annual forecasted runoff volume is less than most of the historic runoff volumes (20% probability of occurrence).

- **Dry (90–100% exceedance).** Annual forecasted runoff volume is less than almost all of the historic runoff volumes (10% probability of occurrence).

These exceedance intervals were chosen to provide guidance for setting peak- and base-flow targets under different hydrologic conditions so as to achieve the desired hydrologic variability. In reality, annual runoff volume is a continuous variable, and any categorization scheme is somewhat arbitrary. Release patterns in any given year would reflect where within the wet to dry continuum the hydrologic condition in that year falls.

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1 Exceedance values refer to the percentage of recorded flows that have been higher than that value. An exceedance value is equivalent to 1 minus the percentile.

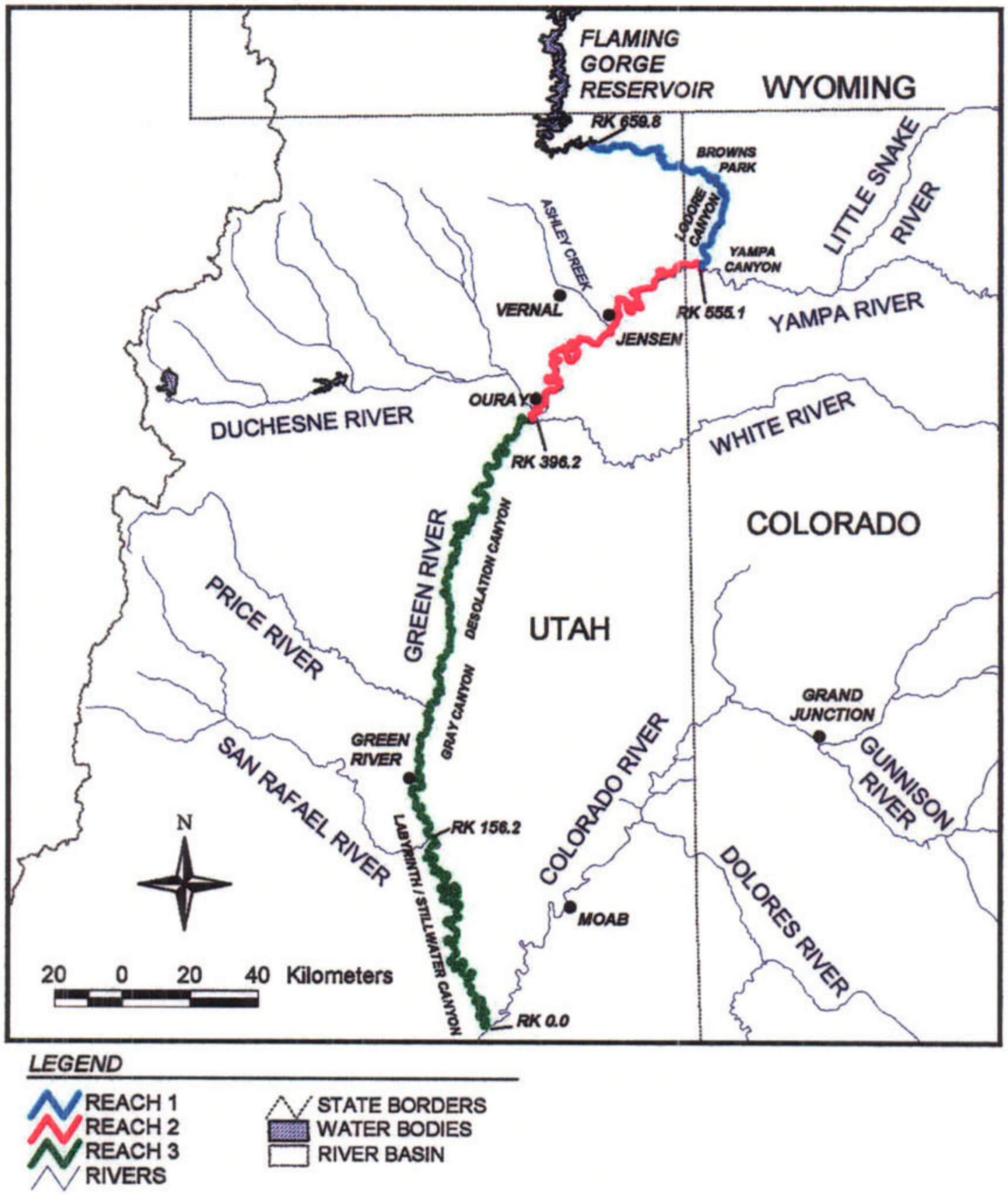

FIGURE 1 Map of the Green River Downstream of Flaming Gorge Dam (Source: Muth et al. 2000)

Due to the fact that it was not feasible to cover every contingency in the flow recommendations, the authors of the flow recommendations recommended that real-time data and other available year-specific information would be factored into annual implementation of the proposed action. Yearly patterns of releases from Flaming Gorge Dam to meet the recommended flows and temperatures for each hydrologic condition could then be adjusted on the basis of information about hydrology, the status of endangered fish life stages and populations, and habitat conditions. Muth et al. (2000) recommended that Reclamation, Western, and the Service establish a technical working group of biologists and hydrologists to help refine release plans for each year and provide advice on modifying releases during changing hydrologic conditions.

Table 1 summarizes the recommended peak and base flows from Muth et al. (2000) for all three reaches of the Green River. Under the proposed action, Flaming Gorge Dam would be operated with the goal of achieving these recommended flows as often as possible while maintaining the other authorized purposes of Flaming Gorge Dam and Reservoir.

Operations under the Proposed Action

This section describes the process that Reclamation would use to implement the proposed action while maintaining other authorized purposes and assuring safe operations of Flaming Gorge Dam under normal operational conditions. Operational plans, however, may be altered temporarily to respond to emergencies. Safe operation of Flaming Gorge Dam is of paramount importance, and is applicable to all dam operations under the proposed action. In order to safely and efficiently operate Flaming Gorge Dam, forecasted future inflows must be incorporated into the decision making process. These forecasted future inflows are provided by the National Weather Service through the River Forecast Center and are issued as monthly or seasonal (April through July) volumes of unregulated inflow that are anticipated to occur during the forecast period. A forecast error is the volume difference between the forecasted and actual inflow volume for the period. Forecast errors mostly are attributable to hydrologic variability and to a much lesser degree the forecasting procedure. Consequently, forecast errors will always be a factor associated with the operation of Flaming Gorge Dam.

Analysis of the historic forecast errors at Flaming Gorge Dam was performed by the Colorado River Forecasting Service Technical Committee (CRFSTC) in April 1987. They determined the magnitude of 5% exceedance forecast errors associated with the various forecast products issued by the Colorado River Basin Forecast Center (CBRFC). These errors occur in one out of every 20 years on average and errors of greater magnitude occur less frequently. From the information provided by the CRFSTC, forecast errors at the 1% exceedance level (1 out of every 100 years) were computed.

Safe operation of Flaming Gorge Dam limits the risk of uncontrolled spills to 1% when the greatest foreseeable forecast error occurs. In other words, safe operation must assure that 99% of the foreseeable forecast errors can be successfully routed through Flaming Gorge Reservoir without uncontrolled spills occurring. To limit this risk, Reclamation maintains vacant storage

TABLE 1 Recommended Magnitudes and Duration of Maximum Spring Peak and Summer-to-Winter Base Flows and Temperatures for Endangered Fishes in the Green River Downstream From Flaming Gorge Dam as Identified in the 2000 Flow and Temperature Recommendations

		Hydrologic Conditions and 2000 Flow and Temperature Recommendations[a]				
Location	Flow and Temperature Characteristics	Wet (0–10% Exceedance)	Moderately Wet (10–30% Exceedance)	Average (30–70% Exceedance)	Moderately Dry (70–90% Exceedance)	Dry (90–100% Exceedance)
Reach 1 Flaming Gorge Dam to Yampa River	Maximum Spring Peak Flow	≥8,600 cfs (244 cubic meters per second [m3/s])	≥4,600 cfs (130 m3/s)	≥4,600 cfs (130 m3/s)	≥4,600 cfs (130 m3/s)	≥4,600 cfs (130 m3/s)
	Peak flow duration is dependent upon the amount of unregulated inflows into the Green River and the flows needed to achieve the recommended flows in Reaches 2 and 3.					
	Summer-to-Winter Base Flow	1,800–2,700 cfs (50–60 m^3/s)	1,500–2,600 cfs (42–72 m^3/s)	800–2,200 cfs (23–62 m^3/s)	800–1,300 cfs (23–37 m^3/s)	800–1,000 cfs (23–28 m^3/s)
Above Yampa River Confluence	Water Temperature Target	≥ 64 °F (18 °C) for 3-5 weeks from mid-August to March1	≥ 64 °F (18 °C) for 3-5 weeks from mid-August to March 1	≥ 64 °F (18 °C) for 3-5 weeks from mid-July to March 1	≥ 64 °F (18 °C) for 3-5 weeks from June to March 1	≥ 64 °F (18 °C) for 3-5 weeks from mid-June to March 1
Reach 2 Yampa River to White River	Maximum Spring Peak Flow	≥26,400 cfs (748 m^3/s)	≥20,300 cfs (575 m^3/s)	≥18,600 cfs[b] (527 m^3/s) ≥8,300 cfs[c] (235 m3/s)	≥8,300 cfs (235 m^3/s)	≥8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 22,700 cfs (643 m^3/s) should be maintained for 2 weeks or more, and flows 18,600 cfs (527 m^3/s) for 4 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 18,600 cfs (527 m^3/s) should be maintained for at 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be main-tained for 2 days or more except in extremely dry years (98% exceedance).
	Summer-to-Winter Base Flow	2,800–3,000 cfs (79–85 m^3/s)	2,400–2,800 cfs (69–79 m^3/s)	1,500–2,400 cfs (43–67 m^3/s)	1,100–1,500 cfs (31–43 m^3/s)	900–1,100 cfs (26–31 m^3/s)

TABLE 1 (Cont.)

Location	Flow and Temperature Characteristics	Hydrologic Conditions and 2000 Flow and Temperature Recommendations[a]				
		Wet (0–10% Exceedance)	**Moderately Wet** (10–30% Exceedance)	**Average** (30–70% Exceedance)	**Moderately Dry** (70–90% Exceedance)	**Dry** (90–100% Exceedance)
Below Yampa River Confluence	Water Temperature Target	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.	Green River should be no more than 9 °F (5 °C) colder than Yampa River during summer base flow period.
Reach 3 White River to Colorado River	Maximum Spring Peak Flow	≥39,000 cfs (1,104 m^3/s)	≥24,000 cfs (680 m^3/s)	≥22,000 cfs[d] (623 m^3/s)	≥8,300 cfs (235 m^3/s)	≥8,300 cfs (235 m^3/s)
	Peak Flow Duration	Flows greater than 24,000 cfs (680 m^3/s) should be maintained for 2 weeks or more, and flows 22,000 cfs (623 m^3/s) for 4 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks or more.	Flows greater than 22,000 cfs (623 m^3/s) should be maintained for 2 weeks in at least 1 of 4 average years.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for at least 1 week.	Flows greater than 8,300 cfs (235 m^3/s) should be maintained for 2 days or more except in extremely dry years (98% exceedance).
	Summer-to-Winter Base Flow	3,200–4,700 cfs (92–133 m^3/s)	2,700–4,700 cfs (76–133 m^3/s)	1,800–4,200 cfs (52–119 m^3/s)	1,500–3,400 cfs (42–95 m^3/s)	1,300-2,600 cfs (32–72 m^3/s)

[a] Recommended flows as measured at the USGS gage located near Greendale, Utah, for Reach 1; Jensen, Utah, for Reach 2; and Green River, Utah, for Reach 3.
[b] Recommended flows ≥18,600 cfs (527 m^3/s) in 1 of 2 average years.
[c] Recommended flows ≥8,300 cfs (235 m^3/s) in other average years.
[d] Recommended flows ≥22,000 cfs (623 m^3/s) in 1 of 2 average years.

space in the reservoir at various times of the year to absorb the additional inflow volume if a forecast error occurs. Reservoir elevation is intentionally drawn down by Reclamation during the fall and winter months to accommodate additional inflow.

The upper limit draw-down levels for safe operation were determined through routing studies of forecast error scenarios. These scenarios were based on the 1% exceedance forecast errors. The scenario that had the largest risk of an uncontrolled spill was routed through the reservoir beginning in May with various reservoir elevations and various inflow volumes that were based on historic records. The highest elevations, where the largest risk scenario successfully routed the inflow volume through the reservoir without an uncontrolled spill, was established as the upper limit draw-down levels for that forecast volume.

Inter-agency coordination would be used to implement the flow and temperature recommendations of Muth et al. (2000). A technical working group representing Reclamation, Service, and Western, as well as other qualified individuals who choose to participate on a voluntary basis, would convene at various times throughout the year to discuss future operational plans and to refine these plans to best meet the needs of the endangered fish. Release patterns for all seasons would be discussed by this technical working group and recommendations would incorporate real time and year specific information identified in Table 5.3 of Muth et al. (2000). These meetings would also provide an opportunity to discuss historic operations in terms of the accomplishments and short comings of meeting the flow and temperature recommendations. Reclamation would maintain an administrative record of these meetings to document the planning process.

Operations in May through July (Spring Period)

Under the proposed action, Reclamation would establish the hydrologic classification for the spring period (May through July) based on the forecasted unregulated inflow to Flaming Gorge Reservoir for the April through July period. This forecast is issued by the River Forecast Center beginning in early January and is updated twice per month until the end of July. Reclamation would classify the hydrology of the Green River system into one of the five hydrologic classifications described above (wet, moderately wet, average, moderately dry, and dry).

The hydrologic classification would be used to establish the range of flow magnitudes and durations that could be targeted for the approaching spring release period. These targets would be incorporated into a spring operations plan. This plan would be prepared each year by Reclamation in coordination with the technical working group prior to the spring Flaming Gorge Working Group meeting. Various year-specific factors listed in Table 5.3 of Muth et al. (2000) along with the established hydrologic classification would be considered in the development of the operations plan.

It is expected that in most years, the flow magnitudes and durations achieved in Reach 2 each spring would be consistent with the flow magnitudes and durations described in Muth et al. (2000) for the hydrologic classification established in May of each year. However, because factors listed in Muth et al. (2000) are also considered, particularly runoff conditions in the Yampa River, there would be some years where the peak flows that occur in Reach 2 achieve the targets for either one or two classifications higher (wetter) or one classification lower (drier) than the actual classification established for the Green River. It is anticipated that in some years, when the hydrologic classification for the Green River is average, that conditions would be such that it would be possible to achieve the targets established for either the moderately wet or wet classifications. Conversely, there would be some years classified as moderately wet when the conditions would be such that targets established for the average classification would be met. There could also be years classified as wet where moderately wet targets would be achieved because of year-specific conditions. It would be Reclamation's responsibility in coordination with the technical working group to assure that over the long term, Flaming Gorge Dam operations are consistent with the Muth et al. (2000) flow and temperature recommendations.

The operations plan would describe the current hydrologic classification of the Green River subbasin and the hydrologic conditions in the Yampa River Basin, including the most probable runoff patterns for the two basins. The operations plan would also identify the most likely Reach 2 flow magnitudes and durations that would be targeted for the upcoming spring release. Because hydrologic conditions often change during the April through July runoff period, the operations plan would contain a range of operating strategies that could be implemented under varying hydrologic conditions. Flow and duration targets for these alternate operating strategies would be limited to those described for one classification lower or two classifications higher than the classification for the current year.

In years classified as wet, bypass releases would usually be required for both safe operation of the dam and to meet the flow recommendations. In some years classified as wet, spillway releases would be necessary for safe operation of the dam. Releases above powerplant capacity in these wet years would be expected to be made for a period of about 4 to 9 weeks. The exact magnitude of the release and duration of the release would depend upon the year-specific conditions of factors listed in Table 5.3 of Muth et al. (2000) as well as the carryover storage from the previous year. Wet year high releases would be expected to occur from mid-May to early July (and in very wet years through July). The bypass and spillway releases, required for safe operation of the dam in wet years, would be timed with the objective to meet Reach 2 wet or moderately wet year targets depending upon the hydrologic conditions in the Yampa River. The initiation of bypass and spillway releases would take place in mid to late May coincident with the Yampa River peak. In extremely wet years, releases above powerplant capacity could be initiated in April or early-May before the Yampa River peak.

In years classified as moderately wet, bypass releases would usually (but not always) be required for safe operation of the dam. Occasionally, some use of the spillway might also be required in moderately wet years for safe operation of the dam. Bypass volume in moderately wet years would be less than in wet years and would generally occur for a period of about 1 to 7 weeks. The timing of these releases would be from mid May to June and could sometimes extend into July. Releases from Flaming Gorge Reservoir in moderately wet years would be timed with the objective of meeting Reach 2 wet, moderately wet, or average year targets depending upon the hydrologic conditions in the Yampa River basin and other factors.

In years classified as average, bypass releases would not likely be required for safe operation of the dam, but would periodically be needed to meet the objectives of the flow and temperature recommendations of Muth et al. (2000). In most average years, spring peak releases would be limited to power-plant capacity (about 130 m^3/s [4,600 cfs]) with peak releases taking place for about one to eight weeks usually in mid-May to late-June (but occasionally extending into July). In about one out of three average years, bypass releases from Flaming Gorge Dam might be required to achieve the Reach 2 flow recommendation peak and duration targets. In these years, the objective would be to achieve targeted flows in Reach 2 of 527 m^3/s (18,600 cfs) for two weeks. To conserve water, bypass releases in these average years would be made only to the extent necessary to achieve this target. It can be expected that bypass releases, when required to meet flow recommendations in average years would be implemented for a period of less than two weeks. In some years classified as average, the targets that would be achieved during the spring would be moderately wet or wet targets as a result of Yampa River flows.

The objective in dry and moderately dry years would be to conserve reservoir storage while meeting the recommended peak flow targets in Reach 2. The bypass tubes and the spillway would not be used to meet flow targets in moderately dry and dry years but on rare occasion might be needed to supplement flows that cannot be released through the power plant because of maintenance requirements. In dry years, a peak release (power-plant capacity or less) of one day to one week would occur during the spring and this release would be timed with the peak of the Yampa River. In moderately dry years, a one to two week power-plant capacity release would occur during the spring and would be timed with the peak and post peak of the Yampa River.

After the spring flow objectives have been achieved, Reclamation would establish a release regime within powerplant capacity that gradually decreases the release rate limited to the down ramp rates described in Muth et al. (2000) until the beginning of the base flow period which begins some time between mid-June and mid-August, depending on the hydrologic classification set during the spring.

The bypass tubes and the spillway at Flaming Gorge Dam have been utilized historically, as needed, for safe operation of the dam. In years with high inflow, bypass releases, and sometimes spillway releases, may be required under the proposed action to meet the flow and temperature recommendations. Bypass and spillway releases, required for safe operation of the dam and to meet the flow and temperature recommendations, would be scheduled coincident with Yampa River peak and post peak flow (the mid-May to mid-June time period) with the objective of meeting flow recommendation targets in Reach 2. There would be some years (moderately wet years and average years) where use of the bypass would not be required for safe operation but would be needed to meet the flow recommendations. As part of the annual planning process discussed above, Reclamation would consult with the Service and Western and coordinate with the technical working group and make a determination whether bypasses should be attempted to achieve the targeted Reach 2 magnitudes and durations.

Cavitation resulting from use of the spillway has been shown to cause excessive erosion in concrete spillway structures at other Reclamation dams. In 1984, the spillway at Flaming Gorge Dam was retrofitted with air slots that have been tested and deemed successful in reducing cavitation. However, should damage to the spillway become excessive as a result of increased use repairs would be made and use of the spillway could be limited to levels that do not cause damage or to only times when hydrologically necessary.

Operations in August through February (Base-Flow Period)

Under the proposed action, Reclamation would classify the hydrology of the Green River during the base-flow period into one of the five hydrologic classifications (wet, moderately wet, average, moderately dry, and dry). For the month of August, the hydrologic classification would be based on the percentage exceedance of the volume of unregulated inflow into Flaming Gorge Reservoir during the spring period. For the months of September through February, the percentage exceedance would be based on the previous month's volume of unregulated inflow into Flaming Gorge Reservoir. If the unregulated inflow during the previous month is such that the percentage exceedance falls into a different classification than the classification assigned for the previous month, then the hydrologic classification for the current month could be shifted by one classification to reflect the change in hydrology. This shift would only be made when the reservoir condition indicates that the shift would be necessary to achieve the March 1 drawdown level of 1,837 m (6,027 ft) above sea level. Otherwise the hydrologic classification for the current month would remain the same as for the previous month.

The range of acceptable base flows for Reach 2 would be selected from the flow and temperature recommendations for the hydrologic classification set for the current month. Reclamation would make releases to achieve flows in Reach 2 that are within the acceptable range that also assure that the reservoir elevation on March 1 would be no higher than 1,837 m (6,027 ft) above sea level.

The flow and temperature recommendations for the base-flow period allow for some operational flexibility, and the proposed action accommodates this flexibility. Under the proposed action, the flows that would occur in Reach 2 during the base-flow period would be allowed to vary from the targeted flow by $\pm$ 40% from August through November and by $\pm$ 25% from December through February as long as the day to day change is limited to 3% of the average daily flow and the variation is consistent with all other applicable flow and temperature recommendations. Reclamation would utilize the allowed flexibility to the extent possible, to efficiently manage the authorized resources of Flaming Gorge Dam. Flaming Gorge Dam would be operated through the base-flow period so that the water surface elevation would not be greater than 1,837 m (6,027 ft) above sea level on March 1.

During the base-flow period, hourly release patterns from Flaming Gorge Dam would be patterned so that they produce no more than a 0.1-m (0.3-ft) stage change each day at the Jensen gage.

Operations in March and April (Transition Period)

Muth et al. (2000) make no specific flow recommendations for the period from March 1 through the initiation of the spring peak release (typically this occurs in mid to late May). For the proposed action, releases during this transition period would be made to manage the reservoir elevation to an appropriate drawdown level based on the forecasted unregulated inflow into Flaming Gorge Reservoir for the April through July period. Appropriate drawdown levels under normal operations during the transition period are those that would allow for safe operation of the dam through the spring.

Implied in the drawdown levels is the assumption that upstream regulation above Flaming Gorge Reservoir remains relatively consistent with historic regulation. In the event that less storage space would be available above Flaming Gorge Reservoir during the spring, these drawdown levels may have to be lower than those specified for safe operation of Flaming Gorge Dam. In extremely wet years, the drawdown level for May 1 could be lower than what is specified to maintain safe operation of the dam.

Reclamation would determine the appropriate reservoir drawdown based on the percentage exceedance of the forecasted volume of unregulated inflow into Flaming Gorge Reservoir between April and July. The forecast is issued two times each month during March and April. Under normal operations during the transition period, releases would be between 23 m^3/s (800 cfs) and power-plant capacity (130 m^3/s [4,600 cfs]).

Releases during the transition period would be patterned to be consistent with the release patterns of the preceding base-flow period. Muth et al. (2000) do not make recommendations for hourly fluctuation patterns during the transition period. However, Reclamation would maintain the fluctuation pattern limitations of the base flow period to provide operational consistency as has been done historically.

Use of Adaptive Management in Implementing the Proposed Action

This biological opinion and the Operation of Flaming Gorge Draft EIS present a number of uncertainties regarding the endangered fish associated with implementing the proposed action. These uncertainties would be addressed by integrating an adaptive management process into the current framework of dam operations, while maintaining the authorized purposes of the Flaming Gorge Unit of the CRSP. This would involve using research and monitoring to test the outcomes of implementing the proposed action and employing the knowledge gained to further refine operations as required. It is expected that any refinements in operation of Flaming Gorge Dam would be within the scope of the current proposed action and that implementation of refinements would occur with appropriate Section 7 consultation (formal or informal). Research and monitoring studies would be conducted within the framework of the ongoing Recovery Program with regard to native fish, undesirable nonnative fish, and related habitat issues. These studies may involve research or test flow releases from Flaming Gorge Dam. As participants in the Recovery Program, Reclamation, Western and the Service would be involved in the identification, discussion, implementation and approval of new tasks within the Recovery Program to address refinement of flows below Flaming Gorge Dam.

Uncertainties about riparian vegetation and geomorphic surfaces, particularly as they may affect Ute ladies'-tresses will be addressed through a monitoring plan developed by Reclamation, Western, Service, NPS, and other knowledgeable scientists. Recommendations for actions to assist riparian vegetation health and Ute ladies'-tresses conservation developed as a result of the monitoring efforts will be will be coordinated by the Service and forwarded to Reclamation or other entities as appropriate. Any requests for flows to benefit Utes'-ladies tresses would be reconciled by the Service with flow needs for other endangered species.

Conservation Measures

Conservation measures are actions that the action agency agrees to implement to further the recovery of the species under review. Section 4.21 of the draft EIS for Operation of Flaming Gorge Dam specifies ten environmental commitments related to implementation of the proposed action. Several of those commitments are reiterated here in order to clarify operations under the proposed action:

- The Flaming Gorge Working Group, an informal stakeholder group, which meets two times per year, would continue to function as a means of providing information to and gathering input from stakeholders and interested parties on dam operations, as described in Section 1.5 of the draft EIS.

- The adaptive management process will rely on the Recovery Program for monitoring and research studies to test the outcomes of implementing the proposed action and proposing refinements to dam operations.

- Reclamation agrees to develop a process for operating the selective withdrawal structure consistent with the objectives of improving temperature conditions for the endangered native fish. Such a process would include identification of lines of communication for planning and making changes to selective withdrawal release levels, coordination with other agencies, recognition of equipment limitations that may affect the ability to release warmer water, and the costs and equipment impacts associated with operating at higher temperatures.

- Reclamation, in coordination with the Service, National Park Service, and other knowledgeable scientists, agrees to develop and implement a monitoring plan for Ute ladies'-tresses populations for determination of possible effects from the proposed action. Possible effects to be monitored include response to any habitat changes (such as geomorphic, hydrologic, and vegetation) associated with the proposed action.

- Reclamation will establish the Technical Working Group, as detailed in Section 2.5.3 of the draft EIS, consisting of biologists and hydrologists involved with endangered fish recovery issues. The Technical Working Group would meet at various times throughout the year to comment and provide input on endangered fish needs and implementation of the flow recommendations.

- Implementation of the proposed action will include development of an administrative record and annual report to document annual operations and the information used to develop those operations. Over time, it is expected that these data will be of benefit in correlating and analyzing conditions for the endangered fish species and their habitat downstream from Flaming Gorge Dam.

Monitoring and research to evaluate the effects of modified flows and temperatures will be conducted through the Recovery Program, and include (1) investigations to determine the effects of increased spillway releases and the concomitant release of fishes from the reservoir on the downstream fish community; (2) an evaluation of the effects of increased release temperatures on the downstream fish community, and (3) an evaluation of increased floodplain inundation in Reach 2 on the fish community. Reclamation, Western and the Service will use any new information collected in these studies and other studies to determine the need for management actions or modification of operations as determined appropriate.

STATUS OF THE SPECIES AND CRITICAL HABITAT

Colorado Pikeminnow

Species/Critical Habitat Description

The Colorado pikeminnow is the largest cyprinid fish (minnow family) native to North America and evolved as the main predator in the Colorado River system. It is an elongated pike-like fish that during predevelopment times may have grown as large as 6 feet in length and weighed nearly 100 pounds (Behnke and Benson 1983). Today, Colorado pikeminnow rarely exceed 3 feet in length or weigh more than 18 pounds; such fish are estimated to be 45-55 years old (Osmundson et al. 1997). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of Colorado pikeminnow longer than 3 or 4 inches consists almost entirely of other fishes (Vanicek and Kramer 1969). Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 500 mm (20 inches) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981). Adults are strongly countershaded with a dark, olive back, and a white belly. Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin.

Critical habitat was designated for Colorado pikeminnow on March 21, 1994 (59 FR 13374). Designated critical habitat makes up about 29% of the species' original range and occurs exclusively in the Upper Colorado River Basin. River reaches (including the 100-year floodplain) that make up critical habitat for Colorado pikeminnow in the Green River system include the Yampa River from Craig, Colorado, downstream to the Green River; Green River downstream of the Yampa River to the confluence with the Colorado River; and White River from Rio Blanco Reservoir downstream to the Green River.

> Colorado: Moffat County. The Yampa River and its 100-year floodplain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6^{th} Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> Utah: Uintah, Carbon, Grand, Emery, Wayne and San Juan Counties; and Colorado: Moffat County. The Green River and its 100 year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6^{th} Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).

Colorado: Rio Blanco County and Utah: Uintah County. The White River and its 100-year floodplain from Rio Blanco Lake Dam in T.1N., R96W., section 6 (6^{th} Principal Meridian) to the confluence with the Green River in T.9S., R20E., section 4 (Salt Lake Meridian).

The Service has identified water, physical habitat, and the biological environment as the primary constituent elements of critical habitat (59 FR 13374). Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation, and competition are important elements of the biological environment.

Status and Distribution

Based on early fish collection records, archaeological finds, and other observations, the Colorado pikeminnow was once found throughout warmwater reaches of the entire Colorado River Basin down to the Gulf of California, and including reaches of the upper Colorado River and its major tributaries, the Green River and its major tributaries, and the Gila River system in Arizona (Seethaler 1978). Colorado pikeminnow apparently were never found in colder, headwater areas. The species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s (Seethaler 1978). By the 1970s they were extirpated from the entire lower basin (downstream of Glen Canyon Dam) and portions of the upper basin as a result of major alterations to the riverine environment. Having lost some 75 to 80 percent of its former range due to habitat loss, the Colorado pikeminnow was federally listed as an endangered species in 1967 (Miller 1961, Moyle 1976, Tyus 1991, Osmundson and Burnham 1998). Full protection under the Act of 1973 occurred on January 4, 1974.

Colorado pikeminnow are presently restricted to the Upper Colorado River Basin and inhabit warmwater reaches of the Colorado, Green, and San Juan rivers and associated tributaries. The Colorado pikeminnow recovery goals (USFWS 2002a) identify occupied habitat of wild Colorado pikeminnow as follows: the Green River from Lodore Canyon to the confluence of the Colorado River; the Yampa River downstream of Craig, Colorado; the Little Snake River from its confluence with the Yampa River upstream into Wyoming; the White River downstream of Taylor Draw Dam; the lower 89 miles of the Price River; the lower Duchesne River; the upper Colorado River from Palisade, Colorado, to Lake Powell; the lower 34 miles of the Gunnison River; the lower mile of the Dolores River; and 150 miles of the San Juan River downstream from Shiprock, New Mexico, to Lake Powell.

Recovery goals for the Colorado pikeminnow (USFWS 2002a) were approved on August 1, 2002. According to these recovery goals, downlisting can be considered if, over a 5-year period:

- a genetically and demographically viable, self-sustaining population is maintained in the Green River subbasin such that (a) the trends in separate adult (age 7+; > 450 mm total length) point estimates for the middle Green River and the lower Green River do not decline significantly, and (b) mean estimated recruitment of age-6 (400–449 mm total length) naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin, and (c) each population point estimate for the Green River subbasin exceeds 2,600 adults (2,600 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and

- a self-sustaining population of at least 700 adults (number based on inferences about carrying capacity) is maintained in the upper Colorado River subbasin such that (a) the trend in adult point estimates does not decline significantly, and (b) mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality; and

- a target number of 1,000 age-5+ fish (> 300 mm total length; number based on estimated survival of stocked fish and inferences about carrying capacity) is established through augmentation and/or natural reproduction in the San Juan River subbasin; and

- certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can be considered if, over a 7-year period beyond downlisting:

- a genetically and demographically viable, self-sustaining population is maintained in the Green River subbasin such that (a) the trends in separate adult point estimates for the middle Green River and the lower Green River do not decline significantly, and (b) mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin, and (c) each population point estimate for the Green River subbasin exceeds 2,600 adults; and

- either the upper Colorado River subbasin self-sustaining population exceeds 1,000 adults or the upper Colorado River subbasin self-sustaining population exceeds 700 adults and San Juan River subbasin population is self-sustaining and exceeds 800 adults (numbers based on inferences about carrying capacity) such that for each population (a) the trend in adult point estimates does not decline significantly, and (b) mean estimated recruitment of age-6 naturally produced fish equals or exceeds mean annual adult mortality; and

- certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Life History

The Colorado pikeminnow is a long-distance migrator; adults move hundreds of miles to and from spawning areas, and require long sections of river with unimpeded passage. Adults require pools, deep runs, and eddy habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats. Spawning occurs after spring runoff at water temperatures typically between 18 and 23 °C. After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters that are restructured by high spring flows and maintained by relatively stable base flows. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by Colorado pikeminnow in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes. The following is a description of observed habitat uses in the Upper Colorado River Basin.

Colorado pikeminnow live in warm-water reaches of the Colorado River mainstem and larger tributaries, and require uninterrupted stream passage for spawning migrations and dispersal of young. The species is adapted to a hydrologic cycle characterized by large spring peaks of snow-melt runoff and low, relatively stable base flows. High spring flows create and maintain in-channel habitats, and reconnect floodplain and riverine habitats, a phenomenon described as the spring flood-pulse (Junk et al. 1989; Johnson et al. 1995). Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow use relatively deep, low-velocity eddies, pools, and runs that occur in nearshore areas of main river channels (Tyus and McAda 1984; Valdez and Masslich 1989; Tyus 1990, 1991; Osmundson et al. 1995). In spring, however, Colorado pikeminnow adults use floodplain habitats, flooded tributary mouths, flooded side canyons, and eddies that are available only during high flows (Tyus 1990, 1991; Osmundson et al. 1995). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in floodplain habitats to exploit food and temperature resources, and may serve as prey. Such low-velocity environments also may serve as resting areas for Colorado pikeminnow. River reaches of high habitat complexity appear to be preferred.

Because of their mobility and environmental tolerances, adult Colorado pikeminnow are more widely distributed than other life stages. Distribution patterns of adults are stable during most of the year (Tyus 1990, 1991; Irving and Modde 2000), but distribution of adults changes in late spring and early summer, when most mature fish migrate to spawning areas (Tyus and McAda 1984; Tyus 1985, 1990, 1991; Irving and Modde 2000). High spring flows provide an important cue to prepare adults for migration and also ensure that conditions at spawning areas are suitable for reproduction once adults arrive. Specifically, bankfull or much larger floods mobilize coarse sediment to build or reshape cobble bars, and they create side channels that Colorado pikeminnow sometimes use for spawning (Harvey et al. 1993).

Colorado pikeminnow spawning sites in the Green River subbasin have been well documented. The two principal locations are in Yampa Canyon on the lower Yampa River and in Gray Canyon on the lower Green River (Tyus 1990, 1991). These reaches are 42 and 72 km long, respectively, but most spawning is believed to occur at one or two short segments within each of the two reaches. Another spawning area may occur in Desolation Canyon on the lower Green

River (Irving and Modde 2000), but the location and importance of this area has not been verified. Although direct observation of Colorado pikeminnow spawning was not possible because of high turbidity, radiotelemetry indicated spawning occurred over cobble-bottomed riffles (Tyus 1990). High spring flows and subsequent post-peak summer flows are important for construction and maintenance of spawning substrates (Harvey et al. 1993). In contrast with the Green River subbasin, where known spawning sites are in canyon-bound reaches, currently suspected spawning sites in the upper Colorado River subbasin are at six locations in meandering, alluvial reaches (McAda 2000).

After hatching and emerging from the spawning substrate, Colorado pikeminnow larvae drift downstream to backwaters in sandy, alluvial regions, where they remain through most of their first year of life (Holden 1977; Tyus and Haines 1991; Muth and Snyder 1995). Backwaters and the physical factors that create them are vital to successful recruitment of early life stages of Colorado pikeminnow, and age-0 Colorado pikeminnow in backwaters have received much research attention (e.g., Tyus and Karp 1989; Haines and Tyus 1990; Tyus 1991; Tyus and Haines 1991; Bestgen et al. 1997). It is important to note that these backwaters are formed after cessation of spring runoff within the active channel and are not floodplain features. Colorado pikeminnow larvae occupy these in-channel backwaters soon after hatching. They tend to occur in backwaters that are large, warm, deep (average, about 0.3 m in the Green River), and turbid (Tyus and Haines 1991). Recent research (Day et al. 1999a, 1999b; Trammell and Chart 1999) has confirmed these preferences and suggested that a particular type of backwater is preferred by Colorado pikeminnow larvae and juveniles. Such backwaters are created when a secondary channel is cut off at the upper end, but remains connected to the river at the downstream end. These chute channels are deep and may persist even when discharge levels change dramatically. An optimal river-reach environment for growth and survival of early life stages of Colorado pikeminnow has warm, relatively stable backwaters, warm river channels, and abundant food (Muth et al. 2000).

Threats to the Species

Major declines in Colorado pikeminnow populations occurred during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the mainstem broke the natural continuum of the river ecosystem into a series of disjunct segments, blocking native fish migrations, reducing temperatures downstream of dams, creating lacustrine habitat, and providing conditions that allowed competitive and predatory nonnative fishes to thrive both within the impounded reservoirs and in the modified river segments that connect them. The highly modified flow regime in the lower basin coupled with the introduction of nonnative fishes decimated populations of native fish.

The primary threats to Colorado pikeminnow are stream flow regulation and habitat modification; competition with and predation by nonnative fishes; and pesticides and pollutants (USFWS 2002a). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. These impairments are described in further detail below.

Stream flow regulation includes mainstem dams that cause the following adverse effects to Colorado pikeminnow and its habitat:

- block migration corridors,
- changes in flow patterns, reduced peak flows and increased base flows,
- release cold water, making temperature regimes less than optimal,
- change river habitat into lake habitat, and
- retain sediment that is important for forming and maintaining backwater habitats

In the Upper Basin, 435 miles of Colorado pikeminnow habitat has been lost by reservoir inundation from Flaming Forge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River. Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam. In addition to main stem dams, many dams and water diversion structures occur in and upstream from critical habitat that reduce flows and alter flow patterns, which adversely affect critical habitat. Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system. It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, majority of the river flow is diverted into unscreened canals. High spring flows maintain habitat diversity, flush sediments from spawning habitat, increase invertebrate food production, form gravel and cobble deposits important for spawning, and maintain backwater nursery habitats (McAda 2000; Muth et al. 2000). Peak spring flows in the Green River at Jensen, Utah, have decreased 13–35 percent and base flows have increased 10–140 percent due to regulation by Flaming Gorge Dam (Muth et al. 2000).

To summarize the threat of streamflow regulation to critical habitat, we first consider the direct effects on two of the primary constituent elements: water and physical habitat. The quantity of water of sufficient quality has been reduced during critical periods of the year; most notably during the spring runoff period when high seasonal flows serve to connect floodplain habitats, shape in-channel habitats, and provide important behavioral cues to spawning adult fish. Stream flow regulation affects the quality of water in several ways: a). colder than normal, hypolimnetic releases from main channel impoundments render historically occupied reaches unsuitable for native fish; b). elevated baseflows can result in reduced temperature and changes in the distribution and abundance of shoreline nursery habitats for endangered fish. Stream flow regulation also indirectly affects the third constituent element: the biological environment. A reduction in the magnitude and durations of the spring peak limits floodplain inundation. Floodplain inundation provides a critical seasonal source of nutrients / food items for fish in a big river ecosystem.

Predation and competition from nonnative fishes have been clearly implicated in the population reductions or elimination of native fishes in the Colorado River Basin (Dill 1944, Osmundson and Kaeding 1989, Behnke 1980, Joseph et al. 1977, Lanigan and Berry 1979, Minckley and Deacon 1968, Meffe 1985, Propst and Bestgen 1991, Rinne 1991). Data collected by

Osmundson and Kaeding (1991) indicated that during low water years nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers. More than 50 nonnative fish species were intentionally introduced in the Colorado River Basin prior to 1980 for sportfishing, forage fish, biological control and ornamental purposes (Minckley 1982, Tyus et al. 1982, Carlson and Muth 1989). Nonnative fishes compete with native fishes in several ways. The capacity of a particular area to support aquatic life is limited by physical habitat conditions. Increasing the number of species in an area usually results in a smaller population of most species. The size of each species population is controlled by the ability of each life stage to compete for space and food resources and to avoid predation. Some life stages of nonnative fishes appear to have a greater ability to compete for space and food and to avoid predation in the existing altered habitat than do some life stages of native fishes. Tyus and Saunders (1996) cite numerous examples of both indirect and direct evidence of predation on razorback sucker eggs and larvae by nonnative species. Introductions of nonnative species affect critical habitat by degrading one of its primary constituent elements; the biological environment. Predation and competition, although considered a normal component of the Colorado River ecosystem, are out of balance due to introduced nonnative fish species.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials; discharge of pollutants from uranium mill tailings; and high selenium concentration in the water and food chain (USFWS 2002a). Accidental spills of hazardous material into critical habitat, particularly when considering water of sufficient quality as a primary constituent element, can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. High selenium levels may adversely affect reproduction and recruitment (Hamilton and Wiedmeyer 1990; Stephens et al. 1992; Hamilton and Waddell 1994; Hamilton et al. 1996; Stephens and Waddell 1998; Osmundson et al. 2000).

Management actions identified in the recovery goals for Colorado pikeminnow (USFWS 2002a) to minimize or remove threats to the species included:

- provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations;
- provide passage over barriers within occupied habitat to allow adequate movement and, potentially, range expansion;
- investigate options for providing appropriate water temperatures in the Gunnison River;
- minimize entrainment of subadults and adults in diversion canals;
- ensure adequate protection from overutilization;
- ensure adequate protection from diseases and parasites;
- regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries;
- control problematic nonnative fishes as needed;
- minimize the risk of hazardous-materials spills in critical habitat; and
- remediate water-quality problems.

Status of Colorado pikeminnow and Critical Habitat in the Action Area

Preliminary population estimates presented in the Recovery Goals (USFWS 2002a) for the three Colorado pikeminnow populations (Green River Subbasin, Upper Colorado River Subbasin, San Juan River Subbasin) ranged from 6,600 to 8,900 wild adults. These numbers provided a general indication of the total wild adult population size at the time the Recovery Goals were developed, however, it was also recognized that the accuracy of the estimates vary among populations.

Monitoring of Colorado pikeminnow populations is ongoing, and sampling protocols and the reliability of the population estimates are being assessed by the Service and cooperating entities. A recent draft report on the status of Colorado pikeminnow in the Green River subbasin (Bestgen et al. 2004) presented population estimates for adult (>450 mm total length (TL)) and recruit-sized (400–449 mm TL) Colorado pikeminnow. The Service recognizes that at this time, the report is draft and the analysis of the data is preliminary, however, the Service finds this is the best scientific information available regarding current population status in the Green River subbasin. The draft report suggests that over the study period (2001 to 2003) there was a decline in abundance of Colorado pikeminnow in the Green River subbasin from 3,338 (95 percent confidence interval, 2815 to 3861) animals in 2001 to 2,324 (95 percent confidence interval 1395 to 3252) animals in 2003. In the Yampa River estimates of adult abundance declined from 322 animals in 2000 to 250 animals in 2003. Adult abundance estimates in the White River declined from 1,115 animals in 2000 to 465 animals in 2003 and recruit-sized estimates declined from 44 animals in 2000 to zero in 2003. In the middle Green River (Yampa River confluence to Desolation Canyon) abundance estimates for adults ranged from 1,629 animals in 2000 to 747 animals in 2003 and estimates of abundance of recruit-sized fish ranged from 103 animals in 2000 to 50 animals in 2003. Estimates for the Desolation-Gray Canyon reach of the Green River ranged from 681 adults in 2001 to 585 adults in 2003 and recruit-sized estimates ranged from 162 animals in 2001 to 64 animals in 2003. In the lower Green River (Green River, Utah to the confluence of the Colorado River) abundance estimates were 366 adults in 2001 and 273 adults in 2003 and recruit-sized estimates ranged from 70 in 2001 to 104 in 2003. Studies indicate that significant recruitment of Colorado pikeminnow may not occur every year, but occurs in episodic intervals of several years (Osmundson and Burnham 1998).

All life stages of Colorado pikeminnow in the Green River demonstrate wide variations in abundance at seasonal, annual, or longer time scales, but reasons for shifts in abundance are poorly understood. Bestgen et al. (1998) captured drifting larvae produced from the two main spawning areas in the Green River system and found order-of-magnitude differences in abundance from year to year. They reported that low- or high-discharge years were often associated with poor reproduction but could not ascribe a specific cause-effect mechanism (Bestgen et al. 1998). In general, similar numbers of age-0 fish were found in autumn in the middle Green River, in spite of different-sized cohorts of larvae produced each summer in the Yampa River. Conversely, numbers of Colorado pikeminnow larvae produced in the lower Green River were similar among years but resulted in variable age-0 fish abundance in autumn.

In the Green River subbasin, radio-telemetry studies have shown that distribution of adults changes in late spring and early summer when most mature fish migrate to spawning areas in the lower Yampa River in Yampa Canyon and the lower Green River in Gray Canyon (Tyus and

McAda 1984; Tyus 1985; Tyus 1990; Tyus 1991; Irving and Modde 2000). Those fish remain in spawning areas for 3–8 weeks before returning to home ranges. Because adult Colorado pikeminnow converge on spawning areas from throughout the Green River system to reproduce at these two known localities, migration cues are an important part of the reproductive life history. In general, adults begin migrating in late spring or early summer. Migrations began earlier in low-flow years and later in high-flow years (Tyus and Karp 1989; Tyus 1990; Irving and Modde 2000). Migrations to the Yampa River spawning area occur coincident with, and up to 4 weeks after, peak spring runoff when water temperatures are usually 14–16 °C (Tyus 1990; Irving and Modde 2000). Rates of movement for individuals are not precisely known, but 2 individuals made the approximately 400 km migration from the White River below Taylor Draw Dam to the Yampa River spawning area in less than 2 weeks. Alteration of the natural hydrograph may alter the environmental cues triggering these spawning migrations.

High magnitude flows of infrequent occurrence are necessary to create and maintain spawning habitat. Infrequent intense flooding redistributes and creates spawning bars (O'Brien 1984). Annual lower-level flooding followed by recessional flows dissect and secondarily redistribute gravels, preparing them for spawning (Harvey et al. 1993). These studies conducted at a known spawning location in Yampa Canyon show that both processes are important for habitat maintenance and activities that reduce or re-time the annual peak or reduce the frequency of high magnitude flows are likely to reduce essential spawning habitat in amount and quality.

Similar to adults, distribution of early life stages of Colorado pikeminnow is dynamic on a seasonal basis and linked to habitat in the mainstem Green River downstream of spawning areas. After hatching and emergence from spawning substrate, larvae are dispersed downstream. A larva may drift for only a few days, but larvae occur in main channels of the Yampa and Green rivers for 3–8 weeks depending on length of the annual reproductive period (Nesler et al. 1988; Tyus and Haines 1991; Bestgen et al. 1998). The Yampa River spawning area consistently produces more larvae than the spawning area in the lower Green River (Bestgen et al. 1998).

Currently, two primary reaches of Colorado pikeminnow nursery habitat are present in the Green River system. The upper one occurs from near Jensen, Utah, downstream to the Duchesne River confluence. The lower one occurs from near Green River, Utah, downstream to the Colorado River confluence (Tyus and Haines 1991; McAda et al. 1994a; McAda et al. 1994b; McAda et al. 1997). Larvae from the lower Yampa River are thought to mostly colonize backwaters in alluvial valley reaches between Jensen, Utah, and the Ouray National Wildlife Refuge. Most floodplain habitat along the current-day Green River is concentrated in this reach. Although the density of age-0 fish in autumn was usually higher in the lower than in the middle Green River (Tyus and Haines 1991; McAda et al. 1994a), differences in habitat quantity may have confounded abundance estimates. The reach of the Green River defined mostly by Desolation and Gray Canyons also provides nursery habitat for Colorado pikeminnow (Tyus and Haines 1991; Day et al. 1999b). These backwaters are especially important during the Colorado pikeminnow's critical first year of life.

Backwaters and physical factors that create them are vital to successful recruitment of early life stages of Colorado pikeminnow. Occasional very high spring flows are needed to transport sediment and maintain or increase channel complexity. Sediment transport from the Little Snake

River provides an estimated 60 percent of the total sediment supply to the Green River and is important to maintain equilibrium channel morphology and ensure continued creation and maintenance of backwater nursery habitats for Colorado pikeminnow and humpback chub (Hawkins and O'Brien 2001). During high-discharge events, the elevation of sand bars increases and if high flows persist through summer, few backwaters are formed (Tyus and Haines 1991). Post-runoff low flows sculpt and erode sand bars and create complex backwater habitat critical for early life stages of all native fishes, particularly Colorado pikeminnow. Deeper, chute-channel backwaters are preferred by age-0 Colorado pikeminnow in the Green River (Tyus and Haines 1991; Day and Crosby 1997, Day et al. 1999a; Trammell and Chart 1999). Alterations to the amount and timing of flows defining the natural hydrology and sediment transport processes may inhibit the processes that create and maintain these habitats.

Past research indicated that certain discharge levels may optimize backwater habitat availability below Jensen for age-0 Colorado pikeminnow (Pucherelli et al. 1990; Tyus and Haines 1991; Tyus and Karp 1991). However, many geomorphic processes are dynamic over time and driven by the level of spring flows, the frequency of large floods, and post-peak discharge levels (Bell et al. 1998; Rakowski and Schmidt 1999). Consequently, flows to achieve optimum backwater availability may be different each year and dependent upon year-to-year bar topography (Rakowski and Schmidt 1999).

Muth et al. (2000) summarized flow and temperature needs of Colorado pikeminnow in the Green River subbasin as:

> "...Colorado pikeminnow are widespread in the system, occurring in both the main stem and tributaries. The Green River downstream of its confluence with the Yampa River supports the largest population of adults and nearly all larval and juvenile rearing areas; thus, this portion of the system is critical for sustaining Colorado pikeminnow populations. Reproduction of Colorado pikeminnow occurred in all years studied, and the current abundance of adults is comparatively high.
>
> However, the abundance of larval and age-0 stages is highly variable among years and is currently low compared to the abundance observed in the late 1980s. Recruitment has been low or nonexistent in some reaches and years.
>
> Habitat requirements of Colorado pikeminnow vary by season and life stage. In spring, adults utilize warmer off-channel and floodplain habitats for feeding and resting. Declining flow, increasing water temperature, photoperiod, and perhaps other factors in early summer provide cues for reproduction. Declining flow in summer also removes fine sediments from spawning substrates, and increases in water temperature also aid gonadal maturation. Reproduction begins when water temperatures reach 16–22°C. After hatching and swim-up, larvae drift downstream and occupy channel-margin backwaters. The potential for cold shock to Colorado pikeminnow larvae drifting from the Yampa River and into the Green River in summer could be eliminated or reduced if warmer water was provided in Reach 1 (Flaming Gorge Dam to the Yampa River confluence). Warm water also promotes fast growth of Colorado pikeminnow, which reduces effects of size-dependent regulatory processes such as predation. This warmer water also may provide conditions suitable for spawning in Lodore Canyon of Reach 1 and would enhance growth of early life stages in nursery habitats (e.g., backwaters) throughout Reach 2 (Yampa River to the White River confluence). Low, relatively stable base flows create

warm, food-rich backwaters that are thought to promote enhanced growth and survival of early life stages through autumn and winter. Similarly, low, relatively stable winter flows may enhance overwinter survival by reducing disruption of ice cover and habitat.

In-channel habitats used by Colorado pikeminnow are formed and maintained by spring peak flows that rework existing sediment deposits, scour vegetation from deposits, and create new habitats. The magnitudes of these flows were highly variable prior to flow regulation, and this variability appears to be important for maintaining high-quality habitats. In-channel habitats preferred by young Colorado pikeminnow are relatively deep (mean, 0.3 m) chute-channel backwaters. High peak flows maintain these habitats by periodically removing accumulated sediments and rebuilding the deposits that provide the structure for formation of backwaters after flows recede."

Critical Habitat for Colorado pikeminnow is located throughout Reaches 2 and 3 of the action area. As was discussed above, all primary constituent elements (water, physical habitat, and biological environment) have been affected throughout designated critical habitat on the Green River and in other occupied areas (Reach 1) and could be further influenced through implementation of the proposed action. To date, water quantity and quality has been affected by flow regulation and land management practices (irrigated agriculture), which has resulted in increased concentrations of contaminants (most notably selenium). Physical habitat (spring adult staging areas (floodplain), spawning and nursery habitats) has been affected through flow regulation, land management practices (diking), and encroachment of nonnative vegetation (primarily tamarisk). The biological environment has been altered primarily due to the introduction of numerous species of nonnative fish disrupting the natural balance of competition and predation. All constituent elements of designated Colorado pikeminnow critical habitat along the Green River will be considered in our analysis of the effects of the proposed action.

Razorback Sucker

Species/Critical Habitat Description

Like all suckers (family Catostomidae, meaning "down mouth"), the razorback sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish white (Sublette et al. 1990). Adults often exceed 3 kg (6 pounds) in weight and 600 mm (2 feet) in length. Like Colorado pikeminnow, razorback suckers are long-lived, living 40-plus years.

Critical habitat was designated for razorback sucker on March 21, 1994 (59 FR 13374). Designated critical habitat makes up about 49% of the species' original range and occurs in both the Upper and Lower Colorado River Basins (USFWS 1994). The primary constituent elements are the same as those described for Colorado pikeminnow.

River reaches (including the 100-year floodplain) of critical habitat for razorback sucker in the Green River system include the lower 89 km (55 mi) of the Yampa River (i.e., from the mouth of Cross Mountain Canyon to the confluence with the Green River), the Green River between the confluences of the Yampa and Colorado Rivers, the lower 29 km (18 mi) of the White River, and the lower 4 km (2.5 mi) of the Duchesne River.

Colorado: Moffat County. The Yampa River and its 100-year floodplain from the mouth of Cross Mountain Canyon in T. 6 N., R. 98 W., section 23 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

Utah: Uintah County; and Colorado: Moffat County. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to Sand Wash in T. 11 S., R. 18 E., section 20 (6th Principal Meridian).

Utah: Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties. The Green River and its 100-year floodplain from Sand Wash at river mile 96 at T. 11 S., R. 18 E., section 20 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (6th Principal Meridian).

Utah: Uintah County. The White River and its 100-year floodplain from the boundary of the Uintah and Ouray Indian Reservation at river mile 18 in T. 9S., R. 22E., section 21 (Salt Lake Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).

Utah: Uintah County. The Duchesne River and its 100-year floodplain from river mile 2.5 in T. 4S., R. 3E., section 30 (Salt Lake Meridian) to the confluence with the Green River in T. 5 S., R. 3 E., section 5 (Uintah Meridian).

The Service has identified water, physical habitat, and the biological environment as the primary constituent elements of critical habitat (59 FR 13374). Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation, and competition are important elements of the biological environment. The Service gave special consideration to habitats required for razorback sucker reproduction and recruitment when critical habitat was designated.

Status and Distribution

On March 14, 1989, the Service was petitioned to conduct a status review of the razorback sucker. Subsequently, the razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 54957). The final rule stated "Little evidence of natural recruitment has been found in the past 30 years, and numbers of adult fish captured in the last 10 years demonstrate a downward trend relative to historic abundance. Significant changes have occurred in razorback sucker habitat through diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams" (56 FR 54957). Recruitment of razorback suckers to the population continues to be a problem.

Historically, razorback suckers were found in the mainstem Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1983). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and, further, that commercially marketable quantities were caught in Arizona as recently as 1949. In the Upper Basin, razorback suckers were reported in the Green River to be very abundant near Green River, Utah, in the late 1800s (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930s and early 1940s. In the San Juan River drainage, Platania and Young (1989) relayed historical accounts of razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

Currently, the largest concentration of razorback sucker remaining in the Colorado River Basin is in Lake Mohave on the border of Arizona and California. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 as late as 1991, to 25,000 in 1993 (Marsh 1993, Holden 1994), to about 9,000 in 2000 (USFWS 2002b). Until recently, efforts to introduce young razorback sucker into Lake Mohave have failed because of predation by non-native species (Minckley et al. 1991, Clarkson et al. 1993, Burke 1994). While limited numbers of razorback suckers persist in other locations in the Lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the Upper Colorado River Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments. The largest populations of razorback suckers in the upper basin are found in the upper Green and lower Yampa rivers (Tyus 1987). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. Osmundson and Kaeding (1991) reported that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Between 1984 and 1990, intensive collecting effort captured only 12 individuals in the Grand Valley (Osmundson and Kaeding 1991). The wild population of razorback sucker is considered extirpated from the Gunnison River (Burdick and Bonar 1997).

Razorback suckers are in imminent danger of extirpation in the wild. As Bestgen (1990) pointed out:

> "Reasons for decline of most native fishes in the Colorado River Basin have been attributed to habitat loss due to construction of mainstream dams and subsequent interruption or alteration of natural flow and physio-chemical regimes, inundation of river reaches by reservoirs, channelization, water quality degradation, introduction of nonnative fish species and resulting competitive interactions or predation, and other man-

induced disturbances (Miller 1961, Joseph et al. 1977, Behnke and Benson 1983, Carlson and Muth 1989, Tyus and Karp 1989). These factors are almost certainly not mutually exclusive, therefore it is often difficult to determine exact cause and effect relationships."

The virtual absence of any recruitment suggests a combination of biological, physical, and/or chemical factors that may be affecting the survival and recruitment of early life stages of razorback suckers. Within the Upper Basin, recovery efforts endorsed by the Recovery Program include the capture and removal of razorback suckers from all known locations for genetic analyses and development of discrete brood stocks. These measures have been undertaken to develop refugia populations of the razorback sucker from the same genetic parentage as their wild counterparts such that, if these fish are genetically unique by subbasin or individual population, then separate stocks will be available for future augmentation. Such augmentation may be a necessary step to prevent the extinction of razorback suckers in the Upper Basin.

Recovery goals for the razorback sucker (USFWS 2002b) were approved on August 1, 2002. According to these recovery goals, downlisting can be considered if, over a 5-year period:

- genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and either in the upper Colorado River subbasin or the San Juan River subbasin such that (a) the trend in adult (age 4+; > 400 mm total length) point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 (300–399 mm total length) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 5,800 adults (5,800 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and

- a genetic refuge is maintained in Lake Mohave of the lower basin recovery unit; and

- two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 5,800 adults; and

- certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can be considered if, over a 3-year period beyond downlisting:

- genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and either in the upper Colorado

River subbasin or the San Juan River subbasin such that (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 5,800 adults; and

- a genetic refuge is maintained in Lake Mohave; and

- two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 5,800 adults; and

- certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Life History

McAda and Wydoski (1980) and Tyus (1987) reported springtime aggregations of razorback suckers in off-channel habitats and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the mainstem river and that razorback suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. Prior to construction of large mainstem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the Upper Basin (Tyus and Karp 1989; Osmundson and Kaeding 1991). Dams changed riverine ecosystems into lakes by impounding water, which eliminated these off-channel habitats in reservoirs. Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel habitats. The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified starvation of larval razorback suckers due to low zooplankton densities in the main channel and loss of floodplain habitats which provide adequate zooplankton densities for larval food as one of the most important factors limiting recruitment.

While razorback suckers have never been directly observed spawning in turbid riverine environments within the Upper Basin, captures of ripe specimens (in spawning condition), both males and females, have been recorded (Valdez et al. 1982a; McAda and Wydoski 1980; Tyus 1987; Osmundson and Kaeding 1989; Tyus and Karp 1989; Tyus and Karp 1990; Osmundson and Kaeding 1991; Platania 1990) in the Yampa, Green, Colorado, and San Juan rivers. Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates (depending on the specific location).

Outside of the spawning season, adult razorback suckers occupy a variety of shoreline and main channel habitats including slow runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1987; Tyus and Karp 1989; Osmundson and Kaeding 1989; Valdez and Masslich 1989; Osmundson and Kaeding 1991; Tyus and Karp 1990).

Habitat requirements of young and juvenile razorback suckers in the wild are not well known, particularly in native riverine environments. Prior to 1991, the last confirmed documentation of a razorback sucker juvenile in the Upper Basin was a capture in the Colorado River near Moab, Utah (Taba et al. 1965). In 1991, two early juvenile (36.6 and 39.3 mm total length (TL)) razorback suckers were collected in the lower Green River near Hell Roaring Canyon (Gutermuth et al. 1994). Juvenile razorback suckers have been collected in recent years from Old Charley Wash, a wetland adjacent to the Green River (Modde 1996). Between 1992 and 1995 larval razorback suckers were collected in the middle and lower Green River and within the Colorado River inflow to Lake Powell (Muth 1995). In 2002, eight larval razorback suckers were collected in the Gunnison River (Osmundson 2002). No young razorback suckers have been collected in recent times in the Colorado River.

Threats to the Species

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, and removal of large quantities of water from the Colorado River system. Dams on the mainstem Colorado River and its major tributaries have segmented the river system, blocked migration routes, and changed river habitat into lake habitat. Dams also have drastically altered flows, temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding, or sheltering. Major changes in species composition have occurred due to the introduction of numerous nonnative fishes, many of which have thrived due to human-induced changes to the natural riverine system. These nonnative fishes prey upon and compete with razorback suckers.

The primary threats to razorback sucker critical habitat are stream flow regulation and habitat modification (affecting both the water and physical habitat constituent elements); competition with and predation by nonnative fishes; and pesticides and pollutants (USFWS 2002b) (affecting the biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to razorback sucker are essentially the same threats identified for Colorado pikeminnow.

Management actions identified in the recovery goals for razorback sucker (USFWS 2002b) to minimize or remove threats to the species included:

- provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations;
- provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion;
- investigate options for providing appropriate water temperatures in the Gunnison River;
- minimize entrainment of subadults and adults in diversion/out-take structures;
- ensure adequate protection from overutilization;
- ensure adequate protection from diseases and parasites;
- regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries;
- control problematic nonnative fishes as needed;
- minimize the risk of hazardous-materials spills in critical habitat;
- remediate water-quality problems; and
- minimize the threat of hybridization with white sucker.

Status of Razorback Sucker and Critical Habitat in the Action Area

The largest concentration of razorback suckers in the Upper Basin exists in low-gradient flat-water reaches of the middle Green River between and including the lower few miles of the Duchesne River and the Yampa River (Tyus 1987; Tyus and Karp 1990; Muth 1995; Modde and Wick 1997; Muth et al. 2000). This area includes the greatest expanse of floodplain habitat in the Upper Colorado River Basin, between Pariette Draw at river mile (RM) 238 and the Escalante Ranch at RM 310 (Irving and Burdick 1995).

Lanigan and Tyus (1989) used a demographically closed model with capture-recapture data collected from 1980 to 1988 and estimated that the middle Green River population consisted of about 1,000 adults (mean, 948; 95 percent confidence interval, 758–1,138). Based on a demographically open model and capture-recapture data collected from 1980 to 1992, Modde et al. (1996) estimated the number of adults in the middle Green River population at about 500 fish (mean, 524; 95 percent confidence interval, 351–696). That population had a relatively constant length frequency distribution among years (most frequent modes were in the 505–515 mm-TL interval) and an estimated annual survival rate of 71 percent. Bestgen et al. (2002) estimated the current population of wild razorback sucker in the middle Green River to be about 100, based on data collected in 1998 and 1999. There are no current population estimates of razorback sucker in the Yampa River due to low numbers captured in recent years.

The lower Yampa River provides adult habitat, spawning habitat, and potential nursery areas occur downstream in the Green River (USFWS 1998a). Modde and Smith (1995) reported that adult razorback suckers were collected between RM 13 and RM 0.1 of the Yampa River. They also reported only one juvenile razorback sucker has been collected in the Yampa River. The single fish (389 mm) was collected at RM 39 in June 1994. The Green River from the confluence with the Yampa River to Sand Wash has the largest existing riverine population of razorback sucker (Lanigan and Tyus 1989, Modde et al. 1996). Razorback suckers are rarely found upstream as far as the confluence with the Little Snake River (McAda and Wydoski 1980 and Lanigan and Tyus 1989). Tyus and Karp (1990) located concentrations of ripe razorback suckers at the mouth of the Yampa River during the spring in 1987-1989. Ripe fish were captured in runs associated with bars of cobble, gravel, and sand substrates in water averaging 0.63 m deep and mean velocity of 0.74 m/s.

Razorback suckers are permanent residents of the Green River below its confluence with the Yampa River and are reliant on in-channel habitat for spawning and flooded off-channel habitats for several aspects of their life history. In turn, these habitats are created and maintained by the natural hydrology and sediment transport provided by the Yampa River.

Spring migrations by adult razorback suckers were associated with spawning in historic accounts (Jordan 1891; Hubbs and Miller 1953; Sigler and Miller 1963; Vanicek 1967), and a variety of local and long-distance movements and habitat-use patterns have been subsequently documented. Spawning migrations (one-way movements of 30.4–106.0 km) observed by Tyus and Karp (1990) included movements between the Ouray and Jensen areas of the Green River and between the Jensen area and the lower Yampa River. Initial movement of adult razorback suckers to spawning sites was influenced primarily by increases in river discharge and secondarily by increases in water temperature (Tyus and Karp 1990; Modde and Wick 1997; Modde and Irving 1998). Flow and temperature cues may serve to effectively congregate razorback suckers at spawning sites, thus increasing reproductive efficiency and success. Reduction in spring peak flows may hinder the ability of razorback suckers to form spawning aggregations, because spawning cues are reduced (Modde and Irving 1998).

Captures of ripe fish and radio-telemetry of adults in spring and early summer were used to locate razorback sucker spawning areas in the middle Green River. McAda and Wydoski (1980) found a spawning aggregation of 14 ripe fish (2 females and 12 males) over a cobble bar at the mouth of the Yampa River during a 2-week period in early to mid-May 1975. These fish were collected from water about 1 m deep with a velocity of about 1 m/s and temperatures ranging from 7 to 16°C (mean, 12°C). Tyus (1987) captured ripe razorback suckers in three reaches: 1) Island and Echo parks of the Green River in Dinosaur National Monument, including the lower mile of the Yampa River; 2) the Jensen area of the Green River from Ashley Creek (RM 299) to Split Mountain Canyon (RM 319); and 3) the Ouray area of the Green River, including the lower few miles of the Duchesne River. The Jensen area contributed 73 percent of the 60 ripe razorback suckers caught over coarse sand substrates or in the vicinity of gravel and cobble bars in those 3 reaches during spring 1981, 1984, and 1986.

Recently, tuberculate or ripe razorback suckers have been collected from reaches of the lower Green River in Labyrinth Canyon near the mouth of the San Rafael River at RM 97 (Tyus 1987, Miller and Hubert 1990, Muth 1995, Chart et al. 1999). Muth et al. (1998) suggested that many of the 439 razorback sucker larvae collected from the lower Green River between RM 28 and 97 during spring and early summer 1993–1996 had been spawned downstream of RM 110 (lower end of the Green River Valley reach), possibly near the mouth of the San Rafael River.

Substantial numbers of razorback sucker adults have been found in flooded off-channel habitats in the vicinity of mid-channel spawning bars shortly before or after spawning. Tyus (1987) located concentrations of ripe fish associated with warm floodplain habitats and in shallow eddies near the mouths of tributary streams. Similarly, Holden and Crist (1981) reported capture of 56 adult razorback suckers in the Ashley Creek-Jensen area of the middle Green River from 1978 to 1980, and about 19 percent of all ripe or tuberculate razorback suckers collected during 1981–1989 ($N = 57$) were from flooded lowlands (e.g., Old Charlie Wash and Stewart Lake Drain) and tributary mouths (e.g., Duchesne River and Ashley Creek) (Tyus and Karp 1990). Radio-telemetry and capture-recapture data compiled by Modde and Wick (1997) and Modde and Irving (1998) demonstrated that most razorback sucker adults in the middle Green River moved into flooded environments (e.g., floodplain habitats and tributary mouths) soon after spawning. Tyus and Karp (1990, 1991) and Modde and Wick (1997) suggested that use of warmer, more productive flooded habitats by adult razorback suckers during the breeding season is related to temperature preferences (23–25°C; Bulkley and Pimental 1983) and abundance of appropriate foods (Jonez and Sumner 1954; Vanicek 1967; Marsh 1987; Mabey and Shiozawa 1993; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998). Twelve ripe razorback suckers were caught in Old Charlie Wash during late May–early June 1986, presumably due to the abundant food in the wetland (Tyus and Karp 1991). Eight adult razorback suckers collected from Old Charlie Wash in late summer 1995 entered the wetland when it was connected to the river during peak spring flows (Modde 1996). Reduced spring flooding caused by lower regulated river discharges, channelization, and levee construction has restricted access to floodplain habitats used by adult razorback suckers for temperature conditioning, feeding, and resting (Tyus and Karp 1990; Modde 1997; Modde and Wick 1997; Wydoski and Wick 1998). The fact that these fish actively seek out this habitat suggests that the conditioning it provides them is important to their continued successful reproduction.

Razorback sucker larvae were collected each year in the Green River during 1992–1996. Over 99 percent (N = 1,735) of the larvae caught in the middle Green River during spring and early summer were from reaches including, and downstream of, the presumed spawning area near the Escalante Ranch (Muth et al. 1998). Based on the few larvae ($N = 6$) recorded from collections in the Echo Park reach in 1993, 1994, and 1996, reproduction by razorback suckers at the lower Yampa River spawning site appeared minimal, but sampling efforts in the two reaches immediately downstream of that site were comparatively low (Muth et al. 1998). Mean catch per unit effort (CPUE) was highly variable among years and river reaches but it is unclear whether this was a true measure of population abundance or was biased by differences in sampling efficiency (Muth et al. 1998). Numbers of razorback sucker larvae captured per year ranged from 20 in 1992 to 1,217 in 1994 for the middle Green River and from 5 in 1995 to 222 in 1996 for the lower Green River.

Collections in the lower Green River during 1993–1996 produced the first ever captures of razorback sucker larvae from this section of river. In the lower Labyrinth-upper Stillwater Canyon reach, 363 razorback suckers were caught; all from flooded side canyons, washes, backwaters, and side channels. Razorback sucker larvae were collected in the Echo Park area of the Green River in 1993, 1994, 1996, indicating successful spawning in the lower Yampa River (Muth et al. 1998).

Historically, floodplain habitats inundated and connected to the main channel by overbank flooding during spring-runoff discharges would have been available as nursery areas for young razorback suckers in the Green River. Tyus and Karp (1990) associated low recruitment with reductions in floodplain inundation since 1962 (closure of Flaming Gorge Dam), and Modde et al. (1996) associated years of high spring discharge and floodplain inundation in the middle Green River (1983, 1984, and 1986) with subsequent suspected recruitment of young adult razorback suckers. These floodplain habitats are essential for the survival and recruitment of larval fish. Relatively high zooplankton densities in these warm, productive habitats are necessary to provide adequate zooplankton densities for larval food. Loss or degradation of these productive floodplain habitats probably represents one of the most important factors limiting recruitment in this species (Wydoski and Wick 1998). The importance of these habitats is further underscored by the relationship between larval growth and mortality due to non-native predators (Bestgen et al. 1997). Predation by adult red shiners on larvae of native catostomids in flooded and backwater habitats of the Yampa, Green, or Colorado Rivers was documented by Ruppert et al.(1993) and Muth and Wick (1997). Water depletions and changes in timing of flows may reduce the quantity and availability of floodplain habitat, thus reducing larval growth and recruitment.

Muth et al. (2000) summarized flow and temperature needs of razorback sucker in the Green River subbasin as:

> "Current levels of recruitment of young razorback suckers are not sufficient to sustain populations in the Green River system; wild stocks are composed primarily of older individuals that continue to decline in abundance. Lack of adequate recruitment has been attributed to extremely low survival of larvae and juveniles. Reproduction by razorback suckers in the Green River was documented through captures of larvae each year during 1992□1996, but mortality of larvae was apparently high, possibly as a result of low growth rates and the effect of small body size on competition and the risk of predation. Only six juveniles have been collected from Green River backwaters since 1990, but 73 juveniles were collected from the Old Charlie Wash managed wetland in Reach 2 during 1995/1996.
>
> Floodplain areas inundated and temporarily connected to the main channel by spring peak flows appear to be important habitats for all life stages of razorback sucker, and the seasonal timing of razorback sucker reproduction suggests an adaptation for utilizing these habitats. However, the frequency, magnitude, and duration of seasonal overbank flooding in the Green River have been substantially reduced since closure of Flaming Gorge Dam. Restoring access to these warm and productive habitats, which are most abundant in Reach 2 within the Ouray NWR area, would provide the growth and conditioning environments that appear crucial for recovery of self-sustaining razorback sucker populations. In addition, lower, more stable flows during winter may reduce flooding of low-velocity habitats and reduce the breakup of ice cover in overwintering areas and may enhance survival of adults.
>
> Spring peak flows must be of sufficient magnitude to inundate floodplain habitats and timed to occur when razorback sucker larvae are available for transport into these flooded areas. Overbank flows of sufficient duration would provide quality nursery environments

and may enhance the growth and survival of young fish. Because at least some young razorback suckers entrained in more permanent ponded (depression) sections of floodplains may survive through subsequent winters, spring inundation will need to be repeated at sufficiently frequent intervals to provide access back into the main channel."

Critical Habitat for razorback sucker is located throughout Reaches 2 and 3 of the action area. As was discussed above, all primary constituent elements (water, physical habitat, and biological environment) have been affected throughout designated critical habitat on the Green River and to a lesser extent in other occupied areas (Reach 1). Habitat in those areas could be further affected through implementation of the proposed action. To date, water quantity and quality has been affected by flow regulation and land management practices (irrigated agriculture), which has resulted in increased concentrations of contaminants (most notably selenium). Physical habitat (spring adult staging areas (floodplain), spawning and nursery habitats) has been affected through flow regulation, land management practices (diking), and encroachment of nonnative vegetation (primarily tamarisk). The biological environment has been altered primarily due to the introduction of numerous species of nonnative fish disrupting the natural balance of competition and predation. All constituent elements of designated razorback sucker critical habitat along the Green River will be considered in our analysis of the effects of the proposed action.

Humpback Chub

Species/Critical Habitat Description

The humpback chub is a medium-sized freshwater fish (less than 500 mm) of the minnow family. The adults have a pronounced dorsal hump, a narrow flattened head, a fleshy snout with an inferior-subterminal mouth, and small eyes. It has silvery sides with a brown or olive colored back.

The humpback chub is endemic to the Colorado River Basin and is part of a native fish fauna traced to the Miocene epoch in fossil records (Miller 1946; Minckley et al. 1986). Humpback chub remains have been dated to about 4000 B.C., but the fish was not described as a species until the 1940s (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990). Because of this, its original distribution is not known. The humpback chub was listed as endangered on March 11, 1967.

Until the 1950s, the humpback chub was known only from Grand Canyon. During surveys in the 1950s and 1960s humpback chub were found in the upper Green River including specimens from Echo Park, Island Park, and Swallow Canyon (Smith 1960, Vanicek et al. 1970). Individuals were also reported from the lower Yampa River (Holden and Stalnaker 1975b), the White River in Utah (Sigler and Miller 1963), Desolation Canyon of the Green River (Holden and Stalnaker 1970) and the Colorado River near Moab (Sigler and Miller 1963).

Critical habitat was designated for humpback chub on March 21, 1994 (59 FR 13374). Designated critical habitat makes up about 28% of the species' original range and occurs in both the Upper and Lower Colorado River Basins. Although humpback chub life history and habitat use differs greatly from the other endangered Colorado River fish the Service determined that the primary constituent elements (water, physical habitat, and biological environment) of their critical habitat were the same.

Critical habitat for humpback chub in the Green River system include the Yampa River within Dinosaur National Monument, Green River from its confluence with the Yampa River downstream to the southern boundary of Dinosaur National Monument, and the Green River within Desolation and Gray Canyons.

> Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
>
> Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the southern boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).
>
> Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

Status and Distribution

Failure to recognize *Gila cypha* as a species until 1946 complicated interpretation of historic distribution of humpback chubs in the Green River (Douglas et al. 1989, 1998). Best available information indicates that before Flaming Gorge Dam, humpback chubs were distributed in canyon regions throughout much of the Green River, from the present site of Flaming Gorge Reservoir downstream through Desolation and Gray canyons (Vanicek 1967; Holden and Stalnaker 1975a; Holden 1991). In addition, the species occurred in the Yampa and White rivers. Pre-impoundment surveys of the Flaming Gorge Reservoir basin (Bosley 1960; Gaufin et al. 1960; McDonald and Dotson 1960; Smith 1960) reported both humpback chubs and bonytails from the Green River near Hideout Canyon, now inundated by Flaming Gorge Reservoir.

Historic collection records of humpback chub exist from the Yampa and White rivers, both tributaries to the Green River. Tyus (1998) verified the presence of seven humpback chubs in collections of the University of Colorado Museum, collected from the Yampa River in Castle Park between 19 June and 11 July 1948. A single humpback chub was found in the White River near Bonanza, Utah, in June 1981 (Miller et al. 1982b), and a possible bonytail-humpback chub intergrade was also captured in July 1978 (Lanigan and Berry 1981).

Present concentrations of humpback chub in the Upper Basin occur in canyon-bound river reaches ranging in length from 3.7 km (Black Rocks) to 40.5 km (Desolation and Gray Canyons). Humpback chubs are distributed throughout most of Black Rocks and Westwater Canyons (12.9 km), and in or near whitewater reaches of Cataract Canyon (20.9 km), Desolation and Gray Canyons (65.2 km), and Yampa Canyon (44.3 km), with populations in the separate canyon reaches ranging from 400 to 5,000 adults (see population dynamics). The Utah Division of Wildlife Resources has monitored the fish community in Desolation and Gray Canyons since 1989 and has consistently reported captures of age-0, juvenile, and adult *Gila,* including humpback chub, indicating a reproducing population (Chart and Lentsch 1999b). Distribution of humpback chubs within Whirlpool and Split Mountain Canyons is not presently known, but it is believed that numbers of humpback chub in these sections of the Green River are low.

The Yampa River is the only tributary to the Green River presently known to support a reproducing humpback chub population. Between 1986 and 1989, Karp and Tyus (1990) collected 130 humpback chubs from Yampa Canyon and indicated that a small but reproducing population was present. Continuing captures of juveniles and adults within Dinosaur National Monument indicate that a population persists in Yampa Canyon (T. Modde, U.S. Fish and Wildlife Service, personal communication). Small numbers of humpback chub also have been reported in Cross Mountain Canyon on the Yampa River and in the Little Snake River about 10 km upstream of its confluence with the Yampa River (Wick et al. 1981; Hawkins et al. 1996).

Recovery goals for the humpback chub (USFWS 2002c) were approved on August 1, 2002. According to these recovery goals, downlisting can be considered if, over a 5-year period:

- the trend in adult (age 4+; > 200 mm total length) point estimates for each of the six extant populations does not decline significantly; and

- mean estimated recruitment of age-3 (150–199 mm total length) naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and

- two genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults (2,100 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and

- certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can be considered if, over a 3-year period beyond downlisting:

- the trend in adult point estimates for each of the six extant populations does not decline significantly; and

- mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and

- three genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults; and

- certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Life History

Unlike Colorado pikeminnow and razorback sucker, which are known to make extended migrations of up to several hundred miles to spawning areas in the Green and Yampa rivers, humpback chubs in the Green River do not appear to make extensive migrations (Karp and Tyus 1990). Radio-telemetry and tagging studies on other humpback chub populations have revealed strong fidelity by adults for specific locations with little movement to areas outside of home canyon regions. Humpback chubs in Black Rocks (Valdez and Clemmer 1982), Westwater Canyon (Chart and Lentsch 1999a), and Desolation and Gray Canyons (Chart and Lentsch 1999b) do not migrate to spawn.

Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982a; Archer et al. 1985; Burdick and Kaeding 1985; Kaeding et al. 1990). Movements of adult humpback chub in Black Rocks on the Colorado River were essentially restricted to a 1-mile reach. These results were based on the recapture of Carlin-tagged fish and radiotelemetry studies conducted from 1979 to 1981 (Valdez et al. 1982) and 1983 to 1989 (Archer et al. 1985; Kaeding et al. 1990).

In the Green River and upper Colorado River, humpback chubs spawned in spring and summer as flows declined shortly after the spring peak (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Karp and Tyus 1990; Chart and Lentsch 1999a, 1999b). Similar spawning patterns were reported from Grand Canyon (Kaeding and Zimmerman 1983; Valdez and Ryel 1995, 1997). Little is known about spawning habitats and behavior of humpback chub. Although humpback chub are believed to broadcast eggs over mid-channel cobble and gravel bars, spawning in the wild has not been observed for this species. Gorman and Stone (1999) reported that ripe male humpback chubs in the Little Colorado River aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs, and eddies, 0.5–2.0 m deep) and were associated with deposits of clean gravel.

Chart and Lentsch (1999b) estimated hatching dates for young *Gila* collected from Desolation and Gray Canyons between 1992 and 1995. They determined that hatching occurred on the descending limb of the hydrograph as early as 9 June 1992 at a flow of 139 m^3/s and as late as 1 July 1995 at a flow of 731 m^3/s. Instantaneous daily river temperatures on hatching dates over all years ranged from 20 to 22 °C.

Newly hatched larvae average 6.3–7.5 mm TL (Holden 1973; Suttkus and Clemmer 1977; Minckley 1973; Snyder 1981; Hamman 1982; Behnke and Benson 1983; Muth 1990), and 1-month-old fish are approximately 20 mm long (Hamman 1982). Unlike Colorado pikeminnow and razorback sucker, no evidence exists of long-distance larval drift (Miller and Hubert 1990; Robinson et al. 1998). Upon emergence from spawning gravels, humpback chub larvae remain in the vicinity of bottom surfaces (Marsh 1985) near spawning areas (Chart and Lentsch 1999a).

Backwaters, eddies, and runs have been reported as common capture locations for young-of-year humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate young-of-year prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second.

Valdez et al. (1982) Wick et al. (1979) and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs.

Threats to the Species

Although historic data are limited, the apparent range-wide decline in humpback chubs is likely due to a combination of factors including alteration of river habitats by reservoir inundation, changes in stream discharge and temperature, competition with and predation by introduced fish species, and other factors such as changes in food resources resulting from stream alterations (USFWS 1990).

The primary threats to humpback chub are stream flow regulation and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; parasitism; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002c) (all affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to humpback chub in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow.

The humpback chub population in the Grand Canyon is threatened by predation from nonnative trout in the Colorado River below Glen Canyon Dam. This population is also threatened by the Asian tapeworm reported in humpback chub in the Little Colorado River (USFWS 2002c). No Asian tapeworms have been reported in the upper basin populations.

Hybridization with roundtail chub (*Gila robusta*) and bonytail, where they occur with humpback chub, is recognized as a threat to humpback chub. A larger proportion of roundtail chub have been found in Black Rocks and Westwater Canyon during low flow years (Kaeding et al. 1990; Chart and Lentsch 2000), which increase the chances for hybridization.

Management actions identified in the recovery goals for humpback chub (USFWS 2002c) to minimize or remove threats to the species included:

- provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations,

- investigate the role of the mainstem Colorado River in maintaining the Grand Canyon population,
- investigate the anticipated effects of and options for providing warmer water temperatures in the mainstem Colorado River through Grand Canyon,
- ensure adequate protection from overutilization,
- ensure adequate protection from diseases and parasites,
- regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries,
- control problematic nonnative fishes as needed,
- minimize the risk of increased hybridization among *Gila* spp, and
- minimize the risk of hazardous-materials spills in critical habitat.

Status of Humpback Chub and Critical Habitat in the Action Area

Monitoring humpback chub populations is ongoing, and sampling protocols and reliability of population estimates are being assessed by the Service and cooperating entities. The humpback chub recovery goals (USFWS 2002c) provided the following preliminary population estimates for adults in the six populations:

Black Rocks, Colorado River, Colorado -- 900–1,500
Westwater Canyon, Colorado River, Utah -- 2,000–5,000
Yampa Canyon, Yampa River, Colorado -- 400–600
Desolation/Gray Canyons, Green River, Utah -- 1,500
Cataract Canyon, Colorado River, Utah -- 500
Grand Canyon, Colorado River and Little Colorado River, Arizona -- 2,000–4,700

Low numbers of humpback chub have been captured in Whirlpool Canyon and Split Mountain Canyon on the Green River in Dinosaur National Monument; however, these fish were considered part of the Yampa River population in the Recovery Goals (USFWS 2002c), and not separate populations.

Tyus and Karp (1991) found that in the Yampa and Green rivers in Dinosaur National Monument, humpback chubs spawn during spring and early summer following peak flows at water temperatures of about 20°C. They estimated that the spawning period for humpback chub ranges from May into July, with spawning occurring earlier in low-flow years and later in high-flow years; spawning was thought to occur only during a 4–5 week period (Karp and Tyus 1990). Similar to the Yampa and Green rivers, peak hatch of *Gila* larvae in Westwater Canyon on the Colorado River appears to occur on the descending limb of the hydrograph following spring runoff at maximum daily water temperatures of approximately 20 to 21°C (Chart and Lentsch 1999a). Tyus and Karp (1989) reported that humpback chubs occupy and spawn in and near shoreline eddy habitats and that spring peak flows were important for reproductive success because availability of these habitats is greatest during spring runoff.

High spring flows that simulate the magnitude and timing of the natural hydrograph provide a number of benefits to humpback chubs in the Yampa and Green rivers. Bankfull and overbank flows provide allochthonous energy input to the system in the form of terrestrial organic matter and insects that are utilized as food. High spring flows clean spawning substrates of fine sediments and provide physical cues for spawning. High flows also form large recirculating eddies used by adult fish. High spring flows (50 percent exceedance or greater) have been implicated in limiting the abundance and reproduction of some nonnative fish species under certain conditions (Chart and Lentsch 1999a, 1999b) and have been correlated with increased recruitment of humpback chubs (Chart and Lentsch 1999b).

Critical habitat for humpback chub includes canyon reaches of the Green River (Whirlpool, Split Mountain, Desolation, and Gray Canyons), which have been affected by stream flow regulation. However, Whirlpool and Desolation Canyons have recently been invaded by high numbers of smallmouth bass changing the biological environment of critical habitat.

Muth et al. (2000) summarized flow and temperature needs of humpback chub in the Green River subbasin as:

> "...The habitat requirements of the humpback chub are incompletely understood. It is known that fish spawn on the descending limb of the spring hydrograph at temperatures greater than 17°C. Rather than migrate, adults congregate in near-shore eddies during spring and spawn locally. They are believed to be broadcast spawners over gravel and cobble substrates. Young humpback chubs typically use low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. After reaching approximately 40□50 mm TL, juveniles move into deeper and higher-velocity habitats in the main channel.
> Increased recruitment of humpback chubs in Desolation and Gray Canyons was correlated with moderate to high water years from 1982 to 1986 and in 1993 and 1995. Long, warm growing seasons, which stimulate fish growth, and a low abundance of competing and predatory nonnative fishes also have been implicated as potential factors that increase the survival of young humpback chubs.
>
> High spring flows increase the availability of the large eddy habitats utilized by adult fish. High spring flows also maintain the complex shoreline habitats that are used as nursery habitat by young fish during subsequent base flows. Low-velocity nursery habitats that are used by young fish are warmer and more productive at low base flows."

Bonytail

Species/Critical Habitat Description

Bonytail are medium-sized (less than 600 mm) fish in the minnow family. Adult bonytail are gray or olive colored on the back with silvery sides and a white belly. The adult bonytail has an elongated body with a long, thin caudal peduncle. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as the hump on a humpback chub.

The bonytail is endemic to the Colorado River Basin and was historically common to abundant in warm-water reaches of larger rivers of the basin from Mexico to Wyoming. The species experienced a dramatic, but poorly documented, decline starting in about 1950, following construction of several mainstem dams, introduction of nonnative fishes, poor land-use practices, and degraded water quality (USFWS 2002d).

Currently, no self-sustaining populations of bonytail are known to exist in the wild, and very few individuals have been caught anywhere within the basin. An unknown, but small number of wild adults exist in Lake Mohave on the mainstem Colorado River. Since 1977, only 11 wild adults have been reported from the upper basin (Valdez et al. 1994).

A total of 499 km (312 miles) of river has been designated as critical habitat for the bonytail in the Colorado River Basin, representing about 14% of the species' historic range (59 FR 13374). River reaches that have been designated as critical habitat in the Green River extend from the confluence with the Yampa River downstream to the boundary of Dinosaur National Monument and Desolation and Gray Canyons. In addition, critical habitat has been designated in the Yampa River from the upstream boundary of Dinosaur National Monument to its confluence with the Green River.

> Colorado, Moffat County. The Yampa River from the boundary of Dinosaur National Monument in T. 6 N., R. 99 W., section 27 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).
> Utah, Uintah County; and Colorado, Moffat County. The Green River from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the boundary of Dinosaur National Monument in T. 6 N., R. 24 E., section 30 (Salt Lake Meridian).
>
> Utah, Uintah and Grand Counties. The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (river mile 12) in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).

The Service has identified water, physical habitat, and the biological environment as the primary constituent elements of bonytail critical habitat (59 FR 13374). Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation, and competition are important elements of the biological environment. Recent information collected by the Recovery Program suggests that floodplain habitats may be more important to the survival and recovery of the bonytail than the Service originally thought.

Status and Distribution

The bonytail is the rarest native fish in the Colorado River. Little is known about its specific habitat requirements or cause of decline, because the bonytail was extirpated from most of its historic range prior to extensive fishery surveys. It was listed as endangered on April 23, 1980. Currently, no documented self-sustaining populations exist in the wild. Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), its populations have been greatly reduced. Remnant populations presently occur in the wild in low numbers in Lake Mohave and several fish have been captured in Lake Powell and Lake Havasu (USFWS 2002d). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966. From 1977 to 1983, no bonytail were collected from the Colorado or Gunnison rivers in Colorado or Utah (Wick et al. 1979, 1981; Valdez et al. 1982; Miller et al. 1984). However, in 1984, a single bonytail was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail were captured in Cataract Canyon in 1985-1987 (Valdez 1990). Current stocking plans for bonytail identify the middle Green River and the Yampa River in Dinosaur National Monument as the highest priority for stocking in Colorado and the plan calls for 2,665 fish to be stocked per year over the next six years (Nesler et al. 2003).

Recovery goals for the bonytail (USFWS 2002d) were approved on August 1, 2002. According to these recovery goals, downlisting can be considered if, over a 5-year period:

- genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and upper Colorado River subbasin such that (a) the trend in adult (age 4+; > 250 mm total length) point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 (150–249 mm total length) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults (4,400 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and

- a genetic refuge is maintained in a suitable location (e.g., Lake Mohave, Lake Havasu) in the lower basin recovery unit; and

- two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and

- certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can be considered if, over a 3-year period beyond downlisting:

- genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and upper Colorado River subbasin such that (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults; and

- a genetic refuge is maintained in the lower basin recovery unit; and

- two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and

- certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Life History

The bonytail is considered a species that is adapted to mainstem rivers, where it has been observed in pools and eddies (Vanicek 1967; Minckley 1973). Spawning of bonytail has ne· been observed in a river, but ripe fish were collected in Dinosaur National Monument during June and early July suggesting that spawning occurred at water temperatures of about 18°C (Vanicek and Kramer 1969). Similar to other closely related *Gila* species, bonytail probably spawn in rivers in spring over rocky substrates; spawning has been observed in reservoirs ov rocky shoals and shorelines. It has been recently hypothesized that flooded bottomlands ma provide important bonytail nursery habitat. Of five specimens captured most recently in the upper basin, four were captured in deep, swift, rocky canyons (Yampa Canyon, Black Rocks Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in Lake Powell. Since 197 bonytails captured in the lower basin were caught in reservoirs.

Threats to the Species

The primary threats to bonytail are stream flow regulation and habitat modification (affectin constituent elements: water and physical habitat); competition with and predation by nonnati fishes; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002d) (affecting constituent element: biological environment). The existing habitat, altered these threats, has been modified to the extent that it impairs essential behavior patterns, such breeding, feeding, and sheltering. The threats to bonytail in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow. Threats to bonytail in relation to hybridization are essentially the same threats identified for humpback chub.

Management actions identified in the recovery goals for bonytail (USFWS 2002d) to minimize or remove threats to the species included:

- provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations;
- provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion;
- investigate options for providing appropriate water temperatures in the Gunnison River;
- minimize entrainment of subadults and adults at diversion/out-take structures;
- investigate habitat requirements for all life stages and provide those habitats;
- ensure adequate protection from overutilization;
- ensure adequate protection from diseases and parasites;
- regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries;
- control problematic nonnative fishes as needed;
- minimize the risk of increased hybridization among *Gila* spp.;
- minimize the risk of hazardous-materials spills in critical habitat; and
- remediate water-quality problems.

Status of Bonytail and Critical Habitat in the Action Area

Bonytail were extirpated between Flaming Gorge Dam and the Yampa River, primarily because of rotenone poisoning and cold-water releases from the dam (USFWS 2002c). Surveys from 1964 to 1966 found large numbers of bonytail in the Green River in Dinosaur National Monument downstream of the Yampa River confluence (Vanicek and Kramer 1969). Surveys from 1967 to 1973 found far fewer bonytail (Holden and Stalnaker 1975). Few bonytail have been captured after this period, and the last recorded capture in the Green River was in 1985 (USFWS 2002d). Bonytail are so rare that it is currently not possible to conduct population estimates. A stocking program is being implemented to reestablish populations in the upper Colorado River basin.

In the Green River, Vanicek (1967) reported that bonytails were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong current and at varying depths generally over silt and silt-boulder substrates. Adult bonytail captured in Cataract, Desolation, and Gray Canyons were sympatric with humpback chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990). The diet of the bonytail is presumed similar to that of the humpback chub (USFWS 2002d).

The only known bonytail that presently occur in the Yampa River are the individuals recently reintroduced at Echo Park, near the confluence with the Green River. In July of 2000 approximately 5,000 juveniles (5 to 10 cm) were stocked. Between 1998 and 2003, the number of bonytail stocked in the Green River subbasin was 189,438 fish, with majority of the fish being juveniles at the time of stocking.

Critical habitat for bonytail includes canyon reaches of the Green River (Whirlpool, Split Mountain, Desolation, and Gray Canyons), which have been affected by stream flow regulation. However, Whirlpool and Desolation Canyons have recently been invaded by high numbers of smallmouth bass changing the biological environment of critical habitat.

Although sufficient information on physical processes that affect bonytail habitats was not available to recommend specific flow and temperature regimes in the Green River to benefit this species, Muth et al. (2000) concluded that flow and temperature recommendations made for Colorado pikeminnow, razorback sucker, and humpback chub would presumably benefit bonytail and would not limit their its future recovery potential.

Ute Ladies'-Tresses

Species/Critical Habitat Description

The Ute ladies'-tresses is a perennial orchid (family Orchidaceae). Its leaves are up to 1.5 cm (0.6 in.) wide and 28 cm (11 in.) long; the longest leaves are near the base. The usually solitary flowering stem is 20 to 50 cm (8 to 20 in.) tall, terminating in a spike of 3 to 15 white or ivory flowers. Flowering is generally from late July through August. However, depending on location and climatic conditions, it may bloom in early July or may still be in flower as late as early October. No critical habitat has been designated for the species.

Status and Distribution

The current range of Ute ladies'-tresses includes Colorado, Idaho, Montana, Nebraska, Utah, Washington, and Wyoming, with an historical occurrence in Nevada. Ute ladies'-tresses are known from 11 counties in Utah, and 10 counties in Colorado.

Populations of Ute ladies'-tresses orchids are known from three broad general areas of the interior western United States: near the base of the eastern slope of the Rocky Mountains in southeastern Wyoming and adjacent Nebraska and north-central and central Colorado; in the upper Colorado River basin, particularly in the Uinta Basin; and in the Bonneville Basin along the Wasatch Front and westward in the eastern Great Basin, in north-central and western Utah, extreme eastern Nevada and southeastern Idaho. The orchid has recently been discovered in southwestern Montana and in the Okanagan area and along the Columbia River in north-central Washington.

Life History

Ute ladies'-tresses orchid is endemic to moist soils or wet meadows near springs, lakes, or perennial streams. The range in elevation of known Ute ladies'-tresses orchid occurrences in Utah is from 1,300 to 2,100 meters (4,300 to 7,000 feet) (Stone 1993). The orchid occurs along riparian edges, gravel bars, old oxbows, high flow channels, and moist to wet meadows along perennial streams. It typically occurs in stable wetland and seepy areas associated with old landscape features within historical floodplains of major rivers. It is also found in wetland and seepy areas near freshwater lakes or springs (U.S. Fish and Wildlife Service 1992b, L. Jordan, U.S. Fish and Wildlife Service, pers. comm., 1998). Jennings (1990) and Coyner (1989) observed that Ute ladies'-tresses orchids seem to require "permanent sub-irrigation," indicating a close affinity with floodplain areas where the water table is near the surface throughout the growing season and into the late summer or early autumn. This observation has been corroborated by ground water monitoring research conducted in Dinosaur National Monument (Martin and Wagner 1992), Boulder, Colorado (T. Naumann, City of Boulder Open Space Department, pers. comm., 1993), and Diamond Fork Canyon, Utah (Black 1998). Soils are generally silty-loam, but occurrences in peat and other highly organic substrates are known (Hreha and Wallace 1994, L. Jordan, U.S. Fish and Wildlife Service, pers. comm., 1998).

The Ute ladies'-tresses orchid occurs primarily in areas where the vegetation is relatively open and not overly dense or overgrown (Coyner 1989 and Jennings 1989, 1990). A few populations in eastern Utah and Colorado are found in riparian woodlands, but generally the species seems intolerant of shade, preferring open, grass, sedge, and forb-dominated sites. Where colonies occur in more wooded areas, plants are usually found on the edges of small openings and along trails. Plants usually occur as scattered groups comprised of a few individuals (5 to 50) and occupy relatively small areas within the riparian system. However, large and dense colonies are known from several of the more stable historic floodplain meadow sites (Stone 1993, L. Jordan, U.S. Fish and Wildlife Service, pers. comm., 1998).

The Ute ladies'-tresses orchid appears to be well adapted to disturbance caused by water movement through floodplains (T. Naumann, City of Boulder Open Space Department, pers. comm., 1992, L. Riedel, National Park Service, pers. comm., 1994). In riparian settings, the species is most typically found in mid-successional habitats (i.e. well established soils and vegetation) within older floodplain features (for example, oxbows and high flow channels). These sites may receive periodic inundation that helps maintain their hydrologic and vegetation characteristics. However, they are generally scoured or significantly reworked by flows that occur at a frequency of approximately 10 years.

Very little is known about the life history and demography of the Ute ladies'-tresses orchid. The orchid first appears aboveground as a rosette of thickened grasslike leaves that is very difficult to distinguish from other vegetation. A distinctive flower stalk appears in late summer (July through September), at which point location, identification, and population size estimates are typically determined. Some individuals remain under ground or do not flower each year (Arft 1993). The percentage of flowering individuals in a population can range from 23% to 79% (Ward and Naumann 1998). Thus, fluctuations in numbers of observed flowering individuals do not necessarily correspond to population fluctuations or indicate habitat alterations. The life span of individuals is unknown.

Ute ladies'-tresses orchid requires pollinators for reproduction. Because of the unique anatomy of orchid flowers, only certain insects can affect pollination. To date, both bumblebees (*Bombus* spp.) and anthophorans (*Anthophora* spp.) (Sipes and Tepedino, 1995a, 1995b) have been identified as species able to accomplish pollination. These insects visit the orchids for the nectar and pollination is accomplished incidentally. Because these pollinators require both pollen and nectar to nourish their young, other flowering species (that provide pollen) must also be available in the same area and at the same time. Furthermore, these insects must have suitable habitat nearby.

Population estimates are generally based upon observations of flowering individuals, although on occasion it is possible to observe and count non-flowering individuals that have produced vegetative aboveground growth (basal rosette). Information on establishment, recruitment, and longevity is lacking. Therefore, it is usually undeterminable whether a marked individual that fails to flower has died or is merely dormant. Criteria have not been established for determining mortality based on the number of seasons without appearance of aboveground parts.

Apparent population numbers, based on flowering individuals, fluctuate greatly, confounding at least short-term estimates of population trends. For example, in Diamond Fork Canyon in Utah, one colony was counted as 203 individuals in 1992 and 2,214 individuals in 1993. Another colony had 27 individuals in 1992, 615 individuals in 1993, and 91 individuals in 1994 (Central Utah Water Conservancy District 1998) The Van Vleet colony at City of Boulder Open Space had nearly 5,500 flowering individuals in 1986, only about 200 in 1987, and over 3,000 in 1992 (Arft 1995). Without a better understanding of life history and species response to environmental factors, it would likely require decades of monitoring at a site to determine long term population dynamics.

Although the range of the orchid is large, it typically occurs as localized clusters of colonies. Most colonies are small, with fewer that 100 individuals, and many fewer than 10. A few colonies have large numbers of individuals, in some cases between 5,000 and 10,000 individuals, however, these large colonies may be the only occurrence of the orchid in that portion of its range. In 1995, the total estimated population size was 20,500 individuals. With discoveries since 1995, population estimates have increased. However, as of the date of this document, the total population size of Ute ladies'-tresses orchid is estimated at less than 60,000 individuals.

Threats to the Species

The Ute ladies'-tresses was federally listed as threatened on January 17, 1992 (USFWS 1992b). As stated and documented in the final listing rule, this action was taken, in part, because of (1) the threats of habitat loss and modification and (2) because the orchid's small population and low reproductive rate make it vulnerable to other threats.

Threats to populations of Ute ladies'-tresses include modification of riparian habitats by urbanization, stream channelization and other hydrologic changes, conversion of lands to agriculture and development, heavy summer livestock grazing, and hay mowing during the flowering period. Most populations are small and vulnerable to extirpation by habitat changes or local catastrophic events (USFWS 1992b). Several historic populations in Utah and Colorado have been extirpated.

Status of Ute's Ladies-Tresses in the Action Area

A large number of colonies of Ute ladies'-tresses occur along the Green River within Reach 1. The occurrence of Ute ladies'-tresses is influenced by river-channel geometry, hydrology, and depositional and erosional patterns (Ward and Naumann 1998). Surveys conducted in 1999 located colonies of Ute ladies'-tresses at 10 sites in Red Canyon, 23 sites in upper Browns Park, and two sites in lower Browns Park (Grams et al. 2002). Surveys in 1998 had identified colonies at the two sites in lower Browns Park and at 81 sites in Lodore Canyon (Ward and Naumann 1998). The numbers of Ute ladies'-tresses at these locations were generally low, ranging from one to 50; however, several sites in Lodore Canyon contained hundreds of flowering individuals.

Within Reach 1, most Ute ladies'-tresses occur on the post-dam floodplain and intermediate bench geomorphic surfaces; both of these features formed in response to Flaming Gorge Dam operations (Ward and Naumann 1998; Grams et al. 2002). The post-dam floodplain is a relatively flat surface that is inundated annually by 130 m^3/s (4,600 cfs) flows, and averages 0.8 m (2.6 ft) above the elevation of base flow (23 m^3/s [800 cfs]). The intermediate bench which is also a relatively flat surface, is higher in elevation, is a greater distance from the river margin, and averages 1.9 m (6.2 ft) above base flow. The intermediate bench is inundated only by flows that exceed powerplant capacity, such as occurred in 1997 (244 m^3/s [8,600 cfs]) and 1999 (308 m^3/s [10,900 cfs]) (Grams et al. 2002). Nearly all of the occupied sites in Red Canyon and upper Browns Park occur at or just downstream of rapids or riffles, and most occur on the intermediate bench (Grams et al. 2002).

In Lodore Canyon, Ute ladies'-tresses occurs most commonly on channel expansion cobble bars, which are located downstream of tributary debris fans. As in Browns Park, Lodore Canyon substrates supporting Ute ladies'-tresses typically consist of cobbles in a sand matrix or a sand veneer over cobbles. Species associated with Ute ladies'-tresses include wild licorice, redtop (*Agrostis stolonifera*), marsh paintbrush (*Castilleja exilis*), sea milkwort (*Glaux maritima*), Western evening primrose (*Oenothera elata*), and silverweed cinquefoil (*Potentilla anserina*) (Ward and Naumann 1998). Otherwise suitable surfaces that have been invaded by tamarisk may support few or no Ute ladies'-tresses.

Within Reach 2, Green River flows are strongly influenced by flows from the Yampa River, and suitable habitat for Ute ladies'-tresses is less common (Ward and Naumann 1998). In Island Park and Rainbow Park, Ute ladies'-tresses typically occurs on post-dam floodplain and intermediate bench surfaces, which are inundated more frequently than in Reach 1. In this portion of the river, the post-dam floodplain averages 1.3 m (4.3 ft) above base flow and is inundated at about 455 m^3/s (16,100 cfs), the post-dam 2-year flood. The intermediate bench averages 2.4 m (7.9 ft) above base flow and likely is inundated by flows above 600 m^3/s (20,000 cfs). Most occurrences of Ute ladies'-tresses were found on surfaces approximately 1 m (3 ft) above the 93 m^3/s (3,300 cfs) elevation. In this reach, nine colonies of Ute ladies'-tresses were found in Island and Rainbow Parks in 1998, and two colonies were found below Split Mountain Canyon (Ward and Naumann 1998). An additional three colonies were found below Split Mountain Canyon in 1999 (Grams et al. 2002). Species associated with Ute ladies'-tresses in Reach 2 include wild licorice, prairie cordgrass (*Spartina pectinata*), coyote willow, western goldenrod (*Solidago occidentalis*), common dogbane, common scouring rush (*Equisetum hyemale*), common reed, and marsh paintbrush. Although terraces dominated by Fremont cottonwood and box elder are generally too dry for Ute ladies'-tresses, and average 4.2 m (14 ft) above base flow, a small colony of Ute ladies'-tresses (about 20 individual plants) was located on such a terrace in Island Park. The site showed no evidence of inundation (Ward and Naumann 1998). No Ute ladies'-tresses have been found in Reach 3.

ENVIRONMENTAL BASELINE

The environmental baseline represents the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process (USFWS and NMFS 1998b). Environmental baselines do not include the effects of the Federal action(s) under review in the consultation. As such, the environmental baseline for this biological opinion is represented by the current physical and biological conditions within the Green River. For the purposes of this consultation baseline hydrology is considered to be those flows that would be released to meet the flow objectives for the 1992 FGBO which has also been defined as the No Action Alternative in the FGEIS. The hydrologic model developed by Clayton and Gilmore (2002) provides the baseline flow conditions for the Green River under existing (No Action) conditions and the proposed action.

The current condition of the physical environment and status of the listed species considered in this opinion also reflect the effects of past and ongoing activities and events. Consequently, the description of the environmental baseline presented herein includes a description of the changes that have occurred in the environment (including those resulting from flow regulation) and how those changes have affected listed species and their habitats.

General Description of the Green River subbasin

The Green River subbasin occupies a total area of 115,800 km^2 (45,000 mi^2) in Wyoming, Colorado, and Utah. The Green River originates in the Wind River Range of Wyoming and flows south about 1,230 km (764 mi) through Colorado and Utah, joining the Colorado River in Canyonlands National Park. The Green River is the largest tributary of the Colorado River. Nearly half of the flow of the Colorado River at its confluence with the Green River is from the Green River subbasin.

Precipitation varies considerably across the Green River subbasin. In the semiarid rangelands, which make up most of the basin's area, annual precipitation is generally less than 25 cm (10 in.). In contrast, many of the mountainous areas that rim the upper portion of the basin receive, on average, more than 1.0 m (3.3 ft) of precipitation per year.

Most of the total annual stream flow in the Green River subbasin is provided by snowmelt. Because of this, natural flow is very high in late spring and early summer and diminishes rapidly in midsummer. Although flows in late summer through autumn can increase following rain events, natural flow in late summer through winter is generally low.

Dams and reservoirs have been constructed in the basin mainly to supply water for irrigated agriculture. The largest depletion in the Green River subbasin occurs in the Duchesne River Basin. In addition to depleting flow volume, reservoirs modify the pattern of flow in the Green River to meet demands of irrigation, power generation, recreation, and other uses. Of the reservoirs in the basin, Flaming Gorge, which is capable of storing approximately twice the annual inflow, has the largest effect on Green River flow patterns.

Historic and current operations of Flaming Gorge Dam have reduced the sediment load in the river downstream. This reduction results primarily from the presence of the dam, which traps sediment. Following completion of the dam, Andrews (1986) estimated that mean annual sediment discharge at the USGS gage near Jensen, Utah, decreased by 54% compared with the average annual pre-dam suspended sediment load. Similarly, the decrease in mean-annual sediment load at the USGS gage near Green River, Utah, was estimated to be 48% following completion of Flaming Gorge Dam (Andrews 1986). Andrews (1986) also noted that the decrease in mean annual suspended sediment load at Jensen is approximately equal to the incoming sediment load to Flaming Gorge Reservoir. At Green River, Andrews (1986) noted that the decrease in suspended sediment load following reservoir closure greatly exceeded the amount of sediment trapped in the reservoir. Sediment inflow to the Green River downstream from the Duchesne River exceeds the transport of sediment out of Reach 3 (Andrews 1986).

Description of the Green River Downstream of Flaming Gorge Dam

The longitudinal profile of the Green River downstream from Flaming Gorge Dam includes steep- and low-gradient segments, and the gradients of these segments do not systematically decrease in a downstream direction. In general, low-gradient reaches of the river have sandy substrates, while steeper-gradient segments have gravel or cobble substrates (Schmidt 1996).

Reach 1, between Flaming Gorge Dam and the Yampa River confluence, is about 104 km (65 mi) long (Figure 1). Reach 1 is straight to meandering and, with the exception of Browns Park, tightly confined by the adjacent steep-walled canyon topography of Red Canyon and Lodore Canyon. Except for usually minor flow contributions from tributary streams, flow in Reach 1 is completely regulated by Flaming Gorge Dam. The mean annual discharge (about 60 m^3/s [2,100 cfs]) has not been affected by Flaming Gorge Dam operations, but the pattern of flow has changed. Prior to regulation, the seasonal flow pattern for Reach 1 featured high spring flows and low summer, autumn, and winter base flows. Releases for power generation have resulted in relatively more uniform monthly release volumes but greater within-day variation.

Reach 2, between confluences with the Yampa River and White River, is about 158 km (98 mi) long (Figure 1). This reach is relatively long and meandering, with numerous segments that have different geomorphic characteristics. Included in this reach are Whirlpool Canyon, Rainbow Park, Island Park, Split Mountain Canyon, and the alluvial areas of the Uinta Basin. Bed materials range from cobbles to sand, and vegetated and unvegetated islands are common. The Uinta Basin portion of Reach 2 contains important nursery habitats for the Colorado pikeminnow (in-channel backwaters) and razorback sucker (inundated floodplains). Reach 2 exhibits a more natural flow and sediment regime than Reach 1 because of inputs from the relatively unregulated Yampa River. Despite this input, the magnitude of the mean annual flood at the Jensen gage has decreased 26% since closure of Flaming Gorge Dam. The Yampa River adds about 1.7 million metric tons (1.9 million tons) of sediment to the Green River annually.

Reach 3, between the White River and Colorado River confluences, is about 394 km (245 mi) long (Figure 1). The White and Duchesne Rivers, at the upper end of Reach 3, add considerable sediment (about 4.4 million metric tons or 4.9 million tons per year) to the Green River. A portion of the flow of the Duchesne River is diverted out of the Green River subbasin. Before entering Desolation and Gray Canyons in Reach 3, the Green River meanders through the Uinta Basin. Numerous sandbars occur in this portion of the reach at low flow, and low-elevation floodplain areas are prominent. In Desolation and Gray Canyons, gravel bars are abundant, and many of the banks are composed of coarse debris-flow material or talus. Recirculating eddies are also prevalent, and there are many regions of stagnant flows in these canyons. The lower 148 km (92 mi) of the Green River flows through the low gradient Labyrinth and Stillwater Canyons.

Green River Flows

Flow in the Green River is dominated by snowmelt; consequently, there was a great deal of seasonal variability in the flow regime prior to regulation. Regulation has resulted in a reduction of flows from April through July and an increase in flows from August through March (Table 2). Reach 1, whose flow is dominated by releases from Flaming Gorge Dam, has been most affected (Figure 2). The effects of regulation are reduced in Reaches 2 and 3, because intervening tributaries, especially the Yampa River, contribute flows with seasonal distributions that are less affected by regulation. Nevertheless, flow variability in the system has been reduced in all three reaches.

TABLE 2 Percent Change in Mean Monthly Flow of the Green River Because of Regulation

	Percent Change in Mean Flow											
River Reach/Gage	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Reach 1/Greendale	+80	+120	+246	+214	+143	+8	-30	-50	-70	-46	+16	+72
Reach 2/Jensen	+52	+71	+140	+121	+82	+6	-13	-17	-35	-32	+10	+54
Reach 3/Green River	+31	+39	+89	+83	+53	+6	-10	-13	-27	-28	+2	+34

The magnitude of annual spring peak flows has been reduced since construction of Flaming Gorge Dam(Figure 2). Before construction of Flaming Gorge Dam, median spring peak flow in Reach 1 was about 330 m^3/s (11,700 cfs); it was reduced to about 85 m^3/s (3,000 cfs) after the dam was built. Releases greater than 200 m^3/s (7,000 cfs) have occurred five times since the dam was completed; such releases occurred in 1983, 1984, 1986, 1997, and 1999. The Flaming Gorge hydrology model (Clayton and Gilmore 2002) predicted that under baseline operations to meet the requirements of the existing 1992 FGBO, safe evacuation of water from the reservoir during wetter years would necessitate use of the bypass tubes in 23% of all years and use of the spillway in 5% of all years.

The frequency of high peak flows also has been reduced by regulation. The difference between regulated and unregulated flows is greatest in Reach 1, with effects of regulation diminishing downstream (Figure 2). At the Jensen gage (Reach 2), the median peak flow was 669 m^3/s (23,625 cfs) without regulation and 448 m^3/s (15,820 cfs) with regulation (Table 3). At the Green River gage (Reach 3), the median peak flow has been reduced from 788 m^3/s (27,800 cfs) to 575 m^3/s (20,300 cfs). The percent reduction in peak flows is provided in Table 5.

The duration and timing of peak flows have also been affected by regulation. Unregulated flows of 475 and 575 m^3/s (16,800 and 20,300 cfs) were exceeded at the Jensen gage 8% and 4% of the time, respectively. With regulation, however, these two flows are exceeded only 3% and 1% of the time. On average, peak flows now occur earlier in the year than they did before regulation. For Reaches 2 and 3, regulated peak flows generally occur about a week earlier than unregulated peak flows.

TABLE 3 Probabilities of Exceedance for Regulated and Unregulated Flows of the Green River at the USGS Stream Gages near Jensen (Reach 2) and Green River, Utah (Reach 3), 1963–1996

Probability of Exceedance (%)	Recurrence Interval (years)	Flow at Jensen Gage (m^3/s)[a]		Flow at Green River Gage (m^3/s)[a]	
		Regulated	Unregulated	Regulated	Unregulated
50	2	448	669	575	788
20	5	618	934	836	1,132
10	10	727	1,076	1,003	1,321
5	20	827	1,192	1,158	1,477
1	100	1,045	1,396	1,495	1,753

[a] To convert from m^3/s to cfs, multiply by 35.3.

TABLE 4 Percent Reduction in Annual Peak Flows of the Green River because of Regulation at Various Exceedance Values, 1963–1996

	Percent Flow Reduction Because of Regulation at Various % Exceedance Values								
River Reach/Gage	10	20	30	40	50	60	70	80	90
Reach 1/Greendale	-61	-73	-70	-67	-63	-61	-60	-58	-52
Reach 2/Jensen	-32	-34	-34	-34	-33	-32	-30	-28	-23
Reach 3/Green River	-24	-26	-27	-27	-27	-26	-25	-23	-19

About 70% of the annual natural flow of the Green River occurs between April and July as a result of melting snow. During the remainder of the year, natural flows (base flows) are generally low. The source of unregulated base flows is predominately groundwater, with occasional augmentation by rain and snowmelt. Regulation and the establishment of the 23-m^3/s (800-cfs) minimum release from Flaming Gorge Reservoir have resulted in higher base flows than occurred pre-dam.

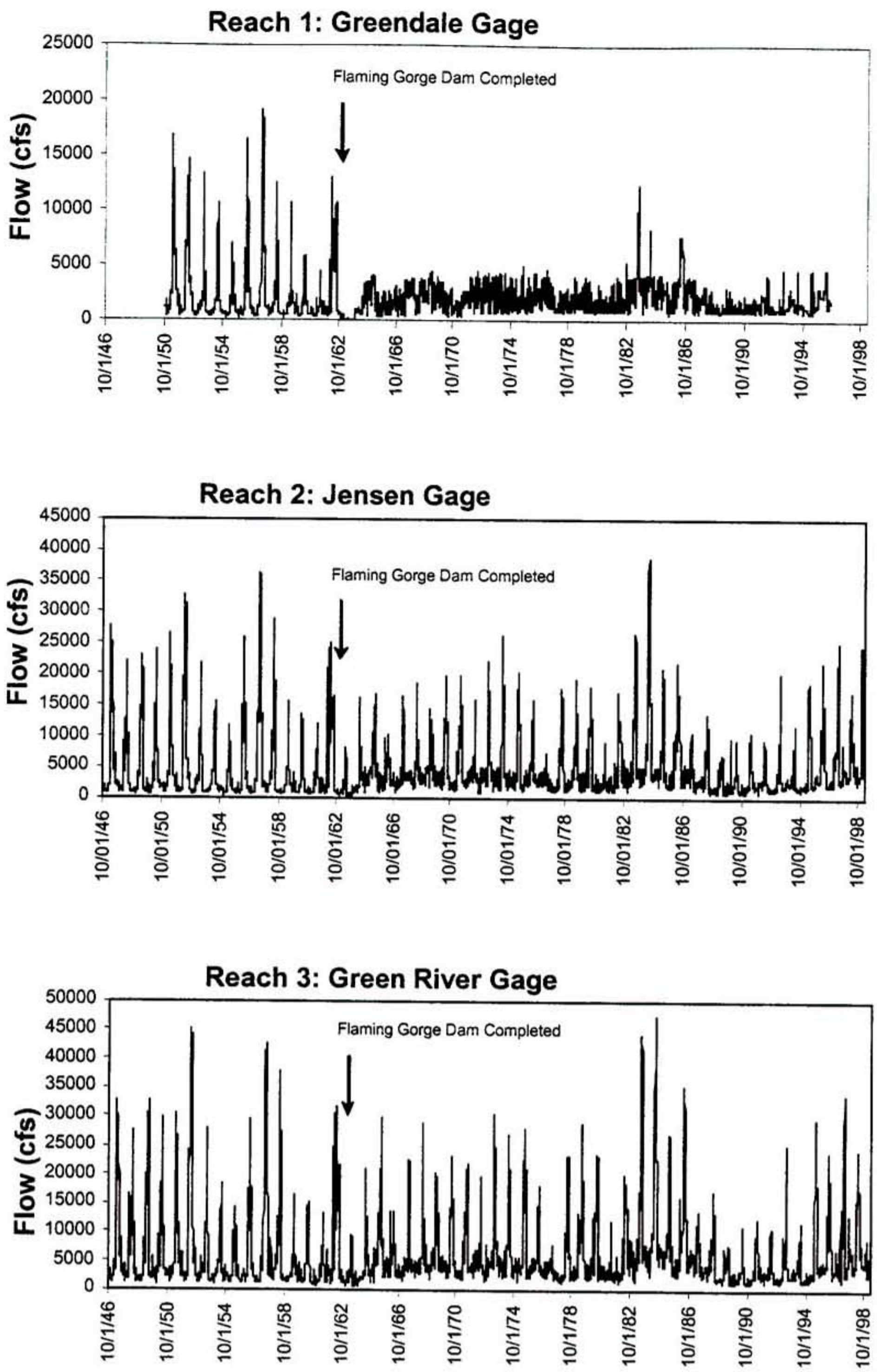

FIGURE 2 Mean Daily Flows in Reaches 1, 2, and 3 of the Green River

Although unregulated base flows in the Green River are generally considered stable, variability in flows occurs during the base-flow period even without hydropower-induced fluctuations. Variability can occur at a number of different time scales, including between years, within years, between days, and within days. Between-year variability in base flows is largely related to annual hydrologic conditions, with higher base flow in wetter years than in drier years. Within-year variability in base flow as measured at the Jensen gage in Reach 2 was higher during the pre-dam period (48% coefficient of variation [CV]) than during the post-dam period (25% CV). Variability during both pre-dam and post-dam periods was less in the winter (December through February) than in the summer and autumn (August through November). During the pre-dam period there was less within-year variability in drier years than in wetter years. Between-day differences in base flows were about 3% (range, 0 to 68%) pre-dam and 5% (range, 0 to 139%) post-dam.

Water-surface elevation (stage) is dependent on flow, but the nature of that relationship varies along the river and is strongly influenced by channel morphology. Stage-flow relationships at the Greendale, Jensen, and Green River gages are presented in Figure 3. This figure illustrates the differences in the relationship at these different locations and the asymptotic nature of each relationship (i.e., as flow increases, the relative incremental increase in stage lessens). Differences in channel width and floodplain characteristics at each location are reflected in the shape of the curves depicted in Figure 3. The river is considerably wider at the Jensen and Green River gages than at Greendale; consequently, as flow increases, the rate of stage change at Jensen and Green River gages is less than the rate at the Greendale gage.

Variations in channel morphology along the river and tributary inputs serve to dampen flow and stage fluctuations that result from hydropower operations at Flaming Gorge Dam. The degree of attenuation of operations-induced fluctuations also depends on specific release parameters, including the ramp rate (the rate of change from minimum and maximum flow expressed as $m^3/s/h$ or cfs/h), minimum and maximum flow levels, and duration of peak releases. This dampening, or attenuation, becomes greater at increasing distances from the dam.

Immediately downstream of Flaming Gorge Dam, flows can change from 23 m^3/s to 130 m^3/s (800 to 4,600 cfs) within a 24-hour period during maximum power-plant-capacity operations. This daily fluctuation would become attenuated downstream, and, under the same operational regime, flows would vary from 62.3 to 141.6 m^3/s (2,200 to 5,000 cfs) at the Jensen gage. These releases would produce daily stage changes of 1.5 m (5 ft) at Greendale and 0.6 m (2 ft) at Jensen (Yin et al. 1995). During August and September, operations that comply with the 1992 FGBO produce flows within a day that vary from 28 to 85 m^3/s (1,000 to 3,000 cfs) at Greendale and 38 to 48 m^3/s (1,300 to 1,700 cfs) at Jensen. These daily flow changes produced stage changes of 90 cm (36 in.) at Greendale and 10 cm (4 in.) at Jensen (Yin et al. 1995). Further attenuation occurs between Jensen and Ouray in Reach 2, and hydropower-related fluctuation effects are difficult to detect by Green River, Utah, in Reach 3.

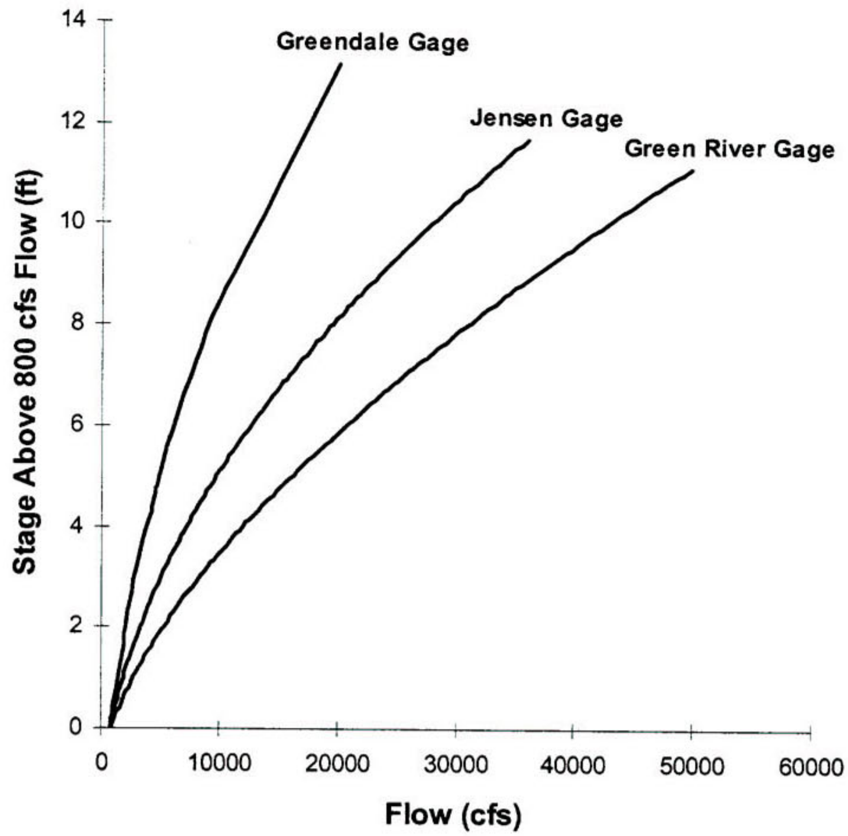

FIGURE 3 Relationships between Stage and Flow in the Green River at the USGS Stream Gages near Greendale, Jensen, and Green River, Utah

Green River Water Temperatures

Winter snows accumulate in the Green River subbasin from October through mid-April. When air temperatures in the basin begin to rise in March and April, snowmelt and runoff begin. As flow increases, the cold water gets warmer as a result of interactions with the channel bed, the atmosphere, and direct solar radiation.

Summer water temperature is important to the endangered fishes because temperature affects the productivity of the aquatic food base, growth and survival of larval fish, and conditioning of adult fish. Summer water temperature is a function of specific weather conditions and the volume and temperature of releases from Flaming Gorge Dam during this period.

As a general rule, in water years[2] with more snowmelt and runoff, the water temperatures remain colder into summer. Water years in which snowmelt and runoff occur early (such as in water

2 A "water year" begins on October 1 and extends through September 30 of the next calendar year.

year 1962, when the peak flow occurred from mid-April to mid-May) are exceptions. During water year 1995, which had a high volume of water with long peak-flow duration, water temperatures stayed low well into July. During water years with less water, water temperatures get warmer earlier in the season because base flows are low and are reached earlier in the year.

The dominant factor influencing water temperature in Reach 1 is the temperature of water released from Flaming Gorge Dam. Release temperature is adjusted through the use of a selective withdrawal structure. During typical winter operations, water is drawn from deep within the reservoir. Released water is 4°C (39°F) and is the warmest available at this time of year. During spring (beginning in late May), warmer water from nearer the surface is released. Reservoir operators adjust the withdrawal system to find a layer of water with a temperature of 13°C (55°F) throughout the summer, so that a constant temperature of release water is maintained until mid-October, when the released water is colder. Because temperatures of water that can be released through the selective withdrawal structure are affected by the rate at which the reservoir stratifies and warms, releases through the selective withdrawal structure are cooler from June through August than pre-dam water temperatures in the Green River, but are warmer during September and October. During the autumn, warmer release temperatures persist later than would have occurred in the river before the dam was constructed.

Air temperature strongly affects water temperature, but this effect is influenced by flow volume (Bestgen and Crist 2000). At higher flows, the water is slower to respond to air temperatures than it is at lower flows. Thus, in summer, higher flows tend to be colder and slower to warm than lower flows. The influence of ambient air temperature increases in importance in a downstream direction. Because ambient air temperature has such a large effect, annual variations in regional weather patterns play an important role in determining the thermal regime of the Green River downstream of Flaming Gorge Dam.

As the river flows through Browns Park, it widens and water temperature increases. From Browns Park, the river enters Lodore Canyon, which has a north-south orientation that limits exposure to direct solar radiation. Summer water temperature in the Green River from the Gates of Lodore to the confluence with the Yampa River typically increases about 2°C (4°F) as the rock mass of the canyon radiates heat to the air and water.

Thermal mixing at the confluence of the Green and Yampa Rivers is seasonally dynamic and has an important effect on Green River water temperatures. During winter, water released from Flaming Gorge Dam is warmer than Yampa River water. Although the Yampa River begins to get warmer in spring, temperature in the Green River remains low and stable as a result of cool Flaming Gorge Dam releases. From the beginning of spring runoff through mid-summer, the temperature of the Green River downstream of the confluence is strongly influenced by the temperature of the relatively large spring flows from the Yampa River. During late summer, the situation reverses as the temperature is controlled by the cooler, higher-volume releases from Flaming Gorge Dam.

From the Yampa River confluence, the Green River flows west into Whirlpool Canyon and then into Island and Rainbow Parks. Water temperature increases in Island and Rainbow Parks during the summer because the river slows down and spreads out, exposing the water to a large channel and radiant solar energy. From Rainbow Park, the river drops into Split Mountain Canyon, where it is shaded by canyon walls and where its water velocity increases. Consequently, the water temperature changes little through this canyon. The Green River enters the Uinta Basin near Jensen, Utah. Through this broad alluvial area, the river spreads out into a wide meandering channel, and, during summer, the water temperature further increases.

The Duchesne and White Rivers join the Green River near Ouray, Utah, but do not appreciably change the temperature of the Green River. Several miles downstream from the confluence of the Green River with the White and Duchesne Rivers, the Green River enters Desolation and Gray Canyons, where diel fluctuations in water temperature are moderated by warmth from the canyon walls radiating to the air and water at night.

Downstream from Gray Canyon, the Green River enters a second large alluvial plain, where the city of Green River, Utah, is located. The river channel widens in this area, water velocity decreases, and water temperature increases slightly. Below Green River, the increase in solar radiation is significant; day and night temperatures are higher and the river is warmer here than upstream.

Flaming Gorge flow and temperature recommendations (Muth et al. 2000) state that temperatures in upper Lodore Canyon should reach at least 18 C (64 F) for two to five weeks at the beginning of the base flow period and that Green River water temperatures should not be more than 5 C (9 F) colder than water from the Yampa River at the confluence of the Green and Yampa Rivers during the summer base flow period. Maximum daily water temperatures in Browns Park have occasionally met or exceeded the 18 C (64 F) target during June, July, and August, but only in July was the temperature target met or exceeded on more than 10% of days. Water measurements made in the Green and Yampa Rivers near the confluence since 1998 indicate that the mean difference between water temperatures of the two streams at the confluence was less than 5 C (9°F) during the months of June through July. However, maximum differences during all months exceeded 5 C (9 F).

Geomorphic Processes in the Green River

Channel Morphology

The Green River downstream of Flaming Gorge Dam consists of a series of linked segments of three channel planform types without a systematic downstream change from one planform to the next. The channel planform types are restricted meanders, fixed meanders, and canyons with abundant debris fans.

Restricted meanders occur in broad alluvial terraces that are bounded by relatively more resistant geology. Valleys in which restricted meanders occur are relatively wide (greater than 1.5 km [1 mi]), and only the outside bends are in contact with bedrock. Restricted meanders occur in Reach 1 (Browns Park) and much of Reach 2.

Fixed meanders are confined by resistant geology on both outside and inside bends and result from symmetrical incision associated with rapid down cutting through the geologic formation. Labyrinth Canyon in Reach 3 is characterized by fixed meanders.

Typical elements of fixed and restricted meanders include the channel, vegetated islands, unvegetated bank-attached compound bars, unvegetated island-attached compound bars, and unvegetated mid-channel compound bars. Permanent islands are less common in fixed meanders than in restricted meanders. In-channel deposits are typically sand, although gravel bars sometimes occur. Typically, bank-attached compound bars occur on alternating sides of the river. Shoreward from these bars is the vegetated floodplain at the edge of the "bankfull" channel (i.e., the channel that can accommodate stream flow without overtopping the banks), and streamward from the bars is the meandering thalweg.

At low discharge, exposed compound bars have an irregular topography caused by chute channels that dissect the bar platform. Chute channels are oriented in a downstream direction, crossing from the streamward to shoreward side at the upstream end of the bar and from the shoreward to streamward side at the downstream end of the bar. The topography of a bar is more complex where there are more chute channels. At some sites and in some years, secondary bars become attached to the shoreward margins of these compound bars. At the downstream end of most compound bars, chute channels may converge into one persistent and deep secondary channel that separates the downstream end of the compound bar from the floodplain. The remainder of the bars consists of broad, level platforms and linear ridges that may be partly vegetated.

As flow recedes from the annual peak discharge, higher-elevation portions of the bar platform are exposed, and small areas of separated flow develop in the lee of these islands. At these discharges, chute channels actively transport sediment. Upon further recession of flow, chute channels at the upstream end of the compound bar become exposed, and flow in the secondary channel ceases. Thereafter, the secondary channel becomes an area of mostly stagnant water. These low-velocity areas (backwaters) provide important nursery habitats for larval fish, especially the Colorado pikeminnow.

Canyons consist of relatively straight sections of river with resistant geology on both sides of the river. Debris fans are areas of coarse sediment deposits at the mouths of tributaries; these sediments are delivered to the main channel during high-flow events in tributaries. In canyons, debris fans form a sequence of conditions that includes (1) a slack-water area upstream from the debris fan, (2) a channel constriction at the debris fan, (3) an eddy or eddies and associated bars in the expansion area downstream from the fan, and (4) a downstream gravel bar (Schmidt and Rubin 1995). These debris fan-eddy complexes exist at the mouths of nearly all tributaries. Downstream of Flaming Gorge Dam, canyons with abundant debris fans include Lodore Canyon (Reach 1), Whirlpool and Split Mountain Canyons (Reach 2), and Desolation and Gray Canyons (Reach 3).

Many debris fans in Desolation Canyon (Reach 3) are large. Only the small, active portion of the fan delivers sediment that restricts flow and causes rapids and eddies in the modern channel, whereas the main portion of the debris fan is so large that it acts more like a meander bend as the river flows around the fan (Orchard and Schmidt 2000).

Within a particular reach, shoreline complexity is affected by sediment-deposition processes and geologic conditions. Consequently, shoreline complexity varies considerably among different planform types. An understanding of shoreline complexity is important because it affects the distribution and suitability of habitats, including backwaters and other low-velocity habitats used as nursery areas by the endangered fishes, especially Colorado pikeminnow and humpback chub.

Shoreline complexity is greatest at those discharges when the bar surface is partly inundated and where chute channels are inactive. At a very low river stage, complexity is determined by the topography of the bar margins, which are typically simpler in shape than are the upper-bar surfaces. When higher discharges inundate the bar surface, complexity is determined by the planform of the floodplain edge. Olsson and Schmidt (1993) showed that the elevation of greatest shoreline complexity changes from year to year because the elevation and topographic complexity of bars change depending on the hydrologic regime during spring runoff.

Restricted meanders have considerable shoreline complexity at bankfull discharge because of the presence of vegetated mid-channel islands. In contrast, fixed meanders have relatively little available habitat at bankfull discharge because the banks are relatively smooth and there are few permanent mid-channel islands. At intermediate stages, complexity increases dramatically, and some segments have significantly more complexity than other segments. At a very low stage, there is little difference in habitat complexity between fixed and restricted meanders, but these segments have higher habitat complexity than canyons (Schmidt 1996).

Except at very low flow, shoreline-complexity indices can be relatively high in canyons with abundant debris fans. In contrast to alluvial reaches, whose banks typically have smooth transitions from one orientation to another, debris-fan segments have banks that are composed of coarse, angular deposits where bank orientations have sharp angles. These divergences give rise to low-velocity habitats even at high river stage.

An important component of shoreline complexity is backwater habitat, which comprises areas of low or no velocity that serve as important nursery habitats for young fishes. After the 1987 spring peak, Pucherelli et al. (1990) found that the total area of backwater habitat in Reach 2 was maximized at flows between 37 and 55 m^3/s (1,300 and 1,900 cfs). The relationship to flow at two study areas within Reach 3 was less clear. Later measurements made by Bell (undated) indicated that flows that optimized habitat availability varied from year to year, and that annual peak flows had an important influence on the relationship between habitat availability and flow. Rakowski and Schmidt (1999) supported Bell's findings and concluded that establishing a single target flow intended to maximize habitat availability every year is inappropriate because bar topography, and therefore habitat availability, changes annually in response to the passage of peak flows.

Eddies are another important component of low-velocity habitat in the Green River, but these habitats form behind geomorphic features (e.g., debris fans, large rocks) that are more resistant than sediment bars to annual peak flows. In Desolation and Gray Canyons, increases in flow change the distribution and type of eddy habitat present, but the total area of eddy habitat changes little (Orchard and Schmidt 2000). At any given flow, approximately 25% of the shorelines occur within eddies.

Although the availability of low-velocity shoreline habitat apparently changes little in Desolation and Gray Canyons with changes in flow, habitat conditions as determined by substrate characteristics in those habitats may change considerably (Orchard and Schmidt 2000). Low flows produce highly complex shoreline habitats with mostly bare sand and gravel substrates. Higher flows submerge these bars and substantially increase the amount of inundated vegetation along shorelines. The amount of talus shorelines in eddies peaked near 198 m^3/s (7,000 cfs) and declined at higher flows.

Flooded side canyons also provide low-velocity habitats used by fish; the relationship between the area of flooded side-canyon habitat and flow in Reach 3 was examined by FLO Engineering, Inc. (1996). Flooding of side canyons begins at a discharge of about 198 m^3/s (7,000 cfs). At greater flows, the area of flooded side-canyon habitat increases linearly until bankfull discharge of 1,104 m^3/s (39,000 cfs) is reached; at this flow, only 2 ha (5 acres) of flooded side-canyon area is available.

Sediment Dynamics

Sediment characteristics and dynamics are important factors that affect the availability and quality of habitat for listed species. Flow patterns have an important influence on sediment dynamics. Flow regulation reduces the dynamics of sediment deposition and erosion patterns. Each year, sediment deposits exposed during base flows are colonized by vegetation, and if subsequent floods do not scour these areas, a process of channel narrowing and increasing bank elevation can occur. At some point, this process becomes difficult to reverse because older, deeper-rooted vegetation is difficult to remove by all but the most extreme flood events.

Andrews (1986) described a sequence of degradation, equilibrium, and aggradation downstream from Flaming Gorge Dam that has developed in response to flow and sediment regulation by the dam. The degrading portion of the Green River channel, where sediment outflow exceeds sediment inflow, occurs just below Flaming Gorge Dam in Reach 1. Equilibrium conditions, where sediment inflow equals sediment outflow, occur in Reach 2. Aggradation, where sediment inflow is greater than sediment outflow, occurs in Reach 3, especially just downstream of the confluences with the White River and Duchesne River.

Andrews (1986) described channel narrowing in Reach 2 as a response to changes in sediment load and flooding caused by Flaming Gorge Dam operations. He determined that, on average, the channel had narrowed by 13% from 213 to 186 m (700 to 610 ft) since dam closure and that further narrowing would continue for another 30 years. Lyons et al. (1992) conducted additional analyses and arrived at somewhat different conclusions. Their results indicated that, in Reach 2, channel narrowing in response to construction of the dam had stopped by 1974 and that a 6% reduction from 217 to 204 m (712 to 670 ft) had occurred. The large floods from 1983 to 1986 reversed some of this narrowing and produced an average channel width of 208 m (680 ft), a 4% reduction from pre-dam width.

Merritt and Cooper (1998) examined channel changes in Browns Park in Reach 1. Three stages of channel change were identified. Stage 1 (channel narrowing and development of banks) occurred initially after closure of the dam. Stage 2 (channel widening, subaqueous bar formation, braided channel) was observed from 1977 to 1994. Stage 3 (bar stabilization, fluvial marsh development, and continued channel widening) has been observed since 1994. Merritt and Cooper (1998) projected that channel widening in Browns Park could continue for several decades but that coalescence of islands will lead to formation of a smaller meandering channel over a longer time span.

High releases in 1997 resulted in significant redistribution of sand in Lodore Canyon in Reach 1 and at least some reversal of the long-term trend of channel narrowing and vegetation encroachment (Martin et al. 1998). Measurements indicated that sediment transport at 244 m^3/s (8,600 cfs) was more than 3 times higher than sediment transport at 130 m^3/s (4,600 cfs).

Orchard and Schmidt (2000) determined that the active channel through Desolation and Gray Canyons decreased an average of 19% since the beginning of the century. They identified two episodes of channel narrowing as evidenced by two new surfaces along the channel. The cottonwood terrace is an abandoned floodplain that began to stabilize between 1922 and 1936 as a result of drier weather conditions. After closure of Flaming Gorge Dam, a second lower surface has become densely colonized by riparian vegetation and is accumulating sediment through vertical accretion. This process is continuing and appears to be contributing to a loss of in-channel fish habitat.

Allred (1997) studied channel narrowing and vertical accretion at the Green River gage in Utah and described the process by which in-channel deposits become stabilized. The stabilization process includes the following steps: (1) emplacement and accretion of a lateral bar as large amounts of sediment are moved through the system; (2) low flood magnitude in years following bar emplacement; (3) rapid encroachment of riparian vegetation onto the exposed bar surface; (4) stabilization of the bar through extensive root system development; and (5) continued vertical accretion of the bar surface during periods of inundation when existing vegetation captures additional sediment.

Channel narrowing occurred at the Green River gage from 1930 to 1938; rapid accretion occurred from 1957 to 1962; and further narrowing occurred after 1962 (Allred 1997; Allred and Schmidt 1999). That research indicates that channel narrowing occurred in response to weather changes and as vegetation (primarily tamarisk) invaded and stabilized newly formed inset floodplain deposits. The large floods of 1983 and 1984 did not reverse the narrowing trend at this site but instead resulted in the deposition of sediments at higher elevations.

Cobble and gravel deposits free of silt and sand are preferred spawning areas of the endangered fishes, and the suitability of these areas for spawning is affected by sediment-transport and depositional patterns. Two spawning areas have been studied to date: a bar used by razorback suckers upstream of Jensen, Utah, in Reach 2, and a bar used by Colorado pikeminnow at the head of Gray Canyon in Reach 3. High flows are responsible for forming both bars, and recessional flows clean the bars of fine sediment, thus making them suitable for spawning by these species (Wick 1997; Harvey and Mussetter 1994)

Floodplain Inundation

Floodplains develop along rivers where the valley floor is extensively covered with alluvium. The normal-flow channel, carved in the alluvium, is flanked by this low-relief surface that becomes part of the riverbed during high-flow periods. The natural integrity of large-river ecosystems is dependent on this interaction (Welcomme 1995, Junk et al. 1989 and Wydoski and Wick 1998). Interrelations between overbank flows and the floodplain provide a conduit for the exchange of nutrients and maintain physical habitat components of the system (Annear et al. 2004). Restricting river-floodplain interaction reduces the ecological integrity of the system and limits the growth, conditions and abundance of fishes dependent on that environment. The frequency and extent of floodplain inundation vary considerably along the Green River, largely in response to site-specific channel morphology (including the presence or absence of natural or manmade levees).

Irving and Burdick (1995) conducted an inventory, largely on the basis of aerial photography, of potential flooded bottomland habitats in the Green River. They determined that approximately 644, 3,500, and 3,300 ha (1,590, 8,650, and 8,150 acres) were present in Reaches 1, 2, and 3, respectively. In Reach 3, about 1,100 ha (2,700 acres) was present between the White River confluence and Pariette Draw, and about 760 ha (1,880 acres) was present in Canyonlands National Park in the lower portion of the reach. The highest priority bottomlands for endangered fishes are in Reach 2 and the upper portion of Reach 3 (Escalante Ranch to Pariette Draw).

In the Ouray portion of Reach 2, significant inundation of floodplain areas occurs at about 527 m^3/s (18,600 cfs). At this flow, and with artificial levees in place, a total of 514 ha (1,270 acres) of floodplain area is inundated. The area of inundated habitat increases greatly as flow exceeds 527 m^3/s (18,600 cfs): 1,457 ha (3,600 acres) is inundated at 575 m^3/s (20,300 cfs); 3,238 ha (8,000 ac) at 643 m^3/s (22,700 cfs); and 3,561 ha (8,800 acres) at 748 m^3/s (26,400 cfs) (FLO Engineering, Inc. 1996). Recently, removal or modification of artificial levees in important habitat areas has allowed flooding to be initiated at flows of 368 m^3/s (13,000 cfs).

Most of the floodplain habitat in Reach 3 is located in the upper portion of the reach just downstream of the confluences with the White and Duchesne Rivers, and this habitat is contiguous with the floodplain habitats of Reach 2. In the upper portion of Reach 3 examined by Bell et al. (1998), the total areas of floodplain inundation were 265, 425, and 767 ha (655, 1,050, and 1,895 ac) at 623, 680, and 920 m^3/s (22,000, 24,000, and 32,500 cfs), respectively, as measured at the USGS gage near Green River, Utah.

Floodplain habitats in Reaches 2 and 3 of the Green River can be classified as depression floodplains or terrace floodplains. Depression floodplains are usually separated from the main channel by an elevated levee (natural or constructed) and typically retain water for a relatively long time after river flows recede. Terrace floodplains are sloping features that fill and drain with changes in river stage (Valdez and Nelson 2004). Both of these floodplain habitat types may become inundated during annual spring peak flows and provide a variety of direct biological benefits to the endangered fishes. Colorado pikeminnow and razorback sucker utilize both types of floodplain habitats for growth resting and conditioning, particularly for adult fish preparing to migrate In addition both types of floodplain habitats but in particular depression floodplains appear to provide nursery habitat for the razorback sucker (Birchell et al. 2002). Overbank flows that inundate depression and terrace floodplain habitats also provide allochthonus energy input to the river system in the form of terrestrial organic matter and insects that are utilized directly and indirectly by the endangered fishes in the river.

As peak flows recede, depression floodplain habitats retain water at an elevation determined by the elevation of associated levee features. During the base-flow period, the amount of water in depression floodplains will usually decrease due to evaporation and percolation losses. The length of time that water is retained in depression floodplains is often site-specific, and some depression floodplains can hold water through one or more years. For these habitats, subsequent spring peak flows of sufficient magnitude will reconnect the floodplain to the main channel before the water in the wetland has been depleted. In contrast, terrace floodplains drain as flows recede; and therefore do not serve as nursery habitat for razorback suckers once peak flows recede.

Valdez and Nelson (2004) identified 16 priority floodplain sites (Figure 4) in the Split Mountain to Desolation Canyon reach of the Green River (Reach 2 and upper Reach 3) and evaluated the potential importance of each of these sites as razorback sucker nursery areas. Important floodplain characteristics considered by Valdez and Nelson (2004) included the type of floodplain (e.g., depression or terrace), the flow at which the floodplain becomes inundated, the potential area of inundation, and the distance from the known razorback sucker spawning bar in the Green River, which is located upstream in Dinosaur National Monument. Characteristics of these priority floodplains for razorback sucker are summarized in Table 6.

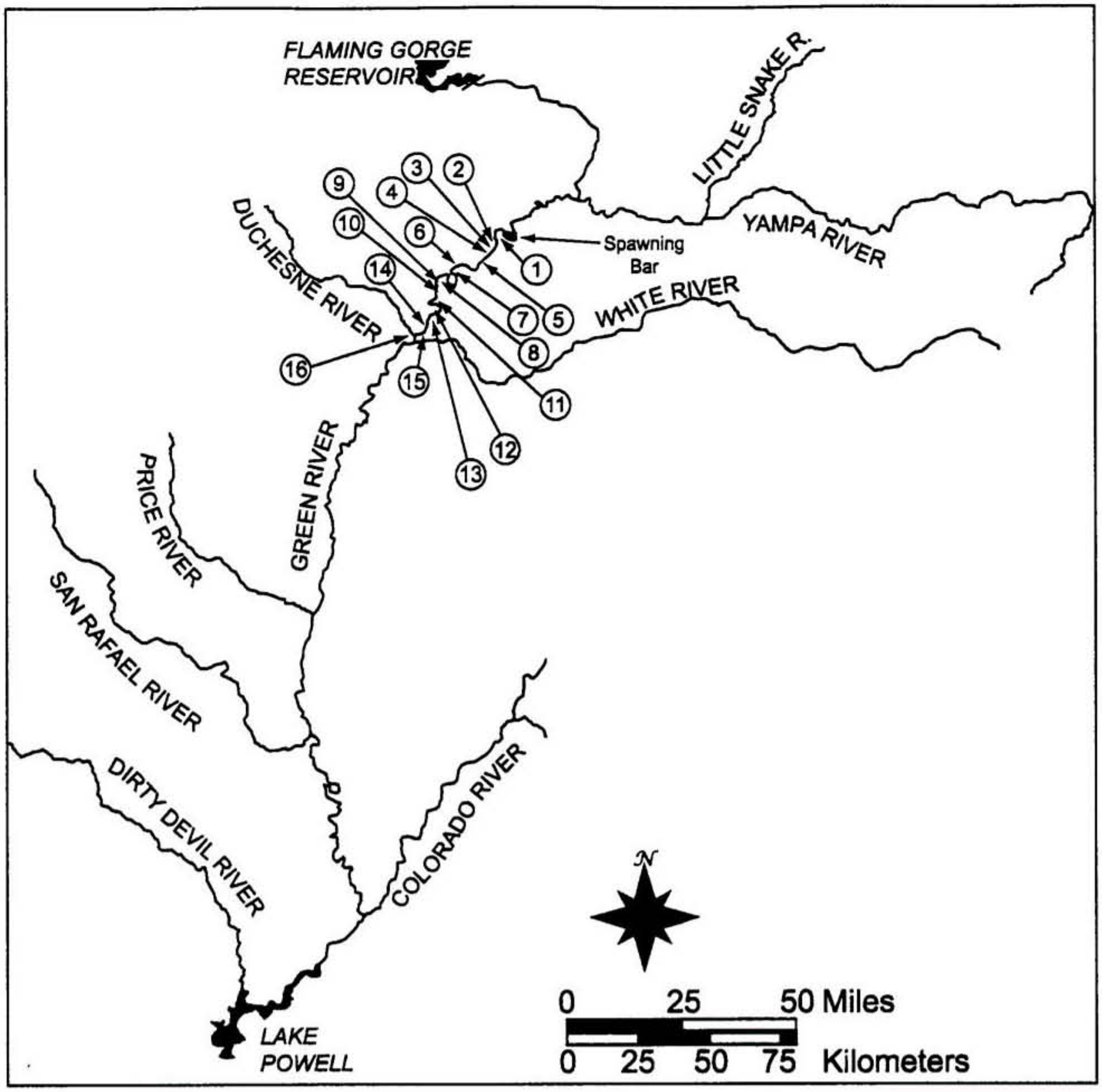

FIGURE 4 Priority Floodplain Areas in the Middle Green River. Refer to Table 6 for a key that matches numbered locations to names for individual floodplain areas. (Source: Valdez and Nelson 2004).

TABLE 6 Floodplain Type, Connecting Flow, Inundated Area, and Distance from the Razorback Spawning Bar for Sixteen Priority Wetlands

Site No.[a]	Floodplain Site	Type[b]	Connecting Flow (cfs)	Inundated Area at Connecting Flow (ac)	Distance from Spawning Bar (river mi)
1	Thunder Ranch	D	13,000[c]	330	5
2	IMC	T	18,600	4	8
3	Stewart Lake	D	7,500	570	11
4	Sportsman's Lake	D	20,000	132	14
5	Bonanza Bridge	D	13,000	23	21
6	Richens/Slaugh	T	18,600	45	25
7	Horseshoe Bend	D	13,000	17	27
8	The Stirrup	D	13,000	20	36
9	Baeser Bend	D	13,000	38	38
10	Above Brennan	D	13,000	41	45
11	Johnson Bottom	D	13,000	146	47
12	Leota Ponds	D	13,000	1,016	52
13	Wyasket Lake	T/D[d]	18,600	850	55
14	Sheppard Bottom	D[e]	25,300	1,[illegible]50	58
15a	Old Charley Wash (Main)	D	14,000	336	60
15b	Old Charley Wash (Diked)	T	13,000	56	60
16	Lamb Property	T	18,600	463	70

[a] Corresponds to numbered locations on Figure 4

[b] D = depression, T = terrace

[c] Inundation flows with notched levees as identified in Muth (2000). Valdez and Nelson (2004) reported that levee removal would allow inundation of the Thunder Ranch floodplain at 16,900 cfs.

[d] Wyasket Lake has little potential to hold water throughout the year and, except for a deep trench and a small depression, acts largely as a terrace floodplain (Valdez and Nelson 2004).

[e] Although much of the area within Sheppard Bottom acts as terrace floodplain (Valdez and Nelson 2004), the entire area identified as floodable has been considered a depression floodplain in this table.

Native and Nonnative Fishes of Flaming Gorge Reservoir

The fish community of Flaming Gorge Reservoir consists of the following nonnative species: lake trout (*Salvelinus namaycush*), brown trout (*Salmo trutta*), rainbow trout (*Oncorhynchus mykiss*), cutthroat trout (*Oncorhynchus clarki*), kokanee salmon (*Oncorhynchus nerka*), white sucker (*Catostomus commersoni*), smallmouth bass (*Micropterus dolomieu*), channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*),Utah chub (*Gila atraria*), redside shiner (*Richardsonius balteatus*), and the Bear Lake sculpin (*Cottus extensus*). It also supports small numbers of some native fish species, including flannelmouth sucker (*Catostomus latipinnis*), mountain whitefish (*Prosopium williamsoni*), and the mottled sculpin (*Cottus bairdi*).

Since the reservoir was filled, rainbow trout have been stocked annually, are the most sought-after species by anglers, and provide the bulk of the harvest. Kokanee salmon and smallmouth bass were stocked during the mid 1960s and have since developed naturally reproducing fisheries. After rainbow trout, kokanee salmon are typically second in harvest and popularity with anglers. Other sport fish occasionally stocked in the reservoir include brown trout and channel catfish.

Lake trout, which drifted into Flaming Gorge from the upper Green River drainage, have also become established as a wild population. Lake trout are managed as a trophy fishery in Flaming Gorge Reservoir. Regulations are designed to keep lake trout numbers in balance with populations of kokanee salmon and Utah chubs, their primary prey.

Smallmouth bass are found in rocky shoreline habitat throughout Flaming Gorge Reservoir. A dense population dominated by smaller fish exists from the dam north to Linwood Bay. From the Antelope Flats area north, fewer but larger bass are found. Smallmouth bass in Flaming Gorge Reservoir feed almost exclusively on crayfish. They spawn from late May through early July, and during this period, mature fish move into shallow water. Smallmouth bass were introduced into Flaming Gorge Reservoir to promote growth of kokanee salmon by reducing the Utah chub population (Tuescher and Luecke 1996).

Native and Nonnative Fishes of the Green River

Twelve native fish species have been reported from reaches of the mainstem of the Green River between Flaming Gorge Dam and the Colorado River confluence and from lower portions of the river's tributaries. This assemblage of fishes includes warm-water species that prefer or require large-river habitats (e.g., razorback sucker and Colorado pikeminnow), species that prefer cool- or cold-water streams or smaller river channels (e.g., Colorado River cutthroat trout [*Oncorhynchus clarki pleuriticus*], mountain whitefish, and mottled sculpin), and species with more generalized habitat requirements (e.g., roundtail chub [*Gila robusta*], speckled dace [*Rhinichthys osculus*], and bluehead sucker [*Catostomus discobolus*]).

Twenty-five nonnative fish species have been reported from the Green River between Flaming Gorge Dam and the Colorado River confluence. The red shiner (*Cyprinella lutrensis*), common carp, sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), channel catfish, and smallmouth bass are widespread and common to abundant (Tyus et al. 1982; Jackson and Badame 2002). Salmonids are generally restricted to Reach 1 and are most abundant in the tailwaters of Flaming Gorge Dam.

Nonnative fishes dominate the ichthyofauna of the Colorado River Basin and have been implicated as contributing to reductions in the distribution and abundance of native fishes as a result of competition and predation (Carlson and Muth 1989; Lentsch et al 1996; Tyus and Saunders 1996). Behnke and Benson (1983) attributed the dominance of nonnative fishes to dramatic changes in flow regimes, water quality, and habitat characteristics. They reported that water development has converted a turbulent, highly variable river system into a relatively stable system, with flow and temperature patterns that allowed for the proliferation of nonnative fish species. Hawkins and Nesler (1991) identified red shiner, common carp, fathead minnow, channel catfish, northern pike (*Esox lucius*), and green sunfish (*Lepomis cyanellus*) as the nonnatives considered to be of greatest concern because of their suspected or documented negative interactions with native fishes. White sucker may affect populations of some species of native suckers, including the endangered razorback sucker, through hybridization.

Recently, considerable concern has been expressed regarding the potential for smallmouth bass to adversely affect native fish populations, and the Recovery Program is currently evaluating methods to control this species in the Green River. Smallmouth bass prey on native species, especially young, and also compete with native fish for food and cover. They occur in Lodore Canyon in small numbers (Bestgen and Crist 2000), and increase in abundance further downstream.

Riparian Communities

Riparian vegetation occurs along most of the Green River below Flaming Gorge Dam. Riparian vegetation is found along all portions of the river except in those areas where sheer rock walls abut the river. Before construction of Flaming Gorge Dam, the vegetation along the river occupied two distinct zones (Fischer et al. 1983). Nearest the river, flooding occurred each year during the spring, and plants in this flood zone were predominantly annuals or scour-tolerant perennials such as wild licorice (*Glycyrrhiza lepidota*), common dogbane (*Apocynum cannibinum*), and sedges (*Carex* spp.). Dominant species above the flood zone included box elder (*Acer negundo*), squawbush (*Rhus trilobata*), Fremont cottonwood (*Populus deltoides. wislizenii*), and coyote willow (*Salix exigua*) (Holmgren 1962). After construction of the dam and the elimination of annual floods, riparian vegetation from adjacent riparian and upland areas colonized much of the old flood zone. Species that spread by underground stems (such as wild licorice, common reed [*Phragmites australis*], and scouring rush [*Equisetum* spp.]) formed dense stands along the shoreline in some areas. These plants stabilize sediment deposits, and this process appears to be gradually making the channel narrower and deeper with steep banks.

Below Flaming Gorge Dam, the Green River alternately flows through narrow canyons and broad valleys that support different riparian communities. The moderate to steep slopes of canyons are vegetated with pinyon pine (*Pinus edulis*), Utah juniper (*Juniperus osteosperma*), Douglas-fir (*Pseudotsuga menziesii*), or ponderosa pine (*Pinus ponderosa*). The riparian zone occurs on a predominantly rocky substrate (mostly cobble and boulder, with sand and gravel becoming more common farther downstream). Vegetation at the summer water level to about 2 m above consists of wild licorice, redtop (*Agrostis stolonifera*), marsh paintbrush (*Castilleja exilis*), sea milkwort (*Glaux maritima*), western evening primrose (*Oenothera elata*), and silverweed cinquefoil (*Potentilla anserina*). Ute ladies'-tresses occurs in this zone. Above the normal high-water line, grasses; scouring rush; giant whitetop (*Cardaria draba*); wild licorice; and a variety of woody species, including box elder, coyote willow, tamarisk (*Tamarix ramosissima, T. chinensis,* or a hybrid of the two), and Fremont cottonwood, are common.

Through the wide valley areas (e.g., Browns Park), the river meanders within a broad, open floodplain of mostly sand and silt (and gravel in upstream areas). Steep cutbanks are common, and in some areas almost all banks are cut and severely eroded. The surrounding uplands support sagebrush (*Artemisia* spp.), desert shrubs, and, in some areas, pinyon pine and Utah juniper. Islands and backwaters are frequent throughout these sections of the river. The riparian zone is relatively broad (up to 60 m [200 ft] wide) and extends to 5 to 6 m (15 to 20 ft) above the low-water level. In the higher elevation portions of the riparian zone, grasses, coyote willow, wild licorice, giant whitetop, and scouring rush are common. Large stands of mature Fremont cottonwood occur on high terraces. These stands became established under pre-dam conditions. Mature cottonwoods are now prone to premature decay, which is likely a result of the reduction in inundation frequency that has occurred since dam construction (Williams 2000). Maintenance of these elevated riparian woodlands is a concern, especially in Reach 1, because reproduction requires occasional high flows for seedling establishment, but normal dam operations reduce the frequency of such flows.

Summary

The Service has consistently concluded in previous consultations that water depletions and the operation of infrastructure associated with those depletions are a major factor contributing to the reductions in the populations of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker. Impacts of depletions and associated storage infrastructure such as dams and reservoirs have resulted in changes in flow and temperature regimes which in turn affect endangered species and their habitat. Removing water from the river and stabilizing the system through regulation reduces the ability of the river to create and maintain important habitats and reduce the frequency and duration of availability of these habitats. Food supply, predation, and competition are important elements of the biological environment. Food supply is a function of nutrient supply and productivity. High spring flows inundate bottomland habitats and increase the nutrient supply and productivity of the river environment. Reduction of high spring flows by water storage reservoirs that store water during spring peak flows may reduce food supply. Other major factors impacting the endangered fishes include competition from and predation by nonnative fishes. These reductions in populations and loss of habitat caused the Service to list these species as endangered and to implement programs to conserve the species. Implementation of the proposed action in conjunction with other activities by the Recovery Program is designed to offset various depletion impacts to the Green and Colorado River and to provide a suitable flow and temperature regime for the endangered fishes in the Green River downstream of Flaming Gorge Dam.

EFFECTS OF THE ACTION

The proposed action would have beneficial effects on the four listed Colorado River fishes and their critical habitats within the action area. These benefits include: Increased frequency and duration of relatively high spring flows will inundate floodplain habitats, which will help maintain the ecological integrity of the river system and provide warm, food-rich environments for subadult and adult Colorado pikeminnow, bonytail and Razorback sucker as well as for young razorback sucker. Increased peak flows and proposed variability in peak flows is expected to maintain spawning areas for the endangered fishes and lead to increased in-channel habitat complexity through formation and reworking of in-channel sediment deposits. Scaling of baseflows to the hydrologic conditions will help favor the formation of low velocity shoreline nursery habitats in Reach 2 and 3. In general, implementation of a flow regime that more closely resembles the natural flow regime of the river will provide benefits to all the endangered fishes and the habitats on which they depend.

Analyses for Effects of the Action

The flow recommendations on which the proposed action is based are intended to meet the habitat requirements of the four endangered fishes by providing adequate flows. Flow regimes that would be produced under the proposed action differ from those of the environmental baseline in several important ways. The most important differences between the new flow recommendations and flows called for under the 1992 FGBO or No Action Alternative are (1) the magnitude and duration of spring peak flows, (2) the level of variability in peak and base flows between and within years, and (3) recommended winter base flows (Muth et al. 2000).

The Flaming Gorge hydrology model (Clayton and Gilmore 2002) was developed to evaluate the long-range effects of operating Flaming Gorge Dam to achieve the Green River flow objectives of the proposed action. Model results (especially predicted flow exceedance values) serve as the basis for much of the effects analysis in this biological opinion. The model includes all relevant river features (reservoirs, river reaches, confluences, diversions, etc.) from Fontenelle Reservoir, upstream of Flaming Gorge Reservoir, to the confluence of the Green and Colorado Rivers. In developing the model, emphasis was placed on details of river features directly below Flaming Gorge Reservoir and on the Yampa River. The model simulates the year-round operation of Flaming Gorge Dam to meet flow recommendations and predicts flows at the USGS streamflow gage on the Green River at Jensen, Utah approximately 150 km (93 mi) downstream of Flaming Gorge Dam. Flows are predicted that would occur over a 39-yr period, beginning in January of 2002.

A model ruleset was developed for the proposed action which incorporated the logic and decision-making processes for achieving the flow objectives. The ruleset was used primarily to calculate the volume of water to be released from Flaming Gorge Dam so that the flow objectives are achieved in Reaches 1 and 2. The ruleset controlled the reservoir elevation for safe operation of the dam, maximized reservoir storage, and minimized bypass releases, while attempting to meet the flow objectives during the spring peak release as well as during the base-flow period. For Reaches 1 and 2, the model indicates that the minimum target recommendations could be met for all flows, durations, and frequencies. The model predicted that more frequent use of the bypass tubes and spillway at Flaming Gorge Dam would occur under the proposed action than under the baseline. The model predicted that the bypass tubes would be used in 50% of all years, under the proposed action, and the spillway would be used in 29% of all years. In comparison, under baseline conditions, the bypass tubes would be used in 23% of all years, and the spillway would be used in 5% of all years. The predicted increased use of the bypass tubes and spillway under the proposed action is primarily attributable to meeting the recommendation to achieve flows of 18,600 cfs for at least 2 weeks in 40% of years. Additional information regarding the model results can be found in Clayton and Gilmore (2002).

The predicted future flows in Reach 3 were estimated (Clayton and Gilmore 2003) by combining the Reach 2 flows predicted by the Flaming Gorge Model with estimated inflows corresponding to the historic input from all Reach 2 and 3 tributaries, as well as losses occurring along the channel due to evaporation, infiltration, and depletions. This estimate was obtained by subtracting the historic flows recorded at the Greendale, Utah, gage (in Reach 1) from the flows recorded at the Green River, Utah, gage (in Reach 3), with an estimated lag period of 5 days. The recommended target of 10% frequency for a single day peak flow of 1,100 m^3/s (39,000 cfs) in Reach 3 would not be achieved by predicted flows under the proposed action; however, all other recommended flows, durations, and frequencies would be met.

A review of the hydrology model by Reclamation and Argonne National Laboratory (see EIS section 2.4) found that while the model performs well in dry, moderately dry and average years, it appeared to bypass or spill more water in moderately wet and wet years. Reclamation acknowledged in the FGEIS that the hydrology model by Clayton and Gilmore (2003) may overstate bypasses necessary to meet the Proposed Action (2000 Flow and Temperature Recommendations)

Critical Habitat Response to the Proposed Action

The primary constituent elements of critical habitat for the Colorado River endangered fishes are water, physical habitat, and the biological environment (59 F.R. 13374). Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation, and competition are also important elements of the biological environment.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

Under the proposed action, releases from Flaming Gorge Dam in most years would be patterned to provide recommended flows in Reaches 2 and 3 rather than achieve specific targets in Reach 1, but releases would be high enough in wetter years to provide significant channel maintenance (i.e., rework and rebuild in-channel sediment deposits, increase habitat complexity, and prevent or reverse channel narrowing) in Lodore Canyon (Muth et al. 2000). Increased channel maintenance would improve in-channel habitat conditions for endangered fishes, reduce vegetation encroachment of channel-margin sediment deposits, and, thus, create a more natural, dynamic riparian corridor.

Under the proposed action, some flow fluctuation would result in Reach 1 from Flaming Gorge Dam hydropower operations. These flow fluctuations would be limited to the extent necessary to achieve recommended levels of variability in Reach 2. Target water temperatures of 18 °C (64 °F) for two to five weeks in the beginning of the base flow period in upper Lodore Canyon are expected to be achieved in most years by targeting release temperatures of 13 to 14 °C (55 to 57 °F) during the midsummer. During high runoff years it may not be possible to meet target temperatures due to the lack of warm water available for release from Flaming Gorge Reservoir (Muth et al. 2000). These temperatures are warmer, and more suitable for native fish than those of the environmental baseline. In addition, temperature modeling conducted for the EIS analysis suggests that a difference of less than 5 °C (9 °F) between waters from the Green and Yampa Rivers will be achieved more consistently under the proposed action than have occurred since implementing operations to meet the 1992 FGBO.

Peak flows in Reach 2 would be sufficient to provide significant inundation of floodplain habitat and off-channel habitats (e.g., tributary mouths and side channels) in wet and moderately wet years (30% of years) (Muth et al. 2000). This inundation would establish river-floodplain connections and provide warm, food-rich environments for growth and conditioning of fishes. In wetter years, peak flows in Reach 2 under the proposed action would also rework and rebuild in-channel sediment deposits (including spawning substrates), increase habitat complexity, form in-channel sand bars, and prevent or reverse channel narrowing.

In Reach 2, significant inundation of floodplain habitat and off-channel habitat would also occur in at least one of four average years, with some flooding of off-channel habitats occurring in all average years (Muth et al. 2000). Significant channel maintenance would occur in at least one of two average years.

Under the proposed action, no floodplain inundation would be expected in Reach 2 during moderately dry and dry years, but some flooding of off-channel habitat would still occur. In addition, some sediment transport would occur in all moderately dry and dry years because peak flows would exceed the incipient-motion threshold of the sand substrate. These flows would prevent vegetation establishment within the river channel.

Under the proposed action, base flows in Reach 2 would more closely approximate pre-dam levels of magnitude, duration, and variability than occur under current operations. Flows under the proposed action would favor the formation of low-velocity shoreline habitats that would be more stable and increase productivity of the river ecosystem. Higher water temperatures would occur at lower base flows in average and drier years (70% of all years) and would enhance ecological productivity.

Expected effects of the proposed action on physical and ecological conditions in Reach 3 would approximate those described above for Reach 2 (Muth et al. 2000). However, floodplain habitat in Reach 3 is more isolated from the river because of vertical accretion of banks and vegetation encroachment. As a result, less floodplain habitat would be inundated in Reach 3 than in Reach 2 under the proposed action. Nonetheless, the frequency and duration of floodplain inundation in Reach 3 are expected to be greater under the proposed action than under current conditions.

Species Response to the Proposed Action

Colorado Pikeminnow

It is anticipated that Colorado pikeminnow would benefit from the proposed action in several ways. The frequency and duration of relatively high spring flows is expected to increase under the proposed action. Floodplain habitats in the Uinta Basin portion of Reach 2 and 3 would be inundated for at least two weeks in four of ten years, and bankfull flows would be achieved in one of two years. These high flows would result in substantial inundation of floodplains, tributary mouths, and side channels in Reach 2 and upper Reach 3 that would provide warm, food-rich environments for growth and conditioning of subadult and adult Colorado pikeminnow prior to spawning. The increased duration of floodplain inundation would prolong the potential benefits provided by these habitats to juvenile and adult Colorado pikeminnow. High peak flows could also result in significant reworking and rebuilding of in-channel sediment deposits, leading to increased habitat complexity and formation of in-channel sandbars behind with associated backwater habitats. Although little or no floodplain inundation would occur in drier years, some off-channel habitats (e.g., side channels and tributary mouths) in Reaches 2 and 3 would be inundated and could benefit juvenile and adult Colorado pikeminnow in those years.

Habitats in Lodore Canyon that are occupied by Colorado pikeminnow could be improved and maintained by the relatively frequent high flows of the proposed action. The Flaming Gorge hydrology model (Clayton and Gilmore 2002) predicted that peak flows would exceed powerplant capacity in about 50% of all years, compared with about 23% of all years under baseline (current) operations. The model also predicted that spillway releases (flows above 244 m^3/s or 8,600 cfs) would occur in about 29% of years under the proposed action compared to about 5% of all years under current operations. The sediment reworking that would occur could improve conditions on cobble beds that could subsequently serve as spawning sites.

Larval pikeminnow drift downstream from spawning bars to occupy nursery habitats found in Reaches 2 and 3. Colorado pikeminnow use backwater nursery areas during their first year of life throughout the base-flow period. These backwaters are characteristically low velocity areas associated with main channel sand bars. Rakowski and Schmidt (1999) conducted a study in Reach 2 to describe the process by which backwaters were formed and maintained. They concluded that a single base flow target from year to year was inappropriate because the shape of sand bars varied based on magnitude of the preceding annual spring flood.

Under the proposed action, base-flow magnitudes would be based on hydrological conditions, and variability in flows around the mean base flow would be greater than under baseline conditions during the base-flow season. Scaling base flows to hydrologic condition and the antecedent peak flow should favor the formation of backwaters and other low-velocity shoreline nursery habitats in Reaches 2 and 3. Maintaining the magnitude of annual mean base flows during summer, autumn, and winter under the proposed action should promote favorable conditions for Colorado pikeminnow in low-velocity habitats. Although the level of fluctuation restriction needed to fully protect low-velocity habitats is uncertain (Muth et al. 2000), it is believed that keeping hydropower-induced changes in mean base flows at Ouray within the recommended levels of seasonal and within-day variability throughout the summer, autumn, and winter would promote favorable conditions for young Colorado pikeminnow in low-velocity nursery habitats in Reach 2. Hydropower-induced fluctuations in flow are largely attenuated by the time flows reach the Ouray portion of Reach 2.

Under the proposed action, warmer water would be released from Flaming Gorge Dam during portions of the base-flow period in most years. As a result, summer water temperatures in Lodore Canyon would typically be higher under the proposed action than under baseline conditions. These warmer summer temperatures could increase the suitability of Lodore Canyon for spawning by Colorado pikeminnow (Muth et al. 2000). In addition, the resulting decrease in the difference between water temperatures in the Green River and the Yampa River at the Echo Park confluence during July would reduce the possibility of cold shock to Colorado pikeminnow larvae drifting out of the Yampa River and into the Green River. Under the proposed action, the recommendation to reduce the temperature difference between the Yampa and Green Rivers at the confluence could be met more often than under baseline conditions. Water temperatures in the lower portions of Reach 2 and throughout Reach 3 under the proposed action would not differ substantially from those under existing baseline conditions.

In addition to the potential benefits of the proposed action to the Colorado pikeminnow described above, there is the potential for some adverse effects as well. To achieve the recommended magnitudes and durations of spring peak flows in Reach 2, water may need to be released over the spillway more than five times as often as under current operations. Increased use of the spillway increases the risk that nonnative fish would be released into the Green River from Flaming Gorge Reservoir. Of particular concern is the potential to release smallmouth bass, a warmwater predator that is thought to adversely affect native fish populations in the basin and that is currently being targeted by Recovery Program control efforts. Increased escapement of this species through spillway releases, together with the increased water temperatures during summer and early fall under the proposed action may increase the potential for smallmouth bass or other nonnative fish to survive, reproduce, and expand their distribution in the Green River, especially in areas of Reach 1 such as Lodore Canyon, where the colder summer temperatures under baseline conditions may currently reduce survival and reproduction by nonnative fish. Even if escapement from the reservoir does not result in increased numbers of nonnative fishes downstream, there is a potential for increased survival, reproduction, and expansion of nonnative fish species in Lodore Canyon due to increased water temperatures alone.

Razorback Sucker

Access to floodplain habitat is considered critical for providing larval and juvenile razorback suckers with nursery habitat. Razorback sucker spawning has occurred at several locations, but is concentrated in an area 154 to 172 km (96 to107 mi) downstream of Flaming Gorge Dam in Reach 2. This spawning area is located immediately upstream of most of the floodable habitat in the vicinity of the Ouray National Wildlife Refuge. Under the proposed action, flows in Reach 2 would reach or exceed 527 m^3/s (18,600 cfs) for at least two weeks in 41% of years, as opposed to only 16% of years under baseline conditions. Timing peak flows to coincide with peak flows in the Yampa River would result in an overlap between the inundation period and the period when drifting razorback sucker larvae are typically present in most years, and would allow larval razorback suckers to be entrained into inundated areas. Because the proposed action would result in bankfull or greater flows in one of two years, there would be sufficiently frequent reconnection of depression wetlands (that maintain water throughout the year) with the main channel that razorback suckers would be able to reenter the main channel after growing to a suitable size.

It is anticipated that peak flows under the proposed action would also regularly inundate floodplains in the upper portion of Reach 3 (e.g., between the White River confluence and the upstream end of Desolation Canyon) and would provide some in-channel habitat maintenance throughout the reach in all years. In most years, the proposed peak flows would also inundate tributary mouths and side channels that provide warm, food-rich environments for growth and conditioning by subadult and adult razorback sucker before and after spawning. Although peak flows of 527 m^3/s (18,600 cfs) or greater would inundate floodplain habitats as described above, recent modifications to existing levees allow flooding of some habitats at lower flows.

Under the proposed action, peak flows are expected to be of sufficient frequency, magnitude, and duration to rework and rebuild in-channel sediment deposits in portions of Lodore Canyon that may be occasionally used by subadult or adult razorback suckers and would remove fine sediments from spawning bars used by razorback suckers in Reaches 2 and 3.

Base flow magnitudes would be established each year according to hydrological conditions, and variability in flows around the mean base flow would be consistent with pre-dam variability throughout the base-flow season. Scaling base flows to hydrologic condition and the antecedent peak flow would favor the development of backwaters and other low-velocity shoreline habitats in Reaches 2 and 3 that are sometimes used by young razorback suckers. Maintaining the magnitude of annual mean base flows during summer, autumn, and winter periods under the proposed action should promote favorable conditions for razorback sucker in low-velocity habitats (Muth et al. 2000).

Under the proposed action, warmer water would be released from Flaming Gorge Dam during the base-flow period. As a result, summer water temperatures in Lodore Canyon and the upper portion of Reach 2 would typically be higher under the proposed action than under current operations. These warmer temperatures could improve razorback sucker growth in those areas in most years. Water temperatures in the lower portion of Reach 2 and throughout Reach 3 would not differ substantially from those under baseline conditions.

In addition to the potential benefits of the proposed action to the razorback sucker described above, there is the potential for some adverse effects as well. To achieve the recommended magnitudes and durations of spring peak flows in Reach 2, water may need to be released over the spillway more than five times as often as under current operations. Increased use of the spillway increases the risk that nonnative fish would be released into the Green River from Flaming Gorge Reservoir. Of particular concern is the potential to release smallmouth bass, a warmwater predator that is thought to adversely affect native fish populations in the basin and that is currently being targeted by Recovery Program control efforts. In addition, there is a potential for white suckers, a species known to hybridize with the razorback sucker, to be released into the Green River. Increased escapement of these species through spillway releases, together with the increased water temperatures during summer and early fall under the proposed action may increase the potential for smallmouth bass or other nonnative fish to survive, reproduce, and expand their distribution in the Green River, especially in areas of Reach 1 such as Lodore Canyon, where the colder summer temperatures under baseline conditions may currently reduce survival and reproduction by nonnative fish. Even if escapement from the reservoir does not result in increased numbers of nonnative fishes downstream, there is a potential for increased survival, reproduction, and expansion of nonnative fish species in Lodore Canyon due to increased water temperatures alone.

Humpback Chub

Under the proposed action, the magnitude, frequency, and duration of high spring releases from Flaming Gorge Dam would increase relative to the environmental baseline. The Flaming Gorge hydrology model (Clayton and Gilmore 2002) predicted that peak flows would exceed powerplant capacity in about 50% of all years, compared with about 23% of all years under baseline (current) operations. Spillway releases would occur in about 29% of years under the proposed action compared to about 5% of years under current operations.

Humpback chub currently do not occur in Reach 1, and no direct effects of the proposed action in that reach are anticipated. If humpback chub should become established within Reach 1 as a result of implementing the proposed action, peak flows would help maintain in-channel habitat areas by reworking sediment deposits in Lodore Canyon in wetter years. The peak flows that would occur under the proposed action are also expected to mobilize in-channel sediment deposits in currently occupied portions of Reach 2 and 3 (Whirlpool, Split Mountain, Desolation, and Gray Canyons). The proposed action would benefit humpback chub in these areas by helping prepare and maintain substrates in spawning areas, increasing habitat complexity, and preventing or reversing channel narrowing. Although significant changes in channel morphology are not anticipated, peak flows of the proposed action are expected to scour and maintain the large recirculating eddies that are used as resting and feeding habitats by adults.

If humpback chub should become established within Reach 1, it is anticipated that the base flows under the proposed action would provide suitable summer, autumn, and winter conditions for humpback chub. These base flows would be appropriate for development of recirculating eddies and for promoting development of complex shoreline habitat in Whirlpool, Split Mountain, Desolation, and Gray Canyons. In addition, maintaining the seasonal, daily, and within-day variability of flows within the ranges identified in the proposed action would maintain stability of conditions in the shoreline habitats that are preferred by young fish.

Higher summer water temperatures in most years could encourage movement and establishment of humpback chub in the lower portions of Lodore Canyon and could enhance growth and survival of young humpback chub in Whirlpool Canyon. Temperature regimes in Split Mountain Canyon and further downstream will be largely unaffected by the proposed action. Water temperatures in Reach 3 under the proposed action are expected to be indistinguishable from those that occur under baseline conditions. Summer water temperatures in Desolation and Gray Canyons would continue to reach the desired humpback chub spawning temperature of at least 17°C (62.6°F) during the descending limb of the spring peak in most years.

In summary, the proposed action is expected to benefit humpback chub in the Green River by improving habitat conditions for all life stages. The proposed action would result in flows that would maintain and improve conditions in the currently occupied canyon reaches. The proposed action would increase the temperature of water released during summer months in most years. Warmer summer water temperatures would improve conditions for growth and survival of humpback chub in Whirlpool Canyon and could result in expansion of the population into Lodore Canyon.

In addition to the potential benefits of the proposed action to the humpback chub described above, there is the potential for some adverse effects as well. To achieve the recommended magnitudes and durations of spring peak flows in Reach 2, water may need to be released over the spillway more than five times as often as under current operations. Increased use of the spillway increases the risk that nonnative fish would be released into the Green River from

Flaming Gorge Reservoir. Of particular concern is the potential to release smallmouth bass, a warmwater predator that is thought to adversely affect native fish populations in the basin and that is currently being targeted by Recovery Program control efforts. Increased escapement of this species through spillway releases, together with the increased water temperatures during summer and early fall under the proposed action may increase the potential for smallmouth bass or other nonnative fish to survive, reproduce, and expand their distribution in the Green River, especially in areas of Reach 1 such as Lodore Canyon, where the colder summer temperatures under baseline conditions may currently reduce survival and reproduction by nonnative fish. Even if escapement from the reservoir does not result in increased numbers of nonnative fishes downstream, there is a potential for increased survival, reproduction, and expansion of nonnative fish species in Lodore Canyon due to increased water temperatures alone.

Bonytail

Little is known of the habitat requirements of the bonytail because it was extirpated from most of its historic range before studies were conducted. In the Green River, Vanicek (1967) generally found bonytail in pools and eddies with low velocities, although these habitat features were often located adjacent to areas of strong current. Similarly, Valdez (1990) reported that bonytail captured in Desolation and Gray Canyons were sympatric with humpback chub in shoreline eddy habitat with boulders and cobble. It has been recently hypothesized that flooded bottomlands may provide important bonytail nursery habitat. The Recovery Program has been building their stocking program to achieve a target release of 5,330 hatchery produced bonytail (target size of 200 mm) in the upper and lower Green River each year for six years. In excess of 20,000 bonytail (many < 200mm) have already been stocked in Reaches 1 and 2 since 2000.

The peak flows that would occur under the proposed action would rework and rebuild in-channel sediment deposits in potential bonytail habitat found in Echo Park, Whirlpool and Split Mountain Canyons in the upper portion of Reach 2. These peak flows would similarly rework and rebuild in-channel sediment deposits in Desolation and Gray Canyons in Reach 3, where bonytail have historically been found. These proposed peak flows could benefit reintroduced bonytail in these areas by preparing and maintaining substrates in spawning areas, promoting increased habitat complexity, and preventing or reversing channel narrowing during wetter years. The proposed peak flows would also scour and maintain eddies. The proposed peak flows would periodically inundate flooded bottomland habitats and would allow access to such areas by bonytail larvae in some years.

Base flows that would occur under the proposed action would be scaled to annual hydrologic conditions. These flows would provide eddies and complex shoreline habitat in Echo Park, Whirlpool, Split Mountain, Desolation, and Gray Canyons.

Higher summer water temperatures in most years could encourage movement and establishment of bonytail within lower portions of Lodore Canyon and could enhance growth and survival of bonytail in Whirlpool Canyon. As occurs under current baseline conditions, summer water temperatures in Desolation and Gray Canyons would reach the desired humpback chub spawning temperature of at least 17°C (62.6°F) during the descending limb of the spring peak in most years. It is assumed that such temperatures would also be suitable for reproduction and growth of bonytail.

Although a great deal of uncertainty remains regarding bonytail habitat requirements, the proposed action is expected to benefit bonytail reintroduced into the Green River and is expected to provide appropriate conditions for survival and recruitment of this species. The proposed action would result in flows that would maintain and improve substrate conditions in historically occupied canyon reaches. In addition, the proposed action would increase the temperature of water released during summer months in most years, resulting in improved potential for spawning, growth, and survival of bonytail in Whirlpool Canyon.

In addition to the potential benefits of the proposed action to the bonytail described above, there is the potential for some adverse effects as well. To achieve the recommended magnitudes and durations of spring peak flows in Reach 2, water may need to be released over the spillway more than five times as often as under current operations. Increased use of the spillway increases the risk that nonnative fish would be released into the Green River from Flaming Gorge Reservoir. Of particular concern is the potential to release smallmouth bass, a warmwater predator that is thought to adversely affect native fish populations in the basin and that is currently being targeted by Recovery Program control efforts. Increased entrainment of this species in spillway releases, together with the increased water temperatures during summer and early fall under the proposed action may increase the potential for smallmouth bass or other nonnative fish to survive, reproduce, and expand their distribution in the Green River, especially in areas of Reach 1 such as Lodore Canyon, where the colder summer temperatures under baseline conditions may currently reduce survival and reproduction by nonnative fish.

Ute Ladies'-Tresses

The distribution and abundance of Ute ladies'-tresses is affected by changes in the frequency and duration of inundation and by changes in patterns of erosion or deposition. Under the proposed action, the magnitude and duration of peak flows would generally be higher than those of the environmental baseline, especially in wet years. Higher peak flows would result in greater depth and duration of inundation in areas below the existing annual peak flow elevation, such as the post-dam floodplain, along with potential increases in flow velocity. Higher elevation surfaces, such as the intermediate bench or cottonwood-box elder terrace, could be inundated more frequently than under the existing flow regime. Depending on local geomorphic characteristics, sites supporting existing Ute ladies'-tresses colonies may experience a range of effects from increased sediment deposition to increased erosion.

Under the proposed action, annual peaks in Reach 1 would generally be higher than under existing baseline conditions, and geomorphic surfaces supporting Ute ladies'-tresses would generally be inundated more frequently. Results of the Flaming Gorge Hydrologic Model (Clayton and Gilmore 2002) indicate that, under the proposed action, the post-dam floodplain in Reach 1 (inundated at 130 m^3/s [4,600 cfs]) would be inundated in all years by the peak releases of at least one day duration, as under baseline conditions. This surface would be inundated in about 74% of years by flows of two weeks duration, up from about 46% under baseline, and in about 55% of years by flows of four weeks duration, up from about 27% under baseline. The intermediate bench (inundated at about 244 m^3/s [8,600 cfs]) would be inundated in about 30% of years by the peak releases of at least one day duration under the proposed action, and about 7% of years under baseline conditions. The intermediate bench would be inundated in about 8% of years by flows of two weeks duration, slightly up from about 7% under baseline, and in about 2% of years by flows of four weeks duration, slightly down from about 3% under baseline.

Ute ladies'-tresses are able to tolerate occasional periods of extended inundation. The post-dam floodplain surfaces in Reach 1 are sometimes inundated for a duration of up to eight weeks. All Ute ladies'-tresses colonies inventoried in Red Canyon and Browns Park in 1999 were inundated that year by peak flows of 308 m^3/s (10,900 cfs), and most were inundated for at least 32 days (Grams et al. 2002). These survived an average of 0.7 m (2.3 ft) inundation, and up to 1.2 m (3.9 ft) at some sites. On average, sites supporting Ute ladies'-tresses are inundated from a few days to 10 days per year under environmental baseline conditions (1 to 3% of the time) (Grams et al. 2002). Post-dam floodplain sites would be inundated for somewhat longer periods, with two and four week inundations occurring in more years than under baseline conditions. In Red Canyon and Browns Park, approximately 6% of the Ute ladies'-tresses colonies occur on the post-dam floodplain, while about 23% occur on an undifferentiated post-dam floodplain/intermediate bench surface. Intermediate bench sites may be inundated more frequently, with the largest difference from baseline being in the flow durations of at least one day. Approximately 71% of the Ute ladies'-tresses colonies in Red Canyon and Browns Park occur on Intermediate bench surfaces, with 23% on the undifferentiated post-dam floodplain/intermediate bench surfaces. In extreme wet years, high flows could result in some mortality on lower elevation surfaces (e.g., post-dam floodplain sites) greater than what now occurs under the environmental baseline.

Erosion and deposition that could be caused by peak flows would likely be low at many occupied sites. The amount of sediment deposited during the high flows of 1999 at occupied sites in Red Canyon and Browns Park ranged from none (most of the sites) to less than 5 cm (2 in.) of very fine sediment (Grams et al. 2002). Total post-dam deposition at these sites apparently averaged 11 cm (4.3 in.). Sediment deposition was greater on unoccupied post-dam floodplain and intermediate bench surfaces. Deposition also occurred on some post-dam floodplain and intermediate bench surfaces in Lodore Canyon, some of which were occupied. Partial and complete burial of Ute ladies'-tresses were recorded. On channel margin deposits, as well as on islands and expansion bars, in Lodore Canyon, sand deposition and/or erosion was observed on 70% of post-dam floodplain and intermediate bench surfaces examined following the 1999 peak flow (Grams et al. 2002). Intermediate bench and the downstream portions of post-dam floodplain features tended to be subject to deposition, with ranges of several centimeters to over one meter observed.

Under the proposed action, sediment deposition could increase on some occupied sites, such as in Lodore Canyon. However, occupied Ute ladies'-tresses sites in Red Canyon and Browns Park tend to be located in positions with low rates of sediment deposition. Ute ladies'-tresses are able to tolerate some sediment deposition. One colony in Lodore Canyon flowered and produced seed after partial burial in 1999. However, some mortality of buried individuals could be expected.

Erosion at sites occupied by Ute ladies'-tresses in Red Canyon and Browns Park is generally absent or minor. Erosion was observed in Lodore Canyon, however, as a result of 308 m^3/s

(10,900 cfs) flows in 1999. Scouring resulted in habitat loss on upstream portions of channel margin deposits, islands, and expansion bars, especially at the post-dam floodplain level. Ute ladies'-tresses were lost as a result. Increased peak flows under the proposed action could result in increased erosion of these Ute ladies'-tresses sites.

Post-dam floodplain or intermediate bench surfaces that experience erosion or deposition and become available for development of early seral stage vegetation could be colonized by Ute ladies'-tresses, and new reproductive colonies could become established. However, some of those new colonies might be only temporary. For example, some areas that are subject to frequent disturbance from flooding (such as some post-dam floodplain surfaces), might not be stable for the length of time required for Ute ladies'-tresses to become established and to reproduce (10 to 20 years) and might not develop beyond early seral stage communities. In addition, some new sites that are relatively stable for extended periods, (such as some intermediate bench surfaces) might become colonized by native woody species, such as coyote willow or cottonwood, or invasive species, such as tamarisk, giant whitetop, yellow sweetclover (*Melilotus officinalis*), or common reed. Such sites might eventually become unsuitable for survival of Ute ladies'-tresses because of decreased light as a result of excess shading by other species.

New colonies could become established on higher-elevation sites in Red Canyon, upper Browns Park, or Lodore Canyon. Studies indicate that Ute ladies'-tresses became established on the higher pre-dam cottonwood-box elder terrace in Island Park after high flows in 1983 or 1984 (Grams et al. 2002). Deposition of fine sediments and increased frequency of inundation at these higher elevations might increase site suitability for Ute ladies'-tresses. However, some of these areas may currently support other plants whose shade might prevent Ute ladies'-tresses establishment or survival.

Sites that support Ute ladies'-tresses typically have a shallow water table during August and are positioned 0.5 to 0.9 m (1.5 to 2.8 ft) above the normal flow elevation (Grams et al. 2002). Under the proposed action, base flows during August and the remainder of the growing season, would be higher in all but the driest years than under baseline conditions and would be expected to support colonies at existing elevations as well as at slightly higher elevations. The average monthly flow in Reach 1 during August under the proposed action would be approximately 45 m^3/s (1,600 cfs). This would be about 11 m^3/s (380 cfs) above baseline operations in August. Under the proposed action, the highest base flow in Reach 1 would be 76 m^3/s (2,700 cfs) and would occur in wet years. Because base flows may vary from targeted flows by as much as 40% during this period under the proposed action, the maximum base flow expected in Reach 1 would be 106 m^3/s (3,760 cfs), which is below the level of the post-dam floodplain and intermediate bench. Although flows in May, at the beginning of the growing season, may be somewhat lower under the proposed action than under baseline conditions, the growth or survival of Ute ladies'-tresses would not be affected as the difference would be small, and flows would be considerably higher than base flows, ascending to a peak in June. Relatively low base flows during dry years (about 1 m^3/s [25 cfs] lower than baseline August operations) would not be expected to adversely affect Ute ladies'-tresses unless an extended sequence of dry years occurred.

Effects of flow changes in Reach 2 would be similar to those described for Reach 1. Model results indicate that, under the proposed action, the post-dam floodplain in Reach 2 (inundated at approximately 455 m^3/s [16,100 cfs]) would be inundated in about 72% years by the peak releases of at least one day duration, as under baseline conditions. This surface would be inundated in about 47% of years by flows of two weeks duration, up from about 35% under baseline, and in about 19% of years by flows of four weeks duration, slightly up from about 18% under baseline. The intermediate bench (inundated at about 600 m^3/s [21,000 cfs]) would be inundated in 39% of years by the peak releases of at least one day duration under the proposed action, as under baseline conditions. This surface would be inundated in about 14% of years by flows of two weeks duration, up from about 9% under baseline, and in about 5% of years by flows of four weeks duration, as under baseline.

In Reach 2, the largest differences from baseline are in the flows of two-week duration or more during the spring-peak period. Sites occupied by Ute ladies'-tresses in Island Park and downstream of Split Mountain might be subject to extended inundation, increased deposition, or increased erosion. The magnitude of effects on occupied sites might be limited in most years, although peak flows in wet years could result in some mortality of Ute ladies'-tresses. There are far fewer colonies in Reach 2 than in Reach 1, however.

As in Reach 1, sites suitable for establishment of Ute ladies'-tresses could become available at higher elevations in Island and Rainbow Parks, if suitable sediments are deposited. However, high peak flows in Reach 2 caused by Yampa River input might decrease the potential suitability of some new sites on post-dam surfaces, such as intermediate bench surfaces. Sites that are subject to frequent disturbance from high flows may not be stable for long enough periods for Ute ladies'-tresses establishment and reproduction.

Under the proposed action, base flows in Reach 2 in August and the remainder of the growing season would be higher in most years and would be expected to support colonies at existing elevations as well as at slightly higher elevations. The average monthly flow in Reach 2 during August, under the proposed action, would be approximately 57 m^3/s (2,000 cfs). This would be about 11 m^3/s (400 cfs) above baseline operations in August. The highest target base flow in Reach 2 would be 85 m^3/s (3,000 cfs), and would occur in wet years. Because base flows may vary from targeted flows by as much as 40% during this period, the maximum base flow expected in Reach 2 would be 119 m^3/s (4,200 cfs), which is below the level of the post-dam floodplain and intermediate bench where Ute ladies'-tresses occur. Relatively low base flows during dry years under the proposed action would not be expected to adversely affect Ute ladies'-tresses in Reach 2 unless an extended sequence of dry years occurred.

It is possible that the proposed action will facilitate the spread and vigor of invasive species such as tamarisk into occupied or potentially suitable habitat of Ute ladies'-tresses orchid. However, the rate and extent of invasion and habitat change is unknown. Tamarisk is an aggressive opportunist and persists in habitats they invade (i.e., are resistant to natural vegetation succession). Invasion tamarisk would result in significant detrimental impacts to habitat and some colonies could be threatened with eventual extirpation.

In summary, Ute ladies'-tresses is well adapted to changing conditions in riparian floodplains. It typically occurs where streams exit steep terrain, retain moderate velocity, and begin to create a meander floodplain corridor. It's occurrence in a steep-walled canyon such as Lodore is considered to be an artifact of Flaming Gorge operation where both high and low flows have been attenuated. This is corroborated by failure to find the species or suitable habitat conditions along the Yampa River. In Reach 1, Ute ladies'-tresses occurs on landforms just below debris fans, conditions which replicate emergence of streams from steep terrain into more moderate terrain. Historically, it is likely that the orchid did not occur in Lodore Canyon, but rather in various locations upstream of Flaming Gorge Dam, and possibly in Browns, Island, and Rainbow parks. While reoperation of Flaming Gorge Dam will more nearly replicate natural flow conditions than historical or baseline operation, it will be insufficient to recreate riparian habitat dynamics and complexity in areas such as Browns, Island, and Rainbow parks due to the excessive sediment buildup in those areas since the dam was built. Thus, we do not expect that suitable potential habitat will be created and sustained in those areas. In addition, it has been speculated that an increase in the frequency and duration of bypasses and spills from Flaming Gorge Dam could adversely effect populations in Reach 1 that were established under prior dam operations.

Uncertainties

In their Biological Assessment, Reclamation and Western, identified a number of uncertainties associated with the proposed action and offered a list of actions to reduce potential adverse effects to the listed species. We summarize those discussions below:

Uncertainties Associated with Hydrology

Reclamation and Western point out the limitations of the Flaming Gorge Hydrology Model (Clayton and Gilmore 2002). The Service recognizes that the Flaming Gorge Model is not an operations model, but was a tool developed to conduct comparative analyses of impacts / effects of alternatives in the environmental compliance arena. Under the proposed action, the Service, through it's involvement on the Technical Working Group and the Flaming Gorge Working Group, would work closely with Reclamation in recommending dam operations to meet the flow and temperature recommendations. In our ITS, we identify the type of information we expect to be included in Reclamation's Annual Operations Report. A thorough accounting of operations will help the Service and others evaluate the extent to which the recommendations were met in the most recent year and how that relates to previous years of operation.

Uncertainty with Selective Withdrawal Operations

Reclamation included a conservation measure in their proposed action that addressed operational uncertainty in their ability to meet the temperature recommendations. We have addressed Reclamation's concern in our ITS by requiring Reclamation to develop a selective withdrawal operations plan, which addresses their uncertainties and outlines a process to resolve them.

Uncertainties Associated With Increased Spillway Use

Based on past experiences, Reclamation foresees potential structural damages to the FGD spillway each time it is used, and therefore commit to inspecting the structure after each spill event. In the biological assessment, Reclamation states that if the amount of damage was deemed unacceptable they would limit use of the spillway to those times it was hydrologically necessary. The Service expects Reclamation to report the results of their post-spill spillway inspections in their annual operations report (see ITS Term and Condition #6). Should Reclamation determine that the increased use of the spillway under the proposed action was unacceptable the Service will consider if re-initiation of Section 7 consultation is necessary.

We encourage Reclamation to coordinate with the State of Utah's ongoing tailrace trout population monitoring to evaluate the level of nitrogen super-saturation associated with use of the spillway. If results of those ongoing efforts in a change in Reclamation's operations to meet the flow recommendations, the Service would determine if re-initiation of this Section 7 consultation was necessary.

The Service recognizes and agrees with Reclamation's concern that spills from Flaming Gorge Dam could result in unacceptable levels of entrainment of nonnative reservoir fish species. We have addressed these concerns by providing the framework for an adaptive management process that evaluates the proposed action (including entrainment) in our ITS.

Uncertainties in Fish Responses to Flow and Temperature Modifications

Reclamation and Western in their biological assessment expressed concern over how the fish community and in particular nonnative species might respond to aspects of the flow and temperature recommendations. Whereas, the action agencies and the Service recognize that the intention of the proposed action is to benefit the endangered fish in the long-term, the Service shares the concern that implementation of the proposed action could result in both temporal and spatial short-term benefits to some nonnative species. Evaluating the effects of the proposed action on the fish community will be of critical importance in determining how to best manage the system for recovery of the endangered fish species. In our ITS (RPM #1 and T&C #1) we identify the need for the action agencies and the Service to work with the Recovery Program to develop a Study Plan that evaluates this proposed action. We recommend that the Recovery Program consider uncertainties, identified by the authors of Muth et al (2000) and as identified by Reclamation through their NEPA process, in the development of that study plan. The Service agrees with the action agencies that the Recovery Program is the appropriate science body to take the lead in developing and implementing that plan. It is the Service's opinion that implementation of that study plan within the context of the Recovery Program and full communication of that plan with interested parties via the Flaming Gorge Working Group represents an appropriate adaptive management solution to these fish community uncertainties.

Uncertainties Associated With Floodplain Inundation

In their biological assessment, Reclamation and Western have brought into question the need for some of the dam releases (based on results of hydrologic modeling presented in Reclamation'

EIS) to meet Reach 2 floodplain magnitude and duration targets as identified in Muth et al (2000) to benefit larval razorback suckers. Reclamation and Western's position on this issue is based primarily on information that was presented in the Recovery Program sponsored Floodplain Management Plan for the Green River Subbasin (Valdez and Nelson 2004). It is the Service's opinion that based on the best available information Muth et al (2000) should be implemented, however the specific questions raised by the action agencies in their biological assessment regarding floodplain inundation should be considered through the adaptive management process outlined in RPM #1, T&C #1 of the ITS.

Uncertainties Associated with Riparian Vegetation

There are uncertainties associated with the response of invasive plant species to the proposed action. Recent research suggests that the flood flows may prevent additional tamarisk establishment on post-dam floodplain surfaces in Lodore Canyon, but may push establishment to higher elevations. Information is lacking on the degree to which these responses would occur.

Uncertainties related to the response of certain native plant communities to the proposed action include duration and magnitude of flood flows necessary to stimulate a positive response in mature cottonwoods and response of wetland species to higher base flows of late summer and lower base flows of winter and early spring.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act. In the action area, the Green River flows mostly through federal land. No future state or private actions are known to be in the planning stage in the action area that would not require Section 7 consultation. For this reason, no cumulative effects are anticipated on the endangered species or designated critical habitat in the action area.

CONCLUSION

After reviewing the current status of the endangered fishes and the Ute ladies'-tresses, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed action is not likely to jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, razorback sucker or Ute ladies'-tresses and will not result in the destruction or adverse modification of critical habitat of these species. The implementation of the proposed action is expected to result in overall beneficial effects to the species and critical habitat in the Green River downstream from Flaming Gorge Dam and induce a positive species response, particularly with the endangered fishes due to a more natural hydrologic regime. The basis for the determination of no jeopardy and no adverse modification of critical habitat for each listed species is summarized below.

Colorado Pikeminnow

The Service concludes that although some aspects of operations to meet the flow and temperature recommendations may result in increased interactions between endangered and nonnative fish species, the proposed action will result in long-term positive benefits for the Colorado pikeminnow and critical habitat. Positive effects of the proposed action include; increased inundation and access to floodplains which would provide warm, food rich environments for adult and subadult Colorado pikeminnow, peak flows of sufficient magnitude to maintain main channel habitats for adult fish including spawning bars, base flows that would encourage development and maintenance of backwaters and other low velocity shoreline habitats favorable for young fish and a temperature regime that would reduce temperature shock to drifting Colorado pikeminnow larvae at the confluence of the Green and Yampa rivers and potentially improve growth of adult fish in lower Reach 1 and the upper portion of Reach 2.

Razorback Sucker

The Service concludes that although some aspects of operations to meet the flow and temperature recommendations may result in increased interactions between endangered and nonnative fish species, the proposed action will result in long-term positive benefits for the razorback sucker and critical habitat. Positive effects of the proposed action include; increased inundation and access to floodplains for young razorback suckers, peak flows of sufficient magnitude to maintain main channel habitats for adult fish, base flows that would encourage backwater development and other low velocity shoreline habitats favorable for razorback suckers and a temperature regime that could improve razorback sucker growth in lower Reach 1 and the upper portion of Reach 2.

Humpback Chub

The Service concludes that although some aspects of operations to meet the flow and temperature recommendations may result in increased interactions between endangered and nonnative fish species, the proposed action will result in long-term positive benefits for the humpback chub. Positive effects of the proposed action include; peak flows of sufficient magnitude to maintain main channel habitats for adult fish, base flows that would encourage development of complex low velocity shoreline habitats and a temperature regime that could enhance growth and survivability of young humpback chub in Whirlpool Canyon in Reach 2.

Bonytail

Although there is uncertainty about some aspects of bonytail life history and some aspects of operations to meet the flow and temperature recommendations may result in increased interactions between endangered and nonnative fish species, the Service concludes that the proposed action will result in long-term positive benefits for the bonytail and critical habitat by providing conditions appropriate for survival and recruitment. Positive effects of the proposed action include; increased inundation and access to floodplains for young bonytail, peak flows of sufficient magnitude to maintain main channel habitats for adult fish, base flows that would encourage backwater development and other low velocity shoreline habitats and a temperature regime that could improve the potential for spawning and growth of bonytail in the Whirlpool Canyon portion of Reach 2.

Ute Ladies'-tresses

The Service concludes that the proposed action is not likely to jeopardize the Ute ladies'-tresses or result in the destruction or adverse modification of critical habitat since no critical habitat has been designated for this species. Along the Green River, Ute ladies'-tresses occur on surfaces that formed in response to construction and past operations of Flaming Gorge Dam. Most colonies are located in Reach 1, but several have also been found in Reach 2. Most individuals occur on post-dam floodplain surfaces, near the annual peak-flow elevation, or on the intermediate bench, which is at a slightly higher elevation. These sites are located within a zone that is inundated between 1% and 3% of the time. Under the proposed action, mean annual peak flows would increase, and the frequency of larger peak flows would increase. While occupied sites might be subject to some erosion, deposition, or extended inundation, direct effects on Ute ladies'-tresses colonies as a result of these flow changes are expected to be small because of site characteristics that often are protective, such as landscape position and substrate composition. The 1 to 3% inundation zone may shift to a slightly higher position along the river margin, potentially resulting in reductions in the number of individuals at lower elevations, such as on some post-dam floodplain surfaces. Locations at elevations slightly above the existing zone of 1 to 3% inundation may become more suitable for Ute ladies'-tresses establishment. The indirect effects of the proposed action include potential changes in location, distribution, vigor, and competitive ability of both native and non-native invasive species, which may in turn adversely affect the ability of Ute ladies'-tresses to occupy suitable habitat.

Ute ladies'-tresses is adapted to and requires occasional disturbance to maintain its preferred seral stage; proposed-action flows would provide this occasional disturbance while maintaining appropriate soil-moisture conditions during the growing season. Implementation of the proposed action may result in some losses of individual plants at currently occupied sites due to erosion or deposition during high flow events. New colonies of Ute ladies'-tresses may become established at higher elevations and offset these losses. However, increased vigor or competitiveness of native and non-native invasive species may preclude or impede orchid establishment and long term sustainability in occupied and potentially suitable habitat.

There are several large populations of Ute ladies'-tresses throughout it 7 state range, and many small populations. Although the population in Reach 1 and 2 is considered significant, anticipated adverse impacts are unlikely to result in extirpation either of this population or of the species throughout its range.

INCIDENTAL TAKE

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent act or omission that creates the likelihood of injury to listed wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken so that they become binding conditions of any Federal discretionary activity, for the exemption in section 7(o)(2) to apply. The following reasonable and prudent measures and terms and conditions are intended to be largely consistent with the 2004 Recovery Implementation Program Recovery Action Plan (RIPRAP) of the Upper Colorado River Endangered Fish Recovery Program[3] (Recovery Program) and will be implemented according to the RIPRAP schedule. This incidental take statement, however, also contains several terms and conditions not included in the 2004 RIPRAP. For these terms and conditions Reclamation and Western will either work with the Recovery Program to include them in future RIPRAP revisions or may assume responsibility for their implementation. The participating Federal Agencies have a continuing duty to monitor the activity covered by this incidental take statement. If Reclamation and Western through the Recovery Program or as individual agencies 1) fail to assume and implement the terms and conditions or 2) fail to retain oversight to ensure compliance with the terms and conditions, the protective coverage of section 7(o)(2) may lapse for the projects covered by this incidental take statement. In order to monitor the impact of incidental take, Reclamation and Western must report to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)] (see TC#5-annual report).

AMOUNT OR EXTENT OF TAKE

The Service believes that managing reservoir releases to be consistent with the flow recommendations is necessary for the survival and recovery of the endangered fish. The Proposed Action is fully intended to benefit the endangered Colorado River fish, and the Service expects an overall, long-term beneficial effect to result from implementation. However, the Proposed Action also has the potential to cause increases in nonnative fish within the action area. Increases in nonnative fish may result in incidental take in the form of harm through predation on and competition with the endangered fish (Hawkins and Nesler 1991; Lentsch et al. 1996; Tyus and Saunders 1996). Incidents of predation by northern pike on endangered fishes have been

[3] The Recovery Program was established in 1988 when the Secretary of Interior; Governors of Wyoming, Colorado and Utah; and the Administrator of the Western Area Power Administration signed a cooperative agreement to implement the program. The purpose of the Recovery Program is to recover the endangered fishes in the Colorado River system while providing for existing and new water development in the Upper Basin. The Recovery Program is also intended to serve as a reasonable and prudent alternative to avoid the likelihood of jeopardy to the continued existence of the endangered fishes and to avoid the likely destruction or adverse modification of critical habitat in Section 7 consultations on depletion impacts related to new projects and all impacts (except contaminants) associated with historic water projects in the Upper Basin.

observed in both the Yampa and Green rivers. Other nonnative predators, such as smallmouth bass and channel catfish, also present a threat to endangered fishes due to both predation and competition for food and space. A rapidly expanding population of smallmouth bass in the Yampa River during the recent drought years was blamed for precipitous declines in the abundance of juvenile native fish (Anderson 2002). Smallmouth bass have also recently expanded into the Green River above its confluence with the Yampa River (Bestgen pers. comm.). Small-bodied nonnative species such as red shiner, sand shiner, and fathead minnow may also negatively interact (competition and predation) with early life stages of native species.

Mechanisms by which populations of nonnative fish may be increased as a result of the Proposed Action include:

1. Release of water through the spillway as identified in the Proposed Action may result in the entrainment of nonnative fish. Use of the spillway and/or bypass tubes and the resulting high flows during the spring may inhibit some nonnative fish populations in the Green River in Reach 1. However, spillway releases will also likely result in the entrainment of nonnative fish, particularly smallmouth bass from Flaming Gorge Reservoir into the Green River during high water years.
2. Increased inundation of the floodplain (duration and magnitude) in Reach 2 and 3 provides important habitats preferred by both native and nonnative species
3. Increased release temperatures from Flaming Gorge Dam create habitat conditions in Reach 1 that could benefit nonnative fish species as well as the native endangered fishes.

The Service is unable to determine the exact level of incidental take that would result from increases in nonnative fish populations due to implementation of the Proposed Action. Estimating the incidental take of individual listed fish associated with a possible increase in nonnative fish populations due to spills, temperature modification and increased floodplain inundation is difficult to quantify for the following reasons: 1) quantifying the amount of predation is extremely difficult due to large extent of the action area and the difficulty of estimating fish populations and predation rates, 2) estimates of nonnative predators in Flaming Gorge Reservoir that are potentially subject to entrainment during a spill are unknown as well as survival rates of fish that are entrained, 3) much of the floodplain inundation that will occur in the future is dependent on the uncontrolled Yampa River spring flows, i.e., the incremental amount of take that could be attributed to Reclamation's operations to fully meet the spring flow recommendations is unquantifiable, and 4) the amount of take directly attributable to the proposed action is confused by a Lodore Canyon fish community that is rapidly changing in response to drought conditions and nonnative species invading from the Yampa River.

In addition to take associated with nonnative fish, the Service expects that an unquantifiable level of take may occur as a result of drifting Colorado pikeminnow larvae in the Yampa River being exposed to thermal shock of differing water temperature in the Green River at their confluence. As larvae drift out of the Yampa River into the Green River they are exposed to cold water released from Flaming Gorge Dam. Take is difficult to quantify since effects of cooler water temperatures on the survival of Colorado pikeminnow larvae are largely unknown. However, Berry (1988) and Tyus (1991) suggested that higher recruitment of Colorado pikeminnow occurred in years when the temperature differences between the two rivers was 2°C or less and Muth et al. (2000) stated that temperature differences of 5-10°C are common and may cause indirect mortality. The Proposed Action is to meet the temperature recommendation of 5°C difference or less at the confluence of the Green and Yampa River during the time when pikeminnow larvae are present. Temperature monitoring, however, at the Yampa / Green Rivers confluence has not been conducted long enough to assess Reclamation's ability to achieve the recommendation.

According to Service policy, as stated in the Endangered Species Consultation Handbook (USFWS 1998b) (Handbook), some detectable measure of effect should be provided, such as the relative occurrence of the species or a surrogate species in the local community, or amount of habitat used by the species, to serve as a measure for take. Take also may be expressed as a change in habitat characteristics affecting the species, such as water quality or flow (USFWS 1998b). Because estimating the number of individuals of the four listed fishes that could be taken by nonnative fishes and by thermal shock of Colorado pikeminnow larvae in this biological opinion is difficult, we have developed a surrogate measure to estimate the amount of anticipated take to listed fish in the form of harm. The surrogate we are using is flows in the Green River below Flaming Gorge Dam. Flows of a magnitude, timing and duration consistent with the Proposed Action and the Flow Recommendations (Muth et al. 2000) provide the short and long-term habitat conditions in the Green River suitable for the survival and recovery of the endangered fish. Take would be exceeded if the Service, after consultation with the action agencies, determined that flows in the Green River below Flaming Gorge Dam were not consistent with the flow recommendations as identified in the Proposed Action and there was evidence of harm to listed species. This would include significant habitat modification or degradation when it kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding or sheltering from failure to meet the flow recommendations. We exempt all take in the form of harm that would occur from normal operations including spills and modified temperature releases from Flaming Gorge Dam operations that are consistent with the Proposed Action to meet the flow recommendations provided the action agencies, working in cooperation with the Recovery Program, comply with the reasonable and prudent measures and the implementing terms and conditions of this Incidental Take Statement.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that the anticipated level of incidental take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service, in cooperation with the Recovery Program, developed the flow and temperature recommendations (Muth et al. 2000) with the although the proposed flows would improve endangered fish habitat that there will be times and situations where warm water nonnative species could benefit and drifting larval Colorado pikeminnow may be impacted at the confluence. Therefore, the Service believes that the reasonable and prudent measures to minimize incidental take associated with the propose action need to be focused on evaluating the effects of implementation of the flow and temperature recommendations (Proposed Action) and understanding and managing negative interactions between native and nonnative fish.

Through implementation of the proposed action, Reclamation and Western intend to protect and assist in the recovery of the populations and designated critical habitat of the four endangered fishes, while maintaining all purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources. As part of their proposed action, Reclamation and Western included a list of environmental commitments in their biological assessment (identified as conservation measures in this biological opinion). Some of those conservation measures stemmed from uncertainties associated with the proposed action that Reclamation identified in their NEPA process and as were identified by Muth et al. (2000). As some of those uncertainties are linked to potential take of the endangered fish, they serve as the basis for the following Reasonable and Prudent Measures. The Service believes the following reasonable and prudent measures are necessary and appropriate to avoid and minimize the impacts of incidental take of the listed Colorado River fishes:

1. Implementation and refinement of the proposed action will occur through an adaptive management process. Reclamation, Western and the Service will work through the Recovery Program to implement appropriate monitoring and research studies to test the result of implementing the proposed action and identify the potential for modifying or refining flows and temperatures from Flaming Gorge Dam. The Service considers the Recovery Program the appropriate science body to develop and implement monitoring and research studies that would address uncertainties associated with the proposed action. In accordance with the Section 7 agreement, Reclamation, the Service, and Western will work with the Recovery Program to revise the RIPRAP as necessary to incorporate the approved studies deemed necessary to evaluate the proposed action.

2. The Recovery Program will assess the need for and implement as necessary nonnative fish control programs in the Green and Yampa River systems in accordance with the RIPRAP and scopes of work approved by the Recovery Program.

3. Reclamation has committed to develop a process for operating the selective withdrawal structure consistent with the objectives of improving temperature conditions for the endangered fish (see Description of the Proposed Action).

4. Reclamation and the Recovery Program should determine if temperature gaging in Reach 1 and Reach 2 is adequate to ensure temperature recommendations are met

5. Reclamation will produce a summary report each year to document annual operations and the information used to develop those operations. Over time, it is expected that these data would be of benefit in determining if flow recommendations are being met and correlating and analyzing conditions for the endangered fish species and their habitat downstream from Flaming Gorge Dam.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the following terms and conditions, which implement the reasonable and prudent measures described above, must be satisfied. These terms and conditions are nondiscretionary.

In order to implement RPM #1 Reclamation will:

A.) Establish the Technical Working Group, as detailed in Section 2.5.3 of the EIS, consisting of biologists and hydrologists involved with endangered fish recovery issues. The Technical Working Group will meet at various times throughout the year to provide input and feedback concerning current and past operations on endangered fish needs and provided recommendations to Reclamation on its operational plan for Flaming Gorge Dam. A representative from the Service's Utah Field Office will participate on the Technical Working Group.

B.) Consistent with the Recovery Program RIPRAP Item No. I.D. in the Green River Mainstem Action Plan which states: *Evaluate and revise as needed, flow regimes to benefit endangered fish populations* - Reclamation, Western and the Service will work through the Recovery Program technical committees to develop a Study Plan to evaluate the Flaming Gorge Flow and Temperatures Recommendations. The Study Plan should be completed within one year of the finalization of this biological opinion and should focus on previously identified uncertainties related to floodplain inundation, nonnative impacts, effects of elevated temperatures and geomorphic processes. Whereas the intent of this Study Plan is to guide future evaluation of the Flaming Gorge Flow and Temperature Recommendations, it should draw heavily on the direction provided in section 7 consultation documents including the biological assessment and biological opinion, Recovery Program guiding documents:

- Strategic Plan for Geomorphic Research and Monitoring (LaGory et al. 2003)
- Green River Sub-basin Floodplain Management Plan (Valdez and Nelson 2004)

and ongoing field studies:

- Gunnison and Green River Sediment Monitoring: Project # 85F
- Cumulative Effects of Flaming Gorge Dam Releases since 1996 on the Fish Community in Lodore and Whirlpool Canyons: Project 115
- Floodplain Habitat Surveys: Project Cap-6 HYD
- Razorback sucker migration / recruitment from floodplain habitat: Cap-6 RZ
- Larval bonytail and razorback sucker survival in floodplain habitats: Cap-6 bt/rz
- Larval razorback and bonytail survival in Baeser; Cap-6 rz/bt
- Entrainment of larval razorback sucker cap6-rz/entr
- Native fish response to nonnative control efforts in Utah: new study
- Yampa and Middle Green River razorback sucker and Colorado pikeminnow larval survey for Flaming Gorge operations: Project 22f
- Population Estimation for Colorado pikeminnow in the Green River (Project 128) and for humpback chub in the Green River (Project 129)

- Annual Fall Monitoring for CPM YOY: Project 138).
- Nonnative Control in the Yampa and Green Rivers (Projects 109; 110; 98a-c; 123)

The study Plan will be structured to provide a framework that demonstrates how past, ongoing and future Recovery Program efforts can be used to test objectives of the flow and temperature recommendations and to address uncertainties identified in the Flaming Gorge EIS and by Muth et al. (2000). These uncertainties include the potential impacts related to the escapement of nonnative fishes from Flaming Gorge Reservoir from the increased frequency of spillway use. Reclamation and Western working through the Recovery Program and within the context of the study plan should also assess and prioritize the possibility of improving connectivity of floodplain habitats and identifying ways to improve entrainment of larval razorback suckers into floodplain habitats at lower peak flow levels. A timeline for producing periodic evaluations (e.g. 5-yr assessments) of the Flaming Gorge Flow and Temperature Recommendations will be provided. In accordance with the Section 7 agreement, Western, Reclamation, and the Service will request the Recovery Program to modify the RIPRAP to incorporate approved studies following standard Recovery Program procedures.

In order to implement RPM #2 Reclamation, Western, and the Service will support the Recovery Program in active implementation of the following RIPRAP items:

From the Green River Action Plan: Mainstem

- III.A.4. Develop and implement control programs for nonnative fishes in river reaches occupied by the endangered fishes to identify required levels of control. Each control activity will be evaluated for effectiveness, and then continued as needed.
- III.A.4.a. Northern pike in the middle Green River.
- III.A.4.c. Channel catfish (e.g. Deso./Gray Canyons) to protect humpback chub populations, and in the middle Green River to protect razorback sucker and Colorado pikeminnow.

From the Green River Action Plan: Yampa and Little Snake Rivers

- III.A.1.b. Control northern pike
- III.A.1.b.(1) Remove and translocate northern pike and other sportfishes from Yampa River.
- III.A.1.b.(2) Reduce northern pike reproduction in the Yampa River.
- III.A.1.b.(2)(a)
- Identify and evaluate natural and artificial spawning/nursery habitats for northern pike in the Yampa River for exclusion devices.
- III.A.1.b.(2)(b) Implement remedial measures to reduce pike reproduction in Yampa River.
- III.A.1.c. Control channel catfish
- III.A.1.d. Remove and translocate smallmouth bass.

The Recovery Program is actively pursuing both nonnative control and native fish response studies in the Green and Yampa Rivers. The Yampa River is outside the action area, but is a primary source of smallmouth bass and northern pike supplying Reaches 1,2, and 3 of the Green River and is therefore referenced here.

In order to implement RPM #3 Reclamation will:

A.) Draft a selective withdrawal operation plan within one year of finalization of this biological opinion. This plan will describe operations to meet the temperature recommendations, describe limitations of meeting the temperature recommendations (physical, budgetary, manpower) and propose experimental solutions to these limitations as needed.

B.) Reclamation's accumulated thermal unit analysis in the EIS indicated that dam releases of 16°C during average and wetter hydrologies increased the potential to benefit adult Colorado pikeminnow in Lodore Canyon and minimized the potential impacts of cold shock to drifting Colorado pikeminnow larvae at the Yampa/Green River confluence. Through development and implementation of an operations plan (T&C #3A) to meet the temperature recommendations, Reclamation should experiment with releases of 16°C during appropriate hydrologies. Such experimentation would not require structural modification of equipment of operation changes affecting hydropower generation.

In order to implement RPM #4:

Reclamation, Western and the Service will work with the Recovery Program to determine the need for real-time temperature gages at the downstream terminus of Lodore Canyon and on the lower Yampa River to assist in their operation of the selective withdrawal device to meet the temperature recommendations. This activity is consistent with tasks in Recovery Program Project No. 19B (Hydrology Support for Biological Research). If a need for real-time temperature gages is determined to exist, the Service will approach the Recovery Program in accordance with the Section 7 agreement to propose installation of such gage(s).

In order to implement RPM #5:

Reclamation will provide to the Service and Recovery Program a concise annual operations report. A primary purpose of the annual report is to provide an assessment of how well operations at Flaming Gorge Dam contributed to meeting flow targets. In addition, the annual report will provide a record of operations as identified under the incidental take statement. Basic information that should be summarized includes the following:

a. A review of the April-July unregulated inflow forecasts provided by the National Weather Service via the River Forecast Center that were used to classify Green River hydrology.
b. Additional factors that were used to determine which flow recommendation hydrologic category was targeted (e.g. Flaming Gorge Reservoir elevation, Yampa hydrology, past operations, power needs, Technical Working Group conversations, etc.),

c. An accounting of actual flows and operations: spring flows and baseflows (reference USGS gages at Yampa River at Deerlodge, Green River at Greendale, Ut at Jensen, Ut, and near Green River, Ut),
d. Results from Reclamation's spillway inspections,
e. A summary of daily and seasonal fluctuations at Jensen, Utah,
f. An overview of Reclamation's operations to meet thermal targets,
g. An accounting of the actual thermal regime in upper and lower Lodore Canyon and the lower Yampa River based on available information.
h. Recommendations to refine operations

The Service recognizes that the Recovery Program may adjust dates and time frames for RIPRAP activities referenced in the terms and conditions in this biological opinion. These changes are made through revisions to the RIPRAP and are subject to Service approval as part of the Recovery Program process. To the extent that such revisions affect dates in this biological opinion, these adjustments are recognized by the Service as modifying dates for those activities in the biological opinion.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Service is recommending the following conservation actions:

1. Install additional SNOTEL sites in the headwater reaches of the Yampa River, Upper Green River and Little Snake River. Additional sites will increase the accuracy and precision of runoff forecasts and increase Reclamation's capability to time releases to meet the flow recommendations.

2. Based on implementation of the flow recommendations, reanalyze economic feasibility of retrofitting the bypass tubes with turbines and implement if viable.

3. Participate with members of the Ute ladies'-tresses/riparian vegetation work group and other entities to identify means, devise strategies, and help implement remediation or mitigation measures for Ute ladies'-tresses recommended by the work group as a result of information gathered through research and monitoring.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the subject action. As provided in 50 CFR sec. 402.16, reinitiation of formal consultation is required for projects where discretionary Federal Agency involvement or control over the action has been retained (or is authorized by law) and under the following conditions:

1. The amount or extent of take specified in the incidental take statement for this opinion is exceeded.

2. New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. In preparing this opinion, the Service describes the positive and negative effects of the action it anticipates and considered in the section of the opinion entitled "EFFECTS OF THE ACTION." New information would include, but is not limited to, not achieving significant portions of the flow and temperature recommendations or unanticipated effects of implementing the proposed action.

3. The section 7 regulations (50 CFR 402.16 (c)) state that reinitiation of consultation is required if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion.

4. The Service lists new species or designates new or additional critical habitat, where the level or pattern of depletions covered under this opinion may have an adverse impact on the newly listed species or habitat. If the species or habitat may be adversely affected by depletions, the Service will reinitiate consultation on the biological opinion as required by its section 7 regulations.

If the Service reinitiates consultation, it will first provide information on the status of the species and recommendations for improving population numbers to the Recovery Program. Only if the Recovery Program does not implement recovery actions to improve the status of the species, will the Service reinitiate consultation with individual projects.

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RECLAMATION

Managing Water in the West

Operation of Flaming Gorge Dam Final Environmental Impact Statement Comments on the Draft Environmental Impact Statement and Responses

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

September 2005

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Front cover artwork courtesy of Arizona Game and Fish Department

Operation of Flaming Gorge Dam Final Environmental Impact Statement Comments on the Draft Environmental Impact Statement and Responses

U.S. Department of the Interior
Bureau of Reclamation
Upper Colorado Region
Salt Lake City, Utah

September 2005


bonytail
Colorado pikeminnow
humpback chub
razorback sucker

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Comments and Responses

INTRODUCTION

A Notice of Intent to prepare a draft environmental impact statement (EIS) on the operation of Flaming Gorge Dam and announcement of public scoping meetings was published in the *Federal Register* on June 6, 2000. A corresponding press release announcing that the Bureau of Reclamation was beginning the EIS process for Flaming Gorge Dam was issued the same date. In November 2001, a newsletter regarding the development of the EIS was sent to those on the EIS mailing list.

Input was actively solicited from a broad range of public constituencies as part of the ongoing public involvement process. Comments and involvement in the planning for and preparation of the Flaming Gorge EIS were generally sought through communication and consultation with a variety of Federal, State, and local agencies; Native American tribes and interest groups; and the formal EIS scoping process and EIS comment process, both of which invited input from the general public.

In June and July 2000, Reclamation, as lead agency, invited a number of State and Federal agencies and the Northern Ute Tribe to become cooperating agencies in preparing the Flaming Gorge EIS. The following are the eight cooperating agencies: the Bureau of Indian Affairs, Bureau of Land Management, National Park Service, State of Utah Department of Natural Resources, U.S. Fish and Wildlife Service, United States Department of Agriculture Forest Service (USDA Forest Service), Utah Associated Municipal Power Systems, and Western Area Power Administration (Western).

The draft EIS was mailed to the interested public for review and comment in early September 2004, and a Notice of Availability of the draft EIS was published in *the Federal Register* on September 10, 2004. The 60-day review and comment period for the draft EIS ended on November 15, 2004.

During the public comment period, five public hearings were held to receive oral comments on the draft EIS: Moab, Utah, October 12, 2004; Salt Lake City, Utah, October 13, 2004; Rock Springs, Wyoming, October 19, 2004; Dutch John, Utah, October 20, 2004; and Vernal, Utah, October 21, 2004. All written and oral comments received during the comment period were considered in preparing the final EIS.

The final EIS, like the draft EIS, has been mailed to over 600 agencies, organizations, and individuals on the mailing list and notice of its availability has been published in the *Federal Register*. It is also available on the Flaming Gorge EIS Web page.

All comments received on the draft EIS were carefully reviewed and considered in preparing the final EIS. Where appropriate, revisions were made to the document in response to specific comments. The comments and responses together with the final EIS will be considered in determining whether or not to implement the proposed action.

This volume contains a scanned copy of each comment letter, followed by the corresponding responses to that letter.

FEDERAL AGENCIES

1. **United States Environmental Protection Agency**
2. **U.S. Fish and Wildlife Service**
3. **National Park Service**
4. **Western Area Power Administration**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
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NOV 12 2004

Ref: 8EPR-N

Peter Crookston
Flaming Gorge EIS Manager
PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, UT 84606-7317

Re: Operation of Flaming Gorge Dam, Draft Environmental Impact Statement, CEQ# 040434

Dear Mr. Crookston:

The Environmental Protection Agency (EPA)-Region 8 has reviewed the Draft Environmental Impact Statement (DEIS) for the Operation of Flaming Gorge Dam. The EPA reviews DEIS documents in accordance with its responsibilities under the National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act. Section 309 of the Clean Air Act directs EPA to review and comment in writing on the environmental impacts of any major federal agency action. EPA's comments include rating the environmental impacts of the alternatives and the adequacy of information in NEPA documents.

The EPA supports the Purpose and Need and proposed management activities in the DEIS and its Action Alternative. The U.S. Bureau of Reclamation (Reclamation) is to incorporate management direction in operations of the Flaming Gorge Dam that affect peak flows, durations, water temperatures, and base flows. New operations criteria are recommended to conserve, protect, and promote the recovery of the populations and designated critical habitat for endangered fish species: bonytail, Colorado pikeminnow, humpback chub, and razorback sucker. Revised dam operations are designed to reduce or eliminate some adverse effects from dam operations and facilities in the Green River below Flaming Gorge Dam to the confluence with the Colorado River.

EPA notes that Reclamation consulted with the U.S. Fish and Wildlife Service to address concerns regarding the Action Alternative's compliance with the Endangered Species Act and Reclamation's Section 7 responsibilities to conserve and recover the listed fish species and other affected fish and wildlife such as the Southwestern Willow Flycatcher and Ute Ladies'-Tresses, and to resolve their Jeopardy Biological Opinion for the endangered fishes.

Based on the procedures EPA uses to evaluate the adequacy of the information and the
1a potential environmental impacts, the Action / Preferred Alternative will be rated "EC-2" (Environmental Concerns - Inadequate Information). A copy of EPA's rating criteria is enclosed. Our rating is based on management direction in the Preferred Alternative that has the potential to adversely affect other wildlife and their habitats and the uncertainties surrounding both the impacts of the proposed management actions and the adaptive management changes that may be

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necessitated in the future. The consideration of No Action and only one alternative – the Action Alternative -- is driven by the project purpose and the elimination of other alternatives from complete study. Other alternatives were not studied further, reportedly because of water consumption and diversions from the Green River and because of Reclamation's interpretation of the Colorado River Storage Project and other legislation that continues authorized dam purposes. Alternatives that were eliminated include Modified Run of the River and Removing Flaming Gorge Dam. EPA is concerned that only one alternative was fully considered to meet the Purpose and Need, not meeting CEQ's intent to assess all reasonable alternatives [CEQ's "40 Most Asked Questions" #1, 40 CFR 18026]. A limited range of alternatives disallows understanding the overall environmental, social, and other effects of other alternatives, particularly the Modified Run of the River, and does not fully satisfy NEPA requirements to fully analyze all reasonable alternatives [40 CFR 1502.14]. NEPA regulation 40 CFR 1514(c) requires that a lead agency, "Include reasonable alternatives not within the jurisdiction of the lead agency." While EPA accepts the unreasonableness of dam removal in this case, the Modified Run of the River alternative and perhaps additional alternatives that strengthen spring pulses and

1b lower summer flows could have been considered for "... sharply defining the issues and providing a clear choice among options by the decisionmaker and the public" [40 CFR 1514]. The EC-2 rating is based on the limited range of alternatives and the lack of information of their potential effects on the listed fish species and other fish and wildlife species.

We note that the Action Alternative appears to be the Environmentally Preferred Alternative between the two alternatives and we concur with Reclamation in its selection as the Preferred Alternative for the two alternatives considered.

Thank you again for the additional protections that are proposed for conservation and recovery of the endangered fishes and their critical habitats. Brad Crowder of my staff coordinated EPA's comments and can be reached at (303) 312-6396. If you wish to discuss our comments, please feel free to call me at (303) 312-6004 to arrange a meeting.

Sincerely,

Larry Svoboda, Director
NEPA Program
Office of Ecosystem Protection
and Remediation

Enclosure

2

U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements

Definitions and Follow-Up Action*

Environmental Impact of the Action

LO - - Lack of Objections: The Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC - - Environmental Concerns: The EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO - - Environmental Objections: The EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU - - Environmentally Unsatisfactory: The EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 - - Adequate: EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 - - Insufficient Information: The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 - - Inadequate: EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment February, 1987.

1. United States Environmental Protection Agency

1a
Comment noted.

1b
Reclamation acknowledges that a full range of reasonable alternatives is desirable. However, despite considerable effort to develop additional alternatives that meet the purpose and need of the environmental impact statement, additional viable action alternatives could not be identified. Please see section 2.2 of the EIS.

United States Department of the Interior
FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
2369 WEST ORTON CIRCLE, SUITE 50
WEST VALLEY CITY, UTAH 84119

In Reply Refer To
FW6/ES
04-1419

November 23, 2004

Memorandum

To: Mr. Peter Crookston, Flaming Gorge EIS Manager, PRO-774, Bureau of Reclamation, Provo Area Office, 302 East 1860 South, Provo, Utah 84606-7317

From: Field Supervisor, Fish and Wildlife Service, Ecological Services Field Office, West Valley City, Utah

Subject: Fish and Wildlife Service Comments on Operation of Flaming Gorge Dam Draft Environmental Impact Statement

The U.S. Fish and Wildlife Service (Service) has reviewed the Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS). We are providing the following comments to assist you in preparing a final Environmental Impact Statement.

General Comments:

We appreciate Reclamation's efforts to move forward toward implementing this important measure for recovery of the endangered Colorado River fish species. We also appreciate the close collaboration and communication during evaluation of effects and preparation of this document. Reclamation has done a very thorough analysis especially when one considers the broad spectrum of resource issues and the geographical scope of the proposed action.

We note that in addition to the benefits that re-operation will have on native endangered fish species, the Action Alternative action is expected to:

- allow Flaming Gorge Reservoir elevations to fluctuate less between seasons as well as generally be higher thereby benefiting kokanee egg incubation;
- allow for warmer releases immediately after spring releases which should allow for a quicker recovery of the aquatic food base and also increase species richness;
- provide a new base flow prescription which will benefit resident native fish by increasing stable backwater habitat, increasing the aquatic food base during summer and fall, and provide more stable overwintering habitat for young-of-year native fish in certain reaches of the Green River;
- increase water temperatures thereby benefiting native fish through an overall increase in productivity and increased growth rates;

- reduce the potential for hybridization between native sucker and nonnative white sucker with the proposed temperature recommendations;
- increase overwinter survival of trout by reducing flow fluctuations through the winter; and
- increase the amount of available spawning substrate for fall spawning trout by increasing summer and fall base flows during average to wet years.

2a The DEIS communicates some uncertainty as to how Reclamation will operate to meet Muth et al. 2000 and perhaps some question as to Reclamation's level of commitment to use of the spillway to meet the same. That said, we do agree with the basic premise that the true test of these recommendations will be over the long term, which we feel is consistent with both the structure and intent of Muth et al. 2000. The Service will work closely with Reclamation and other stakeholders in the implementation of these flow and temperature recommendations.

2b Reclamation's proposal to implement Muth et al. 2000 with an adaptive management approach presents a logical mechanism to deal with the uncertainties associated with the Action Alternative. The Service looks forward to working with Reclamation, the Recovery Program and others to see this through. Throughout the text Reclamation repeatedly references the Recovery Program to serve as the science body and the funding mechanism to address many of the uncertainties dealing with the fish community. We assume there has been communication throughout the development of the document between Reclamation and the Recovery Program Directors office and some reference to those conversations seems appropriate. Such a reference would serve to support the Environmental Commitments made near the end of the DEIS.

2c We appreciate Reclamation's commitment to document the implementation process in an administrative record and we feel that that document will serve a critical role in the Service's long term evaluation of the proposed action from a Section 7 (ESA) perspective. As the Recovery Program has been identified to serve as the science body in charge of the adaptive management process as it relates to the fish community, the administrative record should be made available to them on an annual basis. We suggest that Reclamation make the administrative record available to the Recovery Program consistent with the Recovery Program's Annual Reporting cycle. More specifically we request that the administrative record include:

1. A summary of the river basin forecasting that was used in deciding the appropriate pre-runoff hydrologic category.
2. A summary of other criteria (Yampa River hydrology, reservoir elevation, other authorized purposes, past operations, etc.) used in the development of the annual spring runoff / baseflow operations plan including the ultimate spring and baseflow targets.
3. An accounting of reservoir operations (flow and temperature).
4. The administrative record should be a living document updated each year while maintaining an historical accounting of past operations (all years post-Record of Decision).

2

Specific Comments:

2d Page 28, 2.5.1. Safe Operations of Flaming Gorge Dam. Please provide more basis for operating to assure that 99% of the foreseeable forecast errors are successfully routed through Flaming Gorge Dam in the future. Is this how the reservoir has been operated in the past? How does this compare with other Reclamation or ACOE facilities? Please consider the relative capacity of the outlet works at Flaming Gorge and other facilities in this discussion.

2e Page 43, 2.6.6.2. The document states that "under the Action Alternative, Ute ladies'-tresses could be lost in Reach 1". This is a more extreme conclusion than in the Biological Assessment. We recommend that you review all sections in the DEIS and the BA for consistency in prediction and explanation of potential effects.

2f Page 157, 4.7.1.2. Aquatic Food Base - This section states for both the No Action and Action Alternatives that the proposed action will not affect the aquatic food base in the reservoir. While this may indeed be the case, the document should include at least a brief rationale for this determination.

2g Page 157, 4.7.1.4. Terrestrial and Avian Animals – As mentioned above, the document should include at least a brief rationale for the determination that neither the Action nor the No Action alternative will affect land-based animals or birds.

2h Page 188, 4.7.8.6.3. Mexican Spotted Owl – A rationale for your "no effect" determination for Mexican spotted owl should be included here. You have included a rationale for other Federally listed species.

2i Page 243, 4.19.5. Please consider the comments of the Recovery Program' biology committee and other interested parties to Western's presentation of a Floodplain White Paper, which served as the basis for this section in the DEIS. Based on that discussion and subsequent follow-up commentary it is the Service's opinion that this uncertainty has been given a disproportionate amount of attention in the DEIS. We assume that the Recovery Program is comfortable with the
2j Environmental Commitments they have been tasked with (bulleted items pg 247), and some reference to the Recovery Program's acknowledgment seems appropriate.

Page 246. The discussion on this page implies that floodplain inundation is the only or primary
2k purpose of the high flows and their duration. Perhaps it should be pointed out here that sediment movement and deposition and vegetation establishment and maintenance are also part of the purpose of high flows.

Page 247, 4.19.6. We recommend that Reclamation include an environmental commitment to
2l address riparian/vegetation uncertainties through a monitoring and study program. This section describes several important topics for study.

3

Sections 4.20 Addressing Uncertainties through Adaptive Management

We recommend that this section include a discussion recognizing the opportunity to monitor
2m riparian vegetation and geomorphology as part of the adaptive management process, particularly as they may affect Ute ladies'-tresses, with a focus on Reach 1. Reclamation has already been gathering baseline information. The Action Alternative provides an excellent opportunity to gain a better understanding of the interdependence of flow regime, fluvial land forms, and riparian vegetation. A monitoring program designed to learn from the Action Alternative flows will provide a venue for recommending and evaluating flow adaptations that achieve vegetation as well as native fish recovery goals. Additionally, this will allow proactive management for Ute ladies'-tresses conservation and invasive plant species control.

Section 4.21. As per our comments above, we recommend that the following be added to Section 4.21 as Environmental Commitments:

- Reclamation, in coordination with the Fish and Wildlife Service, National Park Service,
2n and other knowledgeable scientists, will continue to monitor riparian vegetation and geomorphology to gain a better understanding of the interdependence of flow regime, fluvial land forms, and riparian vegetation. A monitoring program designed to learn from the Action Alternative flows will provide a venue for recommending and evaluating flow adaptations that achieve vegetation as well as native fish recovery goals.

- Reclamation, in coordination with the Fish and Wildlife Service, National Park Service,
2o and other knowledgeable scientists, will develop and implement a monitoring plan for Ute ladies'-tresses populations for determination of possible effects from the Action Alternative. This monitoring plan would be designed to assist understanding of Ute ladies'-tresses establishment, response to habitat change (including hydrologic, geomorphic, and vegetation change) and management of habitat. If monitoring or research indicates that conservation measures are necessary or desirable, Reclamation will pledge support and work with other interested parties to ensure their implementation. Recommendations for releases to assist riparian vegetation health and Ute ladies'-tresses conservation will be forwarded to the Flaming Gorge Working Group for consideration.

If you need further discussion or information, please contact Larry Crist, Assistant Field Supervisor, or Lucy Jordan, Fish and Wildlife Biologist, at the letterhead address of (801) 975-3330 ext. 126 or 143 respectively, or email: larry_crist@fws.gov, or lucy_jordan@fws.gov.

L. Crist

2. U.S. Fish and Wildlife Service

2a
The *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam* (2000 Flow and Temperature Recommendations) acknowledge variability, risk, and uncertainty regarding the flow recommendations. Reclamation seeks to meet all of the requirements placed upon the reservoir and dam and seeks to balance the benefits among all authorized purposes of the facility.

Under the Action Alternative, the frequency of spillway use could increase to about 15 days per year in 7 percent (%) of all years. Spillway use of 1 to 10 days is expected in nearly 17 % of all years. With increased spillway use, there is greater opportunity for degradation of concrete in the spillway tunnel. Should damage to the spillway become excessive, repairs would be made or use of the spillway would be limited to when hydrologically necessary.

More frequent use of the spillway also raises the concern of more frequent entrainment of nonnative reservoir fishes. Reclamation does not intend to use the spillway unless releases need to exceed 8,600 cubic feet per second (cfs) (unless use of the spillway is required for dam safety reasons).

As stated in section 2.5.3.2, second paragraph, Reclamation would annually coordinate the decision whether to use the bypass tubes or spillway to meet particular flow targets. That same section, and other sections in the EIS, note uncertainties associated with use of the spillway that will have to be monitored and addressed through adaptive management.

2b
Additional text was added to section 1.4.4 of the EIS.

2c
Comment incorporated in section 2.3.2 and 2.5.3 in the EIS.

2d
Flood routing studies are performed for all Reclamation reservoirs. The level of acceptable risk, i.e., forecast error exceedance percentage, will vary at each facility depending on engineering considerations of the structure and downstream populations at risk. Such a determination is based on engineering judgment. Safe operation of Flaming Gorge Dam provides enough storage buffer in the reservoir to maintain a release hydrograph that includes full capacity powerplant and bypass releases as well as spillway use when an unexpected error in the forecast occurs. Since the high inflow seasons of 1983 and 1984, operation of Flaming Gorge Dam has moved to a more conservative operation. Spillway releases of high volume are a dam safety risk that Reclamation is not willing to accept on a frequent basis. That is, an acceptable risk would be spillway releases of high volume approximately once every 100 years.

Reclamation is unaware of available forecast error exceedance data to make comparisons with other Reclamation or U.S. Army Corps of Engineers facilities.

2e
Section 2.6.6.2 is a brief summary of effects to all threatened and endangered species. In this section it is necessary to state the facts succinctly which may give the impression of being a more extreme position than in the lengthy description appropriate for the biological

assessment and chapter 4 of the EIS. See section 4.7.8.2 for details of effects to Ute ladies'-tresses.

2f
Text in sections 4.7.1.2.1 and 4.7.1.2.2 of the EIS has been clarified.

2g
This section of the EIS was written to disclose environmental consequences of the No Action and Action Alternatives affecting terrestrial and avian animals existing on or near Flaming Gorge Reservoir. Text has been added to section 4.7.1.4 to clarify and support the conclusion.

2h
This section of the EIS was written to disclose environmental consequences of the No Action and Action Alternatives affecting threatened or endangered species existing within the area affected by the project. The ability of these owls to reach and exploit water or water related food or habitats would not be hampered under either alternative. Text has been added to section 4.7.8.6.3 to clarify and support the conclusion.

2i
The text has been clarified in section 4.19.5.

2j
The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) has concurred with the following language in the environmental commitments in the EIS and conservation measures in the Flaming Gorge Biological Opinion: "The adaptive management process would rely on ongoing or added Recovery Program activities for monitoring and studies to test the outcomes of modifying the flows and release temperatures from Flaming Gorge Dam."

2k
Discussion in the EIS has been clarified in section 4.19.5.

2l–2n
Effects to riparian vegetation will, at a minimum, result in no measurable change from the No Action Alternative or will result in a positive response. Therefore, Reclamation does not believe that effects to vegetation, other than those specifically identified, warrant an environmental commitment in this National Environmental Policy Act (NEPA) document. We have funded numerous studies addressing the relationship of river regulation and riparian ecosystems, and we will likely continue studies that overlap with the effects of the proposed action.

2o
Reclamation has added language to section 4.21 which clarifies Reclamation's commitment to monitor for potential effects to Ute ladies'-tresses.

United States Department of the Interior

NATIONAL PARK SERVICE
INTERMOUNTAIN REGION
12795 West Alameda Parkway
PO Box 25287
Denver, Colorado 80225-0287

NOV 15 2004

Memorandum

N1621(IMR-RSR)

To: Flaming Gorge Environmental Impact Statement Manager, PRO-774
U.S. Bureau of Reclamation, Provo Area Office

From: Director, Intermountain Region
National Park Service, Intermountain Region

Subject: National Park Service Comments on *Operation of Flaming Gorge Dam Draft Environmental Impact Statement*

We are writing to provide you with National Park Service (NPS) comments on the *Operation of Flaming Gorge Dam Draft Environmental Impact Statement* (DEIS). As you know the NPS is a member of the Upper Colorado River Endangered Fishes Recovery Program (Recovery Program) and has been a cooperating agency throughout the development of the DEIS. We strongly support the re-operation of Flaming Gorge Dam to assist in the recovery of the Colorado pikeminnow, razorback sucker, humpback chub and bonytail and we believe that the Action Alternative has the potential to achieve this purpose if implemented correctly. In addition, we wish to express our appreciation for the professional relationship we have been able to establish with Bureau of Reclamation staff in working to address the potential effects of re-operation on the diverse river-dependent resources that are managed by NPS.

NPS staff from the Intermountain Region, Dinosaur National Monument and the Water Resources Division submitted extensive comments on the administrative draft of the EIS released in December 2003. While the current draft of the EIS is greatly improved and some of our suggestions have been incorporated, some of our comments on the earlier draft have not been specifically addressed. We have included our continuing comments of priority
3a concern from that administrative draft in this comment memorandum. We believe that addressing these comments is important to ensure that re-operation of Flaming Gorge Dam occurs in a manner that maximizes the benefits to the endangered fishes while providing adequate protection for river dependent resources in Dinosaur National Monument and Canyonlands National Park. For your convenience we are including our earlier comments as an attachment to this letter. It is our hope that we can continue to work with you so these

1

comments can be addressed in the future through the adaptive management process and that the flow recommendations as described in the Action Alternative can be implemented as soon as possible.

We are including additional recommendations that are of particular importance to the NPS and which we believe can be addressed with minimal effort. These recommendations constitute the remainder of this letter:

1. Colorado River Basin Project Act of 1968

3b

   a. We applaud the recognition of the Colorado River Basin Project Act of 1968 (Act) as one of the laws governing the operation of Flaming Gorge Dam as well as the recognition that "*improving conditions for fish and wildlife*" is among the purposes authorized by the Act. We look forward to working with BOR in implementing the Action Alternative in a manner that benefits native, non-endangered fish and wildlife species while contributing to recovery of the 4 endangered fishes.

3c

   b. We are generally pleased with the language describing the technical working group (TWG) and recognize that the US Fish and Wildlife Service and BOR have ESA responsibilities that necessitate their participation as team members. However, we question the rationale for identifying the Western Area Power Authority (Western), alone among the other interested agencies and organizations, as a member of the TWG. This suggests that Western has a special status and that power generation has priority over other authorized purposes. In fact, as noted in the DEIS, both the Colorado River Storage Project Act and the Colorado River Basin Project Act indicate that power generation is to occur "as an incident of other authorized purposes".
   We propose this issue be addressed in one of the following ways:
      i. *Eliminate the specific reference to Western as a member of the TWG.*
      ii. *List the other agencies and organizations that are potential participants in the TWG as well as Western.*
      iii. *Provide the rationale for identifying Western alone among the interested agencies and organizations as a TWG member.*

2. Floodplain uncertainties:

3d

We are concerned about the addition of section 4.19.5 which addresses floodplain uncertainties. This section suggests a possible future change to certain specific flow recommendations. The suggested change is touted as beneficial to razorback sucker in Reach 2. The section also lists a number of uncertainties about floodplain inundation, razorback sucker larval entrainment, and timing and duration of peak flows that need to be resolved through scientific study. We support scientific study to resolve these uncertainties; however, the evidence that this change would provide greater benefits to razorback sucker than the existing flow recommendations should be definitive before that change is adopted. We also point out that the suggested change would reduce the frequency of meeting the flow targets in Reach 1.We suggest some additional language for the section 4.19.5:

2

3e a. We have had verbal assurance from the authors of this section that instantaneous peak flow targets would still be met under the suggested revisions but this is not clear from the text. *Specify that instantaneous peak flow targets will still be met if further study indicates peak flow durations might be revised.*

3f b. The premise behind the flow and temperature recommendations (FTRs) is that inter- and intra-annual variability are key to restoration of the river ecosystem as recognized in the DEIS on pg 241: 'The recommendations are based on a model that the ecological integrity of river ecosystems is linked to their dynamic character (Stanford et al. 1996, Poff 1997) and that restoring a more natural flow and thermal regimes is a key element in rehabilitating an impaired river ecosystem. The evidence that razorback sucker would benefit more from the suggested tradeoff in magnitude and duration of flows above 13,000 or 18,600 than from the overall rehabilitation of an impaired system should be definitive before the flow recommendations are changed. *This should be explicit in the "uncertainties" section.*

3g c. The floodplain white paper from which this section was adapted (Hayse et al. 2004 *draft*) has been revised to reflect the inaccurate assumption in the Valdez floodplain model that razorback sucker larvae are not likely to be available for entrainment at distances greater than 52 miles, due to attenuation in numbers of larvae as they drift downstream. This inaccuracy was identified by two peer reviewers who cited works showing CPE of larvae near the additional floodplain area more than 52 miles downstream is not negligible, but in fact is between 50% and 100% of CPE near Jensen. In addition, the only floodplain area where wild razorback sucker larvae have been shown to be successfully entrained and survived was in Old Charlie Wash, located 60 miles below the spawning bar (Modde and Bestgen comments on the floodplain whitepaper, and citations therein). *The "uncertainties" section should be updated to reflect this information.*

3h d. This section suggests that the main benefit of this change would be to razorback sucker, while the corollary benefit would be to power production. We submit that the certain benefit of this suggested change is to power production, while the corollary benefit <u>might</u> be to the endangered fish, in ways that we don't fully understand. *This should be explicit in the "uncertainties" section.*

3. The importance of control, management and monitoring of the invasive species Tamarisk, and the links to endangered fish habitat and ecosystem health.

3i a. Tamarisk is classified as an invasive species and is regulated under **Executive Order 13112, February 3, 1999--Invasive Species** (published in the Federal Register/Vol. 64, No. 25, pp. 6183-6186.) The executive order clearly articulates responsibilities of federal agencies, including the Department of the Interior. Among these responsibilities are control, management, and monitoring of invasive species. *The EIS should provide for these responsibilities, or at a minimum contain references to the Executive Order, and to monitoring, control and management activities if defined elsewhere.*

b. In addition to federal responsibilities for managing invasive species, tamarisk is widely recognized as contributing to the degradation of riverine ecosystems and thus may directly or indirectly affect endangered fish habitat. In Dinosaur NM it has contributed to channel narrowing in the Green River, and is advancing upstream into the Yampa River from the confluence towards one of the two known Colorado pikeminnow spawning sites in the Green River system. The spread of tamarisk could directly or indirectly affect fish habitat by altering channel morphology. Direct effects include burying cobble bars used for spawning by native fish under sediment and vegetation; indirect effects may include changes in the quantity and diversity of the aquatic food base due to channel narrowing and simplification. The links between tamarisk invasion and riverine fish habitat are not completely understood; however, a species which contributes to the degradation of riverine ecosystems is likely to contribute to the degradation of fish habitat. The DEIS recognizes in the uncertainties section that the action alternative may increase the spread of the invasive species tamarisk. *This uncertainty coupled with federal*
3j *responsibilities to control invasive species strongly suggest the Environmental Commitments section should include a monitoring plan for tamarisk, and commitments to work with the NPS and other interested parties to control this invasive species.*

4. Uncertainties about nonnative fish.

The DEIS recognizes that the increased risk of entrainment at the Reservoir spillway and elevated temperatures of releases, could lead to the proliferation of nonnative species in Reach 1, particularly smallmouth bass. Smallmouth bass numbers are increasing in the Green River upstream from the Yampa River confluence, particularly in recent years, presumably in response to the drought and concomitant warm temperatures. While we believe that the implemented FTRs will be beneficial overall to the endangered fishes, we also believe that the potential negative effects, including enhancement of smallmouth bass populations should be carefully monitored, and control in Reach 1 implemented if necessary. *A commitment to*
3k *monitoring and control, if it is determined to be necessary, should be added to Environmental commitment #3, which deals with operating the selective withdrawal structure.*

5. Determining how target flows are met

The DEIS states that target flows will be delivered on average, and that target flows
3l "will be provided over the long run." Over what period of time will it be determined that flow target are being met? In particular, for targets that are specified for 1 of 2 average years, or 1 of 4 average years, how long is the long run? If the duration peak flow targets are not met for 3 average years running, must they be met in the 4th average year? *Please clarify this in the text.*

6. Ability to meet flow recommendations:

The DEIS suggests that it may become more difficult to meet the FTRs as depletions on Green River tributaries increase over time (4.19.1, paragraph 3). While we recognize relationship between tributary and mainstem flow, it is our understanding as a long time supporter of the Recovery Program that the re-operation of Flaming Gorge Dam is the reasonable and prudent alternative (RPA) for tributary depletions. Thus, in our view, it is the responsibility of BOR to ensure that the flow recommendations are met regardless of these depletions. We note that compensating

3m for reduced tributary inflow may entail greater impacts to the other authorized purpose of the projects; however, we believe that failure to do so would impede efforts to recover the threatened endangered fishes and, in all likelihood trigger the re-initiation of consultation on a number of projects and facilities.

Please call the NPS point of contact for the DEIS, John Wullschleger, at (970) 225-3572 if you have any questions. We look forward to the finalization of this environmental impact statement.

Stephen P. Martin

Attachments

cc:
Regional Director, U.S. Bureau of Reclamation, Upper Colorado Office w/c attachments
Area Manager, U.S. Bureau of Reclamation, Provo Area Office w/c attachments
Program Director, Upper Colorado River Endangered Fish Recovery Program w/c attachments
Superintendents, Colorado River Basin Parks w/c attachments
Chief, NPS-NRPC-WRD w/c attachments

Memorandum: NPS to U.S. BOR Subject: National Park Service Comments on *Operation of Flaming Gorge Dam Draft Environmental Impact Statement*

Attachment:

List of Citations

Bestgen, K. R. 2004. Comments to authors on Floodplain white paper by Hayse et al.

Hayse, J.W., K.E. LaGory, and G.L. Burton. 2004. Consideration of site specific floodplain inundation thresholds in Implementing Peak Flow Magnitude and Duration Recommendations in the Middle Green River, Utah. Draft Report to Western Area Power Administration. Argonne National Laboratory, Argonne, Ill.

Modde, T. 2004. Comments to authors on Floodplain white paper by Hayse et al.

Poff, N. L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegaard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The Natural Flow Regime: A Paradigm for River Conservation and Restoration in *BioScience*, vol 47. pp. 769-784.

Stanford, J.A., J.V.Ward, W.J. Liss, C.A. Frissell, R.N. Williams, J.A. Lichatowich, and C.C. Coutant, 1996. A General Protocol for Restoration of Regulated Rivers in *Regulated Rivers: Research & Management*, vol. 12, pp. 391-414.

Valdez, R.A. 2003. Floodplain model to estimate Nursery Habitat to Recover Razorback Sucker. Excel model for Upper Colorado River Basin Endangered Fish Recovery Program.

3. National Park Service

3a
The comments and responses submitted during the cooperating agency review of the draft EIS are available upon request.

3b
Comment noted.

3c
Reclamation and Western are Endangered Species Act (ESA) co-consultants with the U.S. Fish and Wildlife Service for Section 7 consultations. Thus, all three parties are appropriately identified as members of the Technical Working Group. As stated in section 2.5.3 of the EIS, the technical working group will be open to all qualified individuals who choose to participate.

3d
The 2000 Flow and Temperature Recommendations report anticipates adaptive management testing of flow regimes. It is expected that over time, refinements to the targets will be possible based on increased information and knowledge. Text has been added to section 4.19 in the EIS for clarification.

3e–3h
The EIS states Reclamation's intent to implement all of the 2000 Flow and Temperature Recommendations as described in the Action Alternative. Section 4.19 explains the uncertainties associated with implementing the Action Alternative, including in section 4.19.5 those uncertainties associated with flood plain inundation. Both the EIS and the 2000 Flow and Temperature Recommendations acknowledge that over time, as additional information becomes available, refinements to the flow and temperature recommendations may prove to be warranted if data suggests that tradeoffs between peak flow magnitude and duration provide greater benefits to endangered fish. Reclamation believes that if such refinements are proposed at some as yet unknown point in the future, based upon information developed through adaptive management or through ongoing Recovery Program research, there will be ample opportunity to obtain appropriate review and input from all Recovery Program participants as well as the interested public. The text has been clarified in section 4.19.5.

3i–3j
Our analysis in the EIS, based on best available information, is that the predicted effects of the Action Alternative on tamarisk do not reach the level of significance such that a program of monitoring and mitigation is warranted. See sections 4.7.5 and 4.19.6 of the EIS where this is discussed.

3k
The EIS states that Reclamation will rely on Recovery Program nonnative monitoring and control efforts. See fish response to flow and temperature modifications in section 4.19.4 of the EIS.

3l
It is difficult to isolate a specific number of years to evaluate the percentage of targets and durations achieved because it is unknown what the natural hydrograph will be in the future. Over the long run when several different natural hydrological years have occurred, Reclamation expects to be able to determine if the percentages are in line with the 2000 Flow and Temperature Recommendations. The target flows and durations to be achieved each year are dependent on the natural hydrograph of that year and the hydrological classification of that year. For example, if, as has just occurred, there are 6 consecutive drought years, then only low targets and durations would be

achieved. In very wet years, high targets with long durations would be achieved.

3m

Implementation of reasonable and prudent alternatives (RPAs) is Reclamation's responsibility as part of the Section 7(a)(2) Endangered Species Act consultation process with the U.S. Fish and Wildlife Service; but it should be noted that ESA compliance, like compliance with other statutes and regulations, is part of the Federal regulatory construct under which Reclamation operates Flaming Gorge Dam. Reclamation is committed to upholding its responsibilities under the ESA, as well as meeting authorized project purposes.

From: "Heather Patno" <PATNO@wapa.gov>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 4:44 PM
Subject: FG EIS, WAPA Comments

Dear Mr. Crookston,

Western appreciates Reclamation's efforts to incorporate its comments
as a cooperating agency. Many of Western's concerns have previously
been addressed. However, some comments previously addressed remain
outstanding issues for Western.

The first of these comments deals with the Cumulative Impacts section.
4a Western's concerns were initially addressed in an email dated
7/17/2004. The Cumulative Impacts section needs to be prominently
treated within the EIS. Without more prominent treatment of Cumulative
Impacts in the EIS, the public and the decision maker could easily
conclude that the change to the Proposed Action would have an
insignificant impact to power without a full understanding of the fact
that operational constraints, over time, have caused a significant
reduction to the power value of Flaming Gorge Dam. It is suggested that
the Cumulative Impacts section for hydropower be moved as a subsection
to Section 4.4 Hydropower Generation and additional background regarding
the historical (pre 1992) changes in operation be inserted. While some
background information is available, it does not adequately address in a
clear and understandable manner the importance of the cumulative
impacts.

Additionally, regardless of the location of the Cumulative Impacts
section, the language used in this section is unclear. The insistence
on using the words "economic value" leaves the reader with a feeling
4b that Flaming Gorge Dam operational constraints have increased the value
of water flowing through the dam. More detailed discussion is needed to
make sure the public and the decision maker understand the overall
negative impact continued restrictions on operations at Flaming Gorge
Dam have caused. In addressing these concerns, Table 4-30 on page 232
also needs to show the negative impact. The percentage underneath the
4c column entitled "Comparison of Cumulative Impacts to No Action
Alternative" needs to be a negative to better show the appropriate
impacts to hydropower.

The second unaddressed comment deals with correlating the economic and
financial analyses. Section 4.4.3 the Financial Analysis of Power
Generation discusses Western's role in marketing electrical power from
the CRSP units. It does not correlate the economic analysis of changes
to operational constraints in this specific instance to the financial
analysis of distributing those changes to various customers. A few
4d sentences need to be inserted discussing the fact that the economic
analysis is correlated to the financial analysis through distribution to
Western's customers. In this instance, the correlation between
economic and financial analysis is clear, concise and straightforward
and deserves some discussion at the end of the economic analysis section
or beginning of the financial analysis section.

Regards,
S. Clayton Palmer

4. WESTERN AREA POWER ADMINISTRATION

4a
The Flaming Gorge EIS compares the Action Alternative with the No Action Alternative and captures the existing environment as including changes due to the construction of the dam as well as its operations prior to 1992. Changes and effects resulting from the construction of the dam and its pre-1992 operations are appropriately considered in section 4.16.2 (cumulative effects analysis) of the EIS. The placement of the cumulative effects analysis, and the overall format of the EIS, are consistent with the Council of Environmental Quality (CEQ) and Department of the Interior (Interior) regulations implementing NEPA.

4b
The term "economic value" refers to the level of monetary worth and does not have any implied meaning of direction of change. The discussion of economic value given no biological constraints is labeled as such. The economic value for the simulation with no biological constraints is greater than the economic value for the No Action and Action Alternatives. Clarifying text was added to section 4.16.2 of the EIS.

4c
Comment incorporated into table 4-30 of the EIS.

4d
Section 4.4.3.3 presents the financial analysis results. Because the Action Alternative would not have a significant impact on the rate Colorado River Storage Project (CRSP) customers pay, it was not necessary to distribute the impact of the change in rate to the various customers.

Text was added to section 4.16.2 of the EIS to clarify.

State Agencies

1. **State of Colorado, Department of Natural Resources**
2. **Utah Associated Municipal Power Systems**
3. **State of Utah, Governor's Office of Planning and Budget**
4. **State of Utah, Office of the Attorney General**
5. **Utah State University Extension**
6. **Wyoming Game and Fish Department**
7. **Wyoming State Engineer's Office**
8. **Wyoming State Geological Survey**

STATE OF COLORADO

OFFICE OF THE EXECUTIVE DIRECTOR

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Denver, Colorado 80203
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DEPARTMENT OF NATURAL RESOURCES

Bill Owens
Governor

Russell George
Executive Director

November 19, 2004

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, UT 84606-7317

Re: State of Colorado comments on Flaming Gorge EIS

Dear Mr. Crookston:

Attached please find Colorado's comments regarding the Flaming Gorge EIS, prepared by Randy Seaholm from the Colorado Water Conservation Board staff.

I hope you find these comments constructive to your preparation of a Record of Decision and a Final EIS.

Sincerely,

Tom Blickensderfer

Tom Blickensderfer
Endangered Species Program Director
Colorado Representative – Upper Colorado Endangered Fish Recovery Management Committee

Board of Land Commissioners • Division of Minerals & Geology/Geological Survey
Oil & Gas Conservation Commission • Colorado State Parks • Division of Forestry
Water Conservation Board • Division of Water Resources • Division of Wildlife

Operation of Flaming Gorge Dam
Draft Environmental Impact Statement
August 2004

Comments of the Colorado Water Conservation Board
November 15, 2004

The Colorado Water Conservation Board recognizes that the operations of Flaming Gorge Dam and Reservoir have little impact on water use and development in the State of Colorado, expect to the extent that re-operation of the dam in attempts to meet flow recommendations for the Colorado River Endangered Fish is an important component of the Upper Colorado River Recovery Implementation Program. Therefore, our review of the DEIS concerning Flaming Gorge re-operations has been limited to the executive summary and few key sections dealing with authorized project purposes and the overall portrayal of the Recovery Program.

1a Flaming Gorge Dam and Reservoir are part of the Colorado River Storage Project and as such the portrayal of the authorized purposes of Flaming Gorge are important. Colorado strongly objects to the manner in which the authorized purposes of Flaming Gorge are portrayed in Section 3.1.1 of the Executive Summary and in Section 1.4.1.1 of the DEIS. Specifically, we request that the references to the 1968 Colorado River Basin Project Act and the Coordinated Long Range Operating Criteria be deleted from section 1.4.1.1 of the report as they are a gross misrepresentation of the affect that the 1968 Act and the Long Range Operating Criteria have on the Colorado River Storage Project. While the quote from the 1968 Act is accurate, the interpretation that this section of the 1968 Act modifies the express purposes of the 1956 Colorado River Storage Project Act and is incorrect and in direct conflict with the general provisions contained in Title VI of the 1968 Colorado River Basin Project Act that prohibit such an interpretation. Furthermore, the referenced language from the Coordinated Long Range Operating Criteria deals with information that is to be reported in the annual report on reservoir operations and has absolutely nothing to do whatsoever with the purposes or manner in which the reservoirs are to be operated. The correct portrayal of authorized project purposes is extremely important to Colorado and to all the CRSP facilities that will be re-operated in attempts to meet flow recommendations adopted by the U.S. Fish and Wildlife Service and the Upper Colorado River Recovery Implementation Program.

1b Secondly, the purpose and need statement fairly captures the intent of the DEIS which is to protect and assist in the recovery of endangered fish and designated critical habitat while maintaining the authorized purposes of the Flaming Gorge Unit of CRSP, particularly those related to water development in accord with the Colorado River Compact. This same language should be reiterated in Section S.10.2.1 by adding a phrase, "while allowing existing water uses and future water development to continue in accord with the 'Law of the River.'" It is important to reiterate this balance here and throughout the DEIS.

1c Third, we support the language that is contained in the last paragraph of the Introduction to Section S.5.

1d Fourth, the proposed operations and environmental commitments appear to be consistent with those that have been proposed and refined over the last few years, at least as we understand them. However, we are very concerned that the revised operations are described as "achieving the flow recommendations." The flow recommendations are based on the best available information at the time of there development. Flow recommendations may be revised through the adaptive

management process and thus language indicating that flexibility should be included in the DEIS and reservoir operations allowed to adjust accordingly. The current language in the DEIS seems to stringent in this regard and should be modified when the flow recommendations are discussed in Section S.5.3 and in the discussion of alternatives in Section S.11. Flow recommendations do
1e not establish a separate priority system for water development and this was expressly acknowledged in the program documents and such should not be forgotten.

Fifth, Section S.13.3.2 discusses the use of the Flaming Gorge bypass tubes and spillways. In
1f general it was our understanding that such would be used when needed for the safe operation of Flaming Gorge Dam, which is consistent with the CRSPA. The discussion here states that such can be used when needed to meet the flow recommendations even if dam safety is not a concern. This seems inconsistent with the CRSPA and at the very least requires further explanation as to the justification for such. It would seem appropriate to indicate that all costs associated with use of the bypass tubes and spillways for other than emergency purposes be considered non-
1g reimbursable costs in accord with Section 8 of CRSPA.

Finally, Colorado continues to be supportive of the adaptive management approach to flow recommendations and the refinement of flow-habitat relationships such that the maximum amount of habitat that is the most beneficial to the endangered fish species overall is created with the least amount of water. This is alluded to Section S.16 concerning uncertainties and Section 17 concerning how to address uncertainties through adaptive management. We would urge that Section S.16 include uncertainties associated with respect to the flow recommendations and that
1h Section S.17 at the very least provide for the opportunity to revise flow recommendations as scientific information indicates may be appropriate.

1. State of Colorado, Department of Natural Resources, Colorado Water Conservation Board

1a
The referenced sections provide appropriate background information for the reader. Reclamation is committed to upholding its responsibilities under the ESA as well as meeting authorized purposes.

1b
Reclamation agrees; the appropriate clarification was made in S.10.2.1 of the Executive Summary.

1c
Comment noted;

1d
The proposed action under consideration is meeting the 2000 Flow and Temperature Recommendations while maintaining all authorized purposes of the dam. These flow and temperature recommendations have derived from the 1992 Biological Opinion for Flaming Gorge. The EIS acknowledges the flexibilities and uncertainties of implementing the 2000 Flow and Temperature Recommendations; and if better information is available for this purpose, Reclamation will utilize it in an adaptive management approach to making operational decisions.

1e
Comment noted; see responses to 1a-c above.

1f
Reclamation will not bypass water in a way that would violate the primary purposes of CRSP.

1g
Reclamation agrees that incremental O&M costs should be non-reimbursable.

1h
The Executive Summary was not meant to be an all inclusive document but rather is intended to summarize the full EIS. Please see sections 4.19 and 4.20 of the EIS for full discussions of these issues.

UAMPS

UTAH ASSOCIATED MUNICIPAL POWER SYSTEMS

2825 E. Cottonwood Parkway
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Salt Lake City, Utah 84121-7077
Phone: 801-566-3938
Toll Free: 800-872-5961
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November 9, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager, PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

RE: Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS)

Dear Mr. Crookston:

Utah Associated Municipal Power Systems (UAMPS) represents 38 municipal electric utilities, electric service districts and water conservancy districts that purchase and distribute power generated from the Colorado River Storage Project (CRSP). CRSP power represents a critical portion of our member's power resources and our members have a great interest in proposed changes in Flaming Gorge operations.

UAMPS has closely followed and participated in the development of the DEIS and has had the opportunity to be designated as one of the cooperating agencies. We are grateful for that opportunity.

As a member of the Colorado River Energy Distributors Association (CREDA), UAMPS fully supports oral and written comments made by CREDA in this process. In addition to comments submitted by CREDA, UAMPS wishes to emphasize the following points:

Flaming Gorge is a significant component of the CRSP power relied by not only our members but also power consumers in Wyoming, Utah, Colorado, New Mexico Arizona and Nevada. Any changes to Flaming Gorge operations will have an impact on all CRSP power contractors within those states.

2a The final EIS must consider all operational and financial impacts of all alternatives. As seen from actual operation of the interim criteria, loss of any component of Flaming Gorge resource will be replaced from other sources. These replacements must not only be evaluated in terms of financial impacts to the CRSP system but also in terms of spinning reserve requirements and transmission system capacity affecting all contractors and power customers.

2b Replacement power purchases resulting from the Action Alternative will have a significant financial impact on the Upper Basin Development Fund which as been depleted in recent years due to the ongoing drought and increased operation and maintenance costs resulting from funding of environmental programs. This Basin Fund is the source of funding for the Upper Basin Recovery and Implementation Program (RIP) and other ongoing endangered species mitigation programs in the Colorado River Basin. Increased costs from replacement power resulting from operational changes at Flaming Gorge not only affects rates of CRSP power customers but weakens the integrity of all endangered species programs funded by the Basin Fund.

2c UAMPS agrees with other comments made in this process that the base economic evaluation must cover the period from 1974 when the interim operating criteria were initiated and subsequently modified in 1985 and 1992. These were significant changes that have not yet been included in any other NEPA compliance process. The final EIS must include the impact of operational changes since 1974.

2d UAMPS further suggests the final EIS include additional alternatives relating only to flow changes recommended by the biological opinion for endangered fish at the Jensen gauge. These alternatives include those being developed by the RIP since this program has been specifically established for the recovery of endangered species in the Upper Basin. Flaming Gorge generation is not the exclusive mechanism available for recovery of species.

We wish to express our great appreciation for the opportunity afforded to UAMPS to extensively participate in the EIS process and to submit our views.

Sincerely,

Edward C. Rampton
Manager of Government and Public Affairs

Enclosure

cc: Leslie James, CREDA

2. Utah Associated Municipal Power Systems

2a
Financial impacts to the CRSP rate under the Action Alternative were found to be insignificant (section 4.4.3). Spinning reserve requirements and transmission system capacity affecting contractors and power customers were not considered in the hydropower analysis and were considered to be outside the scope of the analysis.

2b
As the economic and financial analyses indicate, the Action Alternative simulation provides for increased value for the generation resulting in the average costs of replacement power potentially being lower than under the No Action Alternative. However, since the differences between the results for the No Action and Action Alternatives appear to be insignificant, the changes in costs for replacement power would likely be insignificant.

2c
Reclamation, in consultation with the eight cooperating agencies, defined the No Action Alternative to include operations to achieve the flow and temperature regimes recommended in the 1992 Biological Opinion. In making that definition, it was also recognized by Reclamation and the cooperating agencies that hydropower impacts associated with changes made between 1974 and 1992 should be recognized in this EIS as cumulative impacts. Operational changes made prior to 1992 are described in section 1.4.2. Hydropower impacts associated with changes made prior to 1992 have been addressed in section 4.16.2.

2d
Reclamation developed the alternatives in the Flaming Gorge EIS with its public scoping period and with a number of cooperating agency meetings and dialogues. The alternatives derive from the RPA of the 1992 Biological Opinion as described in sections 1.4.5 and 1.4.6 of the EIS with the Action Alternative implementing the 2000 Flow and Temperature Recommendations that define flow targets for all reaches of the river.

The EIS acknowledges that re-operation of the dam cannot by itself achieve recovery of the endangered fish, but that it can assist in recovery along with other Recovery Program activities. Please see section 1.4.4 of the EIS.

State of Utah

OLENE S. WALKER
Governor

GAYLE McKEACHNIE
Lieutenant Governor

Governor's Office of Planning and Budget
WES CURTIS
State Planning Coordinator

Resource Development Coordinating Committee
GLADE SOWARDS
Committee Chairman

JOHN A. HARJA
Executive Director

November 10, 2004

Peter Crookston
Flaming Gorge EIS Manager
PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

SUBJECT: Operation of Flaming Gorge Dam - DEIS
Project No. 04-4504

Dear Mr. Crookston:

The Resource Development Coordinating Committee (RDCC), representing the State of Utah, has reviewed this proposal. The Department of Natural Resources comments:

The UDWR fully supports incorporating flow and temperature recommendations for threatened and endangered species consistent with the maintenance and enhancement of the tailwater sport fishery and other wildlife values.

The division commend the U. S. Bureau of Reclamation (Reclamation) for generally incorporating adaptive management principles and the decisions of the Flaming Gorge Operations Working Group (Working Group) into the preparation of alternatives. In particular, UDWR strongly supports Reclamation's recommendation of flow fluctuation limitations, including a daily single-hump fluctuation and 800 cfs ascending and descending ramp rates, consistent with historic operations.

3a Unfortunately, a few sections of the current document seem to minimize the agreements and recommendations of the Working Group, as evidenced by the addition of the second full paragraph on page 149. This paragraph incorrectly implies that the flow fluctuation limitations mentioned above have not been strictly followed in the past. In reality, these recommendations, which were the result of intensive investigations and discussions by the diverse interests of the Working Group, reflect historic operation except in times of emergency. Although minimizing operational constraints may benefit the incident authorized purpose of power generation, the authorized purposes and associated resources would be negatively impacted by further liberalization of release parameters.

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3b The UDWR supports the recommendation for a 55°F release temperature during dry and moderately dry years, maintaining adequate river temperatures for trout at the Utah/Colorado state line. Additionally, thermal mixing should be incorporated into emergency operations in response to power plant shut-down and a switch from penstock to bypass releases. Consistent with past discussions and decisions between UDWR and Reclamation, temperature warming can be attained (optimized) during spring high flow events by mixing spillway and bypass water to minimize the loss of production. Thermal mixing during emergency bypass will prevent thermal shock and mortality of tailwater fishes. In the absence of selective withdrawal modifications to the bypass penstocks, this mixing should be integrated into operations as a benefit to tailwater trout and downstream native fishes and their food base.

3c Finally, the Bureau of Reclamation has invested in research, monitoring and infrastructure at Stewart Lake Waterfowl Management Area (WMA) near Jensen to remediate the effects of selenium and boron accumulation caused, in part, by concentration through irrigation return waters. It is estimated that the dikes of the WMA are inundated at Jensen gauge discharges of approximately 23,000 to 26,000 cfs. Infrastructure such as operational mechanisms of the inlet and outlet structures will be inundated at these higher discharges, and may be damaged. To fulfill responsibilities of remediation at Stewart Lake Waterfowl Management Area, the Bureau of Reclamation should provide for protection and modification of dikes and associated infrastructure threatened by high discharges; or maintenance and repair of structures damaged by high discharges.

SPECIFIC COMMENTS

3d Section 2.5.2 (pg 65). This section implies all federal ownership, but should include the phrase "some private agricultural and state wildlife mitigation lands."

3e Section 2.6.1.1 (pg 67). Remove the sentence "Kokanee can spawn to a depth of 60 feet according to *Fishes of the Great Basin—A Natural History* (Sigler and Sigler, 1996)." Add (Sigler and Sigler 1996) reference after the sentence, "They spawn from late May through early July, and during this period mature fish move into shallow water 2 to 20 feet in depth." Also, smallmouth bass were originally stocked to promote growth of rainbow trout, not Kokanee salmon.

3f (pg 128). Higher and more stable reservoir elevations from November through April should benefit kokanee salmon egg incubation by inundation of favorable substrates and reduction of egg desiccation.

3g Section 3.2.1.2 (pg 132). Lower winter flows, particularly January through March, will benefit tailwater trout by more closely providing optimum winter habitat as per Modde et al. (1991) and Johnson et al. (1987).

3h Section 3.2.3.1.2 (pg 142). 55-57° F (13-14° C) should read 55-59° F (13-15° C) to match the table.

3i (pg 143). More frequent high spring flows should scour sediment deposits resulting from the Mustang Fire and subsequent rain/flood events.

3j Section 3.3.1 (pg 148). Discussion of 800 cfs minimum flow should reference both the 1974 Interim Operating Criteria and historic operations, which have adhered to this flow except in emergencies.

3k Section 3.6.1.1.2 (pg 158). As described in the General Comments, spillway and bypass water can be mixed during the high spring release to optimize temperature.

The Committee appreciates the opportunity to review this proposal. Please direct any other written questions regarding this correspondence to the Resource Development Coordinating Committee at the above address or call Carolyn Wright at (801) 537-9230 or Kim Frost at (801) 538-7326.

Sincerely,

John Harja
Executive Director
Resource Development Coordinating Committee

3. State of Utah, Governor's Office of Planning and Budget

3a
Section 4.4.1 of the EIS accurately characterizes the historic operations. The issues of daily fluctuations and ramp rate restrictions are not part of the proposed action and are, thus, outside the scope of this EIS; that is to say that any proposed changes to the existing agreement would occur through the Flaming Gorge Working Group.

3b
The temperature recommendations apply to the base flows, not to spring peak flows. Spillway use as described in this comment is outside the scope of the EIS and would be more appropriately discussed in the context of ongoing operations under either alternative. The EIS notes that spillway use is an uncertainty and that we may not be able to use the spillway if O&M costs and dam safety are a concern.

3c
Activities are Stewart Lake are undertaken through a cooperative effort by the U.S. Fish and Wildlife Service, Reclamation, and Utah Division of Wildlife Resources. An agreement is in preparation that will address appropriate ongoing monitoring and maintenance activities.

3d
It appears that this comment refers to chapter 3, section 3.6.2. The first paragraph of that section states "lands along the Green River, downstream from the dam, have a variety of ownership and uses as outlined below."

3e
Comment incorporated.

3f
Please see section 4.7.1.1.2 of the EIS.

3g
Comment incorporated into section 4.7.2.4.1.2 of the EIS.

3h
Comment incorporated into section 4.3.4.1.2 of the EIS.

3i
Comment noted.

3j
It appears that this comment refers to chapter 4, section 4.4.1. While the discussion in section 4.4.1 refers to hydropower economic analysis for the No Action and Action Alternatives, and reference to 1974 operating criteria is made in section 4.16.2, cumulative impacts section, this comment is correct; a minimum flow of 800 cfs has been an operating procedure under an agreement with the State since 1974.

3k
The temperature recommendations apply to the base flows, not to spring peak flows. Spillway use as described in this comment is outside the scope of the EIS and would be more appropriately discussed in the context of ongoing operations under either alternative. Please see response to U.S. Fish and Wildlife Service 2a.

STATE OF UTAH

OFFICE OF THE ATTORNEY GENERAL

MARK L. SHURTLEFF

ATTORNEY GENERAL

RAYMOND A. HINTZE
Chief Deputy

KIRK TORGENSEN
Chief Deputy

November 15, 2004

VIA FAX (801-379-1159)

Peter Crookston
Flaming Gorge EIS Manager
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Re: Operation of Flaming Gorge Dam Draft Environmental Impact Statement August, 2004

Dear Mr. Crookston:

I write at the request and authorization of the Daggett County Commission to comment on Daggett County's behalf regarding the above-referenced Draft EIS.

4a As explained more fully in Daggett County's own comments, the Draft EIS preferred alternative aims to release water from the dam at such a high volume, over such a lengthy amount of time, and at such a time during the year, that the release will adversely affect the commercial and private use of the Green River and hence devastate the businesses of approximately 13 commercial river and fishing guide and outfitting companies, whose income depends almost entirely on their customers' experience on the Green River beneath the dam at a time when the preferred alternative will almost entirely negate fishing and other experiences due to high water volume. Most of the owners and employees of the companies threatened by this action are local citizens of Daggett County, and the local economy stands to suffer if these businesses are ruined.

The purpose of this letter is to advise you on behalf of Daggett County, that these river guide companies whose employment and revenues are so important to Daggett County's

economy, intend to pursue a Court of Claims action under the Tucker Act, 28 U.S.C. § 1491, to recover compensation for economic loss caused by the actions of the preferred alternative. The United States Court of Appeals for the Tenth Circuit in *Gordon v. Norton*, 322 F. 3d 1213 (10th
4b Cir. 2003), recognized that a Tucker Act remedy is available for loss of business occasioned by a federal action related to species preservation.

Please note also that Daggett County reserves the right to pursue Tucker Act and other claims for any other loss or damage that may result from the actions contemplated under the
4c preferred alternative, including but not limited to any damage that high river flows may cause to a bridge on an RS 2477 Daggett County road that crosses the Green River below the dam.

Sincerely,

MARK L. SHURTLEFF
UTAH ATTORNEY GENERAL

J. Mark Ward
Assistant Attorney General
Public Lands Section

cc. Utah Association of Counties
Daggett County Commission
Uintah Basin Association of Governments

4. STATE OF UTAH, OFFICE OF THE ATTORNEY GENERAL

4a
Please see section 4.12 of the EIS and response to Daggett County 1d and 1e.

4b
Comment noted; Reclamation cannot prejudge liability in a NEPA document.

4c
Comment noted; Reclamation cannot prejudge liability in a NEPA document. It is not appropriate to discuss case specific potential litigation in an EIS.

Utah State
UNIVERSITY
EXTENSION

Uintah County Office
152 East 100 North
Vernal, UT 84078

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Email: uintah@ext.us

Comment on the Flaming Gorge Dam Environmental Impact Statement
Boyd Kitchen, USU Extension – Uintah County
October 21, 2004

5a 5b Flood control is one of the authorized purposes of Flaming Gorge Dam but is not addressed in this EIS. Several aspects of the Action Alternative are predicted to increase the frequency of flooding in order to assist in the recovery of endangered fish. However, information given in the EIS indicates that the level of flooding called for in the 2000 Flow and Temperature Recommendations for the Green River may not be necessary to recover the endangered fish. In section S.6.5, "Uncertainties Associated with Flood Plain Inundation", reference is made to strategies (e.g., flows exceeding 13,000 cfs versus flows of 18,600 cfs, levee modification, inlet construction) that could meet the needs of the endangered fish without the extreme flooding predicted in wet years under the Action Alternative. Why were these strategies not evaluated as alternatives?

5c Is there a maximum flow in Reach 2 that if exceeded will jeopardize the recovery of endangered fish? Shouldn't the Action Alternative address how to modify flow regimes in order to avoid exceeding harmful maximum flows within the safety limitations of the Dam?

5d One aspect of Socioeconomic/Regional Economics that has not been addressed by the EIS is the damage to irrigation pumps and irrigation systems that will be caused by the higher flows and increased sedimentation predicted by the Action Alternative. The damage includes the equipment, the cost of installation and the loss of crop production caused by the inability to deliver water to upland crops during the time it takes to repair flood caused damaged irrigation equipment. The crop damage could extend for several years if perennial crops like alfalfa die
5e before irrigation can be restored. Damage to irrigation pumps and equipment could be minimize if adequate warning is given to farmers before peak releases are made. However, little can be done if excessive flooding occurs.

5f In dry years, is there any advantage to the endangered fish in making a 4,600 cfs release from Flaming Gorge. If not, then perhaps the water should be saved for later use.

5. Utah State University Extension

5a
While flood control is an authorized purpose of CRSP, there are no flood control benefits identified for Flaming Gorge. Therefore, there are no restrictive operational rules imposed by the U.S. Army Corps of Engineers for flood control. However, flood plain inundation has occurred less frequently since Flaming Gorge Dam was built.

5b
The referenced strategies do not meet the purpose and need of this EIS. The EIS notes that through the adaptive management process, refinements to the 2000 Flow and Temperature Recommendations and other actions to benefit the endangered fish are possible. See section 4.19.5 in the EIS and response to the National Park Service 3b-3e.

5c
Native and endangered fish evolved under extreme hydrological conditions which included flows far in excess of those described in either the Action or No Action Alternatives, both of which are subject to constraints for safe operation of Flaming Gorge Dam. See section 2.5.1 in the EIS.

5d and 5e
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

5f
Anticipated benefits to endangered fish from a 4,600-cfs release in dry to moderately wet years include significant channel maintenance (habitat complexity and reworking of sediment deposits) in Reach 1 and achievement of flow recommendations and associated benefits in Reaches 2 and 3. See section 4.7.3.2, Action Alternative subsections in the EIS.

WYOMING
GAME AND FISH DEPARTMENT

Dave Freudenthal, Governor   Terry Cleveland, Director

"Conserving Wildlife - Serving People"

November 15, 2004

WER 9767
Bureau of Reclamation
Upper Colorado Region
Provo Area Office
Draft Environmental Impact Statement
Operation of Flaming Gorge Dam

Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774/BOR
Provo Area Office
302 East1860 South
Provo, UT 84606-7317

Dear Mr. Crookston:

The staff of the Wyoming Game and Fish Department has reviewed the Environmental Impact Statement for the operation of Flaming Gorge Dam. We offer the following comments for your consideration.

Terrestrial Consideration:

6a The Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS) does not address the sport fishery and/or the limnology of Flaming Gorge Reservoir. One of the largest benefits of Flaming Gorge Reservoir is the recreational opportunity created by this large reservoir to people of southwestern Wyoming and northern Utah and to those that travel to the reservoir from across the country. The DEIS needs to address the impacts of releases and draw
6b downs on Flaming Gorge Reservoir and how the Bureau of Reclamation (BOR) plans to mitigate or balance water releases to benefit of all forms of recreation created by the reservoir.

Our comments are as follows (Section and page number are included):

S.3.1 Brief History of Flaming Gorge Dam and Reservoir. (Page S-3)
S.3.1.1 Authorized Uses of Flaming Gorge Dam and Reservoir: Colorado River Development. (Page S-4)

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Article I.(2) of Section 402(a) of the Colorado River Basin Project Act requires that the Annual Operating Plan for Colorado River reservoirs "...shall reflect appropriate consideration of the uses of the reservoirs for all purposes , including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife and other environmental factors."

6c Comment: The DEIS needs to consider the effects of the Operation of Flaming Gorge Dam for the recovery program for endangered fishes to the fishery, limnology, and recreational opportunities as a part of the DEIS. The DEIS does not consider or address the effects of selective temperature withdrawal or the timing and magnitude of draw down for flows in the Green River below Flaming Gorge Reservoir for endangered fishes on the reservoir fishery, limnology of the reservoir, or recreational opportunities provided by the reservoir. According to the Colorado River Basin Project Act, these issues should be studied and addressed in order to consider the effects of the Operational Plan presented in the DEIS.

S.3.1.2 Authorized Uses of Flaming Gorge Dam and Reservoir: Flaming Gorge National Recreation Area. (Page S-4)

The Flaming Gorge National Recreation Area was established by the Flaming Gorge National Recreation Area Act of 1968 (P.L. 90-540). According to that act, the purposes of the Flaming Gorge National Recreation Area include providing public outdoor recreation benefits.

6d Comment: The act cited above states that the reservoir shall provide for recreation, which includes fishing, boating, and other forms of recreation as benefits of the reservoir. Again, the DEIS does not consider any of the recreational benefits that the reservoir provides to public.

S.6 Operational Decision Making Process at Flaming Gorge Dam. (Page S-8)

6e Nowhere in this section does the DEIS mention how the operation of the dam will protect the Flaming Gorge Reservoir fishery and recreational benefits provided by the reservoir.

S.9 Scope of Analysis for the Environmental Impact Statement. (Page S-9)

The second paragraph states, "If Reclamation operates Flaming Gorge Dam to achieve the 2000 Flow and Temperature Recommendations......consistent with CRSP purposes, then the effect(s) on the relevant resources/issues, both upstream and downstream from the dam would be....."

Comment: Article I.(2) of Section 402(a) of the Colorado River Basin Project Act requires that the Annual Operating Plan for Colorado River reservoirs "...shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife and other environmental factors." The Flaming

Gorge fishery, limnology of the reservoir and all other recreational benefits effected by the withdrawals needs to be addressed in the DEIS.

S.11 Description of Alternatives. (Page S-14) S.11.1.3 Summary of Alternatives Analyzed in the Flaming Gorge Environmental Impact Statement. (Page S-15) S.11.1.3.1 No Action Alternative. (Pages S-15 thru S-16)

Releases from Flaming Gorge beginning July 1 and continuing until November 1 should be the warmest available, approaching 59 degrees F.

6f Comment: The DEIS does not address how the current release pattern, based on reservoir operations since the adoption of the 1992 Biological Opinion, has effected limnology and productivity of Flaming Gorge Reservoir. Specifically, has a chemocline redeveloped in the Canyon area of the reservoir? How have these releases effected the development of thermoclines, the temperature budget of the reservoir, and productivity? Have releases increased the potential for blue-green algae blooms to occur in the upper portion of the reservoir? None of these parameters have been discussed under the " No Action Alternative" and/or the "Action Alternative."

S.11.1.3.2 Action Alternative. (Pages S-16 thru S-18)

Comment: The "Action Alternative" would not mimic natural flow events in the Green River sections targeted as well as the "No Action Alternative."

S.13 Operational Description. (Page S-19)
S.13.1 Safe Operation of Flaming Gorge Dam. (Pages S-19 thru S-20)

Reservoir. It states, "For this reason, the reservoir elevation is intentionally drawn down during the fall and winter months."

Comments: Draw down prior to the operation of Flaming Gorge Dam under the 1992 Biological Opinion was erratic and varied considerably from year to year (fluctuations up to 25 feet). Since the 1992 Biological Opinion, releases and draw downs, especially between October 1 (kokanee spawning begins) and May 30 (kokanee fry emergence complete) has been less erratic and varied (less than 12 feet). Estimates of emergent kokanee survival after reservoir draw down from depth-adjusted mortality were 8.3% and 38.1% for elevation reductions of 3.3
6g feet and 16.4 feet, respectively (Modde et al. 1997). Modde et al. also found "that greater number of fry emerged from shallower depths in Flaming Gorge. Therefore, unless bias associated with depth-related mortality is accounted for, estimates of kokanee fry losses due to reservoir draw downs may be underestimated." Prior correspondence with the BOR from the
6h Department asked the BOR to keep the draw down of the reservoir from October 1 (beginning of spawn) to May 30 (emergence complete) to 8 feet or less. We will continue to request this regardless of which Action Alternative is adopted by BOR for the operation of Flaming Gorge Dam.

S.13.2 Reservoir Operations Process Under the No Action Alternative. (Pages S-20 thru S-22) S13.2.3 (Pages S-21 and S-22)

The first paragraph on page S-22 of the DEIS states, " After September 15, releases from Flaming Gorge Dam could be increased..........

6i Comment: If natural river flows are to be mimicked, why should releases from Flaming Gorge Dam be increased instead of being operated at a base flow? Decreasing reservoir elevation after October 1 will result in the loss of kokanee eggs (recruitment) along the shorelines of the reservoir. The kokanee population in Flaming Gorge Reservoir supports a nationally important sport fishery and is the primary forage sustaining the lake trout fishery in Flaming Gorge Reservoir.

S.13.2.4 Winter Operations (Late Base Flow) (Page S-22)

The first paragraph states, "There are no specific flow recommendations provided by the 1992 Biological Opinion from November to May."

6j Comment: In order to account for kokanee spawning and emergence of fry, the above sentence would better serve the resource if it stated, "There are no specific flow recommendations provided by the 1992 Biological Opinion from October 1 to May 30." Flows during this period need to be reduced, so draw down is slowed by October 1 and no later than October 15 to accommodate spawning kokanee. Flows from Flaming Gorge Dam should not be increased above inflow levels to the reservoir until after May 30 to accommodate maximum survival of emerging kokanee fry, and no earlier than May 15 to accommodate the peak of emergence of kokanee fry. Draw down of the reservoir should be less than 8 vertical feet.

S.13.3.1 Operations in May through July (Spring Period). (Pages S-23 thru S-26)

First paragraph states, "Under the Action Alternative, Reclamation would establish a hydrologic classification for the spring period (May through July) based on the April forecasted unregulated Inflow."

6k Comment: In order to accommodate maximum survival of emerging kokanee fry, the spring period should be classified as June through July.

S.13.3.3 Operations in August through February (Base Flow Period). (Pages S-26 and S-27)

6l Comment: During the base flow period (August through February), it is critical that large releases and therefore large draw downs of the reservoir not occur after Oct. 1. Should the reservoir elevation be above critical levels, releases should be increased and draw down should occur prior to October 1. Reservoir elevations should not be decreased more than 8 feet until maximum emergence of kokanee fry has occurred (May30).

S.13.3.4 Operations in March and April (Transition period). (Pages S-27 and S-28)

6m Comments: The period of kokanee emergence from the shorelines of Flaming Gorge Reservoir identified above should be addressed in the DEIS. Kokanee and brown trout eggs spawned in the Green River between Fontenelle and Flaming Gorge Reservoirs should be taken into account when releases from Fontenelle are made. Increased flows from Fontenelle after the ice goes off of the Green River is advantageous for emerging kokanee fry and is a key to the timing of emergence and downstream migration to Flaming Gorge Reservoir. However, the timing and volume of early spring flows is critical to the survival and emergence of both kokanee and brown trout fry. Parsons and Hubert (1988) sampled fry in the Green River beginning on March 22 through May 27 when sampling was discontinued due to high flows. The largest numbers of fry were sampled on May 22. Emergence of kokanee fry in the Green River likely continues through the end of May. Flows should remain steady from Fontenelle Reservoir until all ice has left the lower Green River. Increased flows from Fontenelle Reservoir should mimic inflows into Fontenelle Reservoir, with increasing flows taking place in the later part of April or early May.

S.14 Environmental Consequences. (Page S-28)
S.14.2 Water Quality, Water Temperature, and Sediment Transport. (Page S-32)

Paragraph one addresses the effects of draw down on the frequency and severity of algal blooms in Flaming Gorge Reservoir. The conclusion described in this paragraph is correct, "reservoir draw downs during drought conditions cause larger algal blooms."

6n Comment: Blooms of blue-green algae are an annual occurrence on Flaming Gorge Reservoir. The severity and extent of the blooms appears to be tied to drought conditions (poor inflow) and draw down (reservoir elevation). Prolific fish kills in the inflow of the reservoir have occurred during severe algae blooms. Large releases from Flaming Gorge Dam should be minimized during drought years to avoid unusually severe and large scale blue-green algae blooms. Discussion of other limnological parameters of Flaming Gorge Reservoir was not included in this section of the DEIS.

Table S-9. --- Weight and Percent increase in sediment transport under the Action Alternative compared to the No Action Alternative. (Page S33)

6o Comment: Numbers in Reach 1 suggest sediment loading will increase under the Action Alternative. Reach 1 is likely sediment starved because of Flaming Gorge Dam. How will changing the flow regime increase sediment transport by up to 56%? The DEIS needs to explain the mechanism by which sediment transport will increase under the Action Alternative.

S.14.14 Recreation (Page S-37)

6p Comment: There is no mention of impacts to recreational facilities (boat ramps, cut through between the Horse Shoe Canyon and Lower Flaming Gorge, etc.) on Flaming Gorge Reservoir under the No Action or the Action Alternative.

6q Statements in this section are broad and contain little substance. More information needs to be provided in the DEIS to address both positive and negative impacts to both the river below Flaming Gorge Dam and especially the Reservoir above Flaming Gorge Dam. Much of the Reservoir recreation is based on the fishery, which can be significantly impacted by dam operations. An analysis of the Action Alternative's expected impacts on the fishery-based recreation would be appropriate.

S.15 Cumulative Impacts. (Pages S-37 and S-38)

6r Comment: Third paragraph, second sentence ignores the contribution of the sport fishery created in Flaming Gorge Reservoir and the significant benefits the reservoir fishery has to the economy of Sweetwater County, Wyoming and Daggett County, Utah.

6s This fishery can be significantly affected by timing and extent of draw downs. The DEIS needs to address how the pattern of reservoir draw down under the Action Alterative will impact the reservoir fishery.

S.16 Uncertainties. (Page S-38)

6t Comment: The document does not mention the uncertainties the No Action or Action Alternative will have on the Flaming Gorge fishery, limnology of the reservoir, or recreational facilities on the reservoir.

S.17 Addressing Uncertainties Through Adaptive Management. (Pages S-41 and S-42)

6u Comment: Changing the operations at Flaming Gorge Dam has the potential to affect (both positively and negatively) the Reservoir as significantly as the River below. The DEIS should address how the BOR will monitor changes to the limnology and reproductive success and recruitment of kokanee, lake trout, and smallmouth bass found in Flaming Gorge Reservoir.

6v Issues associated with the fishery should be monitored by our Department and UDWR by funds made available by the USFW under the Endangered Fishes Recovery Program. The Flaming Gorge Working Group would take under advisement changes to the Operations of Flaming Gorge Reservoir, which would be of value in improving the reservoir fishery.

S.18 Environmental Commitments. (Pages S-42 and S-43)

6w Comment: A line item concerning the Flaming Gorge fishery and the limnology of the reservoir, as stated above, should be included.

Sincerely,

(for) BILL WICHERS
DEPUTY DIRECTOR

BW:VS:as
cc: Mary Flanderka-Governor's Planning Office
USFWS

REFERENCES:

Modde, T, R.J. Jerie, W.A. Hubert and R.D. Gipson. 1997. Estimating the impacts of reservoir elevation changes on Kokanee emergence in Flaming Gorge Reservoir, Wyoming – Utah. *North American Journal of Fisheries Management* 17: 470-473.

Parsons, B.G. and W.A. Hubert. 1988. Reproductive characteristics of two Kokanee stocks in tributaries to Flaming Gorge Reservoir, Utah and Wyoming. Great Basin Naturalist 48:46-50.

6. Wyoming Game and Fish Department

6a
For detailed descriptions and analysis, please refer to the EIS sections 3.7.1 and 4.7.1. The Executive Summary provides a brief overview and is intended to be concise.

6b
The EIS analyzes and discusses the potential impacts for all resources for Flaming Gorge Reservoir. No significant impacts to the reservoir or mitigation needs were identified. Please see sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11 in the EIS.

6c
Please see sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11 in the EIS for the discussion of these effects.

6d
The recreation section of the EIS (4.11) describes impacts, by recreation activity, to both Flaming Gorge Reservoir and the Green River as a result of differences in reservoir water levels and river instream flows between the alternatives.

6e
The recreation section of the EIS (section 4.11) evaluated impacts to boat fishing based on water level fluctuation between alternatives.

6f
The long-term history and impacts of the reservoir operation on algae and productivity in the reservoir are addressed in section 3.3.2 of the EIS. In general, the combinations of hydrology and operations from 1983 through about 2000 has resulted in higher summer and fall reservoir elevations due to decreased drawdown. This has generally reduced the magnitude of blue-green algae blooms as explained in section 3.3.2. The conditions under either the Action or the No Action Alternatives would have resulted in very similar conditions over these same time periods. Water quality in the reservoir generally is slightly improved in the post 1992 Biological Opinion operating conditions and would continue under either alternative.

The overall heat budget in Flaming Gorge Reservoir was slightly altered by initiation of operation of the selective withdrawal structure to warm the Green River tailwater in 1978. This resulted in a little colder water in the winter and a little more of Flaming Gorge Reservoir being frozen over. However, no changes that have been made since 1978 would alter the heat budget in a perceivable way. The chemocline has not fully redeveloped since the reservoir turned completely over in the winter of 1981-82. The reservoir has become strongly chemically stratified in the canyons reach nearer the dam, but then turned over again. There is no indication another decadal chemocline will develop with foreseeable future conditions.

6g
Figure 4.1 in the EIS indicates that, on average, drawdown of Flaming Gorge Reservoir under the Action Alternative between October and May (Kokanee incubation period) will be less than the No Action Alternative, the latter being no more than the 8-foot maximum requested by Wyoming Game and Fish Department. See sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11 in the EIS.

6h
Under normal operations, or when inflows are sufficient or great enough to maintain reservoir storage while also maintaining the recommended flows under the Action and No Action Alternatives, drawdown elevations will most likely be within 8 feet of the previous year's peak

elevation. It is, however, possible that the reservoir elevation of Flaming Gorge will be such that a drawdown of greater than 8 feet would be necessary for safe operation of the dam in certain circumstances. Reclamation will always operate Flaming Gorge Reservoir to maintain safe levels given varying hydrologic conditions.

Typical drawdown levels in average years would be about 8 feet under the No Action Alternative and about 4 feet under the Action Alternative as is shown in the Hydrological Technical Appendix.

6i
The No Action Alternative operates Flaming Gorge to achieve the flow objectives of the 1992 Biological Opinion. The 1992 Biological Opinion allows releases to be increased after September 15 when it is necessary to release more water to operate Flaming Gorge Reservoir safely. Reclamation would operate under the No Action Alternative to safely operate Flaming Gorge within the constraints of the 1992 Biological Opinion unless conditions were such that safe operation of the dam could be in jeopardy. As has been done historically, Reclamation would consider the resource needs of the kokanee in the operational decisionmaking based on information provided by the Flaming Gorge Working Group. In such case, operations would be guided to maintain safe conditions of Flaming Gorge Reservoir. See answer 6g and 6h above and EIS sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11.

6j
The conditions imposed by the 1992 Biological Opinion cannot be changed. The No Action Alternative operates Flaming Gorge to achieve the flow objectives of the 1992 Biological Opinion. This opinion does make specific recommendation for the period from the spring peak release through the end of October. It does not, however, have specific recommendations for the period from November through the spring peak. Under the No Action Alternative, Reclamation would operate Flaming Gorge Dam to use the flexibility during this time to maintain safe levels in the reservoir. See answer to 6g and 6h above.

6k
This classification was not conceived to account for kokanee survival but rather for implementation of the 2000 Flow and Temperature Recommendations for threatened and endangered fish below Flaming Gorge Dam (i.e., Action Alternative).

6l
Reclamation would safely operate Flaming Gorge Reservoir under the Action Alternative to achieve maximum resource benefit within the flexibility provided for in the 2000 Flow and Temperature Recommendations. See answer to 6g and 6h above and EIS sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11.

6m
Operations of Fontenelle Dam are outside the scope of the Flaming Gorge EIS. Kokanee in Flaming Gorge are discussed in sections 3.7.1.1, 4.7.1.1.1, 4.7.1.1.2, and 4.7.2.4.2.2.

6n
It has previously been noted that drought and greater reservoir drawdown result in larger blue-green algae blooms in the inflow area of Flaming Gorge Reservoir. The seasonally adjusted flows as recommended in the 1992 Biological Opinion result in lower summer releases in all years, including and especially in drought years. That has decreased summer draw down, which is why water quality in the inflow area has improved

since implementation of the seasonally adjusted flows as recommended in the 1992 Biological Opinion. See section 3.2 in the EIS.

6o
It is anticipated that higher flows in Reach 1 will increase erosion of bed material and bank material in portions of Reach 1. Channel morphological changes could occur as a result of this increased erosion. For example, local channel widening could result from this increase in bank erosion. Details of the sediment transport analysis for the EIS are found in the Technical Appendix (Effects of Flaming Gorge Operations Under the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations on Sediment Transport in Green River).

6p
The Flaming Gorge Reservoir recreation visitation analysis was based on a facility availability approach. Information on facility availability is provided in the recreation sections of both the EIS (section 3.11 and 4.11) and Technical Appendix (Recreation Visitation and Valuation Analysis).

6q
Much more detail on the recreation analysis is found in the EIS (section 3.11 and 4.11) as compared to the Executive Summary.

6r
A detailed recreation and socioeconomic/regional economic analysis was developed and described in the EIS (section 4.12).

6s
Please see sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11.

6t, 6u, and 6w
The EIS analyzes and discusses the potential impacts for all resources for Flaming Gorge Reservoir. No significant impacts to the reservoir or mitigation needs were identified; therefore, an uncertainties section and an environmental commitment for the reservoir were not necessary. However, Reclamation limnological studies are currently ongoing in the upper portions of Flaming Gorge Reservoir. See sections 3.2.1.1, 3.3.1, 3.3.2, 3.7.1, 3.11, 4.3.1, 4.3.3, 4.7.1, and 4.11

6v
As stated in section 4.7.1 of the EIS, the Action Alternative would be expected to benefit kokanee because reservoir elevations will fluctuate less between seasons and will tend to be higher. The EIS does not show positive or negative effects to the reservoir fishery of a magnitude that would warrant special actions over and above ongoing management by the States of Wyoming and Utah.

State Engineer's Office

DAVE FREUDENTHAL
GOVERNOR

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PATRICK T. TYRRELL
STATE ENGINEER

November 8, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager, PRO-774
U.S. Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Re: Wyoming State Engineer's Office Comments on August 2004 "Operation of Flaming Gorge Dam Draft Environmental Impact Statement"

Dear Mr. Crookston:

The Wyoming State Engineer's Office was involved in the negotiation of the Upper Colorado River Endangered Fish Recovery Program (Program) and has actively participated in the Program's conduct since its initiation. Accordingly, we have followed and advised the Bureau of Reclamation (Reclamation) concerning the preparation of the subject "Operation of Flaming Gorge Dam Draft Environmental Impact Statement" (DEIS) since Reclamation proposed preparing a National Environmental Policy Act (NEPA) document subsequent to the issuance of the 1992 Biological Opinion on operation of Flaming Gorge Dam and Powerplant by the Fish and Wildlife Service (Service). The 1992 biological opinion included a requirement for additional studies to address uncertainties and data gaps relative to the life history and habitat needs of the endangered fish species and intended to result in refinement of the Service's 1992 recommendations. The September 2000 *Flow and Temperature Recommendations for Endangered Fishes in the Green River downstream of Flaming Gorge Dam* represents the culmination of the additional studies pursuant to the 1992 opinion.

The Wyoming State Engineer's Office supports the action alternative set forth in this DEIS and urges Reclamation to issue the Record of Decision as promptly as practical. Further, as was the case in 1992 when the prior biological opinion on the operation of Flaming Gorge Dam was issued, the biological opinion to be issued in November and included with the final EIS for the dam's operation will, we believe, continue to acknowledge there are many remaining uncertainties and hypotheses about the dam's effects on the endangered fish and their habitat. Accordingly, the adaptive management approach that has historically and will continue to underlie the Program must continue to be used to guide and further refine operations of the Flaming Gorge Dam and Powerplant. The biological response of the endangered fish species to dam and powerplant-related operations remains the primary guiding determinant of whether

Surface Water (307) 777-7354 | Ground Water (307) 777-6163 | Interstate Streams (307) 777-6151 | Board of Control (307) 777-6178

Reclamation's dam operations and the Recovery Program's accomplishments are meeting the Program's objectives. The extensive discussions of "Uncertainties" and "Addressing Uncertainties Through Adaptive Management" found in the DEIS recognizes these facts and their ramifications for continuing within the "framework of the ongoing Recovery Program."

Importantly, the "Environmental Commitments" found in this NEPA document note that Reclamation will continue to participate in the Recovery Program and "the adaptive management process would rely on ongoing or added Recovery Program activities for monitoring and studies to test the outcomes of modifying flows and release temperatures from Flaming Gorge Dam." This is, in our view, the prudent and necessary course of action. The Wyoming State Engineer's Office continues to support the adaptive management approach that is advocated as a basic element of the action alternative. Under this approach, further refinement of the flow recommendations will occur to accomplish the objectives of the Federal action while meeting all authorized project purposes of the Flaming Gorge Unit of the Colorado River Storage Project. This necessarily requires a balancing of competing uses of the available water resources – and the providing of reservoir releases that benefit and provide the needed amount of nursery and other fish habitats while maintaining the greatest amount of conservation storage in the reservoir. Specifically, Reclamation is obligated to minimize the quantity of bypass tube and spillway flows to preserve conservation storage consistent with the Colorado River Storage Project Act while, to the extent practical, meeting the flow and temperature conditions specified in the 2000 Temperature and Flow Recommendations. It is fully anticipated that through the Recovery Program's collaborative, adaptive management approach, a reasonable balancing of the competing demands placed upon the water resources can be accomplished.

As you may be aware, the Wyoming State Engineer's Office was approached about being a cooperating agency to assist Reclamation with the preparation of the subject DEIS when the effort was initiated. Our office declined to do so for several reasons. First, re-operation of Flaming Gorge Dam has been a key element of the voluntary and collaborative conduct of the Program. Second, re-operation of the dam was mandated by the 1992 biological opinion, and further, we believe that Reclamation unilaterally decided voluntarily to prepare this EIS based on a desire to inform its constituency once the additional studies mandated by the 1992 opinion had been completed.

Reclamation has had great difficulty in generating alternatives to analyze beyond the "action alternative", because there really is no viable alternative beyond the preferred alternative/action alternative that complies with the Colorado River Storage Project Act, the Endangered Species Act and the mandates imposed by the previously issued biological opinion. There is no other alternative consistent with Reclamation's participation as a partner in the Program. The Wyoming State Engineer's Office has consistently advised Reclamation of our concerns that preparing this EIS could divert Recovery Program personnel and other resources away from ongoing Recovery Program efforts under the pretext of analyzing a decision that realistically had already been reached when the Program was initiated in 1988. Fortunately, the DEIS has finally been developed and released after many delays and difficulties.

Mr. Peter Crookston
November 8, 2004
Page 3

7a Discussion of the Recovery Program should include specific mention of the Program's dual objectives to recover the four species of endangered fish while allowing the participating States' to develop their Compact-apportioned water supplies. The Program is intended to provide the reasonable and prudent alternative to offset the depletion impacts of existing water projects as well as new water projects (those occurring after the initiation of the Recovery Program in January 1988). The DEIS has specifically described the individual biological
7b opinions that rely upon re-operation of the Flaming Gorge Dam but fails to mention the overall role of the dam's re-operation as a part of the Recovery Program.

Once again, we urge Reclamation to expeditiously move forward with issuing the record of decision to complete this NEPA process and to continue to work cooperatively with its partners in the ongoing, successful Upper Colorado River Endangered Fish Recovery Program. Thank you for the opportunity to provide these comments. Should you have any questions, please don't hesitate to contact this office.

With best regards,

Patrick T. Tyrrell
State Engineer

PTT/jws/jp

7. WYOMING STATE ENGINEER'S OFFICE

7a
See sections 1.4.4 and 4.16.4.1.1 of the EIS regarding the dual role of the Recovery Program in recovering the endangered species while allowing water development to continue.

7b
See sections 1.4.4, 1.4.3 and 1.9.2.1 of the EIS regarding the proposed action and its relationship to the management actions of the Recovery Program.

WYOMING STATE GEOLOGICAL SURVEY

P.O. BOX 1347 • LARAMIE, WYOMING 82073-1347
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STATE GEOLOGIST **– Ronald C. Surdam**

Mr. Peter Crookston
Flaming Gorge EIS Manager
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, UT 84606-7317

November 8, 2004

RE: PRO-774

Dear Peter,

Ramsey Bentley and Seth Wittke of the Wyoming State Geological Survey Hazards Section would like to make the following comments on the Flaming Gorge Dam Draft Environmental Impact Statement.

8a We have no specific concerns with the proposed action. In fact, the action may serve to improve water quality within the Wyoming reaches of the reservoir.

The geographic areas most affected by the Bureau of Reclamation's proposed action are in Utah and Colorado, downstream on the Green River. The action involves modifying water releases from Flaming Gorge Dam throughout the year. The modifications do not appear to present any substantial changes to the present operating effects of the dam on Flaming Gorge reservoir, the Wyoming portion of the Green River, or the surrounding areas. In fact, the modifications are predicted to reduce the frequency and extent that the reservoir would be drawn down annually, which in turn should promote improved water quality in the reservoir. This should also prove to reduce the frequency of algal blooms during the fall in the northernmost part of the reservoir.

All pertinent data was checked, including landslide, earthquake, and hydrologic data, for effect by the proposed action. The only other possible detrimental effect is that there are a few landslides along Flaming Gorge Reservoir. That may be influenced by the cycling of water depth. However this happens seasonally, so we're not sure if the new water level changes will cause any new slope stability problems. The majority of this proposal is outside of Wyoming, so very little of the report is pertinent to the state.

Sincerely,

Ronald C. Surdam
State Geologist

Cc: Governor's Planning Office

Serving Wyoming Since 1933

8. Wyoming State Geological Survey

8a
Comments noted.

LOCAL AGENCIES

1. **Daggett County, State of Utah**
2. **Rock Springs, Wyoming, Chamber of Commerce**
3. **Town of Manila, Utah**
4. **TriCounty Health Department**
5. **Uintah County, State of Utah**
6. **Uintah Mosquito Abatement District**

DAGGETT COUNTY

STATE OF UTAH

95 North 100 West
P.O. Box 219
Manila, Utah 84046

November 15, 2004

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement
PRO-774 Bureau of Reclamation
Provo Area Office
302 East 1850 South
Provo, Utah 84606-7317

Dear Mr. Crookston:

Thanks for the opportunity to respond to the Flaming Gorge Dam Operations DEIS.

1a Daggett County was not asked to be a cooperating agency for this project. We wish we would have been since this could greatly impact Daggett County employment, businesses, visitors and the people living here.

In 1992 a biological opinion was developed. <u>This was used to recommend operational</u>
1b <u>guidelines for the Dam. Was a study done to determine the effects of this opinion? If so could we get a copy of this?</u>

1c The DEIS proposed action is to increase flows under different conditions. There is a major error in the Document on Page 117. 3.13.2 "River flows in Reach 1 . . ." "The river has exceeded 18,000 CFS five (5) times in the past 10 years and 20 times in the past 20 years." This is misleading, as the highest the river has been since the Dam was completed is 12,300 CFS in 1983.

1d <u>How is this major error in the DEIS on water flows going to be communicated to the public?</u>

When the river flows in Reach 1 exceed 4600 CFS a lot of things change. First, it becomes almost impossible for commercial guides to get people to fish the river under high flow conditions. Therefore, most fishermen stay away under these conditions. Second, with high flows some of the infrastructure becomes threatened and third, the high flows cause a safety issue.

Commissioners: Chad L. Reed, clreed@daggett.state.ut.us; Craig W. Collett, ccollett@daggett.state.ut.us; Stewart Leith, sleith@daggett.state.ut.us; 435-784-3218

Clerk/Treasurer: Vicky McKee, 435-784-3154, vmckee@daggett.state.ut.us

Auditor/Recorder: RaNae Wilde, 435-784-3210, rwilde@daggett.state.ut.us

Assessor: Lesa Asay, 435-784-3222, lasay@daggett.state.ut.us

Sheriff: Allen Campbell, 435-784-3255, acampbell@daggett.state.ut.us

Attorney: Dennis L. Judd; *Deputy Attorney:* Rachelle Palmer; 435-789-5359; Fax: 435-789-7075; 461 West 200 South, Vernal, UT 84078

Fax Number: 435-784-3335

Three Areas of Concern

1) Socio Economic Impacts

1e In your opening statements about public concerns, "Socioeconomics" (Tourism related jobs and income) is listed, but we cannot find where loss of jobs and income is specifically addressed.

We have not had time to do surveys or complete analysis to estimate losses with increased flows. We have been able to generate some rough estimates.

The Forest Service allows 50 Commercial Guides to float the river each day in the spring until June 15th. Attachment #1 shows the Guide Launches for 2004. May averages 30/day and June averages 40/day. Attachment #2 shows the effects of high flows. During May of 1999 flows reached 6500 CFS the daily guide trips on the 24th - 29th dropped to between 0 and 7 daily trips.

Over a dozen businesses heavily rely on visitors to the river for their livelihood. Not only the guided fishing trips, but the lodging, restaurant, raft rentals, fishing supplies and R.V. parks, etc.

In the month of May almost all business in the Dutch John area is tied to the river. Very few people have started to visit the Flaming Gorge Reservoir or other areas.

When high flows occur, it greatly affects many businesses in Daggett County. If the Action Alternative is adopted Daggett County and its businesses will seek restitution for losses and damages. Without restitution most of these businesses will not be able to remain in business. Mark Ward from the State Attorney General's office is representing Daggett County on this matter. See attachment #3.

- Estimated Jobs lost during the period of high flows is 80. (16% of the total County employment) See Attachment #4.
- Estimated Sales loss for four (4) weeks over 8600 CFS plus 2 week ramp up and ramp down would be approximately $1.8 million. See Attachment #5 & #6.

1f <u>Will Businesses, the County and employees be reimbursed for economic losses</u>?

2) Infrastructure Damage and Loss

In 1983 the bridge at Taylor Flat was washed out. In 1984 the bridge was replaced. This bridge is the only really good access to the south side of the river between the Flaming Gorge Dam and Jensen. The Swinging Bridge at the Colorado State Line provides some access although it is a suspension bridge and very narrow. The Taylor Flat Bridge provides access to the Taylor Flat Subdivision that has 1000 lots. Most are not developed but several residents live there year round. Mention is made in the DEIS about possible damage to this structure with high flows. We are not aware of any study to determine what flows this bridge could withstand.

1g Would monies be available to replace this bridge quickly if needed?

In 1999 many of the trial between the Dam and Little Hole. In 1983 the Spillway Road and Boat Ramp were washed out. These things could have longer term effects on businesses and visitors.

We believe these impacts should have been better addressed in the DEIS.

1h 3) Safety Concerns
With higher flows the velocity of the river would increase greatly (possibly from 2 mph to 8 mph). This increased velocity, plus the high flows would make accidents more serious for those who happen to tip over their boat or raft. People have rafted, and wade fished this river the past few years during the low flows could be caught off guard by the increased depth and speed of the river, which could lead to more serious accidents.

Thank you for considering these comments. Please respond to the questions which are underlined.

Sincerely,

Chad Reed Commission Chair	Craig Collett Commissioner	Stewart Leith Commissioner

ATTACHMENT #1

Spillway Monthly Total				2004 4/16 To 9/30				
Month	Guide Launches	Guided Clients	Guide Fun Trips	Public Launches	Gen Public # of People	Fishing	Scenic Floating	Trail/Shore Use
April	424	798	45	1,195	2,756	2,675	18	187
May	777	1,533	70	1,394	4,101	3,595	169	290
June	883	1,705	50	2,093	7,219	3,535	3,232	583
July	466	938	81	2,525	13,726	2,468	10,641	701
August	396	767	33	1,614	7,898	1,668	5,757	333
September	512	1,016	32	909	2,855	1,654	855	151
October								
TOTAL	**3,458**	**6,757**	**311**	**9,730**	**38,555**	**15,595**	**20,672**	**2,245**

Little Hole Monthly Total				2004 4/16 To 9/30				
Month	Guide Launches	Guided Clients	Guide Fun Trips	Public Launches	Gen Public # of People	Fishing	Scenic Floating	Trail/Shore Use
April	51	103	4	41	1,865	1,841	18	13
May	122	266	6	70	2,716	2,556	116	53
June	343	672	5	56	3,422	2,997	367	58
July	154	297	12	67	4,041	2,223	1,789	29
August	65	120	8	25	2,709	1,395	1,284	30
September	85	183	4	33	1,785	1,385	379	21
October								
TOTAL	**820**	**1,641**	**39**	**292**	**16,538**	**12,397**	**3,953**	**204**

Combined Total	4,278	8,398	350	10,022	55,093	27,992	24,625	2,449

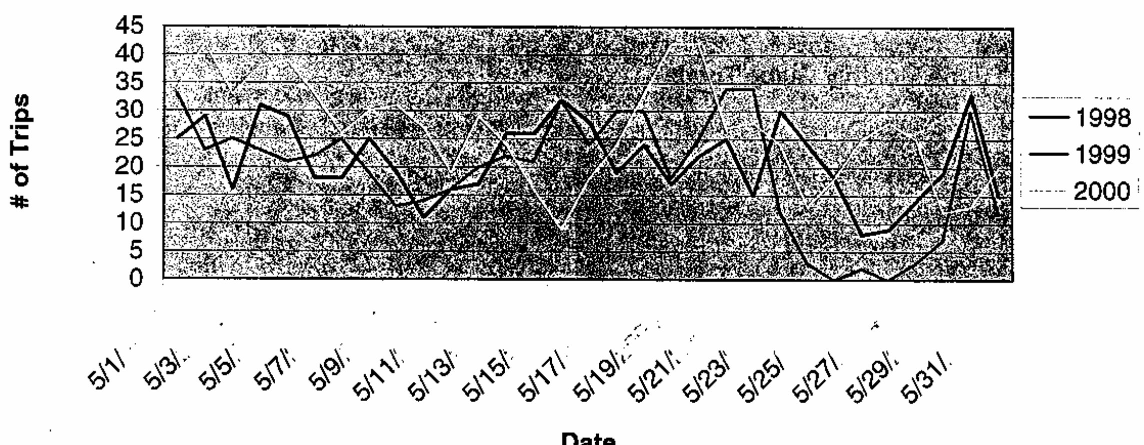
Booths were Staffed for six hours a day Monday through Thursday
Booths were Staffed for ten hours a day Friday through Sunday

MAY AVERAGE GUIDE LAUNCHES 30/DAY
JUNE AVERAGE GUIDE LAUNCHES 40/DAY

	May-98	May-99	May-00
Date	# of Trips	# of Trips	# Of Trips
1-May	25	33	34
2-May	29	23	42
3-May	16	25	33
4-May	31	23	38
5-May	29	21	39
6-May	18	22	33
7-May	18	25	26
8-May	25	19	30
9-May	19	13	31
10-May	11	14	27
11-May	16	16	19
12-May	17	20	29
13-May	26	22	24
14-May	26	21	16
15-May	32	32	9
16-May	28	24	18
17-May	19	30	24
18-May	24	30	33
19-May	17	18	42
20-May	22	25	42
21-May	25	34	27
22-May	15	34	28
23-May	30	12	24
24-May	24	3	13
25-May	18	0	18
26-May	8	2	25
27-May	9	0	28
28-May	14	3	25
29-May	19	7	12
30-May	33	30	13
31-May	15	12	20
TOTAL	**658**	**593**	**822**

	Jun-98	Jun-99	Jun-00
Date	# of Trips	# of Trips	# of Trips
1-Jun	24	12	23
2-Jun	16	12	30
3-Jun	16	17	32
4-Jun	18	11	23
5-Jun	27	23	26
6-Jun	24	15	28
7-Jun	20	17	27
8-Jun	27	9	37
9-Jun	24	11	37
10-Jun	27	27	25
11-Jun	22	7	14
12-Jun	19	10	36
13-Jun	30	15	31
14-Jun	28	21	31
15-Jun	30	24	33
16-Jun	15	20	39
17-Jun	15	13	26
18-Jun	21	21	17
19-Jun	30	19	24
20-Jun	30	16	29
21-Jun	19	22	32
22-Jun	25	20	25
23-Jun	30	15	39
24-Jun	25	28	27
25-Jun	20	38	22
26-Jun	26	29	23
27-Jun	24	23	22
28-Jun	17	25	14
29-Jun	20	24	13
30-Jun	21	25	11
TOTAL	**690**	**569**	**796**

May Guide Trips 1998-2000



KEVIN CLEGG ASSISTANT RIVER MANAGER U.SFS.
FLAMING GORGE RANGER DISTRICT.

ATTACHMENT #2

ATTATCHMENT # 3

STATE OF UTAH

OFFICE OF THE ATTORNEY GENERAL

MARK L. SHURTLEFF

ATTORNEY GENERAL

RAYMOND A. HINTZE
Chief Deputy

KIRK TORGENSEN
Chief Deputy

November 15, 2004

VIA FAX (801-379-1159)

Peter Crookston
Flaming Gorge EIS Manager
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Re: Operation of Flaming Gorge Dam Draft Environmental Impact Statement August, 2004

Dear Mr. Crookston:

I write at the request and authorization of the Daggett County Commission to comment on Daggett County's behalf regarding the above-referenced Draft EIS.

As explained more fully in Daggett County's own comments, the Draft EIS preferred alternative aims to release water from the dam at such a high volume, over such a lengthy amount of time, and at such a time during the year, that the release will adversely affect the commercial and private use of the Green River and hence devastate the businesses of approximately 13 commercial river and fishing guide and outfitting companies, whose income depends almost entirely on their customers' experience on the Green River beneath the dam at a time when the preferred alternative will almost entirely negate fishing and other experiences due to high water volume. Most of the owners and employees of the companies threatened by this action are local citizens of Daggett County, and the local economy stands to suffer if these businesses are ruined.

The purpose of this letter is to advise you on behalf of Daggett County, that these river guide companies whose employment and revenues are so important to Daggett County's

Peter Crookston
Flaming Gorge EIS Manager
Bureau of Reclamation
November 15, 2004
Page 2

economy, intend to pursue a Court of Claims action under the Tucker Act, 28 U.S.C. § 1491, to recover compensation for economic loss caused by the actions of the preferred alternative. The United States Court of Appeals for the Tenth Circuit in *Gordon v. Norton*, 322 F. 3d 1213 (10th Cir. 2003), recognized that a Tucker Act remedy is available for loss of business occasioned by a federal action related to species preservation.

Please note also that Daggett County reserves the right to pursue Tucker Act and other claims for any other loss or damage that may result from the actions contemplated under the preferred alternative, including but not limited to any damage that high river flows may cause to a bridge on an RS 2477 Daggett County road that crosses the Green River below the dam.

Sincerely,

MARK L. SHURTLEFF
UTAH ATTORNEY GENERAL

J. Mark Ward
Assistant Attorney General
Public Lands Section

cc. Utah Association of Counties
Daggett County Commission
Uintah Basin Association of Governments

AttATCHMENT # 4

<<Wed, 10 Nov 2004 09:14:12 -0700>>

Date: Tue, 09 Nov 2004 16:36:28 -0700
From: "Michael Hanni" <mhanni@utah.gov> WORK FORCE SERVICES EASTERN REGION
To: <braymond@daggett.state.ut.us>
Subject: Re: Economic Development

Brian,

Funny you should ask, I just ran those numbers yesterday.

Non-farm employment Totals for Daggett County (2004):

Jan	349	7.7% (% Growth over the same month last year.)
Feb	345	3.6%
Mar	392	9.2%
Apr	491	13.9%
May	513	4.1%
Jun	550	2.8%

While these employment numbers are much better than those of last year, they are slightly lower than the numbers for 2002:

Jan	355	18.3%
Feb	340	15.3%
Mar	347	5.2%
Apr	460	14.1%
May	506	5.2%
Jun	567	6.2%
Jul	563	4.1%
Aug	545	1.1%
Sep	525	1.7%
Oct	473	9.2%
Nov	448	10.3%
Dec	398	13.4%

80 JOBS LOST
16% of TOTAL EMPLOYMENT

Unfortunately, there isn't enough employment in Dutch John that I could give you specific numbers. I'm bound by privacy laws to not disclose data for an industry in an area that has less than 3 businesses, or where one firm makes up the vast majority of the employment in that sector.

What is the impact of a higher river? Does it hurt fishing, or? Sorry, I didn't know they were considering this.

Cheers,

- 1 -

Attachment #5

GROSS TAXABLE SALES BY COUNTY AND BY MAJOR INDUSTRY
CALENDAR YEAR 1999 THROUGH 2003

COUNTY=DAGGETT

OBS	SICMAJOR	SALES 1999	SALES 2000	SALES 2001	SALES 2002
120	MINING (1011-1499)	.	$49,755	.	.
121	CONSTRUCTION (1521-1799)	$110,756	.	$66,294	$300,050
122	MANUFACTURING (2011-3999)	$16,592	$18,907	$25,995	$176,797
123	TRANSPORTATION (4011-4789)	$226,976	$243,126	$340,041	$653,057
124	COMMUNICATIONS (4812-4899)	$554,234	$511,493	$626,233	$1,184,342
125	ELECTRIC & GAS (4911-4971)	$143,948	$427,353	$1,191,690	$895,004
126	WHOLESALE-DURABLE GDS(5012-5099)	$174,503	$36,711	$166,873	$1,035,553
127	WHOLESALE-NONDURABLES(5111-5199)	$79,001	$448,121	$94,230	$97,164
128	RETAIL-BLDNG & GARDEN(5211-5271)	.	.	.	$97,540
129	RETAIL-GEN.MERCHNDISE(5311-5399)	$24,286	$24,499	.	.
130	RETAIL-FOOD STORES (5411-5499)	$144,936	$120,429	$634,589	$152,220
131	RETAIL-MOTOR VEHICLES(5511-5599)	$489,341	$583,666	$736,423	$1,559,796
132	RETAIL-APPAREL&ACCSRY(5611-5699)	$3,568	$21,299	$8,487	$4,655
133	RETAIL-FURNITURE (5712-5736)	$10,752	$11,286	$5,670	$15,966
134	RETAIL-EATING&DRINKNG(5812-5826)	.	.	$668,242	.
135	RETAIL-MISCELLANEOUS (5912-5999)	$248,666	$241,961	$302,523	$172,960
136	FIN.,INS.& REALESTATE(6011-6799)	$30,815	$116,589	$35,677	$54,744
137	SERVICES-HOTEL&LODGNG(7011-7041)	$3,779,233	$4,082,927	$2,727,582	$2,667,262
138	SERVICES-PERSONAL (7211-7299)	.	.	.	$2,041
139	SERVICES-BUSINESS (7311-7389)	$425,747	$434,225	$536,937	$404,546
140	SERVICES-AUTO&REPAIR (7513-7699)	$390,941	$173,090	$68,667	$64,055
141	SERVICES-AMUSEMNT&REC(7812-7999)	$690,620	$1,112,665	$1,327,694	$30,754
142	SERVICES-EDUCATION (8111-8999)	.	.	$12,797	.
143	PUBLIC ADMINISTRATION(9111-9721)	$24,595	.	.	.
144	PRIVATE MOTOR VEHICLE SALES	$704,550	$1,068,012	$1,096,143	$1,038,807
145	OCCASIONAL RETAIL SALES	$819	.	$731	$19,630
146	NONDISCLOSABLE \ NONCLASSIFIABLE	$2,279,074	$4,125,253	$2,844,226	$3,076,797
147	PRIOR-PERIOD PAYMENTS & REFUNDS	$529,967	$-149,393	$1,117,361	$1,044,850
COUNTY		$11,083,920	$13,701,974	$14,635,105	$14,748,590

1.8 MILLION
12% of TOTAL SALES.

http://www.tax.utah.gov/esu/sales/cnty5.htm

11/15/2004

ATTACHMENT# 6

Dear Daggett County Commissioners;

Should the Bureau of Reclamation choose to adopt the Action Alternative flows, our loss would be substantial. Old Moe Guide Service is our major source of income.

If these flows take place in the spring, May and June, as they have in the past, our losses could be as many as 6 boats per day at $375 per boat or $2250 per day. This would mean 6 guide jobs and 3 shuttle driver jobs. If this were to happen for any length of time, it would pretty much put us out of business. We would be forced to sell our home in Dutch John, if we could, and leave the area after being in business here for 25 years.

Thank you,

Terry & Gayle Collier
Old Moe Guide Service

1. Daggett County, State of Utah

1a
Reclamation extended invitations to the States of Colorado, Utah, and Wyoming with the understanding that the States would coordinate with potentially affected counties and represent their concerns. Of the three States, only the State of Utah wished to be a cooperating agency. In fact, Reclamation notes that the Utah Attorney General has commented on the draft EIS on behalf of Daggett County. Nevertheless, Reclamation would have welcomed any county as a cooperating agency, but no requests for such were received from any counties.

1b
NEPA analysis was not undertaken to determine the effects of the 1992 Biological Opinion. The changes in operations prior to and including 1992 were considered to be within the scope and authority of existing operations. This EIS originated with commitments to the public to undertake NEPA analysis for both the 1992 operational changes stemming from the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations.

1c
Reclamation agrees with this comment. The EIS text has been corrected in section 3.13.2.

1d
The text has been corrected in the final EIS.

1e
Changes in employment and labor income for the Action Alternative for the three-county area of Daggett, Uintah, and Sweetwater as compared to the No Action Alternative under average, wet, and dry conditions is presented in the socioeconomic section (4.12) of the EIS. The regional economic analysis is driven by changes in recreational expenditures associated with both river and reservoir recreation. Expenditure information was gathered via recreator surveys which did not provide enough detail for county specific analyses. Based on pretests, it was determined that the survey was already complex (given the need to address visitation, valuation, and expenditure information by alternative), and any attempts to gather more detailed data by county would have significantly added to survey complexity possibly jeopardizing survey usefulness. Attempts to allocate expenditures by county would be highly speculative. The analysis does show the overall effect of losses in Green River recreational expenditures being outweighed by gains in Flaming Gorge Reservoir recreational expenditures during wet and dry conditions. While certain recreation oriented businesses (e.g., lodging, restaurants, and gas stations) could be adversely impacted by losses in Green River visitation under the Action Alternative, many of these same businesses (with the exception of river dependent businesses—e.g., river guides) could also benefit from the additional reservoir recreation visitation and expenditures.

1f
The EIS analysis shows no significant socioeconomic differences between the No Action and Action Alternatives, so no reimbursement would be necessary or required. Lack of appropriate county or community specific data precluded analyses to lower levels of detail. Therefore, since this is a three-county aggregated analysis, we cannot say how individual counties, individual communities, or individual businesses would be affected. It is noted that under either alternative, the same uncertainties regarding future hydrology would continue.

1g
No. As stated in the EIS (section 4.6), there is no significant difference between the Action and No Action Alternatives for structures (bridges and pipelines) crossing the Green River.

1h
Reclamation agrees that as flows vary from the minimum 800-cfs flow to the maximum powerplant flows and occasionally including bypass releases, the velocities will increase as well. However, incremental changes will be made gradually and on an hourly basis. Currently, through efforts of the Flaming Gorge Working Group, the agreed upon ramping rate is established at 800 cfs per hour. This ramping rate has been the agreed upon standard since the Flaming Gorge Working Group meeting of April 11, 1994. It becomes easy to be complacent in the mindset of stable flow regimes during a prolonged drought cycle, but as climate conditions change to more normal hydrologic cycles, rafters and the fishermen are going to have to adapt to the possibility of higher flows in the river under either alternative. If the climactic conditions ever return to a 1983, 1986, or 1992 type hydrologic period, everyone will need to be conscious of the possibility of very high flows in the river. Reclamation will provide notification in advance of projected high release patterns as early as possible to the public through established channels.

Reclamation notes that flows above 4,600 cfs and daily fluctuations have been a normal part of dam operations for over 40 years, and would continue under either the Action or No Action Alternatives.

Attachments 1 and 2
Based on 2004 data on guided launches, commercial guide trips drop essentially to zero by the time flows reach 6,500 cfs. In the text of the letter, Daggett County commissioners suggest that flows in excess of 4,600 cfs makes it “almost impossible for commercial guides to get people to fish the river under high flow conditions.” These data and statements are consistent with the guide boat fishing visitation analysis in the EIS. The recreator survey, conducted by USDA Forest Service in summer of 2001, suggests that guide boat recreators would stop participating on average at flows of 3,731 cfs. Therefore, the analysis used in the EIS is actually somewhat more restrictive and conservative compared to the high end flow threshold that Daggett County is suggesting.

Attachment 3
The State Attorney General’s letter-comment noted; see responses to this letter above.

Attachments 4–6
Daggett County provides data on Daggett County employment by month for 2002 and first 6 months of 2004. They also provide county data for Gross Taxable Sales by industry for 1999-2002. They then claim 80 jobs would be lost (16% of total employment), and $1.8 million in sales would be lost (12% of total sales). It was unclear how they came up with these estimates of loss; no basis was provided, and it is impossible to say whether these losses correlate to river flows.

The City of ROCK SPRINGS WYOMING Chamber of Commerce
A Great Place to Work & Play!

November 17, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager, PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT 84606-7317

Dear Mr. Crookston:

I would like to address some concerns the Rock Springs Chamber of Commerce Board of
Directors have about the recently published Draft Environmental Impact Statement
(DEIS) on the operation of the Flaming Gorge Dam. It appears one of the major
objectives of the proposed release schedule would be to increase water temperature below
2a the Flaming Gorge Reservoir. With water temperature increasing how will it effect the
2b upstream migration of Northern Pike and what negative effects will this have on the
2c current Trout population? Theses populations and their associated economic impact are
2d worth millions of dollars to the local economies. Furthermore, what impact will Northern
Pike have on the recovery of the endangered species you are trying to enhance?

2e Another area of critical concern is the distribution of the New Zealand Mud Snail. This
non-native invasive species is already present below Flaming Gorge Dam. In your data it
is estimated that this species could make up 95% of the invertebrate biomass in the Green
River system. The DEIS also states that Trout derive very limited nutritional values from
the consumption of the New Zealand Mud Snail. Also, on page 73 of the DEIS it states,
"ultimate distribution, densities, and this invasive species effect on the existing aquatic
community remains uncertain." I find it inconceivable that the U.S. Fish and Wildlife
Service and Bureau of Reclamation would in fact participate in the spread and
2f propagation of an invasive non-native species. What are your plans to mitigate any of the
negative outcomes your agency may produce by its action in this matter?

We look forward to your response on this most urgent of issues.

Sincerely,

Jerry N Taylor   Dave

Jerry Taylor, Board President — Rock Springs Chamber of Commerce
David Hanks, CEO — Rock Springs Chamber of Commerce

1897 Dewar Drive • P. O. Box 398 • Rock Springs, Wyoming 82902-0398
Phone: (307) 362-3771 or 1-800-GO-DUNES • Fax: (307) 362-3838
E-mail: rschamber@sweetwaterhsa.com

2. ROCK SPRINGS, WYOMING, CHAMBER OF COMMERCE

2a and 2b

See sections 4.19.4 and 4.21 regarding the role of the Recovery Program in addressing this uncertainty. Additionally, the State of Utah currently has an aggressive and successful northern pike management program in place on the Green River below Flaming Gorge Dam, and the Recovery Program is implementing similar measures in the Yampa River.

2c

Reclamation agrees that the fisheries within the reservoir and river are valuable. That is why analyses of both recreation economic value and regional economic impact were provided in the recreation (4.11) and socioeconomics (4.12) sections in the EIS.

2d

Northern pike have been demonstrated to directly and negatively impact nearly every life stage of endangered fish through predation. However, the State of Utah currently has an aggressive and successful northern pike management program in place on the Green River below Flaming Gorge Dam, and the Recovery Program is implementing and expanding similar measures in the Yampa and Colorado Rivers. It is expected that the Recovery Program will continue to play a significant role in management of nonnative predators such as northern pike in the future under both Action and No Action Alternatives.

2e

The New Zealand mud snail can comprise up to 95% of invertebrate in some aquatic systems, not necessarily the Green River system. See section 4.7.2.1.2, last paragraph.

2f

Reclamation's environmental commitments related to the proposed action are stated in section 4.21 of the EIS. We do not anticipate that the proposed action will result in an increase or spread of the mud snail. After checking with local experts on mud snails in the Green River, we cannot identify any specific mitigation measure that could be implemented, whether or not our action causes an adverse effect. Importation of the New Zealand mudsnail was probably human-caused, and thus prevention measures identified to date pertain to this type of vector. Little (if any) research exists on effects of large-scale perturbations such as dam releases on snail biology. Reclamation encourages all anglers to thoroughly dry or freeze their waders after fishing in one locality to help reduce the spread.

Town of Manila

P.O. Box 189
Manila, UT 84046-0189

Phone: (435) 784-3143
Fax: (435) 784-3356

Home of The Flaming Gorge

Mayor
Chuck Dickison

Town Clerk
Judy Archibald

Deputy Clerk
Andrea Scott

Council Members
Ida Marie Twitchell
Lenita Steinaker
Dellene Alvis
Connie Reed

11/10/04
Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774 Bureau of Reclamation
Provo Area Office
302 East 1850 South
Provo, Utah

Dear Mr. Crookston,

The following will address an area of significant concern for Manila. It will also provide a statement of support for the Daggett County Commission and a concern for the economic welfare of Dutch John. It will ask for your reconsideration in the matter.

3a

The Manila Council and this Mayor share a deep concern regarding the substantial economic impact imposed with the facilitation of the EIS for the operation of Flaming Gorge Dam. Those persons who depend upon the fishing and rafting revenue for their existence will lose significant income. Daggett County estimates the loss to that industry and the support services to be in the hundreds of thousands of dollars. Manila will share in that revenue loss to a smaller degree with the impact to tourism.

3b

Surely, the motivation to consider the high water releases cannot equate to the economic losses to a county population already impacted by the government ownership of 90 % of the land This does not address the certain impact to infrastructure to be sustained below the dam by the high releases. The consequences of such a decision should be a significant part of the process.

In conclusion, the Manila government body and certainly the local constituents willingly provide their support to the request for a decision reconsideration. Subsequently, we respectfully ask that the Bureau of Reclamation consider the legitimate concerns expressed by a significant segment of the affected population.

Cc: Daggett Commission

Sincerely,
Chuck Dickison
Chuck Dickison, Mayor

3. TOWN OF MANILA, UTAH

3a
Reclamation acknowledges and has explained in the EIS that the Action Alternative could create adverse impacts for certain Green River recreation activities and businesses (e.g., commercial operators), particularly under wet and dry conditions as compared to the No Action Alternative. The lack of appropriate county specific expenditure data precluded the development of impacts solely for Daggett County. In anticipation of this data gap, a survey was conducted during the summer of 2001 to specifically identify economic impacts to commercial operators. The results of the survey were presented in a separate subsection under socioeconomics. The EIS analyzed both river and reservoir recreation. While we cannot describe potential impacts specifically for Dutch John, Manila, or even Daggett County due to lack of data, from an overall perspective, it should be noted that expenditure gains on the reservoir appeared to outweigh losses on the river. Therefore, it is possible that under the Action Alternative, certain recreation oriented businesses (e.g., lodging, restaurants, gas stations) will be adversely impacted by reductions in Green River recreation visitation, but many of these same businesses (with the exception of river dependent businesses—e.g., river guides) could also benefit from the additional reservoir recreation visitation and expenditures.

3b
As stated in the EIS (Section 4.6, "Land Use") there is no significant difference between the Action and No Action Alternatives for structures (bridges and pipelines) crossing the Green River. In wet years, there may be greater effects under the Action Alternative for campgrounds, boat ramps, and access roads.

TriCounty Health Department
www.tricountyhealth.com

Joseph B. Shaffer, M. A., M.B.A., E.H.S.
Director/Health Officer

Uintah County Office
147 East Main
Vernal, Utah 84078
(435) 781-5475
Fax: (435) 781-5372
WIC (435) 781-5480

Duchesne County Office
50 East 100 South
P.O. Box 210
Duchesne, Utah 84021
(435) 738-2202

Daggett County Office
Flaming Gorge Community
Health Center
P.O. Box 156
Manila, Utah 84046
(435) 784-3494

Roosevelt Office
281 East 200 North
Roosevelt, Utah 84066
(435) 722-5085
WIC (435) 722-3987

TriCounty
Dental Clinic
198 West 200 North
Vernal, Utah 84078
(435) 781-0875
Fax: (435) 781-0975

November 9, 2004

Mr. Peter Crookston,
Flaming Gorge EIS Manager, PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

RE: Operation of Flaming Gorge Dam Draft EIS

Dear Mr. Crookston,

4a Flooding in the Green River bottomlands region presents enormous acreages of productive mosquito habitat. Millions of mosquitoes per acre can be produced and many thousand of acres are involved. Of great concern is the production of mosquitoes which carry West Nile virus. The almost level contour of much of the Green River bottomland scenery with even minor increases in river elevation at high water can translate into huge additional acreages of overflow mosquito habitat. We have had documented cases of West Nile virus in Uintah County and feel we need to do all we can to prevent it. There is no question that more water in the Green River bottomlands means more mosquitoes. More mosquitoes means more mosquito control and that can be very expensive to perfectly time and repeat applications. At this time the money and applications are sufficient for the number of mosquitoes in the county. Additional applications would be more expensive and would result in an increase in property tax. If the Action Alternative
4b is implemented, the taxpayers of Uintah County should be awarded full and fair federal compensation for higher mosquito control expenses. However, financial compensation still does not protect Uintah County citizens from the influx of mosquitoes and potential diseases.

Thank you for the opportunity to comment on the Operation of Flaming Gorge Dam Draft EIS.

Respectfully,

Joseph B. Shaffer, M.A., M.B.A., E.H.S.
Director/Health Officer

4. TriCounty Health Department

4a
Comment noted

4b
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

UINTAH COUNTY

STATE OF UTAH

Our past is the nation's future

November 15, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager, PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

RE: Operation of Flaming Gorge Dam Draft EIS

Dear Mr. Crookston:

Uintah County takes a strong stance in opposition to the Bureau of Reclamation's proposed action of increased flows of water from the Flaming Gorge Dam.

The following concerns need to be considered and addressed:

5a **Uintah County Plan:** Protection of private property is a crucial element of the Uintah County Plan, and any damage caused to agricultural property would not be consistent with the plan. The release of extra water when the river is at its fullest would purposely flood shallow ground on private agricultural property.

Noxious Weeds: The flood water would carry and spread white top, Russian olives and other
5b noxious weeds throughout the agriculture property reducing crop yields, thus income, and it would create a financial burden on the land owners and the county to control the weeds.

5c **Flood Control:** Flood control is not addressed in this EIS. The action alternative predicts an increase in frequency of flooding in order to assist in the recovery of endangered fish. In section S.16.5 "Uncertainties Associated with Flood Plain Inundation", reference is made to strategies that could meet the needs of the endangered fish without the extreme flooding predicted in wet years under the Action Alternative. These strategies should have been evaluated as an alternative.

The Action Alternative should address how to modify flow regimes in order to avoid exceeding
5d harmful maximum flows within the safety limitation of the Dam. Higher flows and increased sedimentation suggested in the Action Alternative would cause damage to irrigation pumps and
5e irrigation systems. This damage would include the equipment, the cost of installation and the loss of crop production caused by the inability to deliver water to upland crops during the time it takes
5f to repair flood caused damaged irrigation equipment. The crop damage could extend for several years if perennial crops like alfalfa die before irrigation can be restored. Flooding and prolonged

COUNTY BUILDING • 152 EAST 100 NORTH • VERNAL UTAH 84078

standing water will kill crops, especially long term crops, which are expensive to replant. Standing water and flooding leaves land incompatible for agricultural use.

5g Damage to irrigation pumps and equipment could be minimized if adequate warning is given to farmers before peak releases are made. However, little can be done if excessive flooding occurs.

Some of the private lands are diked, which means that flooding elevation would have to be raised to go over the dike and flood the ground.

It is important to the citizens of Uintah County to preserve their culture. Grazing and livestock are
5h part of this culture that has been in the Basin for over 150 years. Flooding these lands would destroy this culture, use and enjoyment, and would be in conflict with the Uintah County Plan.

Release: The timing of the peak release is a concern. (S-30, table S-7) The releases from Flaming Gorge Dam are based on the peak flow of the Yampa River, however the peaks of the Yampa River
5i and the Green River do not coincide. When the Green River is released based on the Yampa peak, this will result in sediment deposits over the spawning area. These impacts must be analyzed and reported in the document. Releasing water at peak time would destroy the trails, campground and
5j parking lot located below the dam.

Mosquitos: Flooding in the Green River bottomlands region presents enormous acreage of productive mosquito habitat. Millions of mosquitos per acre can be produced and many thousand
5k of acres are involved. Of great concern is the production of mosquitoes which carry West Nile Virus. The almost level contour of much of the Green River bottomland topography with even minor increases in river elevation at high water can translate into huge additional acreage of overflow mosquito habitat.

Mosquitos have a substantial impact on livestock by causing weight loss and a deterioration of the general condition of the animals. We have had documented cases of West Nile Virus in Uintah County and feel we need to do all we can to prevent it. There is no question that more water in the Green River bottomlands means more mosquitos. More mosquitos means more mosquito control and that can be very expensive to perfectly time and repeat applications. The land owners will incur a cost associated with mosquito control since mosquitos can only be controlled and not eliminated.

If mosquitos are not controlled, this would prevent enjoyment and use of personal property which is a property right, thus, this could result in a take of this right.

The Uintah Mosquito Abatement District is funded by local property taxes. When flooding occurs, funds are inadequate to control mosquitos. Additional applications would be more expensive and would result in an increase in property taxes. Uintah County citizens should not be the ones to pay
5l for the Recovery Program for Endangered Fish species. If the Action Alternative is implemented, the taxpayers of Uintah County should be awarded full and fair federal compensation for higher mosquito control expenses. However, financial compensation still does not protect Uintah County citizens from the influx of mosquitos and potential diseases. Now that West Nile Virus has been found in Uintah County, we have to deal aggressively to prevent further incidences. Human life is

by far the most important issue, and loss of life is not worth the possible marginal benefit of increased flow rates.

Page 2, 1.2 Lead and Cooperative Agency. A review of this section confirms the County's position that this Draft Environmental Impact Statement was prepared without the participation of Uintah County as cooperator. The Code of Federal Regulations 40, 1501.6 Cooperating Agencies states, "The lead agency shall: (1) request the participation of each cooperating agency in the NEPA process at the earliest possible time." We object to not being included and not having cooperating
5m status to help develop this plan.

Many of the impacts associated with this proposal are on land within the jurisdiction of Uintah County which has governmental powers over such lands and a responsibility to protect the health and welfare of the people impacted, as well as the land and it's associated economics.

Page 117, 3.13.2 Public Safety Considerations for the Green River. At the end of the first paragraph it states, "The river has exceeded 18,000 cfs 5 times in the past 10 years and 10 times in
5n the past 20 years." Data available to us indicates that the river has not exceeded a flow of 12,300 cfs in the past 42 years. The analysis is flawed and the entire project needs to be re-analyzed, as it has tremendous implications with this flawed data.

Uintah County supports the "No Action Alternative".

Uintah County has no further comments at this time but reserves the right to comment later, if warranted.

Sincerely,

UINTAH COUNTY COMMISSION

David J. Haslem, Chairman

Jim Abegglen

Michael J. McKee

Michael J. McKee

cc: Public Lands Committee

5. UINTAH COUNTY, STATE OF UTAH

5a
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. Section 4.5 of the EIS concludes that in comparing the Action and No Action Alternatives, there is not a significant difference for crop losses due to inundation.

5b
Since the arrival of invasive species in the Unitah Basin (tamarisk was probably present by the 1930s) flooding has facilitated their spread. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years and for the spread of invasive species. That potential will continue under either alternative.

5c
While flood control is an authorized purpose of CRSP, there are no flood control benefits identified for Flaming Gorge. Therefore, there are no restrictive operational rules imposed by the Corps of Engineers for flood control. However, floodplain inundation has occurred less frequently since Flaming Gorge Dam was built.

5d
The Action Alternative does not include releases that exceed the ability of the dam to safely make releases. All proposed releases are within the historic range of releases from the dam. Please see section 2.5.1 in the EIS.

5e and 5g
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

5f
These issues were analyzed and discussed in the EIS. Section 4.5 of the EIS concludes that in comparing the Action and No Action Alternatives, there is not a significant difference for crop losses due to inundation. Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less

frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative.

5h
Flood plain inundation has occurred along the Green River in the past, though less frequently since Flaming Gorge Dam was built. There has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. The presence of the dam for over 40 years has indeed served to moderate flooding. However, this was never intended to mean that the flood plain would remain permanently dry. It means only that there is increased ability to moderate potentially catastrophic flows. Since the dam was built, there have been a number of wet years where high flows have occurred, such as 1983. Whether or not the proposed action is implemented, high flows would be expected in the future, and none of the high flow targets in the Action Alternative exceed the very high natural flows that have occurred historically.

As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will under either alternative continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

5i
See sections 4.19, 4.20 and 4.21. The 2000 Flow and Temperature Recommendations are intended to aid in recovery of four endangered fish species by restoring a more natural flow regime to the Green River. The authors of the 2000 Flow and Temperature Recommendations recognized that certain aspects of the flows may affect certain species differently than others. One objective of spring peak flows is to entrain razorback sucker larvae into flood plain depressions, so it is possible that these peak flows would normally occur after spawning activity. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group, which will evaluate criteria listed in table 2-5 when making recommendations. This allows opportunities to refine flow attributes based on an adaptive management process.

5j
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements below the high water mark have always been made by property owners at their own risk. Please see response to 5a and 5h above.

5k and 5l
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1 and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and a threat from West Nile virus or other mosquito-borne diseases.

5m
Reclamation extended invitations to the States of Colorado, Utah, and Wyoming with the understanding that the states would coordinate with potentially affected counties and represent their concerns. Of

the three States, only the State of Utah wished to be a cooperating agency. Nevertheless, Reclamation would have welcomed any county as a cooperating agency, but no requests for such were received from any counties.

5n
Reclamation agrees with this comment. The EIS text has been corrected.

Uintah Mosquito Abatement District

Director
Steven V. Romney

P.O. Box 983
Vernal, Utah 84078

Phone: 435-789-4105
Fax: 435-789-1891

November 8, 2004

Peter Crookston
Flaming Gorge EIS Manager
PRO-774 Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Dear Mr. Crookston:

This for the Public Record commentary addresses the "Operation of Flaming Gorge Dam Environmental Impact Statement" as applies to Green River Bottomlands Reach 2 of Project Area 1.

When seasonally flooded with river sub-up or overflow water the Green River bottomlands region, as referenced, is transformed into enormous acreages of some of the most productive aquatic mosquito habitat in North America. This is a fully documented biological fact. Literally **millions** of mosquitoes per acre can be produced. Many **thousands** of acres of such habitat are involved. Some floodwater mosquito species can migrate in staggering numbers as far as 20 miles from their bottomlands points of origin and are a very real threat to public health, veterinary health, ranching and agriculture, outdoor recreation, outdoor commerce and the economically vital tourist industry in Uintah County, Utah.

Of new and deepest concern is the ongoing potential for the large scale river bottomlands production of the mosquito species, Culex tarsalis, an extremely abundant and superbly competent local vector of West Nile Virus (WNV). Ecologically, the additional mosquito habitat to be activated with the proposed artificially enhanced and prolonged flooding of the Green River periphery presents a reproductive bonanza for this now critically important species. Due to the flattened, almost level contour of much of the Green River bottomlands topography, even "minor" increases in river elevation at high water can translate into huge additional acreages of prime mosquito habitat.

Since the first documentation of the presence of WNV in the Western Hemisphere (New York City, 1999), the virus has rapidly spread westward to encompass 48 U.S. States and the District of Columbia. In 2003, the first human and equine WNV infections ever recorded in Utah were acquired in Uintah County. The same year, the state of Colorado suffered an incredible 2,947 human WNV infections. Sixty-three were fatal, while many more proved to be permanently debilitating. With the ongoing westward expansion of WNV, "only" ten human infections were recorded for Utah in 2004.

The widest spectrum of critical yet often subtle environmental conditions which must fall into place in order to trigger a major WNV event are not yet sufficiently understood to provide an absolute and consistently reliable predictive scenario for the future. Notwithstanding, a **hard biological fact** now confronts our citizens: West Nile Virus is a new, extremely dangerous and thoroughly established **permanent resident** of Uintah County, Utah. There is very sound medical justification for acting in accordance with the distinct possibility that the 2005 and future seasons will prove pivotal in fully defining the long term public health and economic impact of that pathogen. At present our County is in every way unequivocally "primed" for what may well prove to be a major epidemic event. The greater dynamics of WNV amplification in the environment with its ultimate expression in human and other vertebrate populations can though, with certainty, be profoundly influenced by the timely **prevention** and effective **control** of vector mosquito populations.

Large scale river bottomlands mosquito control is extremely expensive and is, for innumerable logistical and biological reasons, immensely challenging. It demands perfectly timed and repeated low level aerial applications of biological control larvicides to flooded mosquito sources randomly dispersed throughout some 50 linear miles of remote, often densely vegetated nearly impenetrable river periphery. Perfect mosquito control in every instance is essentially impossible.

6a The Uintah Mosquito Abatement District is funded with local property taxes. Should Uintah County taxpayers be forced to pay for the critically essential control of the soon to be much larger and **medically important** mosquito populations when their otherwise simple **prevention** is wholly dependent on the whim of the Recovery Program For Endangered Fish Species? Should the same citizens then bear the inevitable medical and economic consequences exacted upon them by such environmental policy decisions? Succinctly stated, artificially sustained, higher than would otherwise seasonally occur Green River flows equal **far more mosquitoes,** some of which the next time around will be carrying WNV with the capacity to kill human beings, equines and a diversity of avian species.

6b There is little doubt that the Flaming Gorge Dam "Action Alternative" will be implemented. The Recovery Program with its ongoing and inexorable agenda is thoroughly entrenched and supported by far reaching legal powers and huge sums in budgetary resources. Accordingly, I am formally requesting that immediate preparatory steps be taken wherein by mutual negotiation the Uintah Mosquito Abatement District (and thus the taxpayers of Uintah County) at the least be awarded full and "fair" federal compensation (such funds **can** be found) for those additional and far higher public health mosquito control expenses which will inevitably result from the policy implementation above. Such totally justified federal supplemental monies would, at least to some limited extent I believe, serve to elevate our citizens above the status of hapless victims in this matter. From the mosquito's perspective, federal support in exchange for Uintah County's blood is no doubt a good deal.

6c Consider this: Do the conjecture based Recovery Program research benefits to be achieved by the "let's see what happens if we flood the river bottomlands" option in fact outweigh the **for certain** adverse consequences to be exacted upon **us** and other vertebrate species?

I am eager, as the need will surely arise, to vigorously address any questions pertaining to the utter **validity in science** of my observations and deepest concerns, above. **Please** perceive this most urgent statement with every prudent care and consideration.

I thank you sincerely for your valuable time and attention.

Respectfully,

Steven V Romney

Steven V. Romney, Ph.D., Director
Uintah Mosquito Abatement District

6. UINTAH MOSQUITO ABATEMENT DISTRICT

6a and 6b

The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1 and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases, such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

Proposed flows are intended to produce a more natural hydrograph, not "an artificially sustained flow." In Reach 2, where the Uintah Mosquito Abatement District sprays, dam operations supplement flows from the Yampa River, to greater or lesser degrees depending on the hydrology of the respective basins.

6c

We do not anticipate adverse consequences to humans if the 2000 Flow and Temperature Recommendations are implemented. The river flood plain is likely to be inundated in wet years under either alternative.

WATER USER AGENCIES AND ORGANIZATIONS

1. **Central Utah Water Conservancy District**
2. **Colorado River Energy Distributors Association**
3. **Colorado River Water Conservation District**
4. **Duchesne County Water Conservancy District**
5. **Sweetwater County Conservation District**

Central Utah Water Conservancy District

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R. Roscoe Garrett, Vice President

Don A. Christiansen, General Manager
Secretary/Treasurer

November 15, 2004

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation
302 East 1860 South
Provo, Utah 84606-7317

Sent Via Fax and Mail

Subject: Draft Environmental Impact Statement (August 2004) – Operation of Flaming Gorge Dam

Dear Mr. Crookston,

Thank you for the opportunity to comment on the August 2004 Draft Environmental Impact Statement for operation of Flaming Gorge Dam. We recognize the importance of Flaming Gorge Dam operations in providing the flexibility in flow and temperature management to protect and assist in recovery of endangered fish populations.

We understand that Flaming Gorge Dam plays an important role in offsetting depletions to the Green River resulting from the operation of federal and non-federal projects in the basin. As stated in Section 1.1, "Modifying the operation of Flaming Gorge Dam will also serve as the RPA, as defined by the ESA, to offset jeopardy to endangered fishes and their critical habitat that could result from the operation of numerous other existing or proposed water development projects in the Upper Colorado River Basin."

1a Even though there are numerous references to the Upper Colorado River Endangered Fish Recovery Program (RIP) program, we believe that it is important to emphasize the important role that the Upper Colorado River Endangered Fish Recovery Program (RIP) plays in the work to recover the fish and in allowing water development to continue.

As to proposed or future water development, the Central Utah Water Conservancy District, the Duchesne County Water Conservancy District, and the Uinta Water Conservancy District are working together to study future water demands in the Uinta Basin and ways to meet those demands. Key factors in this regard include change of use of water, development of new tributary water supplies, conservation, and the utilization

of the Flaming Gorge direct flow water rights that have been conveyed from Reclamation
1b to State of Utah. The Flaming Gorge water rights will be used in the future as Utah
continues to develop its share of the Colorado River. This should be recognized in the
document. Furthermore, the document should recognize, perhaps in Section 4.16.1.1, that
1c as depletion increases, the role of the RIP will become even more important in meeting
its objective of recovery of the fishes while providing for new water development.

If you have any questions, please contact Rich Tullis, at 801-226-7122.

Sincerely yours,

Richard L. Tullis, P.E.
Assistant General Manager

1. CENTRAL UTAH WATER CONSERVANCY DISTRICT

1a
Comment noted. See sections 1.4.4 and 4.16.4.1.1 of the EIS regarding the dual role of the Recovery Program in recovering the endangered species while allowing water development to continue.

1b
The possible effects of the proposed action on water rights were analyzed and, as stated in section 1.8.4 of the EIS, there is no effect to water rights from either the Action or No Action Alternative. Clarification has been added to section 1.8.4 of the EIS.

1c
As stated in sections 1.4.4 and 4.16.4.1.1 of the EIS, the Recovery Program recognizes future depletions in the Upper Basin States.

CREDA
Colorado River Energy Distributors Association

ARIZONA
Arizona Municipal Power Users Association

Arizona Power Authority

Arizona Power Pooling Association

Irrigation and Electrical Districts Association

Navajo Tribal Utility Authority (also New Mexico, Utah)

Salt River Project

COLORADO
Colorado Springs Utilities

Intermountain Rural Electric Association

Platte River Power Authority

Tri-State Generation & Transmission Association, Inc. (also Nebraska, Wyoming, New Mexico)

Yampa Valley Electric Association, Inc.

NEVADA
Colorado River Commission of Nevada

Silver State Power Association

NEW MEXICO
Farmington Electric Utility System

Los Alamos County

City of Truth or Consequences

UTAH
City of Provo

Strawberry Electric Service District

Utah Associated Municipal Power Systems

Utah Municipal Power Agency

WYOMING
Wyoming Municipal Power Agency

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2a

November 8, 2004

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774, Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT 84606-7317 email: fgeis@uc.usbr.gov

RE: Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS), September 1, 2004

Dear Mr. Crookston:

The Colorado River Energy Distributors Association (CREDA) offers the following comments on the above-referenced document. These comments should be considered supplementary to the verbal comments provided at the October 13, 2004 public hearing in Salt Lake City, Utah, and to CREDA's August 4, 2000 comments on the Notice of Intent to Prepare a Draft Environmental Impact Statement (June 6, 2000). Fundamentally, the National Environmental Policy Act (NEPA) process must achieve "a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities." 42 U.S.C. Section 4331(b)(5). NEPA requires informed decisions—not ideal decisions.

CREDA is a non-profit organization founded in 1978, whose members are all firm electric service contractors of the Colorado River Storage Project (CRSP). CREDA members serve approximately three million consumers in six western states. As CRSP contractors, CREDA members have a direct interest in this process. CREDA is also represented in the committees of the Upper Colorado River Endangered Fish Recovery Program (RIP), and participated in the development of the Flow and Temperature Recommendations for Endangered Fish in the Green River Downstream of Flaming Gorge Dam (published in September 2000 by the RIP). Lastly, CREDA members Utah Associated Municipal Power Systems and Utah Municipal Power Agency are cooperating agencies in this process.

I. **General comment about hydropower and drought situation**: The Bureau's power program is the caretaker for some of the Nation's most important electrical resources. Hydropower has been labeled the "most successful form of renewable energy." It provides the only way to "store" electricity (in the form of water) for later use. We are concerned that additional changes in operation of Flaming Gorge will reduce water storage benefits and hydroelectric power supplies as the West suffers from historic droughts and Nation is facing energy shortages and escalating energy costs. In recent years, Utah, and many parts of the West, have reported record-breaking draws on the power grid. 2003 wholesale power prices were at record highs. And demand for electricity is projected to grow substantially over the next two decades. President George W. Bush has directed any agency that takes an action with a "significant adverse effect" on the supply of domestic energy resources to comply with Executive Order No. 13211. The President, in that order, directed the agencies to "appropriately weigh and consider the effects of the Federal Government's regulations on the supply, distribution, and use of energy." We urge Reclamation not to operate Flaming Gorge in a way that continues to reduce its 1974 historic generating capacity or its ability to store water for multiple uses. Flaming Gorge should be operated to avoid jeopardy to endangered species while maintaining the congressionally authorized purposes of, and the requirement to produce the "greatest practicable amount of power and energy..." from, the Colorado River Storage Project (CRSP) (Sec. 7, CRSP Act of 1956). It should be noted that nothing in the 1968 CRBPA affects this section of the CRSP. Moreover, the Supreme Court has held that the discussion of alternatives required by NEPA is limited by an agency's statutory purposes.

2b

2c II. **Purpose and Need**, 1.1, and 1.4.1, pages 2-4: Why is "the development of water resources" called out specifically as an authorized purpose here and in the transmittal letter? This distinction could lead one to believe that this purpose "trumps" the other authorized purposes (as identified verbatim in S.3.1. Reference is made to the Colorado River Basin Project Act of 1968. However, reference should also be made to section 601(a) of that Act, which expressly provides that nothing in it "shall be construed to alter, amend, repeal, modify, or be in conflict with the provisions of", among other things, the compacts, the treaty with Mexico or the Colorado River Storage Project Act. The section 308 references to fish and wildlife and recreation purposes are "in connection with the project works authorized pursuant to" the 1968 Act. In addition, the language contained in the first paragraph of Section 1.4.1, page 4, implies that endangered fish recovery efforts can "hold hostage" the CRSP Section 7 obligation to produce "the greatest practicable amount of power and energy..." (see comment I.) by impacting water resource development. Endangered fish recovery efforts are the express purview of the RIP, and to impose a standard other than the requirement of Reclamation to "avoid jeopardy" is inconsistent with NEPA and ESA.

III. **Hydropower,** 2.6.3, pages 41-42: We understand the need to develop an economic analysis attributable to any alternative. However, an economic analysis should not be the sole indicator of power resource impacts. It is our understanding that the economic analysis indicates generation of 11,374.3 GWH in the Action Alternative, which, when compared to the No-Action Alternative, is a reduction of 529.8 GWH. The analysis is based on market prices, which may lead one to believe that the economics are based on a snapshot of Western's selling the energy on the spot market. Western's contractual obligations to deliver CRSP resources to its firm power contractors assume an integrated CRSP resource. Depending on the availability by hour of the Flaming Gorge resource, the actual financial impact to Western and its customers may be much greater than is portrayed in a market economic analysis. Did the power resource analysis and modeling take into account Western's contractual obligations CRSP-wide as opposed to analyzing spot market impacts and costs based solely on Flaming Gorge's operations?

2d

2e IV. **Description of CRSP customers,** 3.4, page 60, last paragraph: On October 1, 2004, 54 tribes have the opportunity of becoming CRSP firm electric service contractors.

V. **Environmental Consequences,** 4.2.1.2. Action Alternative, page 126: The Action Alternative increases the use of spillways to about 15 days per year in 7% of all years. How does this compare to expectations for original project use of the spillways FOR EMERGENCIES ONLY? CRSP contractors are responsible for the operation, maintenance and repair costs of the Project. The estimated $12,000 annual inspection cost, along with $30,000 repair cost should be factored into the financial impacts to CRSP customers. The Colorado River Basin Fund is in dire straits due to drought, environmental and market conditions. Any action which potentially draws funds from the Basin Fund must be critically scrutinized. The costs attributable to any spillway use resulting from changed operations for endangered fish should be non-reimbursable and provided by appropriations. Historical spillway use both prior to and

2f

2g post-1992 should be assessed for cumulative impact purposes. This same comment applies to increased operation costs as a result of added selective withdrawal adjustments

2h VI. **Financial Analysis Results,** 4.4.3.3.: This section indicates insignificant CRSP rate impact but does not address potential Basin Fund cash implications. In order to meet its contractual obligations to the CRSP firm power customers, Western Area Power Administration at times must make firming purchases to accommodate changed operations. Long-term rate impacts are certainly an essential analysis for the DEIS; however, the DEIS is lacking a cash flow analysis based on the Action Alternative and its potential impact on Western's contractual obligations and potential firming purchase requirements. If CRSP Basin Fund impacts are significant enough, this could result in an emergency rate increase. The Action Alternative indicates that the proposal would "lessen Western's ...purchase requirements by an average of approximately $950,000". Did this analysis take into account changed patterning of the Flaming Gorge resource as it is integrated into the Salt Lake City Area Integrated Projects (SLCA/IP) resource in total? How current is the market price analysis, and does this take into account the potential of an increased CRSP rate (process beginning this month).

VII. **Flow recommendations/flooding,** 4.13, page 224: the flow recommendations are simply
2i one way to meet the endangered fish needs. It is CREDA's opinion that the intent of the recommendation is to obtain an AVERAGE of flows, not to meet specific flows contained in the recommendations. They may be options, such as levee removal, which would serve to meet the intent of the recommendations without causing additional impact to power production. The Biology Committee of the RIP has recently discussed (August, 2004) a report (Hayse, et al. 2004) suggesting refinement of flow recommendations put forth by Muth et al. (2000) to take into consideration two concepts: 1) larval endangered fish may survive nonnative fish predation if the floodplain site has been reset (i.e. gone through a sequence of drying and filling) and 2) the utility of floodplains as nursery sites are likely a function of their site specific features (e.g., depression, terrace) and location. According to a recent study by Valdez and Nelson (2004), for a given volume of water, maintaining inundation of priority depression floodplains could be achieved by removing or modifying levees so the magnitude of flows needed is reduced (e.g., from 18,600 to 14,000 cfs). Sites chosen for this treatment would be depression floodplains closest to spawning areas. In contrast, when flow recommendations were developed, levels were based on the relationship between flow and total area of inundated floodplains with levees in place. Also, they did not differentiate between depression and terrace floodplains or the length of time these habitats would hold water.

Benefits of the Argonne approach, using surplus or spilled water in good hydrologic years to achieve environmental purposes, not only would be to achieve floodplain inundation at lower flows but it would: 1) increase the number of years floodplains are connected to the main channel; 2) increase the duration of floodplain connectivity in a given year; and 3) improve entrainment of larvae into floodplain nursery habitats. Another significant benefit of this
2j proposal would be a reduction in the need for bypass and spill at the dam. The DEIS should take into consideration this significant new information, through implementation of the flow recommendations in accordance with the Argonne approach. In fact, the law requires the use of the best available science in this process. The lead agency must use, to the maximum extent practicable, the environmental analysis and recommendations of cooperating agencies consistent with its own responsibilities as the lead agency. 40 C.F.R. Section 1501.6(a)(2); See also CEQ FAQs at 14(b)(A). Further, if relevant data are known to be available to the agency or will be available as the result of ongoing or imminent studies, the FWS should request that data or any other analyses required by the regulations as part of the consultation. Argonne's work clearly meets these standards and should be considered and incorporated as the best available science. If the needs of the species can be met through non-operational alternatives, it
2k appears prudent to do so, to not only preserve the power purpose of the projects, but to avoid an evacuation situation near Jensen, Utah "because notification of potential high flows will allow

2l ample evacuation time." Notwithstanding health and safety issues, what about property
damage? Prevention of flooding must be addressed during this process, as it is also an
2m authorized purpose pursuant to the CRSP.

VIII. **Hydrology, Cumulative Impacts,** 4.16.2, page 231-232: Please confirm if the cumulative
impacts from changes in operations since 1974 is $98 M. Cumulative impact assessment and
2n incorporation is critical in understanding the true impacts to CRSP power customers resulting
from 30 years of changed operations. Interim operation criteria for the dam were established
in 1974. As a result of initial evaluations of the effects on endangered fish, operations were
modified from 1985 to 1991 to benefit the endangered fish. Operations of the dam were
further modified beginning in 1992 to benefit the endangered fish and to conduct a five-year
research program. To our knowledge, NEPA compliance was not completed on either of these
2o Federal actions. The base from which impacts of the proposed action should be measured
must be the 1974 operations. Changes in operations since 1974 are substantial and must be
adequately addressed in this process. The DEIS should clearly and succinctly identify these
impacts, which are significant in scope. Otherwise, the combined effects of these related
actions will not be discussed and evaluated. "Cumulative effects to power generation have
been negative due to past operational changes, and would continue to be negative on balance."
2p (S-38). Any and all efforts to mitigate increased impacts on power production should be
undertaken.

In the event Reclamation extends the deadline by which comments on the DEIS are to be received, we would like the opportunity to supplement these comments. Thank you for the opportunity to comment and to participate in the public meeting process.

Sincerely,

/s/ Leslie James

Leslie James
Executive Director
Cc: CREDA Board

2. Colorado River Energy Distributors Association (CREDA)

2a
Executive Order No. 13211 relates to actions concerning regulations that significantly affect energy supply, distribution, or use. The proposed action in comparison to the No Action Alternative does not significantly affect the production of electricity at Flaming Gorge Dam.

2b
Reclamation agrees Flaming Gorge should be operated to avoid jeopardy to endangered species while maintaining the congressionally authorized purposes of the dam, and believes that the proposed action as analyzed in the EIS is consistent with this comment.

2c
Development of water resources was highlighted in the EIS narrative to illustrate the close connection between this authorized project purpose, the proposed action, and the Recovery Program. Avoiding jeopardy to listed species and assisting in their recovery is consistent with both statute and the agreements of the Recovery Program.

2d
Western's contractual obligations were not a specific input to the modeling for the economic analysis; however, the market prices that were used implicitly reflect supply and demand conditions for the entire grid. Reclamation did not pursue further detailed CRSP system-wide analysis due to the relatively insignificant economic impact on power. The financial analysis performed by Western, separate from the economic analysis, did explicitly include Western's contractual obligations CRSP-wide. The financial analysis, in section 4.4.3.2 of the EIS, concluded that the Action Alternative would not have a significant effect on the rate CRSP customers pay.

2e
Comment noted. Text was added to section 3.4 of the EIS.

2f
Reclamation agrees that incremental O&M costs should be non-reimbursable.

2g
As stated in the EIS, use of the spillway in the past has been rare. There are uncertainties associated with increased use of the spillway as discussed in section 4.19.3. Reclamation agrees that incremental O&M costs should be non-reimbursable.

2h
The information in section 4.4.3.2, along with the estimate of reducing Western's purchase requirements by $950,000, was calculated and provided by Western. Based on input from Western, although a cash flow analysis of the Basin Fund was not conducted, such an analysis would have shown a small favorable effect on the Basin Fund's liquidity. The $950,000 estimate did reflect the changed patterning of the Flaming Gorge resource. The market price analysis was current at the time of the analysis but was several years old at the time the draft EIS was released to the public. As acknowledged in the draft EIS in section 4.4.2, a more current or different price set could result in a negative impact versus the positive impact displayed in the report; but, in either case, Reclamation and Western believe the impact on the Basin Fund would be small relative to its projected balance. This conclusion would be accurate even with a potential increase in the CRSP rate which is being considered for unrelated reason.

2i
Reclamation does recognize in the EIS that achieving the 2000 Flow and Temperature Recommendations as written is one of several requirements to recover the endangered fish. Reclamation is committed to using the best available information when making decisions regarding the operation of Flaming Gorge Reservoir. If better information becomes available for this purpose, Reclamation will utilize it in an adaptive management approach to making operational decisions. To this point, Reclamation has relied on the 2000 Flow and Temperature Recommendations as the best available information regarding endangered fish recovery in the Green River in the EIS process. Both the 2000 Flow and Temperature Recommendations and the EIS describe spring peak flows as "greater-than-or-equal-to" a given flow, implying a minimum peak flow, not an average. Regarding flood plain inundation uncertainties, see section 4.19.5 and 4.21.

2j
See sections 4.19.5, 4.21, and response to CREDA comment 2h above. The 2000 Flow and Temperature Recommendations of the Action Alternative were the result of 7-8 years of peer-reviewed data collection and analysis. The Argonne report is still the subject of much discussion and has not been fully peer reviewed, however its significance has been addressed in section 4.19.5 alongside other hypotheses for flood plain inundation and endangered fish recruitment outlined in the 2000 Flow and Temperature Recommendations.

2k
The EIS states (section 1.4.4) that the proposed action cannot by itself lead to recovery of the endangered fish. Section 1.4.4 describes the five main elements of the Recovery Program, and states further that operation of the dam relates to two of these five Recovery Program elements.

2l
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative.

2m
The authorized purpose of flood control remains in effect under either the Action or No Action Alternatives.

2n
The cumulative impact estimated for hydropower represents the difference between the alternatives and a scenario without the biological constraints. The economic value resulting from the analysis determined a value under the scenario of limited biological constraints over the same 25-year timeframe as the two alternatives, for comparison purposes.

The estimated cumulative impacts hydropower economic value does not represent what the economic value would have been since 1974 as prices and generation (under the alternatives) from the last 29 years were not available or used in the model. Generation estimated in the cumulative impacts scenario is less than 3 percent greater than under the No Action Alternative.

2o
Reclamation, in consultation with the eight cooperating agencies, defined the

No Action Alternative to include operations to achieve the flow and temperature regimes recommended in the 1992 Biological Opinion. In making that definition, it was also recognized by Reclamation and the cooperating agencies that hydropower impacts associated with changes made between 1974 and 1992 should be recognized in this EIS as cumulative impacts. Operational changes made prior to 1992 are described in section 1.4.2. Hydropower impacts associated with changes made prior to 1992 have been addressed in section 4.16.2.

2p

Cumulative impacts to hydropower have been addressed in section 4.16.2. As stated in the description of the proposed action, Reclamation intends to continue all authorized purposes of Flaming Gorge Dam, including hydropower, if the Action Alternative is implemented.

COLORADO RIVER WATER CONSERVATION DISTRICT

Protecting Western Colorado Water Since 1937

November 15, 2004

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
U.S. Department of Interior
Bureau of Reclamation
Provo Area Office
302 E. 1860 South
Provo UT 84606-7317

SUBJECT: Comments on Operation of Flaming Gorge Dam Draft Environmental Impact Statement, dated August 2004

Dear Mr. Crookston:

3a The Colorado River Water Conservation District (River District) was created by the Colorado Legislature in 1937 to protect and develop Colorado's Colorado River entitlements. The Green River in Colorado is within the River District boundaries. The River District is very concerned with the potential effect re-operation of CRSP projects like Flaming Gorge will have on the ability of Colorado to develop its Colorado River entitlements.

The River District is an active participant in the Recovery Program for the Endangered Fishes of the Upper Colorado (Recovery Program). We understand the purpose of the re-operation considered in the Operation of Flaming Gorge Dam Draft EIS (DEIS) is to meet the flows recommended by the U.S. Fish and Wildlife Service in 2000 for the explicit purpose of recovering the listed fishes.

We have considered the DEIS and offer the following comments:

3b The DEIS does not appear to consider how the proposed changes in operations at Flaming Gorge Dam will impact the authorized original and continuing purpose of meeting downstream compact delivery requirements.

Operations of Flaming Gorge Dam have been adjusted significantly over time as the purported

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flow needs of the listed fishes have been estimated. In the DEIS the USBOR has considered the
3c most recent operations as the baseline and not recognized the impacts of operational changes which have already been made to benefit the listed fishes.

The DEIS says in paragraph 3.7.2.4.2.3 "Efforts to increase the availablity of flood plain habitats *(presumably through meeting the 2000 flow recommendations)* to benefit razorback sucker will
3d have to account for the potential benefit to non-natives as well." We could not find in the DEIS where USBOR has accounted for the potential benefit to non-natives (and related impacts to the listed species) created by the implementation of the recommended flows although, the superior exploitation of the flood plain habitats by non-native fishes is well documented in the DEIS ("In the flood plain habitats, in excess of a million fish were collected with non-native species accounting for over 99% of the total catch in most areas." Paragraph 3.7.2.4.4.2; and in Paragraph 3.7.2.4.4.3 "The nonnative species greatly outnumbered native fish in these important habitats every year." and "As the river flows receded, many of their larvae were flushed out to the main channel.") The non-native fish issue is also not included in the summary of uncertainties
3e which USBOR proposes to address through adaptive management. We request that the USBOR include in the final EIS and Record of Decision the uncertainty for the success of any operational
3f scenario for Flaming Gorge Dam aimed at benefitting the listed fishes in the presence of the non-native fishes.

The DEIS recognizes in Section 4.19.5 that additional information generated since the 2000 flow recommendations which reveals that most of the flood plain habitats in reasonable proximity to the razorback spawning sites can be flooded at 13,000 cfs rather than the recommended 18,600 cfs (Valdez and Nelson, 2004) contributes significantly to the uncertainty that the 2000 flow recommendations as considered by the DEIS are <u>necessary to meet the stated objectives</u>. This uncertainty and the potential that the purposes of Flaming Gorge Dam might be better served by
3g conservation of water in the reservoir need to be addressed more completely in the final EIS and Record of Decision.

The River District looks to USBOR to continue to operate its facilities, including Flaming Gorge Dam, in a manner which is consistent with their original and continuing authorized purposes and with the objectives of the Upper Colorado River Recovery Program, while maintaining the highest standard of scientific integrity. We look forward to continuing our cooperation with the USBOR in this regard.

If you have any questions concerning these comments please contact me at your convenience.

Sincerely,

Ray D. Tenney, P.E.
Senior Water Resources Engineer

3. Colorado River Water Conservation District

3a
The proposed action is consistent with Recovery Program efforts to recover the four endangered species. The Recovery Program was created specifically to recover the endangered species while providing for the continuation of water development.

3b
Section 1.1 of the EIS states that the proposed action is to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact.

3c
The Flaming Gorge EIS captures the existing environment (baseline) as including changes due to the construction of the dam as well as its operations prior to 1992. Changes and effects resulting from the construction of the dam and its pre-1992 operations are considered in the cumulative impacts analysis in section 4.16 of the EIS.

3d
Section 4.19.4 in the EIS has been revised in response to this comment.

3e
Presence of nonnative fish was added to the uncertainties section 4.19. See response to Colorado River Water Conservation District 3d.

3f
Section 4.19.4 in the EIS has been revised based on this comment.

3g
The EIS states Reclamation's intent to implement all of the 2000 Flow and Temperature Recommendations as described in the Action Alternative. Section 4.19 explains the uncertainties associated with implementing the Action Alternative, including in section 4.19.5 those uncertainties associated with flood plain inundation. Both the EIS and the 2000 Flow and Temperature Recommendations acknowledge that, over time, as additional information becomes available, refinements to the flow and temperature recommendations may prove to be warranted if data suggests that tradeoffs between peak flow magnitude and duration provide greater benefits to endangered fish. Reclamation believes that if such refinements are proposed at some as yet unknown point in the future, based upon information developed through adaptive management or through ongoing Recovery Program research, there will be ample opportunity to obtain appropriate review and input from all Recovery Program participants as well as the interested public.

Upper Chain Lake

Duchesne County Water Conservancy District

855 East 200 North (112-10)
Roosevelt, Utah 84066
General Manager: Randy Crozier
Assistant Manager: Don W. Winterton
Admin. Assistant: Adrienne S. Marett

Office: (435) 722-4977
Cellular: (435) 823-5726
Fax: (435) 722-4827

November 15, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager
PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 840606

Dear Mr. Crookston:

When the Ultimate Phase of the Central Utah Project was dissolved, the U.S. Bureau of Reclamation was left with a 430,910 acre-foot storage filing in the Flaming Gorge Reservoir. The Utah Division of Water Resources was given control over the water right in order to preserve the 1956 priority date. The Division of Water Resources segregated the water right to conservancy districts, irrigation companies, and individuals for beneficial use. In 1999, the Duchesne County Water Conservancy District (DCWCD) was approved for 47,600 acre-feet of this Flaming Gorge water (with 3,200 acre-feet of the allocation for municipal and industrial use (M&I) use and 44,400 acre-feet for supplemental irrigation).

We recently reviewed the Draft Environmental Impact Statement for the Operation of Flaming Gorge Dam and wish to voice our concerns that the operation of said dam not impact the delivery of DCWCD's allocated water right. We felt that the comments made in Section 1.8 of the Flaming Gorge DEIS were too
4a brief and did not fully explain how the water rights allocated to the above entities would be protected. As DCWCD is in the process of putting our allocated water rights to beneficial use, we are very concerned that these rights be protected. DCWCD would like to see this issue addressed in more detail, rather than by general reference in Section 1.8.

We appreciate the opportunity to comment on this DEIS. For any further questions, please feel free to call me at the Duchesne County Water Conservancy District office at (435) 722-4977 or my cellular phone at 823-5726.

Sincerely,

Randy Crozier by Don Winterton

Randy Crozier
General Manager

4. DUCHESNE COUNTY WATER CONSERVANCY DISTRICT

4a
In accordance with the Council on Environmental Quality regulations implementing NEPA (40 Code of Federal Regulations [CFR] 1500.1), the EIS is intended to fully disclose significant information while remaining as concise as possible. Since there are no effects to water rights under either the Action or No Action Alternatives, the disclosure of this fact in section 1.8.4 of the EIS is sufficient and appropriate treatment of the issue. Clarification has been added to this section. The statement of purpose and need in section 1.1 provides for the continuation of authorized purposes, including development of water resources.

SWEETWATER COUNTY CONSERVATION DISTRICT

Mary E. Thoman, Chairman   Randy Shipman, Vice Chairman   Jean Dickinson, Secretary   Tom Burris, Treasurer   George Stephen, Member

79 Winston Drive, Suite 110
Rock Springs, Wyoming 82901   (307) 362-3062   (307) 362-1459 Fax

November 9, 2004

Flaming Gorge EIS Manager, PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Re: Comments regarding the Operation of Flaming Gorge Dam Draft Environmental Impact Statement

Dear Mr. Peter Crookston,

The Sweetwater County Conservation District ("District" or "SWCCD") submits the following comment with respect to the Operation of Flaming Gorge Dam Colorado River Storage Project Draft Environmental Impact Statement.

The District is established pursuant to Wyoming law to promote the conservation and management of natural resources within the district, including soil and water. State law defines the term "conservation" broadly to include "development, improvement, maintenance, preservation, protection and use of natural resources, and the control and prevention of floodwater and sediment damages, and the disposal of excess waters." Wyo. Stat. §11-16-102(iv). The District is also granted authority to assist, promote, and protect public lands and natural resources, soil, water, and wildlife resources, to develop water and to prevent floods, to stabilize the ranching and agriculture industry, to protect the tax base, and to provide for the public safety, health, and welfare of the citizens. The District is charged with conserving, protecting, and developing these resources on all lands within the District, including federal, state, and private land. The District boundaries include all of Sweetwater County. For these reasons, the District has a direct interest in the U.S. Department of the Interior (USDOI) Bureau of Reclamation (BOR) operation of Flaming Gorge Dam.

5a The District was not contacted regarding cooperating agency participation in this EIS process. Due to the limited amount of time the District has had to familiarize with the draft, our comments are limited at this time. The District reserves the right to supplement the comments when additional information is made available.

5b The District hereby requests that the USDOI BOR consider the 2001 Green River Basin Plan in all aspects of the Operation of Flaming Gorge Dam Colorado River Storage Project Environmental Impact Statement.

CONSERVATION ● DEVELOPMENT ● SELF-GOVERNMENT

5c The District hereby requests the consideration of the Sweetwater County Conservation District interim policy October 2004 Draft Land and Resource Use Plan and Policy in all aspects of the Operation of Flaming Gorge Dam Colorado River Storage Project Environmental Impact Statement, in particular the policies on pages 37 through 41 (see enclosed draft Plan).

Very truly yours,

Mary E. Thoman

Mary E. Thoman, Chairman
Sweetwater County Conservation District

CONSERVATION • DEVELOPMENT • SELF-GOVERNMENT

5. SWEETWATER COUNTY CONSERVATION DISTRICT

5a
Reclamation extended invitations to the States of Colorado, Utah, and Wyoming with the understanding that the states would coordinate with potentially affected counties and represent their concerns. Of the three States, only the State of Utah wished to be a cooperating agency. Nevertheless, Reclamation would have welcomed any county as a cooperating agency, but no requests for such were received from any county.

5b
As requested, Reclamation reviewed the 2001 Green River Basin Plan, which presented current and future (projected to 2030) recreation use within the Green River and Bear River Basins of Wyoming. As stated in section 1.8.1 of the EIS, the proposed action would not affect the Green River upstream of Flaming Gorge Reservoir. Recreational effects to Flaming Gorge Reservoir were estimated as generally positive (please see section 4.11.3.2.1 and 4.11.3.2.2 of the EIS).

Regarding water quality, Reclamation did not see anything to address or that was of concern in this plan.

Chapter 4.0, Environmental Consequences, clearly describes how the analysis of future water demands within the Upper Green and Little Snake River Basins in Wyoming was performed. Reclamation did not find projected water use data specific to the Upper Green and Little Snake River Basins. The data is combined for both basins into a single value, which makes it difficult to determine how any differences between the data presented in the Wyoming report and the depletions of the Flaming Gorge Model would affect the results of the Flaming Gorge Model.

However, Reclamation has determined that the depletions used in the Flaming Gorge Model are very similar to the depletions reported in the Wyoming report. The report gives three scenarios (low, moderate, and high) of development to the year 2030. Reclamation compared these values to the values presented in the Upper Colorado River Commission (UCRC) Report (dated 1999) which gives estimates of future depletions in the Upper Division States. The depletions used in the Flaming Gorge Model were derived from the UCRC Report. Reclamation found that the depletions in the Wyoming Report are slightly higher than those in the UCRC Report but well within the range of those values. We do not believe that the difference between these sources is significant enough to have any meaningful impacts on the results of the Flaming Gorge Model under any of the alternatives that were modeled.

The UCRC is Reclamation’s source for projected depletion information. Wyoming is an active member of the UCRC. If the Wyoming State Engineer has obtained updated information regarding projected depletions, he should encourage UCRC to share this new information with Reclamation so that Reclamation's modeling efforts on the Colorado River can be updated to the most current projected depletions schedules.

5c
As requested, Reclamation has reviewed the Sweetwater County Conservation District Land and Resource Use Plan and Policy. We do not find anything in that plan that would be of concern relative to the proposed action as analyzed in the EIS.

ORGANIZATIONS

1. **Living Rivers, Colorado Riverkeeper**
2. **Trout Unlimited**
3. **Uintah Mountain Club**
4. **Water Consult Engineering and Planning Consultants**
5. **Utah Waters**
6. **Western Resource Advocates and The Nature Conservancy**

LIVING RIVERS
COLORADO RIVERKEEPER®

November 15, 2004

Mr. Peter Crookston
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606

RE: Comments on Draft Environmental Impact Statement on operations at Flaming Gorge Dam

Dear Mr. Crookston,

Living Rivers and Colorado Riverkeeper submit the following comments on the Draft Environmental Impact Statement (DEIS) for the re-operation of Flaming Gorge Dam to benefit endangered fish, as released on September 7, 2004.

While the four-year effort to produce this document has proved useful in generating a better understanding of the challenges facing the recovery of endangered fish below Flaming Gorge Dam, the analysis is not yet sufficient to support the proposed action. The water supply and hydrograph assumptions do not correlate with present trends. The role of endangered fish recovery relative to other operational objectives has yet to be properly clarified. The proposed action fails to address the pitfalls in the structure and mandate associated with the proposed Adaptive Management Program as experienced with Reclamation's recovery efforts for endangered fish at Grand Canyon. The DEIS did not properly review the merits of recovery efforts through a dam decommissioning alternative. Lastly, as noted in our scoping comments of July, 2000, Colorado River endangered fish recovery should be tiered to a programmatic EIS that evaluates recovery needs and barriers throughout the historic range of these endangered fish species. We hope these matters will be properly addressed prior to completion of the Final EIS (FEIS).

1. Water availability

1a The DEIS failed to sufficiently address how long-term water availability will impact fish recovery in the lower Green River, and as a result did not sufficiently demonstrate whether the proposed recovery efforts can be successful in this limited stretch of river.

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www.livingrivers.org

1b Flow scenarios did not take into consideration the prospect of how climate change will affect river flows. The present drought has demonstrated that flows may be significantly lower than forecasted as precipitation patterns for the Green River watershed may be changing. The Department of Energy has forecasted how western rivers as a whole may experience a 30 percent reduction in flows over the next 50 years due to climate change.

2. Action Alternative is not consistent with the natural hydrograph

The DEIS acknowledges the recommendation to manage the recovery of endangered fish species on a dam-controlled river by mimicking the historic natural hydrograph and thermograph, as much as possible. We believe that the flow recommendations of the DEIS departs from this prescribed treatment. We believe the spring peak flow of the Action Alternative is much reduced and therefore diminishes the success in achieving the goal to recover endangered fish. We also believe that the Action Alternative's base flow, from the summer to winter season, is higher than the historic hydrograph and too does not reflect compliance with the biological data.

1c Furthermore, instead of timing releases from Flaming Gorge Dam with the natural flow of the Green River, the flow recommendation of the Action Alternative is timed to meet the natural hydrograph of the Yampa River, a tributary of the Green River downstream of the dam. We believe this too diminishes the recovery of endangered fish in the Green River, especially in Reach One (Flaming Gorge Dam to the confluence with the Yampa River).

1d We believe the DEIS overlooked the benefits associated with the Run of the River Alternative, as suggested by the National Park Service. We encourage Reclamation to scrutinize further the possibilities of implementing such an action plan. We believe strongly that matching the historic attributes of the river is what will eventually provide a greater measure of success in the recovery of endangered fish species, until which time the dam can and will be successfully decommissioned, as is enevitable.

3. Clarify the priority of satisfying the Endangered Species Act

The DEIS sometimes refers to the recovery of endangered fish as distinct from the authorized purposes of Flaming Gorge Dam (Sec.1.1). At other times the DEIS implies that the authorized purpose of Flaming Gorge Dam does include the improvement of critical habitat for fish and wildlife. The FEIS must make
1e clear that fish recovery is paramount as the Bureau of Reclamation must comply with the Endangered Species Act first and foremost, then allow for other dam operational benefits to be pursued accordingly.

4. Adaptive Management Program protocols

The DEIS indicates that the Action Alternative includes the implementation of an Adaptive Management Program concerning the future operations at Flaming

Gorge Dam. This program will consist of the Flaming Gorge Working Group and a Technical Working Group. The purpose of the Flaming Gorge Working Group is to provide a check and balance system for the purposes that authorized Flaming Gorge Dam, including the recovery of endangered fish. The purpose of the Technical Working Group is to provide scientific expertise for the program.

Such a program has been underway for nearly ten years at Glen Canyon Dam, but the results have been disastrous. One more species has gone extinct, the Razorback Sucker, and the Humpback Chub has declined to nearly irreversible numbers. This has occurred for the lack of: a) a clear mandate for independent, peer-reviewed science that is removed from politics, b) to guide the decision making process by placing fish recovery at a priority below power generation, c) not ensuring there are sufficient funds to operate the program.

1f Reclamation must identify how the Flaming Gorge Dam Adaptive Management Program will avoid the pitfalls that have plagued the program at Grand Canyon.

1g Reclamation must also outline how this program will address uncertainties associated with the operations at Flaming Gorge Dam, and how future supplemental National Environmental Policy Act compliance will be required.

We believe that such uncertainties could include, but not limited to: progressive global warming, extended and prolonged drought, extreme flood events, higher sediment transport, increased human consumption, modifying selective withdrawal (temperature control), and the control and removal of exotic fish.

This should also include a call by the Lower Basin to deliver the minimal annual requirement of 8.23 million acre-feet at the Compact Point (Lee's Ferry, Arizona). As well as dam operations that further compromise the ecosystem values that authorized the creation of Dinosaur National Monument, Ouray National Wildlife Refuge, and Canyonlands National Park.

1h We also believe that another management decision of the immediate future should include a fish passage at the Tusher Wash Diversion Dam near Green River, Utah. This would include a device that prevents mortality of endangered fish from entrapment in the irrigation and hydropower projects associated with this diversion dam.

Therefore, we do expect that the working groups and the general public will have comprehensive access to all information that pertains to the operations of the Green River and Flaming Gorge Dam. This should be accomplished through the web pages of the Bureau of Reclamation and through a regular newsletter that is mailed to all interested parties.

For the agencies, scientists and the general public to be well informed, it is imperative that all program information is made available promptly and that this information is disseminated liberally and is not discretionary. It is also imperative that adequate time be allowed for the public to process this information in a timely manner so as to maximize public outreach opportunities in the NEPA decision making process.

5. The Decommissioning Alternative

1i The DEIS dismissed the decommissioning alternative without sufficient justification or analysis, other than to say, "[decommissioning] does not meet the purpose and need for the proposed action." The principle objective in fish recovery programs is to restore natural processes, which include seasonal flows, temperature, sediment, nutrients and migration.

Decommissioning Flaming Gorge Dam can best meet these objectives and thus should be thoroughly evaluated. While the dam makes some contributions to water storage, power generation and recreation, these contributions are not significant regionally, and are replaceable, whereas the endangered fish are not.

The DEIS also did not fully evaluate the potential for dam failure, and the impacts this may have on endangered fish recovery, as well as other downstream impacts to Dinosaur National Monument and Canyonlands National Park.

6. Basin-wide concerns

Reclamation continues to address fish recovery in the Colorado River watershed in a piecemeal fashion without consideration of the natural species' range, or macro-social and environmental changes that may be affecting the watershed.
1j It's critical for Reclamation to develop a programmatic EIS involving all the recovery needs of endangered fish species in the watershed and the best approaches to resolve them.

We believe the overarching problems that must be thoroughly studied in such a system wide, programmatic approach would include, but not limited to:

- Diminished water supply and water quality
- Increased water demand
- Over allocation of water rights
- Quantifying the water rights of the First Nations
- Impacts to national wildlife refuges, parks and monuments (including the international biosphere at the Colorado River delta)
- Removal of exotic species
- Sedimentation in the reservoirs
- Dam safety
- Modernizing the Law of the River
- Alternative energy production and conservation
- Water storage and conservation alternatives

We believe such a study would show conclusively that the Colorado River system would benefit by having some of its infrastructure removed and that alternative storage strategies, such as the artificial recharge in depleted aquifers, can provide:

- Increased habitat for endangered species
- Restore the natural attributes of the river and its tributaries
- Reduce water loss from evaporation
- Reduce salinity
- Provide protection from extended drought
- Eliminate the consequences of high dam failure
- Prompt a sediment management plan

7. Closing statement

Thank you for this opportunity to comment on the DEIS for Flaming Gorge Dam. We encourage the Bureau of Reclamation to proceed in producing a Final Environmental Impact Statement and we look forward to the subsequent Record of Decision. Please feel free to contact us at any time should you require any additional information or assistance from us.

Sincerely yours,

John Weisheit

John Weisheit
Living Rivers, conservation director
Colorado Riverkeeper

1. Living Rivers, Colorado Riverkeeper

1a
Reclamation has used the best available source of information for estimating "long-term water availability" in Reaches 1, 2, and 3 of the Green River as described in the EIS. The Flaming Gorge Model indicated that the 2000 Flow and Temperature Recommendations could be met, given the increasing depletions schedules and the assumption that future hydrology is similar to the historic hydrology used in the Flaming Gorge Model.

1b
Reclamation did not attempt to project specific climate changes into the future as these projections are considered speculative and difficult to quantify from a hydrologic standpoint. If climate change does occur, it will impact the inflow statistics and the hydrological year classification that will be used for making decisions about how to operate in a given year.

1c
Comment noted.

1d
The scope of this EIS is to assess operation regimes for Flaming Gorge that achieved the 2000 Flow and Temperature Recommendations, while continuing and maintaining the authorized purposes of Flaming Gorge Dam. It was determined through modeling that a run of the river approach to operating the dam would not achieve the peak flows and durations specified in the 2000 Flow and Temperature Recommendations. Specifically the recommended durations were not achieved. For this reason, the Modified Run of the River Alternative was not analyzed further.

1e
Implementation of RPAs is Reclamation's responsibility as part of Section 7(a)(2) of the ESA consultation process with the U.S. Fish and Wildlife Service, but it should be noted that ESA compliance, like compliance with other statutes and regulations, is part of the Federal regulatory construct under which Reclamation operates Flaming Gorge Dam. Reclamation is committed to upholding its responsibilities under the ESA, as well as meeting authorized project purposes.

1f
Reclamation does not agree with this assessment of the Glen Canyon Dam Adaptive Management Program. The razorback sucker has always been rare in Grand Canyon and has not been declared extinct. The Grand Canyon humpback chub population, although experiencing recent decline, has not declined to nearly irreversible numbers. Rather, this population is still the most robust of all humpback chub populations in the Colorado River Basin. The Glen Canyon program has successfully applied adaptive management concepts to develop a better understanding of the relationship between dam operations and resource responses since its inception in 1997. Major experiments utilizing Glen Canyon Dam as an instrument to manipulate hydrology have been successfully completed through the recommendations of program stakeholders to the Secretary of the Interior.

1g
Please see section 4.20 of the EIS regarding the adaptive management process for Flaming Gorge Dam. Future NEPA compliance will be undertaken whenever there is a major Federal action with the potential to affect the human environment, in accordance with 40 CFR 1500-1508.

1h
A decision as to the necessity and feasibility of a fish passage at Tusher Wash Diversion is a responsibility of the Recovery Program and is outside the scope of the Flaming Gorge EIS.

1i
Section 2.2.2.2 of the EIS states why decommissioning Flaming Gorge Dam does not meet the purpose and need for which the EIS was prepared.

1j
A Federal action requiring a programmatic EIS has not been defined.

TROUT UNLIMITED

November 15, 2004

By Fax and Email

Peter Crookston
Flaming Gorge EIS Manager
PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, UT 84606-7317

Re: Operation of Flaming Gorge Dam Draft Environmental Impact Statement

The Utah Water Project of Trout Unlimited would like to comment on the August 2004 Operation of Flaming Gorge Dam Draft Environmental Impact Statement (the "Flaming Gorge Draft EIS" or the "Draft EIS").

Trout Unlimited is the largest non-profit organization dedicated to preserving and restoring North America's trout and salmon fisheries and their watersheds. As the Green River below Flaming Gorge Dam is a world-class trout fishery, Trout Unlimited and its members have a strong interest in the way the dam is operated. Though Trout Unlimited focuses its conservation efforts on cold water fisheries, it supports the Bureau of Reclamation's (the "Bureau's") efforts to assist in the recovery of native warm water species identified in the Flaming Gorge Draft EIS to the extent those efforts do not impair the cold water fishery below Flaming Gorge Dam.

Trout Unlimited supports the flow restrictions and temperature recommendations in the Draft EIS.

In general, Trout Unlimited commends the Bureau on the Flaming Gorge Draft EIS. The Draft EIS addresses in detail the potential impacts on the trout fishery of the Action and No Action Alternatives. In particular, Trout Unlimited commends the Bureau for incorporating into its economic analysis two restrictions on the rate of water released from the dam: (1) the up- and down-ramp rate limit of 800 cfs per hour and (2) the single daily peak "hump" restriction. *See* Draft EIS at 149. These time-honored restrictions have been important in establishing and maintaining the quality of the trout fishery below the dam.

TROUT UNLIMITED

Similarly, Trout Unlimited supports the Action Alternative recommendation that releases not exceed 55°F during dry and moderately dry years and 59°F in moderate to wet years. As the Draft EIS recognizes, these temperature regimes should be followed to protect trout habitat down to the Utah/Colorado State Line. *See* Draft EIS at 164.

Although we generally support the flow restrictions and temperature recommendations in the Draft EIS, we would like to raise three concerns:

(1) The Draft EIS mischaracterizes the nature of the up- and down-ramp rate limit and single daily peak "hump" restriction.

2a The newly added second full paragraph on page 149 of the Draft EIS appears to minimize the importance of the release restrictions described above by asserting that there are no "formalized restrictions," and that these informal restrictions have been in place only since 1993. In fact, these restrictions were the result of lengthy investigations and negotiations by the Flaming Gorge Dam Working Group and have been followed, except for emergencies, since well before 1993.

Our concern is that, by suggesting that the flow restrictions are recent and purely voluntary, the Draft EIS (perhaps inadvertently) lays the groundwork for arguments that power generation can or should be pursued at the expense of other uses generally and fishing in particular. We believe it would be inappropriate to elevate power generation at the expense of fishing and other uses, particularly in
2b that the authorizing legislation (both the CRSP Act of 1956 and the Colorado River Basin Project Act of 1968) describes power generation as "an incident" to the primary listed purposes, which include "providing for basic public outdoor recreation facilities" and "improving conditions for fish and wildlife." *See* Draft EIS at 3-4.

(2) The Draft EIS fails to address the timing of daily up- and down-ramp rates and the potential impact of such rates on the cold water fishery below Flaming Gorge Dam.

2c Although we support the flow restrictions contained in the Draft EIS, we are concerned that the Draft EIS does not address the timing of those flows and the potential impacts that timing can have on the coldwater fishery below the dam. For example, if peak flows occur in the middle of the day (as has happened in the past with test flows), it can have a significant impact on the quality of the fishing as well as the overall quality of the experience (significant fluctuations in flows make fishing unpredictable; high flows also stir up a lot of sediment and organic

TROUT UNLIMITED

2d matter). Moreover, significant flow increases during the day compromise the safety of fishermen who wade the river.

2e Because people travel from all over the United States and even other countries to fish the Green River below the dam, any operational change that impairs the quality of the fishing experience has a negative economic impact as well. Anglers who have a bad experience are unlikely to return.

We believe that the Final EIS should address these issues, and, more importantly, that significant increases or decreases in ramp rates should occur during non-fishing hours.

(3) The Draft EIS fails to address adequately local economic impacts of changes to the tailwater fishery.

2f We are also concerned that the Draft EIS may underestimate the effects of operational changes on the local economy. In particular, the Draft EIS uses a three county model to estimate economic impacts. Doing so may obscure serious impacts to the economy of Dutch John, Utah, and Daggett County, Utah, where the vast majority of economic activity associated with Flaming Gorge occurs.

2g For example, the Bureau estimates that under the Action Alternative, employment in the "Amusement and Recreation Services" industry may fall 8.3 percent in wet years (*see* Table 4-26) and 6.6 percent in dry years (*see* Table 4-27). These losses may appear insignificant when spread over three counties and mitigated by gains in other areas, but could be devastating to the community of Dutch John, where the vast majority of residents are employed by the recreation industry or associated with it. The same is true for Daggett County generally, which lacks the economic and employment diversity of Uintah and Sweetwater Counties.

Again, we applaud the Bureau's efforts to put together a comprehensive and balanced Draft EIS and appreciate the opportunity to comment on the proposed action. If you have questions or would like to discuss these comments further, please contact us at (801) 747-0747.

Sincerely,

Timothy Hawkes
Western Water Project
Trout Unlimited

3

2. Trout Unlimited

2a
Section 4.4.1 accurately describes the limitations of ramp rates.

2b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

2c
Within-day fluctuations are outside the scope of the EIS. It is noted that the changes in flows, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Meeting peak demands is currently tempered, however, by the need to meet environmental concerns. This operational detail would be the same under either the Action or No Action Alternative.

2d
Reclamation agrees that the safety of fishermen and others along the Green River is very important. Currently, through efforts of the Flaming Gorge Working Group, the agreed upon ramping rate is established at 800 cfs per hour. This ramping rate has been the agreed upon standard since the Flaming Gorge Working Group meeting of April 11, 1994. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increase dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so it is common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to Daggett County 1g.

2e
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of ramp rates, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

2f
The EIS acknowledges that the Action Alternative could create adverse impacts for certain Green River recreation activities and businesses (e.g., commercial operators), particularly under wet and dry conditions as compared to the No Action Alternative. The lack of appropriate county specific expenditure data precluded the development of impacts solely for Daggett County. In anticipation of this, a survey was conducted during the summer of 2001 to specifically identify economic impacts to commercial river guide operators. The results of the survey were presented in a separate subsection under

socioeconomics. Attempts have been made, and will continue to be made, to display the adverse impacts to commercial operators prior to the final decision. Finally, recall the analysis was looking at both river and reservoir recreation. While we cannot describe potential impacts by county due to lack of data, from an overall perspective, expenditure gains on the reservoir appeared to outweigh losses on the river. Therefore, it is possible that under the Action Alternative certain recreation oriented businesses (e.g., lodging, restaurants, gas stations) will be adversely impacted by reductions in Green River recreation visitation, but many of these same businesses (with the exception of river guides) could also benefit from the additional reservoir recreation visitation and expenditures.

2g
The EIS shows that Green River commercial operators could experience adverse impacts, particularly under wet and dry conditions. While we cannot definitively describe impacts to Daggett County given the lack of county specific expenditure data, we acknowledge your point and included more discussion in section 4.12 in the EIS. While these impacts could indeed create problems if concentrated in Dutch John (not an unreasonable assumption), we would like to point out that wet and dry conditions were each estimated to occur about 10 percent of the time.

From: "Tom and/or Ann" <taelder@easilink.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 6:41 PM
Subject: Flaming Gorge Draft EIS

To Whom It May Concern: November 14, 2004

3a We, as the elected representatives of the Uintah Mountain Club (a local grassroots conservation organization centered in Vernal, Utah), would like to express our strong support for the Action Alternative as described in the "Operation of Flaming Gorge Dam DEIS".

As we understand the document, in most years, (about 9 out of 10), the high flows will not differ much from the current flows we experience. These other 9 years, the Green will not be very different from what we experience now. What will be the benefit of that 10th wet year? Species that have evolved in the pre-dam environment, will experience better conditions. Wildlife generally will benefit (and all those people who enjoy a healthy river ecosystem).

We believe the 4 endangered fish are currently declining, and that this action will help their recovery. But the fish are only "flagship species" for all of the species present in the river corridor. Such occasional high water conditions are also when boxelders and cottonwoods establish on high enough ground to be relatively safe for a long, reproductive life-span. Cottonwood and boxelder gallery floodplain forests are a vanishing habitat type in Utah and throughout the West, and one that is important to deer, beaver, migrating birds, bald eagles, and (not least importantly) humans. Beaches and sediment bars are also built up as the fine sediments that have sifted down into the main channel, are mobilized and re-deposited on the banks.

The exotic plant big whitetop disperses in such high-water events, and this is a legitimate concern. But not an overarching concern, since the weed is already established up and down the river corridor, and we're not even sure how much new habitat they would be able to colonize, that they aren't already present on. Additionally, whitetop does not compete well with alfalfa so it is primarily a problem with grazing land. There are effective aggressive grazing operations to deal with white top infestations (heavy early grazing by sheep).

The economics of recreation on the river is an important point. People come to Vernal to float the stretches of river that will be impacted by the Action Alternative. On any given day during boating season, hundreds of paying customers, tourists eager to experience the Old West, are scattered up and down the 400 mile stretch of Green River, that stretches from Flaming Gorge dam to the confluence with the Colorado River in Canyonlands National Park. The beaches, cottonwood groves, and wildlife that the Action Alternative will encourage, are part of the allure of the Green River Canyons.

The most serious charge concerns increasing the risk of West Nile virus. In short, we don't think the main issue that determines how an entire, 400 mile-long river is managed should be mosquito control. We do agree that WNV is a serious concern, but should this concern dictate how the entire Green River ecosystem is managed?

Our point is, mosquito management is only one consideration when deciding how to manage a river, but it takes its place alongside water delivery, wildlife management, and a host of other considerations.

Thank you for the opportunity to comment.

Uintah Mountain Club Board of Directors

Tom Elder

Lorna Condon

Chad Hamblin

Mickey Allen

3. UINTAH MOUNTAIN CLUB

3a
Thank you for your comments.

From: "Water Consult" <h2orus@WaterConsult.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 4:13 PM
Subject: Comments on Draft Flaming Gorge Environmental Impact Statement

Water Consult Engineering and Planning Consultants
Water Consult Engineering and Planning Consultants

535 N. Garfield Avenue, Loveland, Colorado 80537 Phone: 970-667-8690 FAX: 970-667-8692
E:mail: h2orus@waterconsult.com

November 15, 2004

Mr. Peter Crookston

Flaming Gorge Environmental Impact Statement Manager

Bureau of Reclamation

Provo Area Office

302 E. 1860 South

Provo UT 84606-7317

SUBJECT: Comments on Draft Flaming Gorge Environmental Impact Statement

Dear Mr. Crookston:

On behalf of the Upper Basin Water Users participating in the Upper Colorado River Endangered Fish Recovery Program, I wish to offer the following comments on the draft Flaming Gorge EIS:

4a 1. The draft EIS emphasizes meeting the flow recommendations (Muth, et al, September 2000). The flow recommendations represent the best available information as of September 2000. The EIS overly emphasizes meeting the flow recommendations, rather than implementing an adaptive management process, which was strongly recommended in the flow recommendations:

4b "Although it is beyond the scope of this report to provide a detailed description of research and monitoring needs, we suggest that the collection of additional data on endangered fishes and their habitats focus on the evaluation and possible modification of our recommendations by following an adaptive management process . . ." (p.5-39)

4c 2. New information has been developed and was not available at the time the *flow recommendations* were completed. This includes the report by Valdez and Nelson (April 2004) regarding management of flooded bottomlands in the Green River. This report points out the importance of depression of bottomlands, rather than terrace bottomlands. A recent draft report by Hayes, et al (2004) shows that as many depression bottomlands can be flooded at 13,000 cfs as can be flooded at 18,000 cfs. Had this information been available in 2000, it is likely the flow recommendations would not be written as they are.

4d 3. The final EIS and the record of decision both need to recognize these recent reports and findings, and emphasize the need for consideration of this information in an adaptive management process that is implemented as part of implementation of the flow recommendations. Furthermore, the final EIS and record of decision also need to include a specific time period for review of the effectiveness of the flow recommendations in achieving goals, in consideration of the information and the results of a trial modification of the flow recommendations during the adaptive management process over the next few years.

4e The flow recommendations developed by the Recovery Program for the last several years represent a "first cut". These recommendations need to be tested for their effectiveness, modified based on the information gained, and revised as new information becomes available. The Recovery Program has adopted this approach, which needs to be included in the EIS and in the record of decision.

If you have any questions regarding these comments, please contact me at your convenience.

Sincerely,

Tom Pitts

Upper Basin Water Users Representative,

Recovery Implementation Program for

Endangered Fish Species in the Upper Colorado

River Basin

(1802-30-03-03)

4. Water Consult Engineering and Planning Consultants

4a and 4b

The proposed action is to implement the 2000 Flow and Temperature Recommendations, therefore their emphasis in the document is appropriate. The use of adaptive management to implement the proposed action is described in section 4.20 of the EIS.

4c

The new information referenced in the comments is discussed in section 4.19.5 of the EIS. See also response to the National Park Service 3b-3e.

4d

Comment noted.

4e

Comment noted.

Utah Waters

Improving communication and expertise on water issues among Utah outdoor groups...... United advocacy in reforming water law and policy for the protection of wildlife and sustainable ecosystems

November 15, 2004

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

SENT VIA FAX

Dear Mr. Crookston,

Utah Waters is conservation group dedicated to protecting the state of Utah's natural water resources through public advocacy and education. In accordance with that mission, we are pleased to provide the following brief comments on the draft EIS on the "Operation of Flaming Gorge Dam." Generally speaking, we think the draft offers a great deal of useful information and quality analysis; however, we have several major criticisms, which are the focus of our comments.

5a Our first objection relates to the lack of alternatives presented in the draft EIS. Although NEPA regulations clearly state that an EIS must analyze all "reasonable" alternatives, your draft evaluates only the Proposed Action and the No Action alternative. We note that in Section 2.2 you have made an attempt to explain this dramatic departure from standard NEPA practice; however, we find the explanation unconvincing. Furthermore, since the No Action Alternative, which is to continue current practice, has already been shown to be inadequate to meet the needs addressed by the DEIS, there is only one plan, and no alternatives, offered for public consideration. We are aware that other conservation groups have already suggested alternatives that should be analyzed in the document, including an alternative that maintains steady flows during daylight hours in support of a quality fishery and for the safety of the fishermen. At a minimum this alternative should be evaluated, and arguably others as well. Not only would this make the draft EIS more useful as guide for policymakers and the public, it would also help to insulate the EIS against potential legal challenges. As you know, the adequacy of alternatives is one of the more common issues in the arena of NEPA litigation.

5b A second objection we have is that the document does not contain "significance criteria". Again, this appears to be a departure from standard NEPA practice which undermines the strength of the analysis. Given that a NEPA document must define "significant impacts to the human environment", it appears impossible to draw meaningful conclusions unless 'significance' is first defined. We are aware that 'significance criteria' can be among the most subjective and controversial aspects of a NEPA document, but we don't think that relieves the authors of an EIS of the burden of making an honest attempt at offering such criteria. It is our opinion that they should be provided and integrated into the analysis in the usual manner.

We appreciate your attention to our concerns and look forward to additional dialogue on this important undertaking.

Comment Letter of Flaming Gorge Draft EIS, November 15, 2004

Sincerely,

James A. Wechsler

James Wechsler
Assistant Coordinator, Utah Waters
2480 E. Fisher Lane
Salt Lake City, UT 84109
801-583-2090

5. UTAH WATERS

5a
Reclamation acknowledges that a full range of reasonable alternatives is desirable. However, despite considerable effort to develop additional alternatives that meet the purpose and need of the EIS, additional viable action alternatives could not be identified. Analyzing the No Action Alternative in the EIS is required by CEQ and NEPA regulations. Please see section 2.2 of the EIS. The EIS uses the best available information as called for by the CEQ regulations implementing NEPA.

5b
The criteria for determining significance are integrated into each resource analysis and discussion, and Reclamation believes that the methodologies and conclusions are sufficiently clear. The resource analysis is based on the issues and indicators described in section 1.8.3 of the EIS.

From: "Bart Miller" <bmiller@westernresources.org>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 5:27 PM
Subject: Comments on Flaming Gorge Draft EIS

To Peter Crookston:

Please accept the attached comments in the Draft EIS for re-operation of Flaming Gorge.
They were generated by Western Resource Advocates and The Nature Conservancy and also endorsed by the following organizations:
* American Rivers,
* Colorado Environmental Coalition,
* San Juan Citizens' Alliance, and
* Sierra Club's Colorado River Task Force.

I have also placed a hard copy of these comments in today's mail.

Please feel free to call with any questions.

Bart Miller
Water Program Director
Western Resource Advocates
Advancing Solutions for the Western Environment
2260 Baseline Road, Suite 200
Boulder, CO 80302
P: 303-444-1188 x.219
F: 303-786-8054
bmiller@westernresources.org
www.westernresourceadvocates.org

COMMENTS OF
WESTERN RESOURCE ADVOCATES, THE NATURE CONSERVANCY, along with AMERICAN RIVERS, COLORADO ENVIRONMENTAL COALITION, SAN JUAN CITIZENS' ALLICANCE, and SIERRA CLUB (COLORADO RIVER TASK FORCE)
ON
OPERATION OF FLAMING GORGE DAM
DRAFT ENVIRONMENTAL IMPACT STATEMENT
NOVEMBER 15, 2004

I. INTRODUCTION

We appreciate the opportunity to comment on the Draft Environmental Impact Statement (DEIS) for the re-operation of the Flaming Gorge Dam and Reservoir (Flaming Gorge) to benefit endangered fish in the Green and Colorado Rivers. The following comments were generated by The Nature Conservancy and Western Resource Advocates and their long-time representatives to the Upper Colorado River Recovery Program. Both of these organizations have been committed for many years to working collaboratively on the operation of Flaming Gorge and the recovery of endangered fish species through the Recovery Implementation Program for the Upper Colorado River Basin. These comments are also endorsed by each of the organizations noted above.

In general, we support the fundamental finding of the DEIS and its technical appendix, i.e., that of the two options presented, the Action Alternative is far better able to assist in the long-term recovery of endangered fish in the Green and Colorado rivers. We are encouraged that the DEIS concludes that implementing the U.S. Fish and Wildlife Service flow recommendations (i.e., the Action Alternative) can be achieved while at the same time meeting the other authorized purposes of Flaming Gorge. Going forward, the most critical issues will be how to quickly and effectively implement the Action Alternative to achieve the best potential result for the endangered fish.

6a The DEIS sometimes implies, however, that meeting the temperature and flow recommendations through the Action Alternative is separate and distinct from other authorized purposes of Flaming Gorge. See, e.g., at pp. S-2, S-23 (sec. S.13.3); DEIS at pp. 1, 31 (sec. 2.5.3). Properly framed, however, and as correctly noted elsewhere in the DEIS, the authorized purposes of Flaming Gorge Dam and Reservoir and other applicable federal law expressly include improving and enhancing conditions for fish and wildlife. S-3; DEIS at 3-4 (sec. 1.4.1.1).[1] As a result, there is no conflict in authorization between implementing the flow recommendation and meeting the other project purposes

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[1] See CRSPA, 43 U.S.C. § 620g (Secretary is to maintain CRSP projects to "mitigate the losses of, and improve conditions for, the propagation of fish and wildlife"); Colorado River Basin Project Act, 43 U.S.C. § 1501 (amending CRSP purposes to include "improving conditions for fish and wildlife"); Federal Water Project Recreation Act, 16 U.S.C. § 4601-12 (requiring Bureau to give full consideration to ways to enhance fish and wildlife); Fish and Wildlife Coordination Act, 16 U.S.C. § 661 (where legislative history makes clear that wildlife conservation shall receive "equal consideration" with other water project features, see S. Rep. No. 1981, 85th Cong., 2d Sess. 5 (1958)).

of Flaming Gorge Dam and Reservoir. The final EIS (FEIS) should specifically and consistently note that meeting flows for endangered fish is among the project purposes of Flaming Gorge.

6b Moreover, since meeting the flow recommendations is not a subordinate purpose and there is agency discretion, the needs of listed species should not be "balanced" against other purposes. Tennessee Valley Authority v. Hill, 437 U.S. 153, 185 (1978) (endangered species legislation reveals a conscious decision by Congress to give endangered species priority over the "primary missions" of federal agencies); Carson-Truckee Water Conservancy District v. Clark, 741 F.2d 257, 262 (9th Cir. 1984) (the Endangered Species Act directs the Secretary to give priority to endangered fish until such time as they no longer in need of protection). The FEIS should, therefore, clarify that Flaming Gorge operations needed to meet the flow recommendations are not balanced against discretionary operations, including hydropower production. Certainly, the impact on hydropower production should be minimized, but hydropower production cannot override operations for the purpose of meeting the flow recommendations.

6c Although we generally support the Action Alternative, we have some continuing concerns, first expressed in our original scoping comments on September 5, 2000 (see Attachment 1 to these comments), that are primarily related to the revision of the flow recommendations. We suggest these concerns (Section II, below) be re-considered in the context of adaptive management to revise the flow recommendations, similarly to any revision to address floodplain inundation, as committed in Section 4.19.5 of the DEIS. We are also concerned about how the implementation of the current flow recommendation will be adaptively managed (Section III, below). Finally, we offer comments about the extent to which the implementation of the current flow recommendations might offset new depletions in the Green River Basin (Section IV, below) and about a few remaining modeling issues (Section V, below). We appreciate your close consideration of all of these comments and look forward to seeing them addressed in the FEIS.

II. REVISION OF FLOW RECOMMENDATIONS

A. Base Flows

As we pointed out in our scoping comments, a comparison of pre- and post-dam average flows for the August through February base flow months showed that the recommended maximum base flows mimic post- rather than pre-dam magnitudes for the average hydrologic conditions, and that the recommended minimums for the moderately wet and
6d wet categories depart much more significantly from pre-dam magnitudes than in the other hydrologic categories. Consequently the base flows in the DEIS for the Action Alternative are much higher than natural magnitudes for the drier average years, and for the moderately wet and wet years.

Some of these departures from natural base flow magnitudes appeared to have been driven by the selection of the hydrologic categories and not the biological data. The

Action Alternative does de-couple the selection of hydrologic categories from the run-off period, but these categories are adjusted to account for closer time hydrologic conditions indicated by the prior month, only when necessary to meet the May 1 draw down target, again without regard to any biological or natural flow indicators.

We also pointed out that there are significant differences in natural base flow magnitude between the summer/fall and winter months. One reason that the recommended base flows then diverge from natural magnitudes is simply because the base flow period is not broken into two sub-periods. Although the base flow period is now broken up into two sub-periods for the Action Alternative, this segregation only distinguishes greater or less variation of the recommended flows around significantly elevated mean flow magnitudes ($\pm$40% of target flows for the summer fall months and $\pm$25% for the winter months). Such variability around unnaturally elevated base flow magnitudes departs significantly from natural flow patterns, and may only allow for greater flexibility in other project operations.

6e We remain concerned that the range and categories for the magnitude of the base flow recommendation are driven by the draw down target or simply allow for greater operational flexibility around a greatly elevated mean flow magnitude during the summer/fall and winter months. We believe two basic concepts should be considered and tested: 1) that base flow period be broken in two sub-periods for flow magnitudes, and 2) that the maximum base flows for each currently recommended hydrologic category be scaled down towards the pre-dam magnitudes so that they are elevated by only 400 cfs in comparison to pre-dam average flows. The incorporation of these two basic concepts would much better mimic natural base flow magnitudes, but would still vary those magnitudes in accordance with hydrologic categories, and would still improve the river habitat as indicated by the biological data.[2]

B. Peak Flows

In the case of peak flows, we continue to believe that natural flow patterns could be better simulated by tracking the duration and timing of peak inflows to Flaming Gorge reservoir rather than keying off Yampa peak flow patterns, per the flow recommendations. We recognize that this operational alternative might reduce the maximum amplitude of peak flows in Reach 2, but we hypothesize that the natural combination of an earlier peak on the Yampa with a later one on the Green would more naturally extend the duration of peak flows in this reach. In our scoping comments we noted the National Park Service (NPS) found that Flaming Gorge would re-fill and natural inflow patterns could be closely mimicked if storage was limited to 10% of the unregulated daily inflows during

[2] *See* Pucherelli, *et. al.* (1990), Rakowski and Schmidt (1999), Tyus and Haines (1991), and Bell *et. al.* (1998). Rakowski and Schmidt did find that backwater habitat was maximized at 5,000 cfs in 1993, and at 4,200 cfs in 1994, but that the flow that maximized the habitat in 1993 produced no habitat in 1994. They did not present these flows as within an "optimum" range, however, and these flows are also outside of the recommended range of 900-3000 cfs. This report and Bell *et. al.* establish that flows that optimize backwater habitat vary from year to year and that a single recommended base flow across a range of hydrologic conditions is inappropriate. A more naturally scaled range of base flows is consistent with this finding.

the run-off period from April 1 – July 31 while releases from storage during the rest of the year were limited to 22% of the daily inflows.

6f The DEIS failed to examine whether this basic concept might meet the flow recommendations. Instead the DEIS presents a "Modified Run of the River Alternative" under which a greater percentage of unregulated daily inflows (13%) is stored from March to July, while releases during the base flow period are only constrained by the broad ranges and rigid categories for base flow magnitudes that are quite divergent from natural patterns, as noted above. Although the DEIS dismisses this alternative because it did not achieve all of the peak flow recommendations, DEIS App. at 84, it comes close in most instances. See Table 1, DEIS App. at 71. There is only one big exception and that is meeting a peak of at least 18,600 cfs for two weeks or more. Id.

6g A more consistent run-of-run river concept that also incorporates more natural base flow patterns should be re-considered in the adaptive management process, especially if the peak flow recommendations are otherwise revised. Alternatively, a key element of this concept, such as timing peak flow releases based on Green River inflow patterns but not attempting to mimic their magnitude, should be examined in seeking to improve the peak flow recommendations.

III. IMPLEMENTATION OF CURRENT FLOW RECOMMENDATIONS

A. Elevated Late Summer Base Flows

The DEIS reports that the average flows for the base flow months of August and September are about 200-300 cfs higher for the Action Alternative than for the No Action Alternative based on the 1992 Biological Opinion. DEIS at 135, Figure 4-6. A fundamental concern of that opinion was that the abundance and growth of young pikeminnow were negatively correlated with high, cooler late summer and fall flows. See
6h 1992 Opinion at 15. We are concerned that the elevation of base flow magnitudes for these two months well above the maximum recommended by the 1992 Opinion could be a step backward and that urge that this expected result of the Action Alternative be carefully monitored and rigorously evaluated. The plan for tracking compliance with the
6i recommended flow temperature regimes during this critical summer and fall base flow period should also be clearly laid out in the FEIS.

B. Real-Time Operations and Monitoring

We are concerned that the Flaming Gorge Model assumes some knowledge (e.g. the timing of the Yampa peak and quantity of future Green River inflows) that may allow target flows to be met in the modeling environment, and which will not be known in the real-time operational environment. It will be important to monitor the compliance with the flow recommendations in the real-time environment, which we recognize will differ from the computer-generated modeling.

6j We suggest that the flow recommendations for any hydrologic condition be posted on the web page for the Flaming Gorge Work Group and compared against the daily hydrology and temperatures from the gages for all three reaches. Where a flow recommendation has duration or frequency parameters, compliance with those parameters should be reported on this web page, along with the methodology for determining compliance with frequency parameters over an extending period of time. Deviations from the releases scheduled in the 24 Month Study should be reported on the web page as soon as they are requested. A summary of how the flow and temperature recommendations have been met to date should then be a standing agenda item for each meeting of the Flaming Gorge Work Group.

The DEIS indicates that Reclamation will first consult with a Technical Work Group of biologists and hydrologists in developing operational plans to meet the flow recommendations, and would then gather information and input from the broader Flaming Gorge Work Group to refine the plan. DEIS at 31 (sec. 2.5.3). This process should provide for the written statements of the hypotheses that will be considered in the refinement of any operational plan and that will guide the collection of information or data monitoring. Reclamation should keep an administrative record of the meetings of
6k both work groups, which should be posted on the same web page.

C. Purpose of Technical Working Group

6l The DEIS makes the false distinction between the implementation of the flow recommendations and the authorized purposes for Flaming Gorge in describing the purpose of the Technical Working Group. DEIS at 31 (sec. 2.5.3). The purpose of this work group cannot be to balance the implementation of the flow recommendations with the other authorized purposes for Flaming Gorge. The DEIS already discloses how the flow recommendations will be met while minimizing the impact on discretionary operations, and this work group will be bound by the scope of the FEIS. The very important function of this work group is to offer biologic and hydrologic expertise to Reclamation on how the flow recommendations can be met from year to year without re-balancing other discretionary operations. Any re-balancing of other authorized purposes must be done by Reclamation outside the Technical Work Group and is likely to require supplemental compliance and further disclosure and analysis under NEPA and the ESA.

IV. DEPLETION COVERAGE

6m The DEIS seems to assume that implementation of the flow recommendations will offset <u>all</u> new depletions in the Green River Basin.[3] The basis for this assumption, however, is

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[3] The DEIS makes several assertions about water depletions whose context and implications are unclear:

- "The 2000 Flow and Temperature Recommendations (Flow Recommendations) as implemented under the Action Alternative would offset the impacts of water depletions [of] these other projects" (page 6). These other projects are listed as the Upalco, Jensen, Uinta, Strawberry Aqueduct and Collection System, all units of the Central Utah Project; all other projects on the Duchesne Rive Basin; the Narrows Project on the Price River; and the Price-San Rafael Salinity Control Project.

conflicting, poorly disclosed, and never fully analyzed. See, e.g., Attachment 2 to these comments. Because this assumption is so speculative and not ever fully analyzed, the DEIS is unable to conclude that the Flow Recommendations will be met by the operation of Flaming Gorge under the Action Alternative if substantial new depletions do occur in the Green River Basin. DEIS at 241.

6n We believe the issue is much more clear-cut. Unless specific, new water depletion projects that are reasonably likely to occur can be identified, unless such new projects are also likely to offset the downward trend in existing depletions, and unless such depletions are fully and consistently incorporated into the hydrologic modeling, the FEIS should straightforwardly assume only current depletions. If significant new depletions do become reasonably foreseeable, they can be addressed as part of the adaptive management approach to Flaming Gorge operations or in separate biological opinions for specific projects or groups of projects.

V. REMAINING MODELING ISSUES

In a conference call with Reclamation staff on November 5, 2004, we had almost all of our questions about the Flaming Gorge Model answered. We wish to thank Reclamation for their efforts to clarify many of the questions we raised. However, a few modeling questions remain.

A. Letter of Review Issues

6o The authors of "Review of the Green River Model Developed for Flaming Gorge," DEIS App. at 61-67, make several suggestions for reducing bypass flows by operating Flaming Gorge model differently from the run set described in the DEIS. They find that the mass balance rule used in the model results in a higher frequency of bypass flows than needed to meet the flow targets. They also suggest that extending the peak period in certain years and increasing the allowable down-ramping rate would reduce bypasses. We understand from our November 5th conference call that Reclamation has not made any of the suggested changes to the model, but we think that in the FEIS it should at least offer its reaction to these proposed changes. In such a response Reclamation could include its view on whether any of the suggestions imply a level of foresight that real time operators will not have. We also believe it is critical that these changes should be adopted only if it is proven they will have, at worst, a neutral effect on the native fish.

- "Historic and reasonably foreseeable future" depletions for all three reaches of the Green River to which the Flow Recommendations apply are listed in Table 4-31 (page 233).
- "The Flaming Gorge Model assumed that water development in the Upper Green River and Yampa River Basin would continue at the rate projected by the Upper Colorado Basin Commission" (page 241).

B. Hourly Ramping Rates

In the "Power System Analysis Technical Appendix," DEIS App. at 115-202), the application of the "single hump per day" rule appears to mitigate some of the impacts of hourly fluctuations in hydropower releases. Although this rule has not been formalized, relaxing it will entail supplemental NEPA and ESA analysis.

With the application of the single hump per day rule, however, it is not clear whether the
hourly ramping rate of 800 cfs per hour assumed for the hydropower analysis is
6p consistent with the recommended daily, down ramping rates that are less, e.g., 500 cfs per
day for the average hydrologic category. Nor it is clear whether the other daily limits
from the flow recommendations --- the change in daily flows at Jensen may not exceed
3%, may not exceed 25% of the monthly mean during the summer and fall, and may not
6q exceed 40% during the winter, were incorporated into the hydropower analysis. See
Table 3.2, DEIS App. at 118. Finally, it is not clear whether the biological impacts of
6r the hourly fluctuations have been adequately addressed. As indicated by Figures 8-3
through 8-7 of the hydropower analysis, see DEIS App. at 187-92, and even after being
dampened by the recommendation that the flow stage not exceed 0.1 meter per day, the
fluctuation in flows at Jensen still range from about 250 to 800 cfs per day. The FEIS
6s should directly address the biological implications of these hourly fluctuations.

VI. CONCLUSION

We again express our appreciation for the tremendous amount of effort that has been expended in generating the DEIS and for the opportunity to submit these comments. Please feel free to contact representatives of The Nature Conservancy or Western Resource Advocates with further questions.

ATTACHMENT 1: SCOPING COMMENTS SUBMITTED IN 2000.

Via Email (kschwartz@uc.usbr.gov), Hard Color Copy to Follow

September 5, 2000

Mr. Kerry Schwartz
Environmental Protection Specialist
U.S. Bureau of Reclamation
Provo Area Office, 302 East 1860 South
Provo, Utah 84606-7317

Re: Comments on the Scoping of Operational Alternatives to Meet the Endangered Fish Flow Recommendations Below Flaming Gorge Dam

Dear Mr. Schwartz:

These comments by Environmental Defense offer several straightforward illustrations of one basic principle: given the broad range of the flow recommendations in the January 2000 draft report (draft flow report) and the substantial scientific uncertainty about many of their features, operational alternatives that both meet the flow recommendations and better mimic natural flow pattern should be preferred.

Base flows. Figure 1 compares the pre- and post-dam average flows for the August-February base flow period (based on Table 3.8 of the draft flow report) with the recommended minimum and maximum base flows for each hydrologic category in Reach 2. This figure shows that the recommended maximum base flows mimic post- rather than pre-dam magnitudes for the average hydrologic conditions, and that the recommended minimums for the moderately wet and wet categories depart much more significantly from pre-dam magnitudes than in the other hydrologic categories. Figures 2A-2G compare the unregulated daily flows for Reach 2 with the recommended minimum and maximum base flows for the operational alternative illustrated in the draft flow report (flow report alternative), which includes three different operational scenarios for the average hydrologic category. These figures show that the base flows in the flow report alternative are much higher than natural magnitudes for the drier average years (1991 and 1964), and for the moderately wet (1980) and wet (1983) years, than for the dry (1992), moderately dry (1981) and wettest average (1974) years. The most significant departures from the natural pattern are in the average and wet hydrologic categories.

Some of these departures from natural base flow magnitudes appear to be driven by the selection of the hydrologic categories and not the biological data. A comparison of Figures 3 and 4 (based on Table 3.8 of the draft flow report) also suggests that there are important differences in natural base flow amplitudes between the summer and winter months of the base flow period. These differences create greater departures in the recommended base flows simply because the base flow period to which the recommendations apply is not broken into two sub-periods.

There are at least four operational alternatives for meeting the recommended range of base flows (900-3000 cfs) that better mimic natural patterns than the flow report alternative:

A. The maximum base flows for each currently recommended hydrologic category could be scaled down towards the pre-dam magnitudes as shown in Figure 5. This scaling simply makes the operational concession that the maximum base flows for each hydrologic category can be elevated by 400 cfs in comparison to pre-dam average flows. This operational alternative better mimics natural base flow magnitudes, but still varies those magnitudes in accordance with hydrologic categories, and still improves the habitat as indicated by the biological data.[4] The operational concession of elevating pre-dam base flow magnitudes by 400 cfs is no less arbitrary than simply partitioning the 900-3000 cfs recommended range of base flows in accordance with the flow exceedance percentages for each hydrologic category.

B. The 30-70% flow exceedance width of the recommended average hydrologic category is much wider than the others and its exceptional width elevates the maximum (2400 cfs) and depresses the minimum (1500 cfs) base flows recommended for this category. It is no less arbitrary and entirely within the recommended range of base flows to partition the hydrologic categories equally, as shown in Figure 6. More natural magnitudes for the drier average years could be achieved simply by breaking the recommended average hydrologic category in two (30-50% and 50-70%), as was done for the Aspinall flow recommendations.

C. More natural base flow magnitudes could also be achieved by simply splitting the base flow period into summer and winter sub-periods as an operational alternative, and assigning more naturally scaled magnitudes to the generally lower winter period as compared with the recommended range of base flows in Figures 7 and 8.

D. Within any recommended base flow hydrologic category, the actual base flow could be based on the magnitude of unregulated inflows to Flaming Gorge. When inflows were low, the low end of the recommended hydrologic category would be the operational alternative, while operations at the high end of the hydrologic category would be triggered by high inflows. Such an operational alternative better mimics natural magnitudes than the flow report alternative in 1991, 1964, 1980, and 1983, as shown in Figures 2A-2G.

---

[4] *See* Pucherelli, *et. al.* (1990), Rakowski and Schmidt (1999), Tyus and Haines (1991), and Bell *et. al.* (1998). Rakowski and Schmidt did find that backwater habitat was maximized at 5,000 cfs in 1993, and at 4,200 cfs in 1994, but that the flow that maximized the habitat in 1993 produced no habitat in 1994. They did not present these flows as within an "optimum" range, however, and these flows are also outside of the recommended range of 900-3000 cfs. This report and Bell *et. al.* establish that flows that optimize backwater habitat vary from year to year and that a single recommended base flow across a range of hydrologic conditions is inappropriate. The more naturally scaled range of base flows is consistent with this finding.

One feature of all base flow alternatives that should be specified operationally is how the hydrologic categories will be adjusted if the run-off volumes do not turn out as predicted. The hydrologic categories for base flow recommendations should be determined based on actual run-off volumes, and adjusted in response to actual base flow volumes mid-way through the base flow period.

Peak Flow Duration and Timing. Natural peak flow duration and timing could be better mimicked within the peak flow recommendations by tracking the duration and timing of peak inflows to Flaming Gorge reservoir instead of keying off of Yampa peak flow patterns. This operational alternative may reduce the maximum amplitude of peak flows in Reach 2, but this potential trade-off could still provide a net benefit to the endangered fishes.

Inflow Driven Alternative. The greatest extent to which natural flow patterns can be mimicked, while still operating to store water and fill Flaming Gorge Reservoir over time, should be considered as an operational alternative that also can meet the flow recommendations especially when the base flow recommendations are more naturally scaled or partitioned. The U.S. National Park Service (NPS) examined a number of operational scenarios that were based on a simple set of percentages for storing inflows and making releases and that would result in the filling of the reservoir at least once over the 1963-1996 period of record, assuming the same system loss that occurred over that period. The NPS found that natural flow patterns could best be mimicked, while still operating to fill the reservoir, if storage was limited to 10% of the unregulated daily inflows to Flaming Gorge during the run-off period from April 1 – July 31 while releases from storage during the rest of the year were limited to 22% of the daily inflows.

In Figures 2A-2G and 9A-9G, this operational alternative is compared with the flow report alternative and unregulated flows in Reaches 1 and 2. The reduction in the departure from natural patterns is most dramatic in Reach 1, but this reduction translates directly to Reach 2, because the major flows into this reach from the Yampa River are almost completely unregulated. This inflow driven alternative could be further constrained to fill the reservoir more frequently, on a different pattern, or to produce more hydropower or other benefits, but could be considered as the minimally constrained operational alternative and used to *illustrate the impacts of* further operational constraints that limit the restoration of more natural flow patterns.

Respectfully,

Dan Luecke, Director
Rocky Mountain Office for Environmental Defense

Attachments: Figures 1 to 9
[*Attachments OMITTED from November 15, 2004, comments but available upon request*]

ATTACHMENT 2: DEPLETION ASSUMPTIONS

The programmatic biological opinion for the Duchesne River Basin supercedes the earlier referenced biological opinions for the Central Utah Project and directly addressed depletions within that basin, not on the Green River. The hydrologic modeling for the Action Alternative for operating Flaming Gorge appears only to consider new depletions above Flaming Gorge, and possibly the Yampa River, but not on other tributaries. The DEIS therefore provides no disclosure or analysis of the offset of future depletions on the White, Duchesne, Price, or San Rafael rivers.

The DEIS also does not provide any disclosure or specific analysis that the Action Alternative for operating Flaming Gorge will offset the set of depletions listed in Table 3-1, DEIS at 233, because these depletions do not appear to be incorporated into the hydrologic modeling analysis. Moreover, some of the assumptions about depletions in that table are questionable:

- One reason for rejecting the Modified Run of River Alternative, was that it did not meet the Flow Recommendation if current depletions above Flaming Gorge were assumed to be about 450,000 acre feet. Table 3-1, however, indicates that current depletions above Flaming Gorge are only about 372,331 acre feet.

- The Modified Run of River Alternative was also rejected because depletions were assumed to increase in the future beyond 450,000 acre feet. The depletion schedule from the Upper Colorado River Basin Commission shows an increase in depletions in Wyoming of 263,000 acre feet, all which would occur above Flaming Gorge except for a small percentage on the Little Snake. Table 3-1, however, indicates that reasonably foreseeable future depletions above Flaming Gorge are only 42,100 acre feet. (The footnoting for Table 3-1 suggests that this latter depletion figure is taken from the 1992 biological opinion for the operation of Flaming Gorge, but that figure is nowhere to found in that opinion or its depletion appendix.)

- Table 3-1 implies that 53,562 acre feet of new depletions are reasonably foreseeable on the Yampa River Basin, including the Little Snake River subbasin in both Colorado and Wyoming. That figure is the amount of new depletions that the U.S. Fish and Wildlife is proposing to find will not jeopardize endangered fish without any certainty of a positive endangered fish population response. But there is hardly any basis for assuming that 53,562 acre feet of new depletions is reasonably foreseeable to occur in the Yampa River Basin any time soon.

- Table 3-1 asserts that the total current depletions for Reach 3 and everything upstream is 1,583,960 acre feet, based on the depletion schedule from the 1992 biological opinion for the operation of Flaming Gorge. The estimate of such depletions for the year 2000 from the Consumptive Uses and Losses Report by the U.S. Bureau of Reclamation, however, is substantially less at 1,275,900 acre feet, suggesting a decrease in total depletions for the Green River Basin. That report indicates a downward trend in total depletions since the year 1995.

The assumption for the hydrologic modeling in the DEIS that future depletions for the Upper Green River Basin and the Yampa Basin will increase at the rate projected by the Upper Colorado River Basin Commission is even more questionable. As noted above, the increase assumed for Wyoming is 263,000 acre feet. The increase for all of Colorado is assumed to be 393,000 acre feet, for Utah the increase is assumed to be 369,000 acre feet, and for the entire Upper Colorado River Basin, it assumed to be 1,194,000 million acre feet.

The DEIS fails to disclose anything about how these exceedingly expansive state-by-state assumptions made by the Upper Colorado Basin Commission are broken down into specific projects depleting any of the three reaches of the Green River within the scope the hydrologic modeling or how these very substantial future depletions are distributed within any year or over all the years in the period of record for that modeling. This lack of disclosure and the recent downtrend in depletions reported by the U.S. Bureau of Reclamation compound the speculative nature of this assumption about future depletions in the Green River Basin.

6. Western Resource Advocates and The Nature Conservancy

6a
The proposed action is not intended to be portrayed as an authorized purpose. Rather, the proposed action is implementation of the 2000 Flow and Temperature Recommendations while maintaining the authorized purposes of the Flaming Gorge Unit of the CRSP. Implementation of the 2000 Flow and Temperature Recommendations to the extent possible is part of Reclamation's responsibility to comply with the Endangered Species Act. It is an action which originated with the Reasonable and Prudent Alternative of the jeopardy 1992 Biological Opinion.

6b
Reclamation recognizes its responsibility to comply with all applicable Federal laws and regulations, including the Endangered Species Act. The proposed action is consistent with that responsibility.

6c
These scoping comments were considered in preparing the draft EIS.

6d
The primary purpose and need of this EIS process is to assess operation regimes for Flaming Gorge Dam that achieve the 2000 Flow and Temperature Recommendations while continuing and maintaining the authorized purposes of Flaming Gorge Dam. Revision of the flow recommendations is not a part of the proposed action. Reclamation recognizes that the base flow ranges recommended in the 2000 Flow and Temperature Recommendations are higher than pre-dam levels.

6e
Comment noted.

6f
The "Modified Run of the River Alternative" that was modeled did achieve many of the flow objectives of the 2000 Flow and Temperature Recommendations; however, it did not achieve all of the flow objectives. It did not meet the purpose and need for this EIS.

6g
Comment noted.

6h
Seasonal base flows are described as "mean base flows," implying that some flexibility is afforded in determining what the base flow will be from year to year during August and September. Additionally, those mean base flows may vary up to +/- 40%, making the differences between the No Action and Action Alternatives for the August and September periods minimal. Uncertainties associated with operating Flaming Gorge Dam under the Action Alternative would be monitored and addressed through an adaptive management process as explained in section 4.20 of the EIS. Therefore, adjustments to seasonal flows can be made overtime within the limits set by the 2000 Flow and Temperature Recommendations and based on sound accumulated information. Based on information gathered since the 1992 Biological Opinion, slightly higher flows during the August and September period may actually be necessary to maintain large, deep, and stable backwater habitats for young-of-the-year and age-1 pikeminnow.

6i, 6j, and 6K
Comment noted. Reclamation intends to maintain an administrative record that will be available to the public. Reclamation is considering use of a web page and other means to keep the public informed on implementation of the proposed action.

6l
Section 2.5.3 of the EIS has been revised to clarify.

6m
Section 1.4.3 of the EIS, referenced by the commenter, is not an assumption but a statement, in the context of compliance with the Endangered Species Act, that the U.S. Fish and Wildlife Service determined the re-operation of Flaming Gorge Dam to be a Reasonable and Prudent Alternative for a number of jeopardy biological opinions.

The Flaming Gorge Model included the best available data regarding future depletions in Wyoming, Colorado and Utah as provided by the Upper Colorado River Commission (memo dated December 23, 1999). The results of the Flaming Gorge Model indicated that the 2000 Flow and Temperature Recommendations for Reaches 1 and 2 could be met with the projected increases in future depletions. However, there is some uncertainty regarding Reach 3.

6n
Section 4.19.1 referenced by the commenter states that the hydrology model (Flaming Gorge Model) used in the EIS assumes that water development in the Upper Green and Yampa River Basins will continue at the rate projected by the Upper Colorado River Commission. The inclusion of reasonably foreseeable conditions in the analysis of the potential effects of the proposed action is essential to the analysis in compliance with NEPA. In the context of hydrology uncertainties, which is the topic of discussion in section 4.19.1, it is appropriate to disclose that future water development could reasonably be expected to affect how, or whether, the 2000 Flow and Temperature Recommendations are met.

6o
Reclamation believes that this issue is adequately addressed in section 2.4 of the EIS.

6p
The ramp rates that apply to the Action and No Action Alternatives are based on average daily flows and apply to seasonal operations between the spring, baseflow, and transitional periods (see section 2.5.3 in the EIS). That is, a ramp rate of 500 cfs actually means that the daily average release should not change by more than 500 cfs from one day to the next. In the hydropower analysis, hourly ramping rates of 800 cfs are used to evaluate power system flexibility within the daily flow change restriction of 500 cfs. Hourly ramping rates limited changes of flows through the powerplant within the daily flow constraints.

6q
The other potential daily flow changes (3%, 25%, and 40% in tables 2.6, 2.7, 2.8, and 2.9 of the EIS) that are a consideration in operations of the releases from the reservoir within the Action Alternative were not included in the modeling (Flaming Gorge Model). Since the hydrology team did not consider these potential operational changes, the hydropower team also did not consider these potential changes.

6r and 6s
Text was added to section 4.7.3.1.1.2 in the EIS to clarify. The extent of the aquatic food base in Reach 2 should increase as minimum discharge increases and daily fluctuations decrease under theAction Alternative. Higher base flows and decreased daily flow fluctuations in average and wetter years should lessen the extent of dewatering (exposure) and increase the extent of habitat available for food base organisms.

The attachment to this letter, scoping comments submitted in 2000, was considered during the preparation of the draft EIS.

BUSINESSES

1. **Eagle Outdoors Sports**
2. **Franson Noble Engineering**
3. **Green River Outfitters**
4. **Green River Outfitter and Guides Association (GROGA)**
5. **Old Moe Guide Service**
6. **Thunder Ranch, LLC.**
7. **Burnell Slaugh Ranch**
8. **Trout Bum 2**
9. **Trout Creek Flies**
10. **Western Rivers Flyfisher**

EAGLE OUTDOORS SPORTS
1507 S. HAIGHT CREEK, KAYESVILLE, UT. 84037

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO 774 Bureau of Reclamation
Provo Area Office
302 East, 1860 South
Provo, UT. 84606-7317

November 15, 2004

Dear Mr. Crookston: We would like to submit our comments on the Draft *Operation of Flaming Dam Draft Environmental Impact Statement* and its *Technical Appendices.*

As a member of GROGA we fully support the comments submitted by them concerning this DEIS.
As a business, Eagle Outdoor Sports has been a Green River guide and outfitter service full time since 1987 and hold a U. S. Forest Service/BLM permit to provide fishing guided, fishing walk wading, scenic float rafting trips. Our customers include guided fishermen, boy scout groups and church groups. We provide many multi-day overnight excursions that include camping on the river. Our business is totally dependent on the recreational dollars generated on the Green River.

Comment 1.
We are very disappointed in the treatment of the economical impacts of this EIS as they pertain to us. A more localized analysis is appropriate in light that the largest economical impacts center around Reach 1 of the Green River and the Flaming Gorge Reservoir. To do an analysis over a 3 county area does not show the real impacts of the recommendations contained within this EIS. We would like to see this EIS fully address the impacts to our businesses. We feel that it has not.

1a Question 1. Is it not possible to prepare an adequate economic analysis surrounding the EIS recommendations as they pertain to our businesses?

Comment 2.
While the GROGA letter states many of our concerns, we must reinforce the points that the ramping up process, flows exceeding 4600 cfs and daily fluctuating flow operations impact our
1b businesses negatively by reducing the quality of the recreational experience for fishermen and other river users that use our services and buy our products. In addition we have safety concerns
1c for fishermen and other water based recreations while these flows are being performed.

Comment 3.
1d Furthermore, we support GROGA's position that power generation takes a lower priority when compared to the other "authorized purposes" of the Flaming Gorge dam. Operational considerations should be given to recreation and fishing in particular by reducing the impacts of
1e daily fluctuations and their effects on these activities. Daily fluctuations performed during fishing daylight hours are an erosion of local economics one day after another with their daily negative

impacts.

1f Comment 4.
We support the recommendations for a 55 degree F release temperature during the dry and moderately dry years, maintaining adequate river temperatures for trout at the Colorado/Utah state line.

Comment 5.
We strongly support BOR recommendations of flow fluctuations limitations with the following
1g exception. Power generation in the form of fluctuating flows should not be at the expense of
other authorized purposes, "and for the generation of hydroelectric power, as an incident of the
foregoing purposes" (Vol. 1, pg 3 and 4, 1.4.1.1).

Comment 6.
1h We strongly support the 800 cfs ascending and descending ramp rates. We would support a formalization agreement for these ramp rates.

Comment 7.
1i We fully support the maintaining of the minimal flow agreement between UDWR and Reclamation for the maintenance of river flow supporting the tailwater trout fishery and furthermore request the formalization of this agreement as stated in Vol. 1, pg 5, second full (italicized) paragraph.

Comment 8.
1j Except in emergencies, flows should not exceed the capacity of the power plant of 4600 cfs, bypass flows should only occur as a last resort, and the frequency of such events should be kept at an absolute minimum.

Comment 9.
1k We share GROGA's opinion that in general we found this DEIS complicated to review based on its overlapping of the treatment of subjects. So many references that seemed to contradict previous statements were made clearer only after rereading them in the context of their specialized subject. It required a lot of time spent in the effort to discover this EIS's overall direction. In light of our comments, you know that we were disappointed with the overall economic analysis. We would be happy to answer any questions you have on our comments or assist in any manner possible. We can be reached at 801-721-2677. Once again thanks for this opportunity.

Rex Mumford
Doug Smith
Dennis Breer
Eagle Outdoor Sports
1507 S. Haight Creek
Kayesville, UT. 84023

1. EAGLE OUTDOORS SPORTS

1a
To estimate regional economic impacts associated with changes in river and reservoir recreation, information was collected from surveys of recreators as to their expenditures. The expenditure information gathered via the recreator survey did not allow for county specific analyses. Based on pretests, it was determined that the survey was already complex (given the need to address visitation, valuation, and expenditure information by alternative), and any attempts to gather more detailed data by county would have significantly added to survey complexity, possibly jeopardizing survey usefulness. Attempts to allocate expenditures by county would be highly speculative. As a result, the decision was made to use the three-county model utilizing both river and reservoir expenditures and to supplement that analysis with specific commercial river guide operator survey information.

Even if we had enough detail to estimate economic impacts for Daggett County alone, the aggregated nature of the regional model would preclude estimation of impacts for individual businesses. This is because the lowest level of detail provided by the model reflects the economic sector which typically combines information across a range of somewhat similar businesses. Reclamation believes that the economic analysis in the EIS is sound and provides sufficient information to assess potential impacts.

1b
Flows above 4,600 cfs and daily fluctuations have been a normal part of dam operations for over 40 years and would continue under either the Action or No Action Alternative.

1c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increase dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. See response to Daggett County 1g

1d and 1g
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

1e
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of ramp rates, and other daily operational details, would remain substantially the same under either the Action or No Action

Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

1f
Comment noted.

1h and 1i
Comment noted.

1j
Under either alternative, flows above powerplant capacity would be expected as a normal part of dam operations.

1k
Comment noted.

FRANSON NOBLE
ENGINEERING

October 28, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager
PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

Dear Mr. Crookston,

The purpose of this letter is to comment on the ***Operation of Flaming Gorge Dam Draft Environmental Impact Statement.***

When the Ultimate Phase of the Central Utah Project was dissolved, the U.S. Bureau of Reclamation was left with a 430,910-acre-foot storage filing in the Flaming Gorge Reservoir. The Utah Division of Water Resources was given control over the water right in order to preserve the 1956 priority date. They have since segregated the water right to conservancy districts, irrigation companies, and individuals for beneficial use. Please refer to the enclosed table.

Some of the entities who were allocated a portion of the Flaming Gorge water right are our clients. As they have planned to implement their Flaming Gorge water rights, they have inquired as to how the flow recommendations for the endangered fish would affect their projects. We have, therefore, been anxious to review the Flaming Gorge DEIS with respect to this issue.

To our disappointment, Section 1.8 of the Flaming Gorge DEIS, quoted below, dismisses the water rights issue without much explanation.

> **1.8 Scope of Analysis for This Environmental Impact Statement**
> ***1.8.4 Issues Raised During Scoping Which Are Not Analyzed in Further Detail in This EIS***
> *During the scoping process for this EIS, concerns were expressed regarding how the Proposed Action might affect water rights. A review of the hydrology modeling of both alternatives confirms that neither operational alternative would affect water rights within the context of the authorized purposes of Flaming Gorge Dam.*

2a To me this seems like a token statement to appease existing downstream users that their rights will be protected. However, the water rights with which we are concerned have not yet been put to beneficial use and are not Green River rights, but are actually part of a Flaming Gorge storage right.

1276 South 820 East, Suite 100, American Fork, Utah 84003
T 801 756-0309 or 888 756-3726 (toll free) F 801 756-0481

15 YEARS

In addition, Section 1.8 mentions hydrology modeling and that the modeling showed that water rights would not be affected. The hydrology modeling appendix, however, did not explain how existing or future rights were taken into consideration. Were the Flaming Gorge rights
2b considered in the model? If so, how?

The only other section in the DEIS from which we could imply anything about future water development was Section 4.16 as quoted below.

> **4.16 Scope of Analysis for This Environmental Impact Statement**
>
> ***4.16.1 Water Resources and Hydrology***
>
> *<u>4.16.1.1 Water Consumption</u>*
>
> *The 2000 Flow and Temperature Recommendations for Reaches 1, 2, and 3 are based on the needs of the endangered fish, and they do not account for any future change in water consumption. As consumption increases over time, it may become more difficult to achieve the 2000 Flow and Temperature Recommendations through the re-operation of Flaming Gorge Dam. Because of increasing water consumption in the tributaries of the Green River below Flaming Gorge Dam, it is anticipated that releases from Flaming Gorge Dam will have to be greater in the future than what would be required now to achieve the 2000 Flow and Temperature Recommendations under similar hydrologic conditions. Increasing release requirements would reduce the ability of Flaming Gorge Dam to store water during wet periods. During dry periods, drawdown conditions would become more severe as a result of increased release requirements to meet downstream flow recommendations.*
>
> *With increased water consumption in the basin, flows in Reaches 2 and 3 during the base flow period might achieve the 2000 Flow and Temperature Recommendations at lower levels than would occur at current water consumption levels. Increased pressure on reservoir storage could cause Reclamation to target lower flows within the range of acceptable flows for Reaches 2 and 3 to reduce the impact to reservoir storage. During the transition period, releases potentially could be lower in the future than they would be now as a result of increasing water consumption.*
>
> *Water consumption above Flaming Gorge Reservoir is also expected to increase, and this could reduce the inflows to Flaming Gorge Reservoir. With less water flowing into Flaming Gorge Reservoir, pressure on water storage could increase in the future.*

2c From Section 4.16.1.1, we infer that the Flaming Gorge water rights allocated to the conservancy districts and irrigation companies can be developed without consideration for the endangered fish and the 2000 Flow Recommendations. We also infer that in the future, as water is developed out of the Green River, meeting the flow recommendations will become increasingly more difficult and may even be unfeasible.

We feel that this water rights issue should not be dismissed in the DEIS with one token
2d statement. If water rights truly will not be affected, there should be a section explaining the reasoning behind that conclusion. Included in that section should be reference to the *Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin* (RIPRAP), whose main objective is to ensure recovery of listed species while providing for new

water development. This is accomplished through a one-time per acre-foot depletion charge for each water project.

We appreciate this opportunity to comment on the DEIS and look forward to the final document.

Sincerely,

Jay W. Franson

Jay W. Franson, P.E.
President

SUMMARY OF FLAMING GORGE WATER RIGHT APPLICATIONS						
No.	Assignee	Intended Use	Place of Use	Board Award AF Diversion	Board Award AF Depletion	Balance AF Depletion
						158,890
1	Uintah WCD	Agricultural	19 mi south of Vernal	8,400	4,745	154,145
2	Eastside High Ditch Irr Co	Agricultural	5 mi north of Green River	2,900	1,769	152,376
3	Dead Horse Point Water Co	Municipal	Dead Horse Pt State Park	50	26	152,350
4	Trust Lands	Municipal	Resort at Bullfrog Marina	600	313	152,037
5	Western Water Assoc	Industrial	40 mi NE of Moab	120	12	152,025
6	Sheffer, Brent D	Agricultural	3 mi SW of Jensen	120	68	151,957
7	K Ranch Water Co	Agricultural	5 mi east of Jensen	2,400	1,356	150,601
8	Green River City	Municipal	Green River City	2,000	899	149,702
9	Wilson Arch Water & Sewer Co	Municipal	25 mi south of Moab	100	56	149,646
10	Red Cut Water Co	Agricultural	1 mi east of Escalante	2,000	1,160	148,486
11	Cannonville Town	Municipal	Cannonvile Town	724	326	148,160
14	Henrieville Town	Municipal	Henrieville Town	930	419	147,741
15	Kane County W C D	Municipal	Kanab vicinity	6,000	4,000	143,741
17	Tropic Town	Municipal	City of Tropic	1,100	616	143,125
18	Boulder Farmstead Water Co	Municipal	Boulder Town	300	132	142,993
23	Garfield County School District	Municipal	Escalante	50	29	142,964
24	Washington County W C D	Municipal	St George vicinity	69,000	69,000	73,964
29	Escalante City	Municipal	20 mi. north of Escalante	550	391	73,573
31	Grand County W C D	Municipal	SE of Moab in Spanish Valley	652	339	73,234
35	Duchesne County W C D	Municipal	Central & Eastern Duchesne Co.	3,200	2,300	70,934
39	Daggett County	Municipal	12 mi SE of Dutch John	200	68	70,866
1A	Uintah W C D	Sup. Agricultural	20 mi. SW of Vernal	8,400	5,370	65,496
21	Pine Creek Irr Co	Sup. Agricultural	2 mi. north of Escalante	240	158	65,338
22	Gardner, Leo J	Sup. Agricultural	2 mi. SE of Boulder	560	325	65,013
32	WW Water Co	Sup. Agricultural	43 mi. NE of Moab	3,655	2,230	62,783
35	Duchesne County W C D	Sup. Agricultural	Central & Eastern Duchesne Co.	44,400	28,860	33,923
1A	Uintah W C D	Agricultural	20 mi. SW of Vernal	35,000	14,630	19,293
2A	Eastside High Ditch Irr Co	Agricultural	5 mi. north of Green River	4,900	2,989	16,304
25	Nelden C Nielsen Enterprises	Agricultural	20 mi. SW of Vernal	1,280	820	15,484
26	Clark, Glen & Esther	Agricultural	4 mi. north of Green River	100	61	15,423
27	Goff, James S	Agricultural	14 mi. SE of Vernal	440	280	15,143
37	Gunnison Butte Mutual Irr Co	Agricultural	Green River vicinity	24,825	15,143	0
36	Trust Lands	Agricultural	Emery & Grand Counties	0	0	0
12	Larson, Stanley L	Agricultural	SE of Jensen	0	0	0
13	Minchey Construction, Inc.	Municipal	1 mi. north of Escalante	0	0	0
19	Fryer, Colin	Agricultural	14 mi. east of Moab	0	0	0
20	Rio Colorado at Dewey Wtr Co Inc	Municipal	40 mi. NE of Moab	0	0	0
30	Sand Mountain Mutual Water Co	Agricultural	6 mi. south of Hurricane	0	0	0
33	Green River Supplemental WUA	Agricultural	Green River Corridor	0	0	0
34	Manila Town	Municipal	Manila Town	0	0	0
38	Reynolds, Adrian K	Municipal	12 mi. SE of Dutch John	0	0	0
40	Green River Canal Co	Agricultural	Green River City	0	0	0
41	Daggett County W&S District	Municipal	4 mi. east of Manila	0	0	0

2. Franson Noble Engineering

2a
In accordance with the CEQ regulations implementing NEPA (40 CFR 1500.1), the EIS is intended to fully disclose significant information while remaining as concise as possible. Since there are no effects to water rights under either the Action or No Action Alternatives, the disclosure of this fact in section 1.8.4 of the EIS is sufficient and appropriate treatment of the issue. Clarification has been added to this section. The statement of purpose and need in section 1.1 provides for the continuation of authorized purposes, including development of water resources.

The United States segregated the undeveloped portion of Water Right No. 41-2963 (A30414) and assigned it to the Utah Board of Water Resources on March 12, 1996. This segregated Water Right No. 41-3479 (A30414b) is commonly referred to as the "Flaming Gorge Right" and is being reserved for future water development.

Both the segregation application that created Water Right No. 41-3479, and the assignment documents that gave it to the Department of Water Resources, subordinate Water Right No. 41-3479 to Water Right No. 41-2963. These documents clearly show Water Right No. 41-3479 is not entitled to storage in Flaming Gorge Reservoir and is entitled to divert water only as it is being released under Flaming Gorge Dam operations.

2b
Water rights were not a consideration in the Flaming Gorge Model. That is to say that none of the rules that govern the Flaming Gorge Model under either the Action or No Action Alternative are activated based on water rights. There was a minimum release restriction of 800 cfs that was enforced throughout the model run. The results of the Flaming Gorge Model indicated that the 800 cfs minimum release could be maintained through foreseeable drought conditions while maintaining adequate storage in the reservoir to service downstream diversion requirements.

2c
This EIS does not relieve agencies or individuals of the obligation to comply with the Endangered Species Act for future actions. Available information on future water development was factored into the Flaming Gorge Hydrology Model. Section 4.19.1 articulates uncertainties associated with meeting the 2000 Flow and Temperature Recommendations in the future.

2d
Clarification has been added to section 1.8.4 of the EIS. See sections 1.4.4 and 4.16.4.1.1 of the EIS regarding the dual role of the Recovery Program in recovering the endangered species while allowing water development to continue. Please see response to Franson Noble 2a above.

GREEN RIVER OUTFITTERS
P.O. BOX 200, DUTCH JOHN, UTAH 84023

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO 774 Bureau of Reclamation
Provo Area Office
302 East, 1860 South
Provo, UT. 84606-7317

November 15, 2004

Dear Mr. Crookston: We would like to submit our comments on the Draft *Operation of Flaming Dam Draft Environmental Impact Statement* and its *Technical Appendices*.

As a member of GROGA we fully support the comments submitted by them concerning this DEIS.

As a business, Green River Outfitters has been a Green River guide and outfitter service full time since 1987 and hold a U. S. Forest Service/BLM permit to provide fishing guided, fishing walk wading, scenic float trips. We share a 7000 square foot facility with Trout Creek Flies that provides us with a base of operations for these recreational services. Our customers include guided fishermen and scenic rafters. We are totally dependent on the recreational dollars generated on the Green River and Flaming Gorge Reservoir. We operate 12 months of the year although we have a seasonal business that is most active from April through October annually. We employ 8 plus river fishing guides full time. We are employers, full time residents, property owners and taxpayers.

We live in Daggett County and the town of Dutch John. Like us, this County, town and region is extremely dependent on the recreational dollars. With the exception of government workers, we are the only industry in Dutch John. Within Daggett County there are 12 outfitters, 80 guides, 4 lodges, restaurants, 2 snack bars, 4 convenience stores, 3 gas stations, 3 raft rental services and their associated employees just on the east side of the reservoir alone. On the west near Manila and north around the reservoir there are many more businesses that too depend on recreational visitor dollars. Our county has less than 800 full time residents and is only 682 square miles in size.

Comment 1.

3a We are very disappointed in the treatment of the economical impacts of this EIS as they pertain to us. A more localized analysis is appropriate in light that the largest economical impacts center around Reach 1 of the Green River and the Flaming Gorge Reservoir. To do an analysis over a 3 county area does not show the real impacts of the recommendations contained within this EIS. We would like to see this EIS fully address the impacts to our businesses. We feel that it has not.

3b Question 1. Is it not possible to prepare an adequate economic analysis surrounding the EIS recommendations as they pertain to our businesses?

Comment 2.

3c While the GROGA letter states many of our concerns, we must reinforce the points that the ramping up process, flows exceeding 4600 cfs and daily fluctuating flow operations impact our businesses negatively by reducing the quality of the recreational experience for fishermen and other river users that use our services and buy our products. In addition we have safety concerns
3d for fishermen and other water based recreations while these flows are being performed.

Comment 3.

3e Furthermore, we support GROGA's position that power generation takes a lower priority when compared to the other "authorized purposes" of the Flaming Gorge dam. Operational considerations should be given to recreation and fishing in particular by reducing the impacts of daily fluctuations and their effects on these activities. Daily fluctuations performed during fishing
3f daylight hours are an erosion of local economics one day after another with their daily negative impacts.

Comment 4.

3g We support the recommendations for a 55 degree F release temperature during the dry and moderately dry years, maintaining adequate river temperatures for trout at the Colorado/Utah state line.

Comment 5.

We strongly support BAR recommendations of flow fluctuations limitations with the following
3h exception. Power generation in the form of fluctuating flows should not be at the expense of other authorized purposes, "and for the generation of hydroelectric power, as an incident of the foregoing purposes" (Vol. 1, pg 3 and 4, 1.4.1.1).

Comment 6.

3i We strongly support the 800 cfs ascending and descending ramp rates. We would support a formalization agreement for these ramp rates.

Comment 7.

3j We fully support the maintaining of the minimal flow agreement between UDWR and Reclamation for the maintenance of river flow supporting the tailwater trout fishery and furthermore request the formalization of this agreement as stated in Vol. 1, pg 5, second full (italicized) paragraph.

Comment 8.

Except in emergencies, flows should not exceed the capacity of the power plant of 4600 cfs,
3k bypass flows should only occur as a last resort, and the frequency of such events should be kept at an absolute minimum.

Comment 9.

31 We share GROGA's opinion that in general we found this DEIS complicated to review based on its overlapping of the treatment of subjects. So many references that seemed to contradict previous statements were made clearer only after rereading them in the context of their specialized subject. It required a lot of time spent in the effort to discover this EIS's overall direction. In light of our comments, you know that we were disappointed with the overall economic analysis. We would be happy to answer any questions you have on our comments or assist in any manner possible. We can be reached at 435-885-3338. Once again thanks for this opportunity.

Emmett Heath- Manager
Green River Outfitters
P.O. Box 200
Dutch John, UT. 84023

3. GREEN RIVER OUTFITTERS

3a
To estimate regional economic impacts associated with changes in river and reservoir recreation, information was collected from surveys of recreators as to their expenditures. The expenditure information gathered via the recreator survey did not allow for county specific analyses. Based on pretests, it was determined that the survey was already complex (given the need to address visitation, valuation, and expenditure information by alternative), and any attempts to gather more detailed data by county would have significantly added to survey complexity, possibly jeopardizing survey usefulness. Attempts to allocate expenditures by county would be highly speculative. As a result, the decision was made to use the three-county model utilizing both river and reservoir expenditures and to supplement that analysis with specific commercial river guide operator survey information.

3b
Even if Reclamation had enough detail to estimate economic impacts for Daggett County alone, the aggregated nature of the regional model would preclude estimation of impacts for individual businesses. This is because the lowest level of detail provided by the model reflects the economic sector which typically combines information across a range of somewhat similar businesses. Reclamation believes that the economic analysis in the EIS is sound and provides sufficient information to assess potential impacts.

3c and 3f
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of ramp rates, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

3d
Please see section 4.11.5 of the EIS for the discussion of safety as it relates to recreation activity in the Green River. See also response to Daggett County 1g.

3e and 3h
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

3g, 3i, and 3j
Comment noted.

3k
Under either alternative, flows above powerplant capacity would be expected as a normal part of dam operations.

3l
Comment noted.

GREEN RIVER OUTFITTER AND GUIDES ASSOCIATION
GROGA

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO 774 Bureau of Reclamation
Provo Area Office
302 East, 1860 South
Provo, UT. 84606-7317

November 15, 2004

Dear Mr. Crookston: We would like to submit our comments on the Draft *Operation of Flaming Dam Draft Environmental Impact Statement* and its *Technical Appendices*.

INTRODUCTION
The Green River Outfitter and Guides Association (GROGA) consists of ten guided fishing and two scenic rafting outfitters operating under Ashley National Forest Service permits on the Green River (Reach 1) below the Flaming Gorge (FG) dam. Many of the outfitters have been providing services to visitors of the Green River for nearly twenty years, others longer. We are a huge "stakeholder" in how the FG dam is operated. Our interests are twofold:
1. The protection of and wherever possible, enhancement of the Flaming Gorge tailwater trout fishery.
2. The economic survival of our businesses. With dedication and perseverance we have spent many years and dollars in the building of our businesses. Our industry provides great recreational experiences to our visitors while making value contributions to our areas economies and employment opportunities. Our needs are simply to protect our investments and secure our ability to survive.

COMMENT 1.
4a Thank you for the opportunity to comment on the *Operation of Flaming Dam Draft Environmental Impact Statement* and its *Technical Appendices*. We have been a part of the Flaming Gorge Work Group (FGWG) since its inception after the release of *The Final Biological Opinion on the Operation of Flaming Gorge Dam* (1992 FBO) in November 1992. GROGA has taken an active role as representatives of its members and trout issues within that work group. We know how difficult the management issues surrounding the operation of Flaming Gorge Dam by the Bureau of Reclamation (BOR) has been, we were there. The BOR is to be complimented on its efforts to be inclusive to all the interests that have evolved around the operation of the FG dam. From that effort, we believe there has developed a greater understanding and a sharing of the issues by all the participants. We feel the FGWG has been extremely effective and we encourage the BOR to follow the same formula wherever possible.

COMMENT 2.
In our comments, we will refer to "Operation of Flaming Dam Draft Environmental Impact Statement" as Vol. 1 and "Operation of Flaming Dam Draft Environmental Impact Statement Technical Appendices" as Vol. 2 to simplify discussions, i.e. (Vol. 1 pg_, paragraph/line).

COMMENT 3.
A promise was made to us by the BOR that when the EIS for the Flaming Gorge dam came out, it would address all impacts of the Action Alternatives recommendations (including economic) on all who are effected by their impacts, to include fishing outfitters. Having spent a great deal of time reviewing this document, we see many examples of keeping that promise while recognizing some serious shortfalls. We would like very much to make a positive contribution to the EIS in our comments whether they are positive or negative. While we don't believe for our part that any of the shortfalls were intentional, past experiences make us vigilant wherever there are a lot of groups competing around the operation or management of any resource. We have been a solid partner *in the FGWG, considerate of all the parties* with interests revolving around the operation of FG dam. We support many of the flow and water temperature recommendations for the recovery of T&E fishes (see below). We believe that some of these recommendations may provide biological benefits to the tailwater trout fishery.

COMMENT 4.
We support the recommendations for a 55 degree F release temperature during the dry and moderately dry years, maintaining adequate river temperatures for trout at the Colorado/Utah state line.

COMMENT 5.
4b We strongly support BOR recommendations of flow fluctuations limitations with the following exception. Power generation in the form of fluctuating flows should not be at the expense of other authorized purposes, "and for the generation of hydroelectric power, as an incident of the foregoing purposes" (Vol. 1, pg 3 and 4, 1.4.1.1).

COMMENT 6.
4c We strongly support the 800 cfs ascending and descending ramp rates. We would support a formalization agreement for these ramp rates.

COMMENT 7.
We fully support the maintaining of the minimal flow agreement between UDWR and Reclamation for the maintenance of river flow supporting the tailwater trout fishery and furthermore request the formalization of this agreement as stated in Vol. 1, pg 5, second full (italicized) paragraph.

COMMENT 8.
4d Except in emergencies, flows should not exceed the capacity of the power plant of 4600 cfs, bypass flows should only occur as a last resort, and the frequency of such events should be kept at an absolute minimum.

COMMENT 9.

4e Select sections of the current document somewhat minimizes the agreements and recommendations of the FGWG, as evidenced by the addition of the second full paragraph in Vol. 1, page 149 on this DEIS. This paragraph incorrectly implies that the ramp rates and single-hump operations are not strictly followed. In reality, these recommendations were the result of intensive investigations and discussions by the diverse interests of the work group, and reflect historical operation except in the times of an emergency. While minimizing these operational constraints may benefit the incident authorized purpose of power generation, the authorized purposes and associated resources would be negatively impacted by further liberalization of these release parameters. Inaccurate portrayal such as this should be avoided.

COMMENT 10.

4f It is important for us to report that, following the release of the 1992 FBO, a five year study of flow recommendations from the preliminary research provided by the Upper Colorado Endangered Fish Recovery Program (RP) were performed. (After twelve years we haven't seen the end of the 5 year study). These were advertised as "test flows" designed to further refine flows for the T&E fishes recovery program. "Test flows" do not require going through the NEPA process, therefore, Recovery Program proponents gave no considerations to impacts of such actions on recreation and sport fishing. Nor has there been any economical considerations given to local businesses since the 1992 FBO was started, up to the release of this DEIS. Only biological issues concerning trout survival were considered. As complaints from the public, fishing guides and impacted businesses were expressed about the dirty water and flows that impacted their fishing, their complaints were ignored. The negative economic (losses) resulting from these flows to the "fishing outfitter community" came in the form of canceled or a depression of guided fishing trips and other businesses losses came as related expenditures of lodging, food, services and retail. These are not just perceived impacts, but real. GROGA Chart 2 demonstrates this point with guided boat number declines on 5/9/99 as flows reach upward, look at 5/25 and 5/27/99 where the values are zero as flows go above 4600 cfs and the remaining suppression of boat numbers until the flows start to recede 6/25/99 and after. This chart shows an extreme wet hydrological year, but it is perfect in showing (by the magnification of) the impacts during flows changes that occur even during the smallest of flow changes. These various forms of "test" flows were most often performed in the heart of our (identified as "guided boat fishing" in the EIS) busiest time of year (April, May, June). They rarely come with little advance notice, commonly as little as 24 hours, then delays or changes are made that are hard to adjust to (see COMMENT 17. EXAMPLE). (This has not changed despite applaudable efforts by BOR to provide information). We have experience with the FGWG and can relate to the unpredictability of mother nature in planning flow releases. However, the fishing public and our guided fishing guests seldom understand finding poor river conditions effecting their fishing productivity, especially when man made. The Recovery Programs objective (Vol. 1, pg 70, first full paragraph) of "gaining public support for all these activities through an information and education program" has fallen extremely short of its goals in the sport fishing community. But then, maybe there is a reason for that in light of its stated agenda (Vol. 1, pg 70, first full paragraph). These "test flows" lasted longer than the 5 year study. We have been experiencing the refinements of T&E flows for twelve years now, but the negative economic impacts on "guided boat fishing and shore fishing" until this EIS have never been considered. So what we are looking for here is that this EIS addresses all the impacts to fishing and businesses that depend on the use of the Green River within Reach 1. Through your comments (Vol. 1, 4.19 Uncertainties (particularly under 4.20) it is very plain to us that, the Recovery Program will go on indefinitely with tests, emergencies and modifications to the recommendations for some time to come. Consequentially, so will the impacts to us and our businesses. This built in flexibility without further NEPA makes us nervous.

4g Question 1. What are the Recovery Program, its recommendations and programs liabilities in addressing the negative economic impacts of its actions as identified in this EIS ?

4h Question 2. If it is liable, how would it mitigate damages?

COMMENT 11.

We have heard that landowners near Jensen, Utah are financially compensated for the loss of use of their flooded fields.

4i Question 3. Is this true, if so how are the losses calculated?

COMMENT 12.

We are concerned that some elements within the Recovery Program would like to eliminate all competition for the Flaming Gorge resources. The FG tailwater trout fishery is an attractive target. In the promotion of T&E issues, we are hopeful that attempts were not and are not being made to negatively impact our businesses. But there seems to be little concern about it. Within the FGWG we have been able to address trout issues, but have been dismissed in any conversations of the economic impacts to our businesses. The mood was and is Recovery Program at any costs. Great, if you are not the one paying. We are very small in economical picture when compared to the money being spent on the Recovery Program. The number of governmental jobs that are solely dependent on this program and losses in power generation alone is worth multi-millions of dollars annually. At Glenn Canyon, Arizona, gateway to the Grand Canyon, there are millions of dollars in private contracts studying Recovery Program goals. Within the scientific community, Glen Canyon is known as an "economic goldmine" for anyone wishing to perform an experiment of some kind. Flaming Gorge, though slightly smaller in scale is no different. As of the date of this letter, despite Lake Powells historical storage depletion from the current drought, they are sending huge amounts of water through big releases to "build beaches" (a big "test flow") within the Grand Canyon. The EIS (Vol. 1, pg 70, first full paragraph) speaks to the Recovery Programs goals and is very revealing to us. "In addition to identifying the flow needs of the endangered fish, the Recovery Program has directed effort at developing habitat, reducing nonnative species, reducing the impacts of sport fish and sport fishing, raising and stocking endangered species, and gaining public support for all these activities through an information and education program." While we would like to interpret this as impacts of sport fish and sport fishing directly on the T&E fishes themselves, the wording could easily be interpreted differently by those whose ambitions would like to see the demise of the FG tailwater trout fishery. The Recovery Program "has directed effort" at "reducing the impacts of" who? Rainbow and Brown trout are nonnative species, trout are a sport fish, and river fishing guides and the fishing public are sport fishermen. We know that at Glenn Canyon (Colorado River) that eradication of rainbow trout has been performed in lower river sections. We have also heard that some spring flows there may be timed to scour the spawning redds of the rainbow trout to reduce spawning productivity. There are groups there actively pursing the removal of the Glenn Canyon tailwater trout fishery. We fully anticipate that there will be a similar program of non-native fish removal on Reach 2 and 3 of the Green River. So our concern is that, there are no formalized agreement protecting the FG tailwater trout fishery.

4j We know that T&E issues "trump" all the other "authorized purposes"(Vol. 1 pg 3 and 4, italicized text)of the FG dam, but it disappoints us that there is a potentially stated bias (DEIS Vol. 1, pg 70, first full paragraph) towards specific Green River inhabitant and users. Let us say that we are disappointed with language that creates uncertainties as to intent, leaves us to wonder how extensively this policy is being pursued, how it is being interpreted and how it is influencing the recommendations stated in this EIS. We know that this EIS is not a forum for debating the goals of the Recovery Program. However, since this EIS and its recommendations sprang from the implementation of the Recovery Programs goals, we respectfully request your answers to Questions 3 and 4 below.

4k Question 3.Are there any elements within the flow and temperature recommendations or in other portions of this EIS that would support or facilitate the removal or suppression of the Flaming Gorge tailwater trout fishery between the FG dam and the Utah/ Colorado state line? Please list those parts of this EIS that speak to: the progress has already been achieved in "reducing nonnative species; what future plans are being made to further achieve "reducing nonnative species"; what progress has already been achieved in "reducing the impacts of sport fish and sport fishing"; what future plans are being made to further achieve "reducing the impacts of sport fish and sport fishing."

4l Question 4. Would you foresee that any such development would not have the need to undergo further NEPA processes?

COMMENT 13.

4m This EIS brings up wherever possible, the positive benefits to the tailwater trout fishery under the "action alternative." however, there are only a few rare acknowledgments as to the negative economic impacts on Green River recreational activities which include: guided boat fishing, scenic floating, shore fishing, private boat fishing, boat based camping. Focusing in on the guide boat fishing, there is an attempt to not address the economic impacts. In fact the document says that "despite reasonable survey response rates" (Vol 2, App-325, last paragraph) by commercial operators, "the survey data did not provide enough information to estimate the impacts by alternative" and that "an estimation of the direct impacts to them shouldn't be used because it is figured in the regional modeling report." Yet you had enough info to state losses in several locations within the document (Vol. 1, pg 205, first paragraph, sentence starting with "While these losses", next paragraph, sentence starting with "The largest gains",pg 216, second column, second full paragraph and in particular the sentence starting with "These gains......". The regional modeling report spreads the impacts over a 3 county area (Daggett, Uintah, Sweetwater) (Vol. 1, pg 221, second paragraph) says that "The difficulty with the regional modeling results are that they are aggregated by economic sector and industry and do not provide detailed impacts for specific businesses" and that "it would have been useful to separately identify the impacts on both the river and reservoir." we fully expected that this EIS would fully do just that. We were promised that it would. Issues 11 and 18 (Vol. 1, pg 15 &16) says you are supposed to. Your acknowledgment of the "difficulties" mentioned above and that are "a small sector in the three county economy" (Vol. 1, pg 217, right column, first paragraph) is small consolation in a county (Daggett) and town (Dutch John) that is totally dependent on the recreational services dollars. There are 12 outfitters, 80 guides, 4 lodges, 2 restaurants, 2 snack bars, 4 convenience stores, 3 gas stations, 3 raft rental services and their associated employees in a county that has less than 800 full time residents. Four businesses are involved in more than one part of the economic impacts, having a fishing guide service, lodging, retail and more. Maybe there are small impacts in Sweetwater and Uintah counties, but it translates into big economic impacts on businesses and in employment here for Daggett County. Our complaint is that there are a number of places within the DEIS that these details are missing, that facts effecting Reach 1 commercial guiding operations are glossed over, minimized or omitted completely. The explanation (Vol. 2, App-325, last paragraph) seems to demonstrate this point. In a document that gives so much detail to flows, fish, power generation and a myriad of other complicated subjects, the authors just didn't have enough data? And if you did, you couldn't/wouldn't use *it (Vol 2, App-325, last paragraph)*?

COMMENT 14. We would like to see a fuller economic analysis that addresses the full measure of these impacts.

COMMENT 15.

4n We are providing information that may assist you. The statement that "the survey data did not provide enough information to estimate the impacts by alternative"might be true, but there is plenty of such information out there for those interested in finding it. We simply went to the Forest Service and asked for daily boat launch totals by day, then took BOR Weekly Reports on FG flows (the weekly e-mail) and transposed the flow data over it to make a "Flows vs Guided Boat Numbers" chart for the years 1998, 1999, 2000 during the months of May and June. The 1998 chart is labeled GROGA Chart 1, 1999 GROGA Chart 2, 2000 GROGA Chart 3 and are included in this comment package for your reference. While 1998 and 2000 might be considered "average"(highest flows at 4600cfs) hydrological conditions, 1999 was definitely "wet"(high flow peaked at 10,600cfs). But you would need to see how you would classify them. The Forest Service could provide you with the data on any year you deemed "dry" fully completing the "average, wet, and dry" hydrological conditions. Forest Service figures show May/June totals for 1998 for guided boat numbers at 1348 total, 1999 at 1162, and the more moderate flow year of 2000 at 1618. These numbers show a suppression of guide boat numbers during the wet year of 1999. Since during all these years, the dam was operated under the "Action Alternative" recommendations, we would assume they would represent the "Action Alternative" By using these charts you can calculate the impacts of both alternatives on the numbers of guided boat fishing under each hydrological scenario.

4o Question 5. Will you take this information and use it to address the direct economic impacts to the recreational community under the "Action Alternative"?

Question 6. If not, why?

4p Question 7. In your addressing the positive effects of the Action Alternative in Vol 1, 4.16.9

Socioeconomic, how can you say that it will result in increases when "it is assumed that the majority of economic development (of Dutch John) will cater to tourist activities" when compared to your acknowledged losses to the recreational services sectors?

4q Question 8. Explain to us the difference between "tourist activities and recreational services".

4r COMMENT 16.
Within the framework of our COMMENT 13, we felt that within the DEIS, we were treated as a small economic sector over a three county region. There was a lack of detail concerning our (and the reservoir guide operations) operational information. Information that was well represented for other groups. In Vol 1, 3.11 Recreation (pg 107 last paragraph) and the Recreational analysis (Vol. 2, App 222, second paragraph) has an extensive treatment addressing the rafting community operating in Dinosaur National Monument (DNM) Reach 2 and continues on with discussions talking about: that the number of private and outfitters permits are constrained; that commercial rafting operations are popular requiring early reservations; that due to the degree of planning and financial commitment that there was a strong incentive to take the trip regardless of river conditions; that there was also the fact that there were other rivers (Yampa) where trips could be diverted to should rafting the Green River in Reach 2 be undesirable.

The closest description of us and our activities comes on Vol 2. App.325, 3.3 Commercial Operator Surveys, paragraphs 1 and 2. Your recreation analysis "focuses upon the effects on recreation visitation and economic value within Reach1", "where the majority of the potentially impacted water-based recreation occurs (Vol. 1, page 107, second to the last paragraph). Yet you have no discussions about commercial operations such as those that start in the referenced paragraph and page (108) directly following?

COMMENT 17.
An analysis could go on to read: that boat fishing operators within Reach 1 share many similarities to their commercial rafting counterparts operating in DNM. They hold a Forest Service (currently managed by Bureau of Land Management) (BLM) "special use permit" which limits the numbers of outfitters. Daily launches have established limits for all combined outfitters (therefore our total trips in certain river sections are limited)(unused allotments cannot be recovered and constitute a permanent loss), their guests too have to make long term commitments for guiding services, lodging and travel. They also have a few basic differences. Unlike their rafting counter parts who prefer lots of water, they don't have guests that are likely to book high flow trips (above 4600 cfs), nor are they likely to keep our guests from moving to out of the region, losing them financially altogether to other destinations when they find river conditions other than what they had expected (see GROGA Chart 2). Remember that flow changes come often with little advance notice, commonly as little as 24 hours, then delays or changes are additionally made that complicate further adjustments to long term reservations.

EXAMPLE
Imagine traveling from NY or California (we even get clients from around the world) at great expense to arrive for a 2-4 day fishing trip (that you planned and reserved six months or more

before) the day the flows were raised. You arrive to find the river dirty and high even though two days before, when you checked in with your service provider, river conditions were good. The most common reaction is that they were lied to gain their business by the service provider. Given that, you have now lost a customer for life. See "Ramping Up" for a discussion as to why this is a bad time to visit the river for fishermen. Also see chart our on 1999 flows. And there are no alternative rivers to move our guests to when conditions reach an unusable level. They seldom stay long, seeking somehow to "save" their fishing vacations elsewhere. The future opportunities to re-attract that visitor to the river are small once he feels that conditions on the river are unpredictable or that he has been betrayed.

COMMENT 18.
The US Forest Service is a collaborating Agencies for this EIS. In the forest service position paper (Vol 2, pgs 5&6) they identify issues to be addressed in the EIS. The last paragraph page 5 and the first 4 paragraphs page 6 contain the parts we are most concerned with.

4s Question 9. How do you feel this EIS addresses these issues directly?

COMMENT 19.
In section 3.3 Commercial Operator Surveys (Vol. 2, App-325), you state that "of the 12 river commercial operators, 10 returned surveys. Then in several places within the analysis (one in Vol. 2, App-331, paragraph 6) the following paragraph appears. "Two of the four boat fishing operators indicated..................to $35,000." There are 12 commercial boat fishing operators.

Question 10. What two of four?
Question 11. Where are the other ten or eight?
4t Question 12. Are your economic figures right? The figures are available from the Forest Service.

4u COMMENT 20.
We have to point out something. Table 13 (Vol. 2, App-329) came from the surveys, but something is warped here. Under Dry Conditions, Boat Fishing, the river is "Beyond Usable Range" below 1039 cfs. No matter what this chart says, to commercial boat fishing operators, the river is usable down to a 800 cfs level. We experience this flow the majority of our season, it provides enough water to float a boat down the river. Below 800 cfs would be another matter, it is the true threshold. We disagree with the analysis provided in Vol. 2, App-331, paragraph 5.

COMMENT 21.
We further find suspect that the 1999 IMPLAN data base is considered reflective of the No Action wet conditions (Vol 1, pg 215, last paragraph) when real time 1999 data was produced under the river flow conditions formulated from the Action Alternative wet conditions. And this is what the economic analysis was based on?

4v Question 13. Since 1992 to current, flows on the Green River have reflected the "action alternative" under all hydrological conditions. Unless we mis-understood the statement above, where did you get your baseline data that represented the "no action alternative"?

4w COMMENT 22. DEFINITIONS

To explain our position more fully requires understanding what anglers consider acceptable. The terms that we will use in this attempt may not have clarity to everyone reading this. So here are several definitions that we will use.

1. Fishable- defined as "conditions that are favorable to the pursuit of fishing" or "conditions that most anglers would to expect to find (most anywhere that fishing occurs) that creates a positive fishing experience".
2. Un-fishable- defined as "conditions that frustrate or discourage anglers from the pursuit of fishing".
3. Fishing Productivity- defined as "the number of fish caught when compared with the effort expended to catch them".
4. Catch Rates- average number of fish caught in a specific time frame.
5. Tailwater Fisheries- defined as "fisheries existing in the downstream reaches of a dam".

COMMENT 23. TAILWATER TROUT FISHERIES

Anglers who visit "tailwater fisheries" have come to rely on their attributes for their fishing activities. There are many well known trout tailwater fisheries located in the Rocky Mountain region of the west. Notably: the South Platte below Cheeseman dam (CO.), the Frying Pan below Ruedi dam (CO.), the San Juan below Navejo dam (NM), the Big Horn River (MT). On the positive side tailwaters provide: controlled flows, moderated impacts of spring run-off, sustained in stream flows during droughts, improved water quality, and in the case of the Flaming Gorge Dam regulated water temperatures to benefit trout and invertebrates. On the negative side: released flows can be high, fluctuating, unpredictable, create water quality issues and angler safety concerns.

4x COMMENT 24. FLOW CHANGES

Angler visitation to the Green River tailwater fishery is most notable in April, May and June, with July and August decreasing, September rebounding somewhat before a steady decline in October. (Though the winter months see some angling activity it has not a this point seen substantial use levels). July and August have considerably less angler visitation because other western waters are opening up to anglers to fish. Having visited the Green River in the earlier months, they head to other destinations. Under the Action Alternative, the months of April, May, June and July (which are the main part of our fishing season) have the highest Reach 1 average monthly flows (Vol. 1, Figure 4-4). More specifically, using the "average flow" term is very misleading in what really occurs on the rivers flow releases for those months. The FG dams recent operation for T& E fishes has translated into low to moderate flows in the early half of May, then as the Yampa River rises, flows are increased at 800 cfs a day to 4600 cfs that lasts into early to mid June (depending on water availability). This results in the ramping up period, the 4600cfs flow release and the down ramping period occurring during a substantial portion of our prime season.

4y Question 14. Does not the term "average flow" dilute the real indicators of impacts in your analysis?

COMMENT 25. EFFECTS OF FLOW CHANGES

There are two major effects of changing flows on trout and anglers. The first is water quality, the second is stability of flows.

4z COMMENT 26a. WATER QUALITY and RAMPING UP

Increasing water flows, initially produces some floating debris such as pine needles, sticks, and moss in the river as it rises. In severe cases when the debris is substantial, it can accumulate, clogging up many of the larger backwater areas. This is especially true when going to an extremely high flow, after extended periods of low flows when trees, tree limbs and other trash is brought into the flooded river bed. In early spring, water quality can be additionally compromised by the dying feathering moss beds breaking apart with higher flows. While these are the worst possible effects to water quality by higher flows, conditions can improve after several days of flushing. Angling opportunities will certainly be effected during this period by compounding poor water quality with the displacement of the trout population due to higher flows. This brief interim period is the worst possible time for anglers on the river. Those anglers impacted (under some flow recommendations for days) will have to wait for the water quality to improve and trout to adjust to their new environment. They are not often willing to do so. GROGA Chart 2 demonstrates this point with boat number declines on 5/9/99 as flows reach upward, look at 5/25 and 5/27/99 where the values are zero as flows go above 4600 cfs and the remaining suppression of boat numbers until the flows start to recede 6/25/99 and after. The first several days of ramping up don't have profound effects to the rivers fishability except for water quality issues as stated above and during the surge. Above the 3000 cfs threshold is where the volume of water really increases velocity and rises above the normal river bed bringing additional trash and debris into the rivers flows and the effects on trout occur. Starting at a base flow of 800 cfs it takes five days to reach 4600 cfs. We incur our biggest financial losses in this ramp up period from canceled fishing trips due to poor water quality. The higher the flow goes (3000 cfs and above), the more days it takes to ramp up, the greater the economic impacts. See GROGA Chart 2 (1999 a wet scenario year) to see the depression of guided boat numbers as the water ascends and how the depression continues for days afterwards. It does takes several days before water quality improves and the fish settle down to return anglers to the ability to fish. We would rate a settled and stable 4600 cfs flow as fishable. After settling out from flow changes, we would rate 6600 cfs as difficult to fish, 8800 cfs as extremely difficult fishing except for experienced anglers, above 10,000 cfs is attempted only by the most determined anglers. Over the years, we have tried to put a positive spin on flows up to 4600 cfs. After the initial ramping up period, the trout do seem to settle down, many of them concentrate on the rivers edges in lower velocity water where they become more accessible to shore fishermen. Flows above 4600 cfs have proved difficult to promote even when there is the possibility of decent fishing productivity. As commercial fishing guides, our knowledge of the river helps short cut through some of the difficulties associated with fishing high flows. The complaint factor remains high among those anglers who have less skills or little patience for increased difficulty in accessing and catching fish. The greatest impacts to fishability comes on the up-ramp period, during fluctuating flows (see COMMENT 26b) and at flows exceeding 4600 cfs. Ramping down from higher flows have not caused us issues as long as they did not contain fluctuations within them.

COMMENT 26b. FLUCTUATIONS

The impacts of ramping up for higher flows should not be confused with daily fluctuating flows because after the ramp up they are stabilized. Fluctuating flows, are flows that start at a base flow then ramp up and down within a single 24 hour period. See GROGA Chart 4. Though smaller, daily or hourly fluctuations, give trout a shorter time-frame to adjust and in the most severe cases, they could be affected for up to two hours. This occurs even from changes in flows that originate from a base flow as low as 800 cfs. Trout do not initially deal well with these short term up and down changes in flows, each change can result in their needing to leave preferred habitat because of changes in current velocities and the energy requirements needed to match them. Their response to these movements in flows requires time for them to adjust to this newly created environment. When done within the average fishing hours of 6 am to 9pm, fishing productivity decreases as catch rates decline while the fish make these adjustments. Additionally, increased energy expenditures does results in stress for trout and increases mortality of trout fry. This can be lethal for wintering trout whose energy reserves are at their lowest. Anglers often have to stop fishing until the trout re-orientate themselves. Descending flows will require time for the trout to once again, re-distribute themselves throughout the river as their environment is reduced, again. This is a second period of lost fishing productivity when these changes occur during the hours of the day containing fishing activity. Fluctuations are normally the results of power generation. Even though the operational restrictions of a single daily hump restriction are a part of this EIS, the impacts of these "daily fluctuation" operations are felt by anglers when they are performed and

4aa scheduled during the hours between 6 am and 9 pm. Power generation in the form of fluctuating flows should not be at the expense of other authorized purposes, "and for the generation of hydroelectric power, as an incident of the foregoing purposes" (Vol. 1, pg 3 and 4, 1.4.1.1). We believe it is inappropriate to elevate power generation at the expense of fishing and other uses. BAR must address the impacts of such operations on other authorized purposes and find a way to lessen or eliminate their effects. The 2004 operation after the reduction of the spring flows (early June 2004) was an example of how power generation was performed without consideration to other river users that have a priority over power generation. See GROGA Chart 4. The chart shows the up ramp and down ramp all occurring in the early afternoon to late afternoon hours with only a short period of time between them. Daily fluctuations performed during fishing daylight hours are an erosion of local economics one day after another with their daily negative impacts. With up ramping towards a higher flow we lose business until flows stabilize, with fluctuating flows we lose business every day with disgruntled anglers. We heard many complaints about this activity and its timing. We heard how the fishing "shut down" and how "they (visiting anglers) weren't staying if it was to continue", were the most common comments. Safety issues involving wading anglers were extremely common. Boaters who had their boats anchored even experienced boats being picked up by higher water flows and dislodged from anchor. The most common questions asked in local businesses revolves around: what are the flows? how safe is the river? is there enough (or too much) water? are they doing any releases during the day? The up ramping and down ramping constitutes two impacts in a single day to other river users. Considerations by BAR must be made when discussing such operations requests from Western Area Power Authority (WAPA) as to their "timing" and the "effects" of these operations on others. We would prefer never to see such operations during the anglers day of 6 am to 9 pm except in emergency conditions.

4bb COMMENT 26c. STABLE FLOWS:

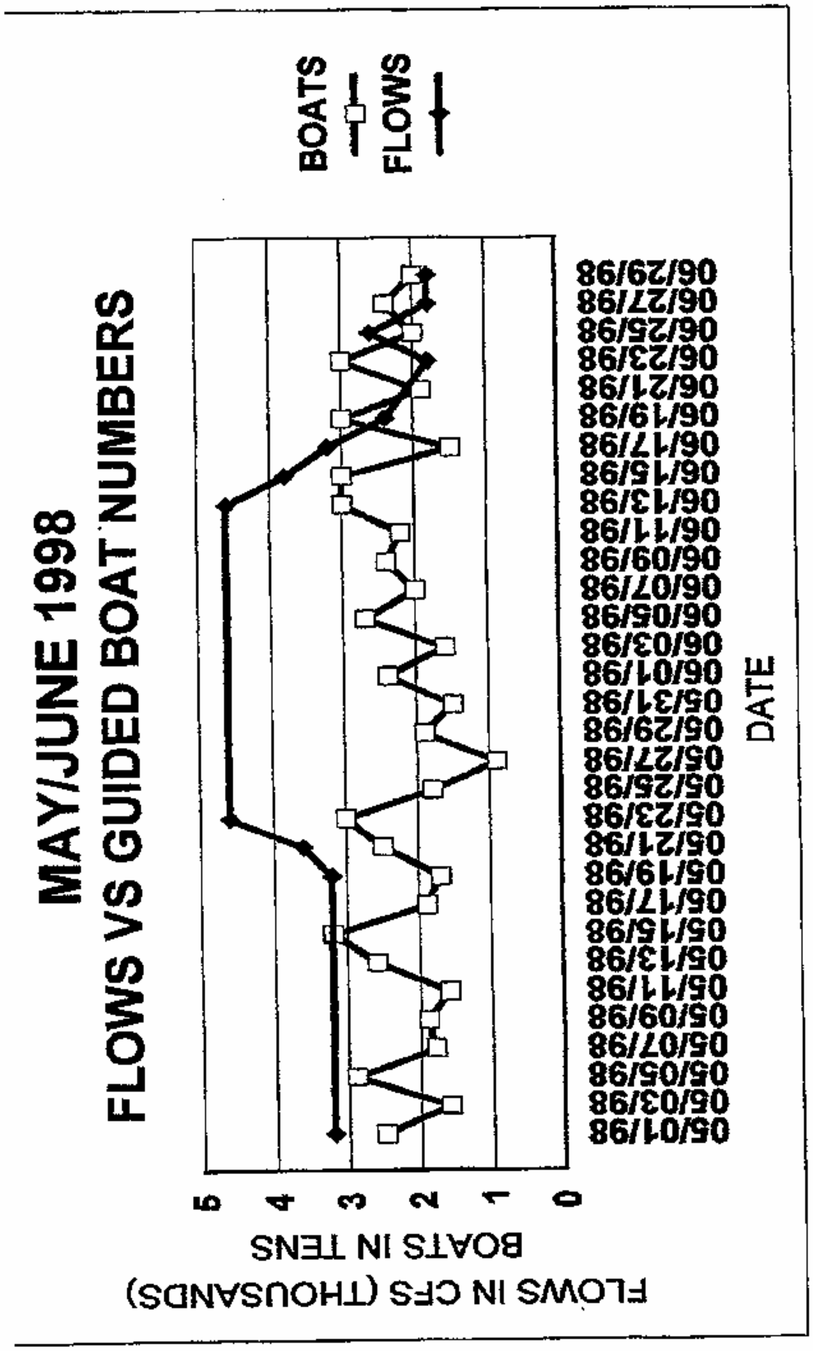
Stable flows are what we favor under all scenarios. Stable river flows from 800 cfs to 4600 cfs are fishable (except during ramping up periods). Water quality and stable flows are most important for fishing. After the initial raising of the river, water quality improves after a short period of flushing. Steady high flows provide trout an opportunity to adjust to their environment. It will mean that river levels might be less than an anglers ideal and beyond their concepts and experiences as acceptable river flows. We have made a real effort over the years to educate anglers not to make the mistake of other anglers by dismissing the river as unfishable. This has been a tough sale. Most anglers who fish many other places know that higher water volumes result in higher river water velocities, in most cases this is fatal to the fishability of such a river. They often base their views on experiences elsewhere. We feel with stable flows, the opportunities for exceptional trout fishing still exist. Higher flows most effect the wading angler in his ability to physically wade around in the river. But with the trout more concentrated from being pushed into the rivers slower edges and pools, they often become readily accessible from the shoreline. Boats add immeasurably to the versatility in accessing more fish in high water. The difficulty in floating is in an increased awareness of safety issues.

COMMENT 27.
All of the impacts of flows that impact outfitters, impact shore fishermen and private boat fishermen too!

COMMENT 28.
4cc In 4.13 Public Safety and Public Health (Vol. 1, pg 224) there are no references to the potential of drowning by fishermen or other river users such as rafters as flows change or fluctuate.

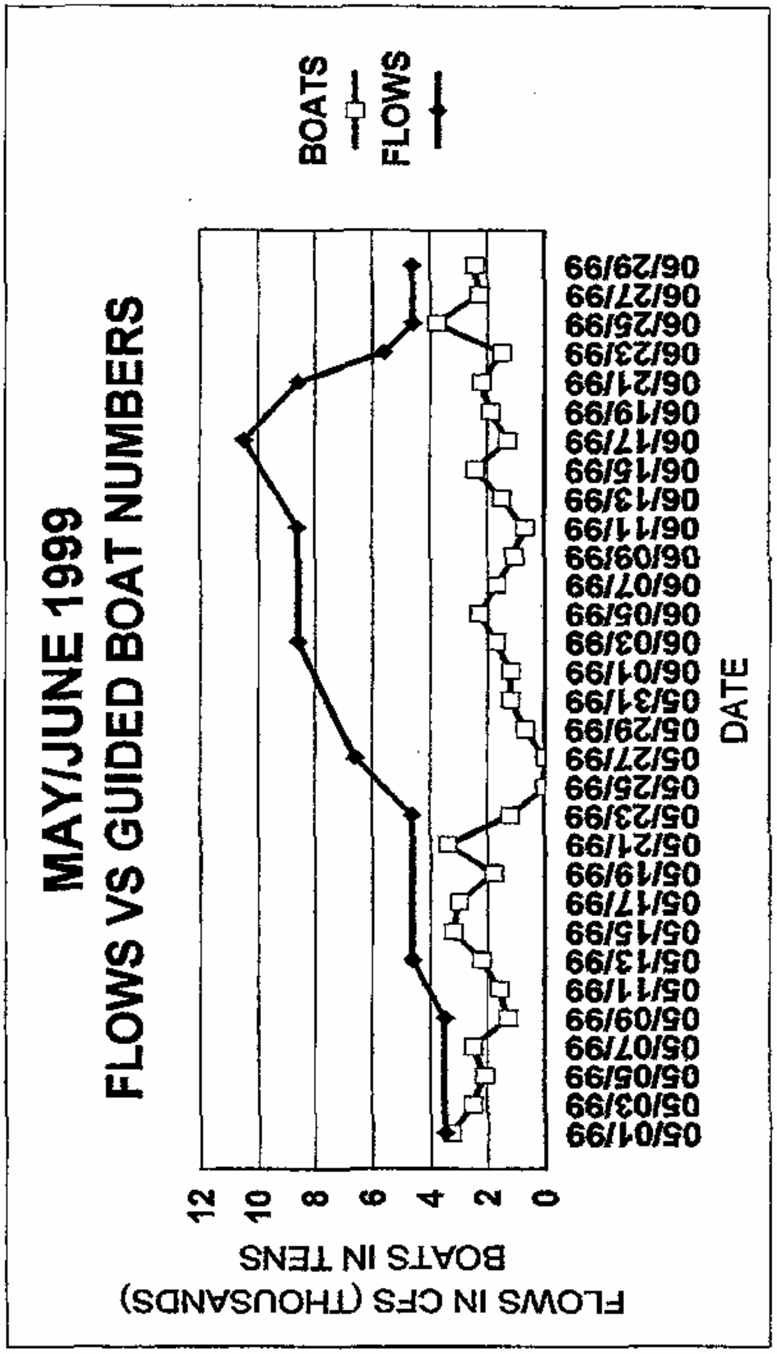
IN SUMMARY
4dd You are fortunate that we ran out of time to comment further. In general we found this DEIS complicated to review based on its overlapping of the treatment of subjects. So many references that seemed to contradict previous statements were made clearer only after rereading them in the context of their specialized subject. It required a lot of time spent in the effort to discover this EIS's overall direction. In light of our comments, you know that we were disappointed with the overall economic analysis, especially in the area of omissions. We would be happy to answer any questions you have on our comments or assist in any manner possible. We can be reached at 435-885-3355. Once again thanks for this opportunity. These comments sent to you by fax will be followed by a paper copy and a disk for your convenience.

Dennis Breer for GROGA
GROGA Representative Flaming Gorge Workgroup.
GROGA
P.O. Box 416
Dutch John, UT. 84023



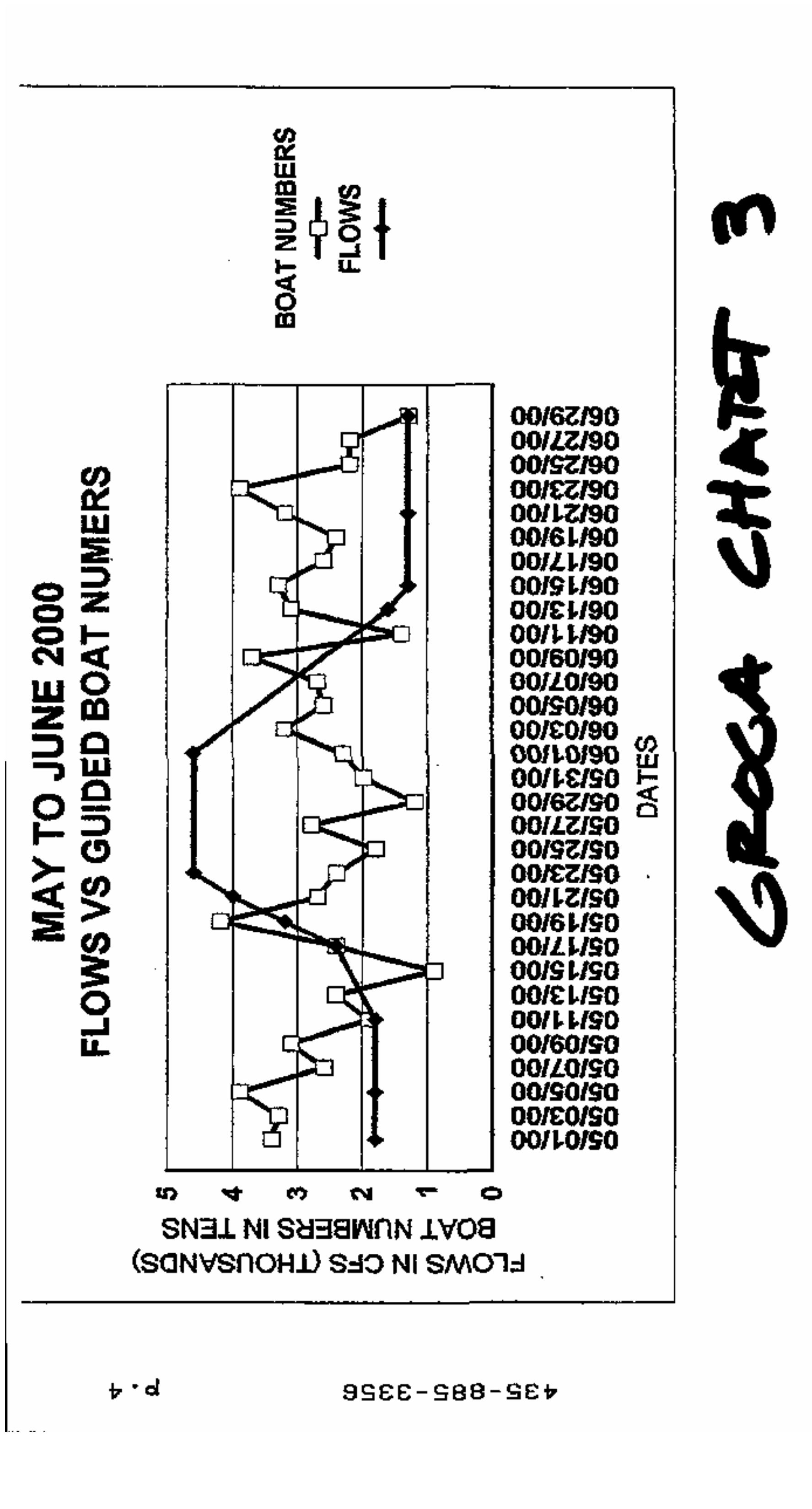
GROGA CHART 1

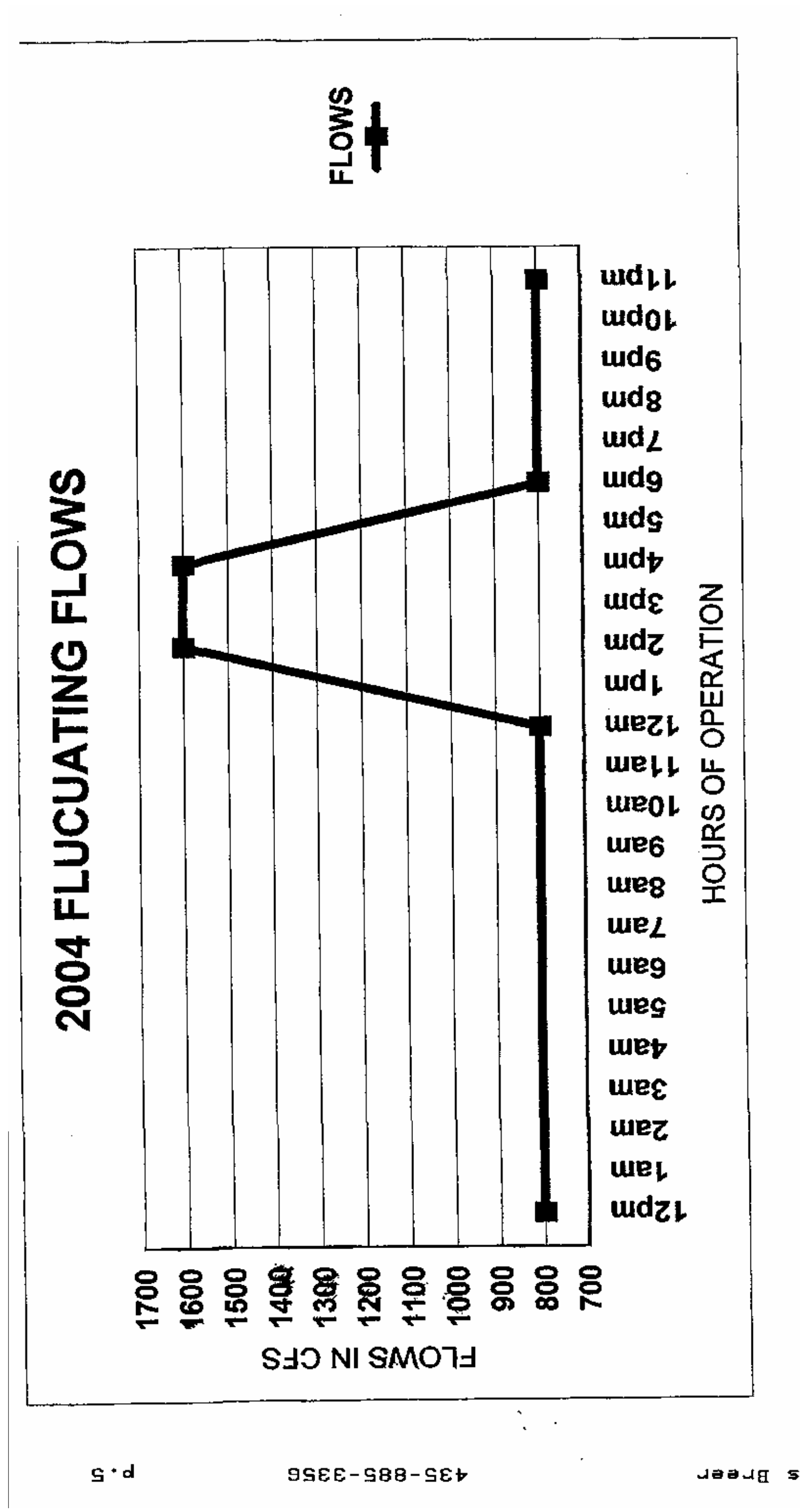
s Breer 435-885-3356 p.2



GREGG CHART 2

Breer 435-885-3356 p.3


MAY TO JUNE 2000
FLOWS VS GUIDED BOAT NUMERS
BOAT NUMBERS
FLOWS
FLOWS IN CFS (THOUSANDS)
BOAT NUMBERS IN TENS
0
1
2
3
4
5
05/01/00
05/03/00
05/05/00
05/07/00
05/09/00
05/11/00
05/13/00
05/15/00
05/17/00
05/19/00
05/21/00
05/23/00
05/25/00
05/27/00
05/29/00
05/31/00
06/01/00
06/03/00
06/05/00
06/07/00
06/09/00
06/11/00
06/13/00
06/15/00
06/17/00
06/19/00
06/21/00
06/23/00
06/25/00
06/27/00
06/29/00
DATES
GROGA CHART 3
435-885-3356
p.4


2004 FLUCUATING FLOWS
FLOWS
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
FLOWS IN CFS
12pm
1am
2am
3am
4am
5am
6am
7am
8am
9am
10am
11am
12am
1pm
2pm
3pm
4pm
5pm
6pm
7pm
8pm
9pm
10pm
11pm
HOURS OF OPERATION
s Breer
435-885-3356
p.5

4. GREEN RIVER OUTFITTERS AND GUIDES ASSOCIATION (GROGA)

4a Comments 1-4
Comments noted.

4b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

4c Comments 6 and 7
Comments noted.

4d
Under either alternative, flows above powerplant capacity would be expected as a normal part of dam operations.

4e
Section 4.4.1 of the EIS accurately characterizes the historic operations.

4f
Reclamation is well aware of the recreation value created by the construction of Flaming Gorge Dam, including the trout fishery which did not previously exist. It must be remembered that fluctuations, depending on hydrologic year, will continue under either alternative.

4g
Reclamation, not the Recovery Program (of which Reclamation is a member), is the Federal agency responsible for the proposed action as analyzed in the EIS. The EIS shows that there are not significant socioeconomic differences between the No Action and Action Alternatives.

4h
As noted above, the Recovery Program is not responsible for implementation of the proposed action Reclamation has that responsibility. Based on the analyses in the EIS, there is the potential for both negative and positive effects to recreation and related businesses under the proposed action. Reclamation does not anticipate a need for mitigation. Under either the Action or No Action Alternatives, the opportunity to provide input to the Flaming Gorge Working Group regarding all resource concerns will continue.

4i
Reclamation does not offer compensation for flood plain inundations along the Green River. Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative.

4j
Text referred to by the commenter is already quoted from legislation. Please see section 1.4.3 in the EIS.

4k
Commentors are urged to read EIS sections 1.5, 3.7.2.3.4, 3.7.2.4.4, 3.7.2.5.4, 4.7.2.4, 4.7.3.2.5, 4.7.3.2.6, 4.7.4.2.5, 4.7.4.2.6, and 4.19.5. Control of nonnative fish is not within the scope of this EIS. At present, Recovery Program management of nonnative fish is primarily directed at cool and warmwater species such as channel catfish, smallmouth bass, and northern pike, at present most commonly found below the Utah/Colorado State line. Information regarding the Recovery Program's nonnative fish control program can be found at <http://www.r6.fws.gov/crrip/rea.htm> or by contacting the Recovery Program directly. The Flaming Gorge Working Group provides a forum whereby concerns for resources such as the tailwater trout fishery can be heard and forwarded as input for Reclamation to consider in planning dam operations. As stated in section 4.21, this working group will continue to be a valuable component of the adaptive management process following implementation of either the No Action or the Action Alternative.

4l
The need for NEPA compliance is analyzed each time there is a major Federal action with the potential to affect the human environment. Until such future actions are identified, it is impossible to speculate as to the NEPA compliance needs.

4m
Long-term negative effects to the tailwater trout fishery are not expected under the Action Alternative. Please see section 4.7.2.4 in the EIS and response 4o below.

4n
The data Reclamation used was more restrictive and able to show adverse impacts better than the attachments provided. See 4o below.

4o
Reclamation believes that the economic analysis in the EIS is sound and provides sufficient information to assess potential impacts. Given the inherent aggregation associated with regional economic impact models, and the expectation that commercial river guide operators might be adversely impacted, a survey was conducted during the summer of 2001 to specifically identify economic impacts to commercial operators. Since economic impacts to the commercial operators are included in the aggregated regional analysis from a revenue perspective (but not a profitability perspective), it would have been inappropriate to add survey results to the overall regional impacts. Nevertheless, the survey was conducted to provide additional detail on commercial operators. While the response rate to the survey was good, the respondents didn't answer all the questions, thereby precluding the estimation of economic impacts specifically for commercial operators.

While the commercial operator surveys proved less than fully successful, they did provide flow preference information which was reported in the EIS. In addition, estimates of changes in visitation for river recreation activities are reported in section 4.11, and recreational expenditures (including guides) are reported in the socioeconomic section (section 4.12). We acknowledge and have estimated adverse impacts to river recreation associated with the Action Alternative, especially under wet and dry conditions (20% of all years).

Attachments 1–3
Reclamation concurs with this analysis based on supporting data (attachments 1-3) from May/June 1998-2000 that commercial guide fishing trips decline as flows exceed 4,600 cfs. This is consistent with the recreation visitation analysis in the EIS. The interpolation analysis of

guide boat fishing visitation actually used a more restrictive high end threshold of 3,731 cfs as obtained from the survey of recreators conducted by the USDA Forest Service in the summer of 2001. For sake of conservatism (to identify adverse impacts), the EIS relies on the more restrictive high end flow threshold currently used in the EIS recreation visitation analysis.

4p
Based on average conditions, the recreation and socioeconomic analysis estimated an increase in recreation visitation and expenditures on both the river and reservoir. The EIS has been revised to clarify that this statement refers to average conditions, and that during wet and dry conditions, it is not possible to determine if the gain in reservoir expenditures would outweigh the loss in river expenditures from the perspective of Dutch John.

4q
Tourist activities" refer to the economic needs of the tourists or recreators (e.g., food, lodging, gas), whereas the "recreational services sectors" refer to the associated economic sectors (businesses) within the regional economic model.

4r and 4u
The intent of the geographic impact area subsection of the affected environment portion of the recreation section is to outline the focus of the impact analysis. The fairly detailed discussion of Dinosaur National Monument rafting activity was to explain why recreation impacts were not developed for this activity. Clarifying text was added to section 4.12.2.2 in the EIS.

4s
The USDA Forest Service participated heavily in developing the recreation and socioeconomic methodologies and analyses used in the EIS and emphasized the need to address recreation effects on both the river and the reservoir. In addition, the USDA Forest Service conducted the data gathering surveys of both the recreators and commercial operators. The recreation visitation and expenditure information gathered via the recreator survey did not allow for county specific analyses. Based on pretests, it was determined that the survey was already complex (given the need to address visitation, valuation, and expenditure information by alternative), and any attempts to gather more detailed data by county would have significantly added to survey complexity possibly jeopardizing survey usefulness. Attempts to allocate expenditures by county would be highly speculative. Finally, the analysis was looking at both river and reservoir recreation where gains on the reservoir might outweigh losses on the river. As a result, the decision was made to use the three-county model utilizing both river and reservoir expenditures and to supplement that analysis with specific commercial operator survey information.

4t
While 10 river commercial operators responded to the survey, not all of them answered all the questions. Therefore, information reported on less than 10 data points is because of question nonresponse. The reported figures are based on those that answered the questions. Since many of the financial impact questions were not answered, Reclamation could not provide an overall estimate of financial impacts. This was clarified in the EIS.

4u
As suggested by this comment, the low end threshold for river boat fishing was reduced to 800 cfs, and the analysis/write-up was revised. The overall results of the analysis did not change significantly.

4v
From 1992 to the present, operation of Flaming Gorge Dam has mostly reflected the No Action Alternative, not the Action

Alternative. The No Action Alternative parameters of this operation were based on achieving the flow objectives of the 1992 Biological Opinion while also maintaining and continuing the authorized purposes of Flaming Gorge Dam. Please refer to chapter 2 of the EIS for a complete description of the alternatives.

4w Comments 22-23
Comment noted.

4x
Reclamation agrees with the comment. Under the No Action Alternative, the 3 months with the highest average flow in Reach 1 are April, May, and June. Under the Action Alternative, the months with the highest average flow in Reach 1 are May, June, and July.

4y
Reclamation performed analysis of resources based on the full distribution of flows that potentially could occur under the Action and No Action Alternative. This flow analysis can be found in the hydrologic modeling report in the Hydrologic Modeling Technical Appendices.

4z
Comment noted. This information is useful in planning dam operations under any alternative. Reclamation notes that the adverse conditions for fishing described here would occur under either the Action or No Action Alternative, particularly in wet years.

4aa
Please see response to 4b above.

4bb
Comment noted.

4cc
Please see section 4.11.5 of the EIS for the discussion of safety as it relates to recreation activity in the Green River. See also response to Daggett County 1g.

4dd
Comment noted.

Mr. Peter Crookston, Flaming Gorge Environmental Impact Statement Manager
PRO 774 Bureau of Reclamation
Provo Area Office
302 East 186- South
Provo, UT 84606-7317

Dear Mr. Crookston;

Old Moe Guide Service has been doing business below Flaming George Dam for 25 years. I am a local, born in Vernal, and raised on the Green River south of town near Horseshoe Bend. In the past 52 years I have seen many changes in the area and in the river, some good some not so good.

As a kid growing up on a farm on the Green before the dam, I remember spring runoff flows flooding some 100 to 150 acres of prime farm land. I also remember the mosquitoes that followed. I remember when the Fish and Wild Life Department were trying to eradicate the now endangered species.

5a I do not understand why that in these years of no water the Bureau would even consider implementing the Action Alternative flows. The Action Alternative flows would cause the loss of at least 52 jobs just in the guide service business when flows exceed approximately 4000cfs, please see the charts provided by GROGA - Green River Guides and Outfitters Association. The guide services generate approximately $1.9 million just in moneys collected in guide service fees. This does not include what our clients spend on getting here, airplane tickets, rental cars, motels, fees, gas, fishing licenses, meals, fishing equipment purchased while here, and souvenirs.

5b Ramping up to these higher flows are of great concern due to the relocation factor of the fish and all the other aquatic life in the river, not to mention what it does to the fishing. The ramping schedule that occurred during the summer of 2004 is a good example - the double daily peak. One of these peaks, occurring midday, had a very negative effect on the fishing sending many fishermen, who spent a very substantial amount of money getting to and staying in our recreational area, home with a less than happy experience.

5c I am sure that the farmers and ranchers below Split Mountain are not happy about the Action Alternative Flows. We are also very concerned about the West Nile virus. The higher flows would create a vast amount of new breeding habitat from Jensen to the confluence with the Colorado River. This could also have a
5d very negative affect on white water recreation and other recreational activities throughout the area such as hiking and biking.

Thank you,

Terry & Gayle Collier
Old Moe Guide Service

5. OLD MOE GUIDE SERVICE

5a
Planned flows for each year would depend on the type of water year; high flows in the Green River below Flaming Gorge Dam would not be expected to occur in dry years. Please see chapter 2 for information on flow targets by hydrologic year.

The EIS states that the Action Alternative could create adverse impacts to Green River commercial river guide operators, particularly under wet and dry conditions as compared to the No Action Alternative.

5b
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of ramp rates, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

5c
The EIS acknowledges (section 4.13.3) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

5d
Comment noted.

THUNDER RANCH, LLC.
2900 South 12500 East
P.O. Box 160
Jensen, UT 84035
(435) 781-2662

December 8, 2004

Uintah County Commission
152 E 100 N
Vernal, UT 84078

To Whom It May Concern:

The proposed change in the operation of Flaming Gorge could cause significant damage to the Thunder Ranch, financial and otherwise. We are strongly opposed to the increased flows proposed in the Environmental Impact Statement.

6a We estimate that the potential damage to our property and equipment could easily reach $155,000. Our analysis is attached.

Thunder Ranch has 3 pumping stations located on the Green River. These pumps would incur significant damage if the dam is operated as suggested in the environmental impact statement.

6b As we read the EIS, at least 10% of the time water flow will more than triple in Reach 2 of the Green River, where our assets are located. Flow in an average year would more than double in the same reach.

Such drastic and unnecessary increases would cause damage to our equipment, and significant erosion of our property, which is located right on the river.

6c The EIS itself states on page S-5 that previous studies indicate that fish habitat conditions can be maintained at lower flows.

Sincerely,

Shayne McKee

Shayne McKee
Ranch Manager

	NO ACTION (CURRENT OPERATION)					
	Dry Year		Average Year		Wet Year	
	Duration	Flow	Duration	Flow	Duration	Flow
Spring Peak	1-2 Weeks	4000 cfs	2-5 Weeks	4600 cfs	5+ Weeks	4600 + Spillways
Summer-Fall		1100-1800 cfs		1100-1800 cfs		1100-1800 cfs
Sept15 - Nov		1100-2400 cfs		1100-2400 cfs		1100-2400 cfs
Nov-May		800-3000 cfs		800-3000 cfs		800-3000 cfs

ACTION (PROPOSED)					
Dry Year		Average Year		Wet Year	
Duration	Flow	Duration	Flow	Duration	Flow
1-2 Weeks	8300 cfs	1-8 Weeks 2 Weeks one out of every three years	8300 cfs 18600 cfs	4-9 Weeks	26,400 cfs
	900-1100 cfs		1500-2400 cfs		2800-3000 cfs
	900-1100 cfs		1500-2400 cfs		2800-3000 cfs
	900-1100 cfs		1500-2400 cfs		2800-3000 cfs

Damage Potential to Equipment and Land:

Pump #1	50,000
Pump #2	30,000
Pump #3	50,000
Booster #4	5,000
Erosion	40,000
Total	175,000

6. THUNDER RANCH, LLC

6a

Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

6b

These statements are incorrect. The flows that would occur in Reach 2 under the Action and No Action Alternatives are very similar. In general, the spring flows in Reach 2 under the Action Alternative would be 10 to 20% higher in magnitude than the No Action Alternative about 40% of the time. The other 60% of the time, flows in Reach 2 would be nearly identical to the No Action Alternative during the spring.

6c

The reference to low flows was from an outdated interim agreement entered into by Reclamation and the U.S. Fish and Wildlife Service in 1985. Under the 1992 Biological Opinion, dam operations were found to jeopardize the continued existence of endangered fish in the Green River. More current information arising from a 5-year scientific investigation conducted under the 1992 Biological Opinion (2000 Flow and Temperature Recommendations) has since taken precedent in developing the flow and temperature recommendations.

12/15/04

PRO OFFICIAL FILE COPY
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DEC 20 '04

COPY

Mr. Peter Crookston
Flaming Gorge EIS Manager, PRO-774
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, UT 84606-7317

Dear Mr. Crookston:

We would like to express grave concerns about the increased flows proposal in the Operation of Flaming Gorge Dam EIS. The damage we would incur on our 500 acres of property located nine miles below Jensen, just half mile east of the Bonanza highway on the Green River, would be devastating.

7a The increased flows would flood a 100 acre field of which 50 acres is in alfalfa. This field yields 700 tons of hay per year and the hay sells for $100 per ton, which would be a loss of $70,000 per year. Increased flows causes an increase in white top which takes three years of treatment to get rid of. Then reseeding will have to take place. The cost of treatment to get rid of the white top and the cost of reseeding added to the loss of income from the hay and it is over $210,000 for those three recovery years.

7b The other 50 acres is in pasture pasture with 50 head of cows. These cows calve each year and the selling price for each calf is $700 @. The loss would be $35,000. White top would also be a concern in the pasture which would mean the cows would have to be supplemented with feed for the three years that white top is in the pastures. There is $20,0000 worth of fences around this
7c pasture area. Debris that would lodge against the fence and damage to the fences would cost approximately $5,000. The corrals and the shed would also be destroyed at a loss of $6,000.

7d The four sprinkling systems used for these pastures would be damaged up to $2,000 and the two pumps that supply this pasture would be destroyed at a loss of $50,000.

7e Additional mosquitos would cause a 10% loss on livestock and West Nile virus would become a greater risk. Twenty years ago mosquitos were so thick a coat had to be worn for protection from them. The current mosquito abatement program has made a great deal of difference. It would be too costly for the County to control so many additional mosquitos.

7f The Bass pond valued at $20,000, has taken years to become established. The flood waters would overflow the pond banks and all of the fish would be washed away.

7g A 30 acre gravel pit, 20 feet deep, which equals one million yards is located on our property. The proposal of increased flows has directly affected the $750,000 sale of this pit.

7h We have a stock water well and pump located next to the river. The increased flows would fill the well up with sediment, therefore there would be no water left to pump and the pump would be non-retrievable.

7i We have proven up on 6 ½ second feet of water and are in the process of proving up the remaining 3 ½ second feet. Our plans were to put it in a new $25,000 pump and 4 new sprinkling systems @ $8,000 to develop an additional field of 100 acres. The total loss for equipment not being able to follow through on this plan would be $57,000. In 1985 we were offered $3,500 per acre for our farm land, and the land is worth more on todays market. With the threatened increase of flows, we would not be able to develop this 100 acres as we have had in our plans which is a minimum of $350,000 loss to us.

An additional 120 acres are being irrigated. There will be no irrigation possibility. Since there can be no pumps added, that leaves 180 acres that cannot be developed..

7j Dikes, worth $10,000, have been in place for a number of years. An increased flow would destroy the dikes. Normal flow has been handled for years and dikes have been repaired as needed.

7k It is hard to put a dollar amount on the value of a mature tree, but there are numerous mature trees on our property.

7l In the late 50's promises were made to farmers by the Bureau of Reclamation that when the dam was built, flooding would be controlled. Many people bought their land based on these promises. The local promotion was to control the flooding.

7m We have not made these claims without having some knowledge of the damage high water can cause. The natural floods of 1983 took us 3 years to overcome and was a very costly to us. Please consider the damage increased flow would cause to both of us. This farm was intended to provide retirement income for my father, who still spends most of his time working on the property, and it is my sole income.

7n If the Bureau of Reclamation still plans to continue with the increased flows which would cause our land to flood, we are asking that we be offered flood rights.

Sincerely,

Burnell Slaugh

Burnell Slaugh

7. Burnell Slaugh Ranch

7a-7d, 7g, 7h, 7j, and 7n
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

7e
The EIS acknowledges (section 4.13.3) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

7f
Please see response to 7a above. The Utah Division of Wildlife Resources has no record of issuing a permit for the referenced bass pond. Their policy is to not issue any permits for nonnative fish stocking on private land in the 100-year flood plain.

7i
The United States accepts no liability for flood damage to improvements made within the historic flood plain. Please see response to 7a above.

7k
Research on relationship of mature flood plain trees and flood flows suggest that mature trees likely live longer and have more robust life forms if subjected to flood flows. Please see section 3.7.2.6.1 of the EIS.

7l and 7m
The presence of the dam for over 40 years has indeed served to moderate flooding. However, this was never intended to mean that the flood plain would remain permanently dry. It means only that there is increased ability to moderate potentially catastrophic flows. Since the dam was built, there have been a number of wet years where high flows have occurred, such as 1983 as noted by the commenter. Whether or not the proposed action is implemented, high flows would be expected in the future. It must be remembered that a drought has been in place for 6 years, which has served to reduce flows on the river.

7n
Please see 7a above.

From: "K Kapaloski" <kkapaloski@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 9:04 PM
Subject: Environmental Impact Statement Comments and Questions

Mr. Peter Crookston,
Flaming Gorge EIS Manager
Bureau of Reclamation
Provo Area Office
302 East 1860 South
Provo, UT 84606

Dear Mr. Crookston,

I would like to offer the following comments and concerns regarding the August 2004 Operation of Flaming Gorge Dam Draft Environmental Impact statement.

I am the manager of Trout Bum 2 in Park City, Utah. We are a fly fishing store and outfitter operating as a permittee of Ashley National Forest on the Green River below Flaming Gorge Reservoir. A large poriton of our store's guiding business and retail sales rely on the Green River trout fishery. As a result, the operation of the Flaming Gorge Dam directly effects our business operations. I am also a licensed fishing guide on the river myself and have been for over 12 years. In addition I own a home in Dutch John and my brother is the head guide for Western Rivers Flyfisher, another permitee on the river. All of these factors make the future operation of Flaming Gorge Dam a concern to me both economically and personally.

I support many of the issues addressed in the action alternative and I appreciate the diligence of the Bureau in conducting the statement. I appreciate the bureau addressing in detail the potential impacts on the trout fishery of the Action and No Action Alternatives. Specifically, in the economic analysis the limit of release of the dam to an up and down ramp rate limit of 800 cfs and the single daily peak, bump restriction. (refer to EIS page 149) These long standing restrictions are very essential in maintaining the world class trout fishery below the dam and should continue to be followed.

8a In addition, I support the recommendations regarding the temperature restrictions of no more than 59 degrees in moderate to wet years and 55 degrees in dry and moderately dry years.(Refer to EIS page 164). These temperature recommendations should be followed in order to maintain the blue ribbon world class trout fishery below the dam.

I would like to bring up a few concerns that I do have in regards to flow restrictions and temperature recommendations. These are concerns that I share with many fellow businesses in the area and fellow fishermen that enjoy the incredible recreational resources that the Green River below Flaming Gorge offers.

8b The EIS seems to marginalize the importance of the restrictions on the up and down ramp rate and single daily hump restriction. It seems as if the EIS concludes that the above mentioned restrictions have not been formalized and that the restrictions have only been in place since 1993. The reality is that these restrictions were the result of lengthy investigations and negotiations of the Flaming Gorge Working Group and have been followed, except in extreme circumstances for some time before 1993.

This raises a concern that the flow restrictions are simiply voluntary and unnecessary and opens the door to arguments that power generation should be pursued at the expense of fishing and other recreational pursuits. I believe that it would be a mistake to elevate power generation as a priority over other uses including but not limited to trout fishing. Past legislation has described power generation as an incident to the primary listed purposes of the dam including providing for basic outdoor recreation facilities and improving conditions for fish and wildlife. (Refer to EIS 3-4) I would pose the question to the Bureau: Should trout fishermen and others involved in
8c outdoor recreational pursuits take a back seat to power generation and be subject to enjoying the resource at the mercy of power demand? Should past legislation and extensive discussion be ignored and pushed to the side in order to allow power generation to take priority?

Secondarily I am concerned that the EIS fails to sufficiently address economic impacts of changes to the tailwater fishery. In using a model that
8d includes three counties, the EIS fails to illustrate the true impacts to the economy of Dutch John and Daggett County where most of the economic impact occurs.

The EIS estimates under the Action Alternative a possible loss of emplyment in the Amusement and Recreation Services of 8.3 percent in wet years (table 4-26) and 6.6 percent in dry years (table 4-27). These are small losses when they are calculated across three counties but could be devastating to the community of Dutch John and Daggett County where the majority of residents
8e are employed by this industry or associated with it. Has this serious economic impact on this area been fully researched and if so is it an acceptable impact?

In summary, I commend the well researched and thorough approach that the Bureau took in formulation and creating the EIS. I appreciate the opportunity to raise the concerns that I and many people effected by the operation of Flaming Gorge have put forth.

Sincerely,

Kory Kapaloski
Gen. Mgr
Trout Bum 2
4343 N. Hwy 224 #101
Park City, Ut. 84098
(435) 658-1166

CC: <troutbum2@qwest.net>, <kkapaloski@hotmaill.com>, <LKapaloski@pblutah.com>

8. TROUT BUM 2

8a
Comment noted.

8b
Section 4.4.1 of the EIS accurately characterizes the historic operations.

8c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

8d
To estimate regional economic impacts associated with changes in river and reservoir recreation, information was collected from surveys of recreators as to their expenditures. The expenditure information gathered via the recreator survey did not allow for county specific analyses. Based on pretests, it was determined that the survey was already complex (given the need to address visitation, valuation, and expenditure information by alternative), and any attempts to gather more detailed data by county would have significantly added to survey complexity, possibly jeopardizing survey usefulness. Attempts to allocate expenditures by county would be highly speculative. As a result, the decision was made to use the three-county model utilizing both river and reservoir expenditures and to supplement that analysis with specific commercial river guide operator survey information.

8e
The EIS acknowledges that Green River commercial operators could experience adverse impacts, particularly under wet and dry conditions. Reclamation cannot definitively describe impacts to Daggett County given the lack of appropriate county specific expenditure data. While these impacts could create problems if concentrated in Dutch John, Reclamation notes that wet and dry conditions were each estimated to occur about 10 percent of all years. We do acknowledge your point and included more discussion in section 4.12 in the EIS.

Trout Creek Flies

P.O. Box 247
Dutch John, Utah 84023

Email: info@fishgreenriver.com
www.fishgreenriver.com

(435) 885-3355
Fax: (435) 885-3356

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO 774 Bureau of Reclamation
Provo Area Office
302 East, 1860 South
Provo, UT. 84606-7317

November 15, 2004

Dear Mr. Crookston: We would like to submit our comments on the Draft *Operation of Flaming Dam Draft Environmental Impact Statement* and its *Technical Appendices*.

As a member of GROGA we fully support the comments submitted by them concerning this DEIS.

As a business, Trout Creek Flies has been a Green River guide and outfitter service full time since 1987 and hold a U. S. Forest Service/BLM permit to provide fishing guided, fishing walk wading, scenic float trips and a vehicle shuttle service. We have a 7000 square foot facility that provides us with a base of operations for these recreational services. Within our facility we offer a retail fly shop, snack bar, raft rentals, motel rooms, convenience store and are a Phillips 66 gas distributor. Our customers include guided fishermen, the fishing public, rafters, hikers, boaters on the reservoir, people seeking lodging, travelers, local residents and out of area visitors. We are totally dependent on the recreational dollars generated on the Green River and Flaming Gorge Reservoir. We operate 12 months of the year although we have a seasonal business that is most active from April through October annually. We employ 20 plus river fishing guides and 25-30 other employees many who are full time. We are employers, full time residents, property owners and taxpayers.

We live in Daggett County and the town of Dutch John. Like us, this County, town and region is extremely dependent on the recreational dollars. With the exception of government workers, we are the only industry in Dutch John. Within Daggett County there are 12 outfitters, 80 guides, 4 lodges, restaurants, 2 snack bars, 4 convenience stores, 3 gas stations, 3 raft rental services and their associated employees just on the east side of the reservoir alone. On the west near Manila and north around the reservoir there are many more businesses that too depend on recreational visitor dollars. Our county has less than 800 full time residents and is only 682 square miles in size.

Comment 1.

9a We are very disappointed in the treatment of the economical impacts of this EIS as they pertain to us. A more localized analysis is appropriate in light that the largest economical impacts center around Reach 1 of the Green River and the Flaming Gorge Reservoir. To do an analysis over a 3 county area does not show the real impacts of the recommendations contained within this EIS. We would like to see this EIS fully address the impacts to our businesses. We feel that it has not.

9b Question 1. Is it not possible to prepare an adequate economic analysis surrounding the EIS recommendations as they pertain to our businesses?

Comment 2.

While the GROGA letter states many of our concerns, we must reinforce the points that the **9c** ramping up process, flows exceeding 4600 cfs and daily fluctuating flow operations impact our businesses negatively by reducing the quality of the recreational experience for fishermen and **9d** other river users that use our services and buy our products. In addition we have safety concerns for fishermen and other water based recreations while these flows are being performed.

Comment 3.

9e Furthermore, we support GROGA's position that power generation takes a lower priority when compared to the other "authorized purposes" of the Flaming Gorge dam. Operational considerations should be given to recreation and fishing in particular by reducing the impacts of daily fluctuations and their effects on these activities. Daily fluctuations performed during fishing **9f** daylight hours are an erosion of local economics one day after another with their daily negative impacts.

Comment 4.

9g We support the recommendations for a 55 degree F release temperature during the dry and moderately dry years, maintaining adequate river temperatures for trout at the Colorado/Utah state line.

Comment 5.

We strongly support BAR recommendations of flow fluctuations limitations with the following exception. Power generation in the form of fluctuating flows should not be at the expense of other **9h** authorized purposes, "and for the generation of hydroelectric power, as an incident of the foregoing purposes" (Vol. 1, pg 3 and 4, 1.4.1.1).

Comment 6.

9i We strongly support the 800 cfs ascending and descending ramp rates. We would support a formalization agreement for these ramp rates.

Comment 7.

9j We fully support the maintaining of the minimal flow agreement between UDWR and Reclamation for the maintenance of river flow supporting the tailwater trout fishery and furthermore request the formalization of this agreement as stated in Vol. 1, pg 5, second full (italicized) paragraph.

Comment 8.

9k Except in emergencies, flows should not exceed the capacity of the power plant of 4600 cfs, bypass flows should only occur as a last resort, and the frequency of such events should be kept at an absolute minimum.

Comment 9.

9l We share GROGA's *opinion that in general we found this DEIS complicated to review based on* its overlapping of the treatment of subjects. So many references that seemed to contradict previous statements were made clearer only after rereading them in the context of their specialized subject. It required a lot of time spent in the effort to discover this EIS's overall direction. In light of our comments, you know that we were disappointed with the overall economic analysis. We would be happy to answer any questions you have on our comments or assist in any manner possible. We can be reached at 435-885-3355. Once again thanks for this opportunity. These comments sent to you by fax will be followed by a hard paper copy for your convenience.

Dennis E. Breer- President
Trout Creek Flies, Inc.
P.O. Box 247
Dutch John, UT. 84023

9. TROUT CREEK FLIES

9a
To estimate regional economic impacts associated with changes in river and reservoir recreation, information was collected from surveys of recreators as to their expenditures. The expenditure information gathered via the recreator survey did not allow for county specific analyses. Based on pretests, it was determined that the survey was already complex (given the need to address visitation, valuation, and expenditure information by alternative), and any attempts to gather more detailed data by county would have significantly added to survey complexity, possibly jeopardizing survey usefulness. Attempts to allocate expenditures by county would be highly speculative. As a result, the decision was made to use the three-county model utilizing both river and reservoir expenditures and to supplement that analysis with specific commercial river guide operator survey information.

9b
Even if Reclamation had enough detail to estimate economic impacts for Daggett County alone, the aggregated nature of the regional model would preclude estimation of impacts for individual businesses. This is because the lowest level of detail provided by the model reflects the economic sector which typically combines information across a range of somewhat similar businesses. Reclamation believes that the economic analysis in the EIS is sound, and provides sufficient information to assess potential impacts.

9c
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of ramp rates, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have the benefited the trout fishery.

9d
Please see section 4.11.5 of the EIS for the discussion of safety as it relates to recreation activity in the Green River. See also response to Daggett County 1g.

9e and 9h
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

9f
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of ramp rates, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

9g, 9i, and 9j
Comments noted.

9k
Under either alternative, flows above powerplant capacity would be expected as a normal part of dam operations.

9l
Comment noted.

From: Dennis Kubly
To: Crookston, Peter
Date: 11/16/04 12:13PM
Subject: Fwd: Inquiry to UC Region

Peter,

for your consideration of public comments.

dk

>>> Lisa Iams 11/16/2004 10:02:37 AM >>>
Here is another inquiry regarding the test flows

>>> Steve Schmidt <nobody> 11/15/2004 6:48:46 PM >>>

From Steve Schmidt () on Tuesday, November 16, 2004 at 01:48:20

message: RE: Operation of Flaming Gorge Dam Draft Environmental Impact Statement Executive Summary.

I have read this document several times and find the information within to be vague and incomplete in regards to schedules and impacts proposed by the 2000 Flow and Temperature Recommendations Executive Summary.

10a My concern is the Green River tailwater fishery from Flaming Gorge Dam to the Colorado Border. I am one of a handful of permitted outfitters on this resource and have been since 1986. In reading this document there is hardly a mention of the fishery or the potential and real bearing the 2000 Flow and Temperature Recommendations may have. If the proposed recommendations should significantly impact this fishery, the economic effect to Dagett County, businesses and those individual who rely on this resources for their livelihood could be devastating.

10b As I read the Executive Summary, much of what is being proposed under the right time frame and conditions would bear little consequence to the Green River fishery. However, irregular daily fluctuations over extended periods of time could inflict substantial environmental harm to this resource. In reading the Summary the time frame for possible increased flows under all 5 scenarios extends over a long period of time. Significant fluctuation outside of the rivers normal seasonal flow regime would greatly impact users and the economy of all businesses that rely on this fishery for their livelihood for years to come. In this document there is no mention of the impact to the fishery these recommended flows would have, nor is there any consideration given to this fishery under the proposed flow recommendations.

10c 10d Regarding temperature, a broader overall range from the dam to the Colorado Border may improve the diversity of aquatic life in this section of the river thus enhancing many a users experience on this resource. However, on dry years, which we have experienced over the past 6, we have seen temperatures in the Browns Park portions of the river approach and exceed 70 degrees during the July to August time frame. If temperatures were increased over this time period under such conditions, as we have recently experienced, we could loose the lower sections of this fishery. Due to the most recent drought and increased temperatures in this portion of the Green, we have already seen a decline in the overall health of the lower Green River fishery. There is no indication in this report, that if and when possible steps would be taken to protect or possibly even enhance this resource in regards to temperature changes.

I support the Bureau's efforts in protecting these four endangered species. I recognize the value in such efforts and if recovery of these four endangered species should occur the better off we will all be. Yet there is nothing in the 2000 Flow and Temperature Recommendations that suggests that steps will be

10e taken to protect or possibly enhance the economic viability of this resource when and if possible. There is virtually no regard given anywhere in the recommendation to the individuals and businesses whose lives depend on the health of the Green River fishery. Until such steps and considerations are taken, I find it difficult to support the proposed action.

Sincerely, Steve Schmidt
President, Western Rivers Flyfisher

emailaddress: schmidt@wrflyfisher.com

previous_page: http://www.usbr.gov/uc/library/envdocs/eis/fgDEIS/index.html

Submit: Send

REMOTE_HOST: 166.70.13.136

10. WESTERN RIVERS FLYFISHER

10a
Fishery discussions are contained in sections 3.7.2.3.4, 4.7.2.1, 4.7.2.4.1, 3.11, 3.12, 4.11, 4.12, and 4.21 of the EIS.

10b
The Action Alternative requires that the variation in elevation at the Jensen gauge stay within the 0.1-meter range per day. In dry conditions, the flow of water needs to be kept within a narrower range than under wet conditions. However, within these variations in flows, the change in depth, or elevation, of the water stays within the required 0.1-meter-per-day range. Even though the flows vary by up to 800 cfs per day depending on the minimum and maximum flows of the day, the change at the Jensen gauge remains within the 0.1-meter requirement. Reclamation notes that flows above 4,600 cfs and daily fluctuations have been a normal part of dam operations for over 40 years, and would continue under either the Action or No Action Alternatives. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

10c
See section 4.7.2.4.1.2. In dry and moderate years, 55 degrees Fahrenheit (°F) (13 degrees Centigrade [ºC]) water would continue to be released from the dam as it is currently, resulting in no more impacts to trout during summer months than are currently sustained.

10d
See section 4.7.2.4.1.2. The 2000 Flow and Temperature Recommendations were designed to benefit endangered fish. The Flaming Gorge Working Group provides a forum whereby concerns for other resources such as the tailwater trout fishery can be heard and forwarded as input for Reclamation to consider in planning dam operations. As stated in section 4.21, this working group will continue to be a valuable component of the adaptive management process following implementation of either the No Action or the Action Alternative. Issues such as temperature modification to protect the trout fishery can be raised through this process.

10e
The EIS discloses that there may be both adverse and beneficial effects to businesses under the Action Alternative. Under either the Action or No Action Alternative, Reclamation will continue to consider the needs of all resources when making operational decisions. Please refer to sections 3.7.2.3.4, 4.7.2.1, 4.7.2.4.1, 3.11, 3.12, 4.11, 4.12, and 4.21.

INDIVIDUALS

1. **G. Howard Abplanalp**
2. **Lew Albright**
3. **Mark Allen**
4. **John and Mickey Allen**
5. **Dick Apedalle**
6. **Justin Barker**
7. **Lynn Barlow**
8. **Nancy Bostick-Ebbert**
9. **Allen Brisk**
10. **Alan Bronston**
11. **Michael Brown**
12. **Bob Brownlee**
13. **Scott Brunk**
14. **Ted Butterfield**
15. **Reneé Buzarde**
16. **Bryan Campbell**
17. **Jay P. Carlson**
18. **Mel Cisneros**
19. **Randall M. Connett**
20. **Robert W. Day**
21. **James DeSpain**
22. **Frank Doyle**
23. **Paul J. Ebbert**
24. **Bryan Eldredge**
25. **Jeff Erkenbeck**
26. **Kurt Finlayson**
27. **Richard Fitzgerald**
28. **Robert Freestone**
29. **Bruce Gibbs**
30. **Kerry M. Gubits**
31. **J. Dean Hansen**
32. **Virginia L. Harrington**
33. **Corey Harris**
34. **Craig W. Hauser**
35. **Rick Hayes**
36. **Jeffrey Himsl**
37. **Jack Hunter**
38. **Dale Huskey**
39. **Bob Johnston**
40. **Don E. Jorgensen**
41. **Dora J. Jorgensen**
42. **Wade Kafkaloff**
43. **Bruce Kautz**
44. **Ted E. Kulongoski**
45. **Heather Kuoppamaki**
46. **Scott A. Marshall**
47. **Jeff Martin**
48. **Jerry McGarey**
49. **Patrick Mehle**
50. **Norman Miller**
51. **Richard L. Mimms**
52. **Arthur D. Moeller**
53. **Mark Naccarato**
54. **Sean P. O'Connor**
55. **Mauria Pappagallo**
56. **Edward Park**
57. **Lex Patterson**
58. **Chet Preston**
59. **Tom Prettyman**
60. **Jairo Ramirez**
61. **Robert Rutkowski**
62. **Peter Sagara**
63. **Cris and Amanda Shiffler**
64. **Jay Smith**
65. **Les Smith**
66. **Kent Spittler**
67. **Wayne Stewart**
68. **Steven Strong**
69. **Jeffrey W. Talus**
70. **John I. Taylor**
71. **James W. Thompson**
72. **Phil Waters**
73. **Bryan Weight**
74. **Jim Wilson**
75. **Marshall Wilson**
76. **Crista Worthy**

November 14, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager
PRO-774 Bureau of Reclamation
Provo Area Office
302 E. 1860 So. Provo UT
84606-7317

Dear Sir,

After reading the newspaper article in the Vernal Express dated 11-4-04, I would like to submit
1a my comments: I fully Support Dr. Steven Romney's concerns of creating excess flood plain to promote increased endagered fish populations - I witnessed the hard work Dr. Romney and his crew did this year to keep mosquito populations in check as they were continually checking and eradicating larvae throughout the area.

1b It also doesn't make sense to flood usable fields, irrigation systems & to lose power generation when the endangered fish are
1c making a comeback anyway. there's a good chance the Yampa River will provide a extremely
1d easy flow this year & provide some of the

benefits you are hoping for. I think the desire to increase the endangered species is one we all support.

I also feel that we need to increase the storage capacity of the Green River at higher elevations such as Fontenelle &
1e flaming Gorge for future use since we've been experiencing a 6 year drought.
1f Water is too valuable a commodity to use for just one reason.

Respectfully.

G Howard Alzplanalp

1. G. HOWARD ABPLANALP

1a
Please see responses to the Uintah Mosquito Abatement District letter 6 and public hearing speaker 9 (Dr. Steve Romney).

1b
Under either alternative, higher flows will inundate the historic flood plain. Any improvements by landowners in the flood plain have always been at the landowners' risk.

1c
There are few data suggesting that the four endangered species are making a comeback; in fact, most data suggest that populations of four species are either stable at dangerously low levels or declining in some cases. At best, all four species currently exist at diminished population levels which preclude removing them from the Endangered Species Act (ESA) or improving their ESA status. See the Recovery Program website <http://www.r6.fws.gov/crrip/rea.htm> or call the Recovery Program at 303-969-7322, ext. 227 for more information.

1d
As stated in the EIS, Yampa River flows have a greater influence on the flows in Reaches 2 and 3, and the Action Alternative takes this into account.

1e
Comment noted; increasing storage capacity is outside the scope of the EIS.

1f
Reclamation's intent is to continue balancing the needs of all resources when making operational decisions and not focus on just one resource. Reclamation would continue this practice under both the Action and No Action Alternatives.

From: "lew" <albrightlr@iwvisp.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 5:27 PM
Subject: Water Flows on the Green

Dear Mr.. Crookston,

I have been fishing the Green River for at least 12 years. The last 6 years I have fished it twice a year. This last year, especially October, the flows really disrupted the fishing. It seems that the flows were changed during prime time, during the middle of the day. It was the worst fishing that we have ever had on
2a the Green. We spend over a $1000.00 to the Utah merchants for every trip that we make but if the flows stay like they are, we plan on fishing in Oregon and Colorado. We do love the Green River fishery, but why fish it if the flows keep changing during the day and cutting hours of fishing out of our day. It is very
2b discouraging. It wouldn't it be better for everyone if the flows were changed during the late evening and not
2c during the day when the river is full of anglers, boats and rafters?? It is also a safety hazard because many wade fishers cross over to the opposite bank to fish and when the water rises it is almost impossible to get back, unless you are a good wader. I hope that an agreement can be reached that will not disrupt the fishing during prime time.

Thank you for your support.

Lew Albright

2. LEW ALBRIGHT

2a and 2b
Fluctuating releases during the day have been the normal operations of the powerplant since it began power generation 40 years ago and would continue under either alternative. The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

2c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38.

From: "Mark Allen" <markallen2@qwest.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 7:28 PM
Subject: Green River Problems

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152
801-379-1159 FAX

Mr. Crookston,

I have been fishing on the Green River for many years. There are a
number of things which are of grave concern to me. The past several
times I have been fishing out there I catch many fish that seem to have
health issues. I am not sure of all the things that disrupt the
3a feeding cycles of the fish, but I think the change of flows in a quick
manner does in fact impact the fish in negative fashion.

3b It is difficult to know if I wade to the far side of the river if I
will be stranded by high releases or if I will be able to safely return
at the end of a fishing day.

The reputation of the Green River as being a world class fishery has
come into question when I find the disruption that high water brings to
my personal experience. If water flows need to be ramped up I would
3c suggest this happen from midnight until 4am, so things can settle back
down during the day hours. If the flows are ramped up during the night
3d the electricity generated could be sold to those in the East at a
premium.

3e Please consider the issues which affect the fishing, which result in
economic gains or losses to the area as they are directly tied to
individuals fishing experiences and word of mouth as to how the fishery
is doing. It has been quite sometime since fishing has been splendid.
I would guess that if an environmental and biological study were done
on the disruption of feed in the river channels due to rapid increase
of water flows, we would find that much of the food sources for fish
3f are being blasted downstream and hence those fish that remain have
undue competition, this results in marginally healthy fish.

I would like to get an update as to the solutions you deem appropriate
for this wonderful resource. Please protect it. As a former river
guide in the Grand Canyon we experienced dramatic flow changes. There
is great safety issues here that need to be considered. High water and
3g swift currents can consume lives. It is common sense that if flows are
to be increased that it is done prudently and at a time which presents
the lowest opportunity to affect fisherman frequenting the area.

Thank you,

Mark Allen
1729 North 80 West
Orem, Utah 84057

3. Mark Allen

3a and 3f
Comment noted.

3b and 3g
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

3c
Fluctuating releases during the day have been the normal operations of the powerplant since it began power generation 40 years ago and would continue under either alternative. The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

3d
Electricity in the East is provided by separate transmission systems that are not connected or synchronized with the Western network, so the power could not be sent directly to the East.

3e
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of fluctuating releases, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery. Please see response to individual letter 38.

From: "Mary Allen" <jackpinesavageco@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 11:52 PM
Subject: Increased Flows from Flaming Gorge Dam

To whom it may concern:
4a We are residents of Rangely, and take much pleasure from the rivers of Dinosaur National Monument. We strongly support the Action Alternative.

John and Mickey Allen
Rangely, CO

Mary Allen
jackpinesavageco@earthlink.net
Why Wait? Move to EarthLink.

4. JOHN AND MICKEY ALLEN

4a
Comment noted.

From: "Dick" <flyfishing@readytek.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 6:47 PM
Subject: Operation of Flaming Gorge Dam

5a I support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities,
5b especially fishing. An issue of safety, wadding fishermen's safety is affected negatively when river flows change abruptly during peak fishing hours of the day.

Please take in consideration my notes

Thank you

Dick Apedaile

flyfishing@readytek.net

5. DICK APEDALLE

5a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

5b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: <Jlbarker5@cs.com>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 23, 2004 11:48 PM
Subject: Flaming Gorge Dam Flows

Mr. Peter Crookston

Flaming Gorge Environmental Impact Statement Manager

PRO-774

Bureau of Reclamation, Provo Area Office

302 East 1860 South

Provo, UT. 84606-7317

801-379-1152

I am writing in regard to the changing flows on the Green River below Flaming Gorge Dam this last summer. I come to the area about every other month to fish and stay in Vernal for the duration of the trip. I usually come with at least one friend.

6a I wade fish on the Green and the flows are particularly important to me. Changing the water flows during the day is a safety issue for many fishermen that wade like myself. I know the river changes and plan accordingly, but the river is constantly full of newcomers and they are rarely ready for a large increase in the amount of water being let out of the dam.

6b I support the single daily peak hump restriction, but it could be done at a time when it would not impact the fishing. The daily changes this last summer killed the fishing during most of the day. It takes the fish a while after the increased flow to calm down and begin feeding. By this time, the flow was decreased and the fishing was again thrown off. I know the Green River is a national destination river for fly fishermen and this summer was a disappointing experience for many of them. We need to keep the flows as constant as possible during the day in order to maintain the excellent fishing and keep tourist dollars flowing in to this region. Thank you for you time.

Justin Barker
1911 W 800 N
Pleasant Grove, UT 84062
801-785-7811

6. Justin Barker

6a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

6b
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Lynn" <lynn@kathyquilts.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 10:58 PM
Subject: Power generation impact on Green River fishing

To: Peter Crookston
From: Lynn Barlow

Dear Sir,

I would like to mention to you how I enjoy visiting the Green River, especially the A section below the Flaming Gorge Dam. I have visited numerous times and had different experiences each time. Out of all the places I like to fish, the Green River can be the most fun and the most frustrating. There have been times when the raising of the river has severely affected the fish. Since I live about 4 hours away from Dutch John, in Brigham City, Utah, the time investment is quite significant. When I visit the Green River I am rewarded with the beauty and awesome canyon view as I float serenely down the river. The opportunity to catch fish makes the trip all the more enjoyable.

7a It is come to my attention that the power generation can occur during time periods when fishing will not be affected. This could make for more enjoyable trips to the river as well as safer fishing. Not knowing whether
7b the river will be raised or lowered without warning really is a cause for concern. It is my hope that a time frame can be reached for power generation that will not affect the fishing.

Better fishing conditions will affect the amount of dollars for local merchants as well as for Utah in general.

I thank you for reading this message,

Lynn Barlow

7. LYNN BARLOW

7a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

7b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Nancy Bostick-Ebbert" <nancyb@sbtnet.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:39 AM
Subject: Comment Addendum

Below you will find a duplicate comment to which I have added my contact information that I inadvertantly left off earlier.

Thanks,

Nancy Bostick-Ebbert

To Whom it May Concern:

8a My name is Nancy Bostick-Ebbert. I am a fifth generation Utah resident and was born and raised in Vernal. I very strongly support the action alternative for increasing flows every 10 years on the Green River below the dam. I think it is critical that we do everything we can to mimic conditions favorable for the endangered species of fish in the Colorado River drainage. In addition, these releases help improve the riparian ecosystems along the river and provide better habitat for the birds and animals who inhabit those environs.

I appreciate the opportunity to comment on this and encourage you to make a decision based on good science not fears and misinformation.

Sincerely Yours,

Nancy Bostick-Ebbert
1 North 2500 West
Vernal, UT 84078
(435) 781-1518

"If you want another to adopt your beliefs, you must first
become someone they wish to emulate..."

---nancy bostick-ebbert---
nancyb@sbtnet

8. NANCY BOSTICK-EBBERT

8a
Comment noted.

From: Allen Brisk <Allen.Brisk@paccoast.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:06 PM
Subject: Green River

I am a 64 year old man who has fished the Green River for the past 25 years. I take an average of 4 guided trips per year. I have fished when the water is high and when it is low. I have fished and been caught in high water when the water levels have flucuated. I have seen trees and debris washed downstream when the water is increased.

In all cases when the level increases or decreases during normal fishing hours, the experience decreases and is not so enjoyable.

9a Please do not change the flow pattern. Increase the volume at night if more water is required.

From a financial point, my Green river float trips would cease and so would the lodging.

I do not necessarly want to go to Montana to fish.

Please.

Allen Brisk allen.brisk@paccoast.com

9. ALLEN BRISK

9a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Bronston, Alan" <Alan.Bronston@USFOOD.COM>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 10:57 AM

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152

Dear Mr. Crookston,

I am writing this note in regard to the review of the Environmental Impact Statement of the Flaming Gorge Dam that is underway. I would like to comment on how the flows were managed this last year from two separate perspectives.

First, let me say that I live in Utah, do business in Utah, recreate in Utah, and do as much as possible of all three at Flaming Gorge. Flaming Gorge has not only been the best place in the west for a top quality fishing experience, it is also the most convenient. This year, however, with the
10a daily rise and fall of the water levels; the fishing was so suppressed that it was hardly worth the effort and expense to come, other than for the scenery. It is inevitable that if the flows are managed in the same way in the future, I, and others like me, will have no alternative than to find other places to go. This would be a real shame since Flaming Gorge by all rights aught to stand alone as the prime fishing destination in the United States, if not the world. The impact on the local economy cannot be
10b overstated.

Secondly, this is a serious safety hazard. Let me relate an experience that
10c I myself had this summer, which I understand was not unique from what others have told me. We launched just after midday from the put in below the dam. On board my drift boat was a young child and older man. Just after the second or third bend we encountered a wading fisherman who had become stranded in the middle of the river when the levels began to rise. He was very close to loosing his footing when we came along. We had no choice but to attempt to rescue him, of course. However, due to where he was, the current, and our having to ferry across to get to him, in the end the only way we could get him was for him to grasp hold of the upriver side of the boat by the oarlock. This crippled the maneuverability of the boat since I no longer had the use of one oar, and the additional weight and dragging effect to the upriver side of the boat nearly swamped us. This was not an event I would enjoy repeating.

I hope that when the Environmental Impact Statement is complete it will be discovered that there is a way to accomplish whatever it is that is required from the dam without having such a dramatic impact on those who are trying to enjoy the river.

Thank You,

Alan Bronston
Territory Manager

888-295-4803 Ext. 502
435-901-3138 Mobile
alan.bronston@usfood.com

10. ALAN BRONSTON

10a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

10b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

10c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Michael Brown" <mike_utdairy@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 8:36 AM
Subject: Daily Peak Restriction

Dear Mr. Crookston,

11a As a frequent visitor to the Flaming Gorge recreation area, primarily to fish the Green River below the dam, I would like to voice my support of a single daily peak hump restriction, but I believe its timing should be in a manner that it has no impact on river recreation activities, especially fishing.

I know I am preaching to the choir when I talk about the revenue generated by those who fish the river, but I think the drastic change in flows has the possibility of reducing that revenue. I know my frequency has decreased since I was stranded on the West side of the river during a high flow.

11b Again, I understand the need to maximize the usefulness of the dam, but not at the expense of the purpose for which the dam was authorized.

Respectfully,

Mike Brown
Riverton, Utah

11. MICHAEL BROWN

11a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

11b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: "Bob Brownlee" <brwnle@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:27 PM
Subject: Flaming Gorge Discharge Rates

12a Dear Mr. Crookston, I am writing to encourage use of the single daily peak hump restriction but in a manner which does not impact fishermen. I have fished the Green River extensively and have been negatively surprised by the flow changes more than once. Not only does the flow change turn the fish bite off for a time but it also has some potentially dangerous consequences. I have been trapped twice by rising flows and had to fill my waders to reach shore when I realized what was happening. People who are

12b not aware of the possible flow changes could be trapped on a shallow bar for an extended time, or worse. If there are ways of preventing this potential I would certainly like to encourage the consideration of those actions.

Thanks for your consideration. Bob Brownlee, Golden, Colorado.

12. BOB BROWNLEE

12a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

12b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "scott brunk" <bighorn1478@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 12:24 PM
Subject: Flaming Gorge water flows.

13a I have found that the fishing experience at Flaming Gorge can be dangerous as well as frustrating do to the peaks and valleys of water releases for power generation. Please try to do a better job of managing the flows.

Scott Brunk
303-665-3261

13. SCOTT BRUNK

13a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Ted Butterfield" <buttuhs@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 6:10 PM
Subject: In regards to flaming gorge dam.

I'm writing in regards to the flow changes at flaming gorge in order to produce electricity. I beleive that a
14a constant flow is preferable to fluctuating flows. This is due to experiences which I had in early july of this
year while fishing the Green just below flaming gorge. The fishing was severely affected by the flow
changes and i know of several men on that day who were stranded on the other side of the river as they
did not know that the flows would rise later in the day. One man even lost his driftboat when the river rose
and picked it up off the rocks. This causes personal loss and distasteful memories of what could have
been a long anticipated trip to a one off America's top rivers. Therefore I support the single daily peak
14b hump restriction, and hope that the timing off the paeked flow will be such that it will not disturb fishing or
14c place fishermen in needless danger. Thank you for your time.

Ted Butterfield
buttuhs@hotmail.com

14. TED BUTTERFIELD

14a and 14b
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

14c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: "Renee Buzarde" <rbuzarde@union-tel.com>
To: <fgeis@uc.usbr.gov>
Date: Thu, Nov 4, 2004 2:26 PM
Subject: Flaming Gorge EIS

I would like to join Dr. Romney in opposition to changes in operations of the Flaming Gorge Dam. I live near the dam and love this area and hope we can protect it.

15a With the huge threat of the West Nile Virus and possible danger to our fishing industry, I strongly oppose proposed changes in water flow.

15b We need to protect the trout in the Green River.

Please leave things the way they are.
A concerned citizen of Daggett/Uintah County.

Reneé Henderson Buzarde
670 Flaming Gorge Acres
Dutch John, Utah 84023
rbuzarde@union-tel.com

15. Reneé Henderson Buzarde

15a

The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and a threat from West Nile virus or other mosquito-borne diseases.

15b

Long-term negative effects to the tailwater trout fishery are not expected under the Action Alternative.

From: "BRYAN CAMPBELL" <BCAMPBELL@wmccat.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:19 PM
Subject: flaming gorge dam...

It has come to my attention that the Bureau of Reclamation is undergoing a Draft Environmental Statement on the Operation of Flaming Gorge Dam and asking for comments. I was only able to fish my favorite river, the Green River twice this summer. Both times the trip was dramatically effected by fluctuating flows coming from the dam. On the first occasion, our group crossed the river early in the morning, and we underestimated the effect of the increase in flow, that evening we tried several times to cross back over, but it was impossible. Finally we had to return to little hole to cross where two of us took water over the top of our waders, and a younger member of our group barely made it across. On the second ocassion, we left very early in the morning to make it to the river in time to fish, we were having a great day until again the flow increased and the fishing came to a screaching halt forcing us to leave earlier than we had hoped. I understand the purpose
16a of the dam, but I also feel that dramatic fluctuations during daylight hours not only affects fishing, but affects the safety of people on the river. Please change the fluctuation times to a time when people aren't
16b negatively affected.

Thank you,
Bryan Campbell

CC: fishgreenriver <dbreer@union-tel.com>

16. BRYAN CAMPBELL

16a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

16b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 below.

FGEIS ZZ401 PRO

From: "Jay Carlson" <jpcvail@msn.com>
To: <fgeis@uc.usbr.gov>
Date: 11/15/2004 8:49 AM

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152
801-379-1159 FAX

I would like to share something that frustrates many of us who fish below dams especaily the Flaming Gorgre Damn is the erratic way flows can suddenly jump up and down while we are fishing. This can often disrupts water quality and upset the fish for set periods of time. The end result
17a is a spoiling of our fishing day. know this is occurring, I would like to mention how my fishing dollars impact local businesses and Utahs overall economy. I support the single daily peakhump restriction, but its timing should bein a manner that it has no impacts on river
17b recreation activities, especiallyfishing. I would also like to address the issues of safety, a waders safety is effectednegatively when river
17c flows change abruptly.

17d You have the ability to do the power generation flows in non-fishing hours or maintain a slightly higher steady flow that generates the same amount of electricity.

Please rectify this situation.

Jay P. Carlson
jpcvail@msn.com

17. JAY P. CARLSON

17a
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

17b
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

17c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

17d
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 below.

From: "mel cisneros" <mel_cisneros@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 5:06 PM
Subject: Green River Flows

I support the single daily peak hump restriction, but its timing should be
18a in a manner that it has no impacts on river recreation activities,
especially
fishing.
Is their not a way to meet the needs for power in a maner allowing both
sportsman and consumers to enjoy their day?

Mel Cisneros

18. MEL CISNEROS

18a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Connett, Randy" <Randy.Connett@VECO.COM>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 7:29 AM
Subject: Flaming Gorge Environmental Impact Statement Comments

Mr Peter Crookston

Dear Sir:

19a I am forwarding my comments regarding the desire of the operators of Flaming Gorge Dam to respond to peak power requirements by varying the flows from Flaming Gorge Reservoir. I am very concerned about the impact that this has on this world class fishery, and the safety of those who are wading the river.

19b Sudden increases in flow can lead to unobservant or unfamiliar river users to wad water which becomes unwadable at higher flows, thus presenting a safety risk to the public.

19c I am very opposed to allowing fluctuating flows to negatively impact the
19d fishing of this magnificent river. I do support the daily single hump restriction, but encourage the Bureau to require the timing of the fluctuating flows to avoid unnecessary impact to fishing or other river use.

Thank you

Randall M. Connett, PE
VECO USA, Inc
9000 E Nichols, Suite 250
Centennial, CO 80112
(303) 268-3499
(800) 292-1012
(303) 549-3227 (cell)

19. RANDALL M. CONNETT

19a and 19d
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative.

19b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

19c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative.

From: "Robert W. Day" <abqbob@ix.netcom.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 12:07 AM
Subject: Green River Flow changes

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
Bureau of Reclamation, Provo Area Office

Sir:

I have fished the Green River below Flaming Gorge for over 10 years and have considered it as one of the greatest trout rivers in the world. As in all tail water fisheries the change of water flow materially
20a deteriorates the the quality of the fishing as well as providing a serious item of safety to the fishermen. It would seem that if these flow changes were to be made during the time that fishermen are not on the river it would add to the attraction of fishing the area. It is discouraging to travel a good distance and then find
20b that the fishing is artificially manipulated and so diminished.

The local economy, I am sure, would benefit from this change as well as Utah and Wyoming. I
20c understand also that fishing and recreation have a priority in the operation of the dam and this priority is not always considered. I don't know what considerations are met by having the flow at mid-day but if there
20d are no overriding reasons for mid-day then it would seem the fishing and recreation priorities could be used in having the flow changes at non fishing and recreation times.

Thank you for your attention.

Robert W. Day
2924 Cagua NE
Albuquerque, NM 87110

Robert W. Day
abqbob@ix.netcom.com
EarthLink Revolves Around You.

20. ROBERT W. DAY

20a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

20b and 20d
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 below.

20c
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

From: "James DeSpain" <despainjames@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 5:30 PM
Subject: Draft Environmental Statement

Dear Mr. Crookston,

I am a native Utahn, living in Pennsylvania. I make three fishing trips every year to the Flaming Gorge recreation area, specifically to fish the Green River. There is a group of 5 that go, and generally have a great time. It can be disappointing though when river flows change dramatically, and we experience periods of bad fishing. It makes us re-think the money we spend, and how we could have experiences in other parts of the country that are not interupted by water changes. We love the area, and want to continue our
21a tradition. We support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities, especially
fishing. I'm sure you've also heard many times the risky situations sudden
21b changes present to waders and other fisherman. I hope you can take these comments, and use them contructively as the draft environmental statement is being created, and know that these views are possessed by almost all fishermen I encounter on the green. We love the river, and obviously want our experience enriched, but at the same time understand the need of electrical production. We just feel like it could be done in a more controlled and predictable environment.

Thank you for your time,

James DeSpain
Telford, PA

21. JAMES DESPAIN

21a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

21b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Franc Doyle" <francd1999@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 16, 2004 4:15 PM
Subject: Flaming Gorge Dam

To Whom It May Concern:

22a I would like to express my displeasure with the fluctuations in the river levels that have been occurring on the Green River during the summer months. I understand that demand for electricity goes up in the summer to provide air conditioning to the millions of people that have made a choice to live in a desert environment and can't handle the heat, but I have my interests as well. During the summer months, fishing and floating on rivers is my main pastime. I am a teacher and have plenty of time to pursue my interests.

The awesome fishing on the Green for years past prompted me to buy a fishing boat to use on the rivers. I fished over 30 days on the Green for 3 years
22b in a row, but I noticed a sharp decline this past year with the flow fluctuations, so this year I only was up there for about 12 days. The fishing was lousy when normally it is spectacular. I believe that the fluctuations not only affect fish behavior but the timing of the bug hatches as well. Due to this, I fished more in Colorado this year, but was unable to use my boat as much because most of our rivers are too small to float.

22c I urge you to consider providing electricity by raising the flows to a level that would allow the flow to be more constant and deliver the power you need for electric demand. This would create a win-win situation, you would generate electricity, fishing would be more fun, and people wading the river would be in less danger of getting stuck on the opposite bank.

Your engineers can certainly create a model that would average the flows to equal the generating capacity of raising the flows with such a steep peak and drop every day.

Frank Doyle
Denver, CO

22. FRANK DOYLE

22a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

22b
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative.

22c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

From: "Nancy Bostick-Ebbert" <nancyb@sbtnet.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:36 AM
Subject: Action Alternative

To Whom it May Concern:

23a My name is Paul Ebbert. I am a resident of Vernal and a member of the UDWR Regional Advisory Council. I am writing to express my support for the Action Alternative which allows for increased flows down the Green River during the 10th wet year. The best information available indicates that this is important for the recovery of the endangered fish in the Colorado River system as well as improving habitat along the river corridor.

Thank you for this opportunity to comment.

Sincerely Yours,

Paul J. Ebbert
1 North 2500 West
Vernal, UT 84078

(435) 722-5122 (work)

23. PAUL J. EBBERT

23a
Comment noted.

From: "Bryan Eldredge" <bryeld@zcloud.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 7:45 PM
Subject: Green River Water Flows

Dear Mr. Crookston,

It is my understanding that you are asking for comments in regards to the operation of the Green River Dam at Flaming Gorge. I am an avid flyfisherman who very much enjoys the recreational opportunities available below the dam, of fly fishing the River. This Past September I was part of a group of 5 men who took valuable time off from our jobs to spend a few days fishing in the Little Hole area. We were very disappointed to find the fishing so slow. None of us are very well off and it was quite some sacrifice financially for all of us, not only to take the time off work but the cost of travel and fishing tackle as well. I think we all left the river feeling that the sacrifice of time and money was not worth it. I feel that the high flows of the river in the middle of the afternoon were a big reason for the fishing to be so slow. Further I would like you to know that I support the single daily peak hump restriction, but its timing should be in a
24a manner that it has no impacts on river recreation activities, especially fishing.

Thank you for listening, Bryan Eldredge
This email scanned for Viruses and Spam by ZCloud.net
For more information on our $99 per year dial-up internet with filtered email please visit us at: http://www.zcloud.net

24. BRYAN ELDREDGE

24a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please seen response to individual letter 38 below.

From: <erkpsyd@cox.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 2:18 PM
Subject: Green River Flows at Flaming Gorge

Dear Mr. Crookston,

25a I would like to express my thoughts regarding the fluctuating flows at Flaming Gorge I experienced while fishing the Green River this past season. Because of these flow changes, I chose not to fish the Green after flying into Salt Lake because it ruins the dry fly fishing at mid day. Instead, I spent my vacation
25b dollars that day in the Heber area. Regarding safety, nothing gets one's attention like having the river rise while one is wading near the opposite bank, leaving one to contemplate fording the river at waist to chest
25c deep levels! We support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities, especially fishing.

Respctfully,

Jeff Erkenbeck, Psy.D.
San Diego, CA

25. JEFF ERKENBECK

25a and 25c

The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

25b

Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

.

From: "Kurt Finlayson" <KFinlayson@iconfitness.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 8:29 AM
Subject: flow changes

26a I am an angler and I enjoy fishing the green River. I am strongly against mid day flow changes. It is my understanding these can be done once a day, possibly at night. Flow changes are bad for fishing and are
26b unsafe for wading anglers.

Thanks

Kurt Finlayson

26. KURT FINLAYSON

26a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

26b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Fitz Fitzgerald" <troutbum@colorado.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:22 PM
Subject: green river flows

27a If possible please keep the green river flows constant during the day light fishing hours.

Thank you,

Richard Fitzgerald

27. RICHARD FITZGERALD

27a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Robert Freestone" <rafreestone@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 9:29 PM
Subject: Flaming Gourge Environmental Impact Statement

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Dear Mister Cookston

I was bom and raised in Utah. I now live in the Chicago area. The highlight of my vacation each year to Utah is going fishing in the Green River below Flaming Gorge Dam.

This past June was a disappointing fishing trip. The low flows in the morning followed by the high flows in the afternoon moved the fish from where they had been in past years. I prefer to fish from the bank of the river. I have never seen so few visible fish as there was this year during the low flows. The fish would appear with the higher waters but were not interested in feeding.

Some fisherman who waded across the river at the Little Hole boat ramp would have had a real surprise when they tried to get back across the river.

28a I realize that the purpose of the dam is more than to provide a place to fish. I support the single daily peak hump restriction. Any daily peak hump should be in hours where the recreation activities of the river are affected the least.

Thank you,
Robert Freestone
5S400 Stewart
Naperville, IL 60563

Robert Freestone
rafreestone@earthlink.net
Why Wait? Move to EarthLink.

28. ROBERT FREESTONE

28a

The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "bruce.gibbs@juno.com" <bruce.gibbs@juno.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:00 AM
Subject: Green River flows

29a I received an email saying that you are considering jacking with the flows on the Green River at Flaming Gorge. Please don't! This bouncing the flows makes it much less attractive to fish and raft. My kids and I
29b would like to use this river and enjoy this canyon and I don't want to worry about flows and related safety questions.

Thanks!
Bruce Gibbs
8425 Wright St
Arvada CO 80005
(303) 467-2656

29. BRUCE GIBBS

29a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

29b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: <KMGSage@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:36 AM
Subject: Green River flows

Dear Mr. Crookston,

I am a resident of the Denver metropolitan area. I have been fishing the tailwater below Flaming Gorge for the last twelve years. I make an average of three trips per year to Dutch John to pursue my passion for fishing, and I also visit locations in New Mexico, Colorado and Montana with the same frequency. I seldom travel alone. My two sons and my wife also fish, and we enjoy the beauty of the Green and the hospitality of the local tourism industry.

On a September trip to the Green this year, my wife and I fished the A section for three days. On the second day, we particularly noticed the flow fluctuation during the day. As we stopped for a late lunch, we noticed the rise in stream flow. Our boat, which had been partially beached, became buoyant. We adjusted the anchor line and continued to picnic and fish without incident. However, we noticed that just downstream a large raft had become riverborne without an oarsman. We watched helplessly as the party below us called out to fishermen below them to save their raft. Miraculously, a rescue was mounted and the raft was saved at the last moment. The runaway raft was commandeered and the grateful boaters were reunited with their craft without mishap.

30a Did such an incident need to occur? No. Extreme flow fluctuations can occur naturally on freestone rivers, but do not need to happen on "managed" rivers. At least, not during the afternoon hours on a popular flyfishing and rafting tailwater that is supposed to be "managed" for recreation. As an experienced fisherman, I can state unequivocally that extreme fluctuations in flow also have a deleterious effect on fishing. The fish simply stop feeding in reaction to the drastic change in their environment. In freestone rivers, where
30b fluctuations occur normally, it often will take days for fish to resume their "normal" feeding behavior. Drastic daily flow fluctuations simply can not be good for the fish population. Certainly, flow fluctuations during the daylight hours are terrible for the fsherman as well.

I am writing to ask you to reconsider this policy. The rivers in the West (and the resident fish populations) are in serious trouble from a variety of influences: de-watering due to drought and agricultural diversion; pollution from mining, agriculture, and industrial runoff; whirling disease; non-native species introduction; and erosion from wildfires. It is unconscionable to continue
30c a policy that creates further stress on this important resource.

Thank you for your consideration of this request. It is my fondest hope that I can continue to visit the Green River with my friends and family for many years to come, and that the experience will remain as enjoyable as it has always been.

Sincerely,

Kerry M. Gubits
1 Meadow Rose Lane
Littleton, CO 80127
303 972-8153

30. KERRY M. GUBITS

30a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

30b and 30c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 below.

From: "uela" <uela@ubtanet.com>
To: <fgeis@uc.usbr.gov.>
Date: Fri, Nov 12, 2004 11:50 AM
Subject: Flaming Gorge Dam Proposed Change of Water Flow

Bureau of Reclamation
Provo Area Office
302 E. 1860 S.
Provo, Utah 84606-7317

Attention: Peter Crookston
Flaming Gorge EIS Manager
PRO-774

Dear Sir:

31a I believe one of the prime purposes for building the Flaming Gorge Dam was to ameliorate the Ravages of flooding, not to enhance them. Speaking as one who has had to deal with the high water surges along the Green River, the idea of increasing the flow from "the dam" to correspond with the flow of the Yampa borders on insanity. The liabilities certainly
31b outweigh the benefits of such an action. Given the likelihood of above normal precipitation, flooding will be severe enough, without making it worse.

Signed,
J. Dean Hansen
2631 E 2500 S
Vernal, Utah 84078

31. J. DEAN HANSEN

31a
The presence of the dam for over 40 years has indeed served to moderate flooding. However, this was never intended to mean that the flood plain would remain permanently dry. It means only that there is increased ability to moderate potentially catastrophic flows. Since the dam was built, there have been a number of wet years where high flows have occurred, such as 1983. Whether or not the proposed action is implemented, high flows would be expected in the future; and none of the high flow targets in the Action Alternative exceed the very high natural flows that have occurred historically.

31b
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

From: Virginia Harrington <vernalwriter@yahoo.com>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 9, 2004 3:17 PM
Subject: EIS for Flaming Gorge

I am a Ph.D. medical anthropologist and former teacher with the University of Utah and Weber State University as well as the University of Maryland. I have a thorough understanding of the evolutionary relationship between the environment, disease pathogens and resident mammal species, including humans.
With this background, I am totally opposed to the proposed change in the operation of Flaming Gorge Dam to match the flow and temperature of water in the Green River and the Yampa River at their point of confluence. The flat bottomlands of the Green River would cause a massive increase in the breeding grounds for all species of mosquitoes if this flooding is allowed to take place.
32a The mosquitoes would rapidly spread West Nile virus to people, horses and other animals. In addition, the spread of heart worm to family pets and working farm dogs would be dramatic.
Dr. Steven Romney of the Uintah Basin Mosquito Abatement District does an admirable job. However, he cannot be expected to protect our health with his limited funds if thousands of additional acres of mosquito breeding grounds are created.
In addition, there are serious problems with trying to match the flow of the two rivers. It is apparent from statements made by local experts, including the Department of Fish and Wildlife, that there is the
32b potential for damaging spawning bars used by at least one of the four species of endangered fish that this
32c proposed change is supposed to protect. The fish are making a comeback, granted a slow one, without this change. Why take the chance on harming them while at the same time endangering the health of Uintah County residents and their animals?
I have one last concern with the proposed change. The farmers and ranchers in this area already struggle
32d with noxious weeds damaging their crops and interfereing with grazing. (These noxious weeds also damage the grazing grounds for deer, elk, etc.) Increased flooding would spread the weed seeds across many acres of farm land. The land would be unusable in wet seasons and covered with weeds in dry seasons.
Please put the people of Uintah County first as you make your decision on this proposed change.
Thank you for your consideration,
Virginia L. Harrington, Ph.D.
PO Box 3
Vernal, UT, 84078

32. VIRGINIA HARRINGTON

32a
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and a threat from West Nile virus or other mosquito-borne diseases.

32b
The 2000 Flow and Temperature Recommendations are intended to aid in recovery of four endangered fish species by restoring a more natural flow regime to the Green River. The uncertainties associated with operating Flaming Gorge Dam under the Action Alternative, summarized in section 4.19, would be monitored and addressed through an adaptive management process if the Action Alternative is implemented. This adaptive management process would consist of an integrated method for addressing uncertainty in natural resource management. It is an ongoing, interactive process that reduces uncertainty and continually incorporates new information in the decisionmaking process.

Damage to spawning bars due to the proposed action is not anticipated but would likely be addressed through adaptive management projects designed to evaluate channel maintenance and endangered fish spawning activities.

32c
There are few data suggesting that the four endangered species are making a comeback; in fact, most data suggest that populations of four species are either stable at dangerously low levels or declining in some cases. At best, all four species currently exist at diminished population levels which preclude removing them from the ESA or improving their ESA status. Implementing the 2000 Flow and Temperature Recommendations is one measure which is expected to substantially aid in their recovery. See the Recovery Program website <http://www.r6.fws.gov/crrip/rea.htm> or call the Recovery Program at 303-969-7322, ext. 227 for more information.

32d
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Since the arrival of invasive species in the Unitah Basin (tamarisk was probably present by the 1930s), flooding has facilitated their spread. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years and for the spread of invasive species, and that potential will continue under either alternative.

From: "Corey Harris" <corey@big3consulting.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 11:25 AM
Subject: Green River Flows

Peter,

33a Please accept my opinion about the proposed fluctuation of flows on the Green River at Flaming Gorge Dam during peak fishing hours. As an avid flyfisherman, I make numerous trips to the Green River each year to float and fish the Green River and camp in local campgrounds.

33b Last summer the flow fluctuations during mid-day really impacted not only the fishing but the overall experience on the Green River. We had to be conscious of where we could anchor our boat while eating lunch or wade fishing and where we could wade safely. The flow changes also dramatically impact the quality of fishing.

As fisherman and outdoor enthusiasts, we spend a lot of money on fishing licenses, fishing equipment, boats and registration, fuel, lodging, campground reservations and supporting local restaurants and gas stations. The flow fluctuations on the Green continuing (especially during peak fishing hours) will seriously affect my decision to own a drift boat and make fishing trips from the Salt Lake valley to the Green River. If the quality of fishing is not the same and we have to deal with the flow fluctuations, I will drive the other direction and spend my time and dollars in Idaho on the Henry's Fork.

Please accept our comments and help us find "middle ground" between power generation and fishing opportunities.

Regards,

Corey Harris, Managing Partner
Big 3 Consulting
724 West 500 South, Suite 700B
Bountiful, Utah 84087
801-677-6006 x2
801-677-6007 Fax
801-856-6795 cell
<mailto:Corey@big3consulting.com> Corey@big3consulting.com
<http://www.big3consulting.com> www.big3consulting.com

33. COREY HARRIS

33a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

33b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below

From: "Craig W. Hauser" <chauser@rockymountainfoodsinc.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:24 AM
Subject: Green River/Flaming gorge dam

I understand you have the issue of the change flow out of the Flaming Gorge Dam before you at this time. It is my opinion that the flow should either be changed during none fishing hours, or regulated though out the day so
34a that we do not experience the big changes that occurred this year. It had a very negative impact on many of my trips to the Green River this year. The changing flow has a negative impact on the fishing often putting the fish down for hour during the peak of the day. It also is dangerous for those of
34b who are wading to have the sudden increased flow while we are in the river. I make many trips a year to the Green River and spend several $ on lodging, food , gas, tackle etc. Please do all in your power to control the flow and
34c keep the Green River a great fishing experience.

Craig W. Hauser

34. CRAIG W. HAUSER

34a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

34b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

34c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 below.

From: "Rick Hayes" <eps@sopris.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:18 AM
Subject: Flaming Gorges Releases of water

Dear Sirs,

As a concerned fisherman I would like to comment on the releases of water from Flaming Gorge Dam. I feel strongly that the releases could be timed
35a better so that the flows do not effect the safety of fisherman during daylight hours. As well the fish do not respond well to fluctuations and it sets them off. Thus, making the sport even more difficult. I love the Green River and spend many dollars there each year along with my family and friends. Please try to set the fluctuations for nighttime hours. Thank You
35b for your help in this matter.

Sincerely,

Rick Hayes

257 Cheyenne Ave.

Carbondale, CO 81623

970-704-1154

CC: <dbreer@union-tel.com>

35. RICK HAYES

35a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

35b
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: <Jeb.Himsl@RxAmerica.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 3:52 PM
Subject: DEIS on the Operation of Flaming Gorge Dam

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office

Dear Mr. Crookston:

36a The following is a comment regarding the operation of the Flaming Gorge Dam. Specifically, I oppose daily release fluctuations during daylight hours. The reasons for my opposition are due to impacts on safety and environment.

36b I have been an avid floater of the Green River since becoming a resident of Utah in 1986. Since that time, I have witnessed many dangerous activities that are only complicated with increased flows. These range from waders being stranded and attempting a crossing that had been previously safe, to floaters that are simply unprepared to deal with the dangers of increased hydraulics. Changing flow conditions during peak daily use puts users in unanticipated situations. While there is no substitute for common sense, changing flows and limited access points through the Green River corridor actually increases the risks that users must confront. Inexperienced users, which are the overwhelming majority on the Green, often make poor decisions when confronted with the changing conditions.

Keeping flow constant during peak daily use periods minimizes risk and improves safety.

36c As for the environment, changing flows during daylight hours also has an adverse affect on the fishing resources of the Green. It changes the distribution patterns of anglers, causing congestion and overuse during certain periods of the day. It also affects daytime food availability to the fish. Although I do not know the biological implications on a river that is so dependent on terrestrial food sources, I do know the impact on the recreational use of the fishery.

Please be sure to address these concerns in the DEIS and oppose ongoing daily flow fluctuations.

Thank you,

Jeffrey Himsl
2441 Cliff Swallow Dr.
Sandy, UT 84093

36. JEFFREY HIMSL

36a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

36b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

36c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 below.

From: "Hunter, Jack" <jack.hunter@hp.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 9:16 PM
Subject: Green River Flows below Flaming Gorge Dam

To: Mr Peter Crookston

RE: Flaming Gorge Environmental Impact Statement Manager

Dear Mr. Crookston,

As an avid sportsman and a frequent visitor to the Flaming Gorge area I am concerned about the recent Draft Environmental Statement being considered but the Bureau of Reclamation. Specifically, I am concerned about the apparent disregard for maintaining consistent flows from the
37a flaming gorge dam in support of fishing conditions below the dam.
37b Clearly this draft statement favors power production over the needs of the fish and the fisherman. Last year I experienced the major change in flows from 800 cfs to 1500 cfs during mid-day fishing. It completely shuts down the fishing below the dam and negatively impacts both the fish and the fisherman. If this plan is implemented again this year it is fair to say that I will not visit the area because I will not be able count of the consistent fishing and river flows of the past. Please consider this input and that of other fisherman in making your decision on this matter...

Best Regards,

Jack Hunter

37. JACK HUNTER

37a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

37b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: "Dale Huskey" <kayceejake@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 7:23 AM
Subject: Fw: Green River Alert- Please Read This!

If this is accurate, and you can increase the flows during "non recreational" hours, why not? I have spent a lot of money in the local economy for fishing trips. I take two annual trips with my customers. I may look elsewhere if the fishing was not so good and predictable.

Please take this into consideration when making your decision.

Thank you,

Dale Huskey
Signode Western Operations
----- Original Message -----
From: Allen Brisk<mailto:Allen.Brisk@paccoast.com>
To: 'kayceejake@msn.com'<mailto:'kayceejake@msn.com'>
Sent: Friday, November 12, 2004 4:51 PM
Subject: FW: Green River Alert- Please Read This!

-----Original Message-----
From: fishgreenriver [mailto:dbreer@union-tel.com]
Sent: Friday, November 12, 2004 2:01 PM
To: Allen Brisk
Subject: Green River Alert- Please Read This!

GREEN RIVER ACTION ALERT!

Dear Green River fishers. We need your help! November 12, 2004

The Bureau of Reclamation is undergoing a Draft Environmental Statement on the Operation of Flaming Gorge Dam and asking for comments.

One of the things that frustrates many of us who fish below dams is the erratic way flows can suddenly jump up and down while we are fishing. This can often disrupt water quality and upset the fish for set periods of time.
38a The end result is a spoiling of our fishing day. The Draft EIS allows for fluctuating flows for power generation up once a day and then down. In 2004 this was experienced by many of us on the Green as they went from 800 cfs to 1500 cfs every day (at 1:00 pm, right in the middle of the day) after our high flows in early June to the end of September. We hated the reaction from the trout, the fishing could and often did go flat for periods of time. Then they brought the flows down while we were trying to start fishing again and the process started again. The ups and downs and the disruption they caused to our fishing experiences were uncalled for. They have the ability to do the power generation flows in non-fishing hours or maintain a slightly
38b higher steady f
low that generates the same amount of electricity.

38c Recreation and fish have a priority over power generation under the authorized purposes of the Flaming Gorge dam. They never advertise this. They have hoodwinked us into never protesting their exploitation of your rights. Make your views known.

If you can share our frustration with this, e-mail or fax these guys and tell them. Relate to them your experiences with changes in flows while you were fishing. What happened and whether or not you are likely visit rivers where you know this is occurring. You might mention how your fishing dollars impact local businesses and Utahs overall economy. The technical sentence
38d you might include is- We support the single daily peak hump restriction, but
38e its timing should be in a manner that it has no impacts on river recreation
38f activities, especially fishing. You can also address the issues of safety, a waders safety is effected negatively when river flows change abruptly.

We need note writers and fast. These don't have to be extended notes unless you feel compelled to do so. Just give your feelings on the subject, if you have experiences that you can relate to them, even better. Anything will help. This is your chance to be heard. Time is unfortunately an issue. We are nearing the comment periods ending, it closes next Monday, November 15, 2004. That's why we suggest e-mail or faxes.

Help us if you can, pass this note onto others that you know fish or that appreciates the world class trout fishery at Flaming Gorge that might add their voices as well. We know we are late in requesting your help, the document is large and we have had to spend a lot of time determining issues and their impacts on fishing. We would appreciate all the assistance we can get. Denny. dbreer@union-tel.com<mailto:dbreer@union-tel.com>

Address your comments to-
Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152
801-379-1159 FAX
E-MAIL- fgeis@uc.usbr.gov<mailto:fgeis@uc.usbr.gov>

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ast.com&p=8026

Click this link, or copy and paste the address into your browser.

38. DALE HUSKEY

38a
Daily fluctuating releases are permitted under both the Action and No Action Alternatives.

38b
Fluctuating releases during the day have been the normal operations of the powerplant since it began power generation 40 years ago and would continue under either alternative. The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

38c
Reclamation seeks to meet all of the requirements placed upon the reservoir and dam and seeks to balance the benefits among all authorized purposes of the facility. The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. Please see section 1.4 of the EIS for authorized purposes of the dam.

38d
The single daily peak hump restriction is outside the scope of the EIS; however, it is noted that the changes in flows, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Hydropower is the best source available for meeting peak demands. Meeting peak demands is currently tempered; however, by the need to meet environmental concerns and safety of anglers.

38e
Reclamation is well aware of the recreation value created by the construction of Flaming Gorge Dam, including the trout fishery which did not previously exist. The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of fluctuating releases, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

38f
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: <BISON1BOB@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:07 PM
Subject: Green River Flow Management

Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO 774
BuRec, Provo, UT

For safety, economic and recreation purposes, please do not allow the erratic
39a flow changes from Flaming Gorge Dam. Please find a flow pattern which does
not disrupt water quality and still permits adequate power generation. Please
uphold the priority that recreation and fish have over power generation. Past
39b behavior suggests that your agency has little regard ro these priorities.

Bob Johnston
p.o. box 50872
Henderson, NV 89016

bison1bob@aol.com

CC: <BISON1BOB@aol.com>, <dbreer@union-tel.com>

39. BOB JOHNSTON

39a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

39b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives.

We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: <DonxJane@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Thu, Nov 4, 2004 9:09 PM
Subject: EIS report on flooding the Green River bottoms

Mr. Peter Crookston:
40a I would like to express my strong opposition to the flooding of green river bottoms.
I live within one mile of Green River, and when the bottoms are flooded, the bugs come
40b out in the millions. With West Nile probllem, it could be deadly.
To suggest a fish if more important than my family is very wrong. We know the West
Nile will kill, and we don't know what the endangered will do, or if they have any
benifit
Please give this more and serious throught doing something that would kill people

Thank You....Don E. Jorgensen

40. DON E. JORGENSEN

40a
Flood plain inundation has occurred along the Green River in the past, though less frequently since Flaming Gorge Dam was built. There has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. The presence of the dam for over 40 years has indeed served to moderate flooding. However, this was never intended to mean that the flood plain would remain permanently dry. It means only that there is increased ability to moderate potentially catastrophic flows. Since the dam was built, there have been a number of wet years where high flows have occurred, such as 1983. Whether or not the proposed action is implemented, high flows would be expected in the future, and none of the high flow targets in the Action Alternative exceed the very high natural flows that have occurred historically.

As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will under either alternative continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

40b
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

Reclamation notes that the issue of mosquito control along the Green River has been discussed annually at the Flaming Gorge Working Group meetings, and we expect such dialogue to continue in the future, whether or not the proposed action is implemented. As noted in section 4.21 of the EIS, Reclamation is committed to continuing dialogue with county officials to explore the potential to assist with mosquito control.

From: <DonxJane@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 5, 2004 2:15 PM
Subject: EIS report on flooding the Green River bottoms

Mr. Peter Crookston:

41a I would like to express my strong opposition to the flooding of Green River bottoms.

41b I live within one mile of Green River, and when the bottoms are flooded, the bugs come out in the millions. With West Nile Virus on the move, it could be a great problem for those who live near by. I have esperienced some health problems with severe bronchitis and other resporitory infections. I would strongly suggest that you take another look
at this issue.

Thank You, Dora J. Jorgensen

41. DORA J. JORGENSEN

41a and 41b
Please see response to individual letter 40 above.

From: Wade Kafkaloff <wade.kafkaloff@jpl.nasa.gov>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 8:55 AM

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Mr. Crookston, I have visited the Green River several times over the last few years. This year I have been fishing in Northern California in part because of the variable flows being experienced on the Green this year. I urge you to consider increasing/decreasing the flows during non-fishing hours on the Green. Although my fly fishing buddy and I are only two people, I'm sure their are many others with the same concerns. You're competing directly with the city of Redding California. It's an easy flight from Southern California (I fly a small plane to my fly fishing destinations). The Redding Airport, The Fly Shop, its guides, and the State of California will be happy to continue receiving my fly fishing dollars if you continue to adversely affect the fishing on the Green by varying flows
42a during the day.
Thank you for listening to my concerns.
Sincerely,
Wade Kafkaloff
South Pasadena, Ca.
818-354-4769

42. WADE KAFKALOFF

42a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Bruce Kautz" <blkautz@adelphia.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 7:18 AM
Subject: Green River flows

Dear Mr. Peter Cookson,

I, my family and my friends frequently come to north eastern Utah to fish the Green River below the Flaming Gorge Reservoir. The only reason we drive 8 hours is to fish. We always hire a guided drift boat for at least 2 days of our trip. We spent 4 days there this past May and had an enjoyable time for the most part. We did notice that because of the way the outlet flow from the dam had been ramped up and then turned down, the fishing was off a couple days. That made it very difficult for our guide and made the trip less enjoyable as in the past. Again, our trips there are for 1 reason - to fish. Losing us and others
43a because of poor fishing due to sporadic flow changes will potentially send us to other rivers in Colorado,
43b New Mexico, Wyoming and Idaho in our pursuit of great fishing. That will affect the financial economy of the Flaming Gorge / Dutch John, Utah area.

I would like to encourage you and your division to do whatever you can to keep flow adjustments in a realm that continues to give the electrical power needed, yet maintain a great fishery every day of the year.

Sincerely,

Bruce Kautz

43. BRUCE KAUTZ

43a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

43b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

MEMO

TO: Mr. Peter Crookston, *Flaming Gorge Environmental Impact Manager*
PRO-774, Bureau of Reclamation, Provo Area Office,
302 East 1860 South
Provo, Utah 84606-7317

FROM: Mr. Ted E. Kulongoski, E.I.T.
Graduate Student
Environmental Resources Engineering Department
Humboldt State University
1 Harpst Street
Arcata, CA 95521

DATE: Wednesday, October 06, 2004

SUBJECT: Comment on Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS) ending November 15, 2004.

1.0 SUMMARY

To protect and assist in the recovery of four endangered fish species currently listed as threatened by the Endangered Species Act, the Bureau of Reclamation is considering whether to implement a Proposed Action under which the Flaming Gorge Dam would be operated to meet specified peak flows, water temperatures, flow durations, and base flow levels on the Green River. Alternatives will require greater variation in annual river flow as a means to recreate and reestablish a more historic riverine ecosystem conducive to the endangered fish populations.

Although the Bureau of Reclamation has made substantial progress in identifying and addressing the many impacts associated with the two alternatives, the DEIS in its current form was found incomplete in three technical areas:

1. Groundwater Impacts

   Both of the alternatives considered in the DEIS will increase the flows of the Green River, resulting in increased infiltration and a potential impact on the groundwater system. Further modeling of the groundwater system, in regard to the Action and No Action Alternatives, will be needed to better understand how the increased flows will likely impact the basin groundwater.

2. Sensitivity Analysis for Models

   The lack of parameter sensitivity information for any of the models used in the DEIS casts a shadow of uncertainty on the results discussed. Much of the work completed for the Flaming Gorge DEIS involved sophisticated modeling of the Flaming Gorge Dam and downstream reaches. Evaluation of the model's robustness by means of a sensitivity analysis of key parameters was not included in the DEIS. Completing and providing a documented sensitivity analysis is necessary in validating the model's results and supporting the conclusions derived from those results.

3. Impacts of Future Diversions and Increased Consumption

   The need to examine in greater detail scenarios of reduced flow is justified by the Final Biological Opinion on the Operation of Flaming Gorge Dam where the U.S. Fish and Wildlife Service (1992) determined that flow depletions from water resource projects, both up and downstream, would likely jeopardize the continued existence of endangered fish. Further use of the Flaming Gorge Dam model will be needed to adequately explore how future water diversions, increased consumption, and depletions from the Green River will alter the flow regimes considered by the two alternatives considered in the DEIS.

I request the Bureau of Reclamation to consider these recommendations and to assimilate the needed information for the Final Environmental Impact Statement.

BACKGROUND

The Bureau of Reclamation is considering whether to implement a Proposed Action under which the Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the September 2000 report *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam*, published by the Upper Colorado River Endangered Fish Recovery Program. The 2000 Flow and Temperature Recommendations specifically describe the recommended peak flows, durations, water temperatures, and base flow criteria on the

Green River, to protect and assist in the recovery of four endangered fish species currently listed as threatened by the Endangered Species Act. The four endangered fish species are the humpback chub (*Gila cypha*), the Colorado pikeminnow (*Ptychocheilus lucius*), the razorback sucker (*Xyrauchen texanus*), and the bonytail (*Gila elegans*).

DEIS TECHNICAL POINTS NEEDING FURTHER ATTENTION

Although the Bureau of Reclamation has made substantial progress in identifying and addressing the many impacts associated with the Proposed Action, the DEIS in its current form was found incomplete in three technical areas.

Groundwater Impacts

The Proposed Action Alternative and the No Action Alternative outlined in the DEIS will increase river flows for the 410 river miles of the Green River below Flaming Gorge Dam and inundate the historic flood plain. The increase in available surface water will influence the groundwater of the Green River Basin. Although analysis and discussion were presented in Chapter 4, Section 4.3.2, that "addresses impacts to water resources within the affected environment downstream from Flaming Gorge Dam," the DEIS failed
44a to identify groundwater as a hydrological impact. A search of the DEIS document reveals that no consideration was made to groundwater impacts. The only mention of groundwater is in Chapter 3, Section 3.3.2, regarding water salinity where drawdown of the reservoir may result in bank storage (groundwater) flowing into the reservoir. Neglecting to introduce the impact of the two Alternatives on the groundwater system of the Green River Basin was a gross oversight and should be given due consideration.

Hydrology for a riverine system where there is an increase in flood plain surface water will commonly result in an increase in groundwater infiltration. The quantity of water infiltrating depends on the soil texture, soil structure, vegetation, and soil moisture status. Because soil characteristics vary over the 410 river miles of the lower Green River, the amount of groundwater infiltration occurring from the proposed flow regimes is unknown. Further modeling of the groundwater system, in regard to the Action and No Action Alternatives, will be needed to better understand how the increased flows will likely impact the basin groundwater. This is an important consideration given the geographic location and environment of the Green River Basin.

The Green River Basin is classified as a high desert environment and has an average annual rainfall of less than ten inches (World Climate, 2004). Given the limited annual precipitation, water rights and the development of water resources is critical to the economic and recreational vitality of the area and is subject to numerous federal, state, and county laws and regulations. Because the region can be described as water poor, an increase in available groundwater will qualify as a significant impact to the Green River Basin. Higher groundwater levels would significantly impact agriculture, ecology, and land use around the Green River. If larger quantities of groundwater became available due to the increased flows on the Green River (as a result of the Action and No Action Alternatives) and that water was allocated for beneficial use through water rights, it would be very difficult to substantially modify the Flaming Gorge Dam discharge program in the future. A groundwater study of the Lower Green River Basin is therefore necessary to evaluate and consider the possible impacts of the Action and No Action Alternatives.

Sensitivity Analysis for Models

An important tool to assist in developing any model is a sensitivity analysis. The sensitivity analysis illustrates the model's response to slight changes in model parameters. For a model to prove robust, it must produce similar results (output) when small changes to key parameter values are made. If the model's results vary significantly after slight variation of the key parameter values, then the model may require further calibration, or in some cases, the parameter values used will need to be documented and/or tested to assure model validity.

Completing and providing a documented sensitivity analysis is necessary not only to help in validating the model's results, but also to support the conclusions derived from those results. Much of the work completed for the Flaming Gorge DEIS involved sophisticated modeling of the Flaming Gorge Dam and downstream reaches. Documentation of the model building, calibration, and validation process was included in Appendix 2 –
44b Hydrologic Modeling. Unfortunately, no results of a sensitivity analysis on the Flaming Gorge Dam model could be found in the Appendices or main DEIS. The same was true

for the hydroelectric power model developed to compare electricity generation capacities

44c of the two alternatives (Appendix 5). The lack of parameter sensitivity information for any of the models used in the DEIS casts a shadow of uncertainty on the results discussed.

The inclusion of a sensitivity analysis will also allow the opportunity to document "What if" scenarios. A "What if" scenario will document the model's results when realistic changes are made to the model's parameters or input values. An example of a "What if" scenario for the Flaming Gorge DEIS is the economics of electricity generation using the power model. The economics of the No Action and Action Alternatives are based on net present value (NPV) calculations of the hourly value of Flaming Gorge electricity generation over the 25-year study period. The value of generation is computed by multiplying hourly electricity production by the hourly spot market price. All NPV calculations are based on an annual discount rate of 5.5 percent. The model results presented in the DEIS indicated no significant difference in electricity generated revenue

44d among the two alternatives, but that was for only the 5.5 percent discount rate. What if the model was run again but the discount rate was changed by ±0.5 percent? Are the results, the difference between NPVs of each alternative, still insignificant? What if the discount rate were changed by ±1.0 percent? What if the Average Spot Market Price was changed by ±$5/MWh? The sensitivity analysis would document the nuances of these different variations and any significant findings they revealed.

Impacts of Future Diversions and Increased Consumption

44e Future water demands need to be considered in the Flaming Gorge Dam model. In Chapter 4, Section 4.19.1, the Flaming Gorge Dam DEIS (2004) states, "The Flaming Gorge Model assumed that water development in the Upper Green River Basin and the Yampa River Basin would continue at the rate projected by the Upper Colorado River Commission." The DEIS then continues, "it is uncertain what resource impacts would occur as a result of future water development in the Green River Basin above and below Flaming Gorge Reservoir." Considering that the Affected Environment (Chapter 3) and the Environmental Consequences (Chapter 4) depicted in the DEIS are based on the results of the Flaming Gorge Dam model, it is disconcerting to read that no "What if" scenarios were performed to examine impacts from future water diversions and increased consumption.

The need to examine reduced flow scenarios is justified by the Final Biological Opinion on the Operation of Flaming Gorge Dam where the U.S. Fish and Wildlife Service (1992) determined that flow depletions from the Duchesne and Green Rivers caused by the Strawberry Aqueduct and Collection System, "would likely jeopardize the continued existence of the endangered Colorado pikeminnow and humpback chub." This Biological Opinion included a Reasonable and Prudent Alternative stating that, "Flaming Gorge Dam and Reservoir would compensate for those depletions and be operated for the benefit of the endangered fishes in conjunction with its other authorized purposes." The concern raised by the Biological Opinion is, "What happens if the water in the reservoir isn't enough to compensate for depletions?"

A wider range of flow scenarios for modeling must be considered to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes. Further use of the Flaming Gorge Dam model will be needed to adequately explore how future water diversions, increased consumption, and depletions from the Green River will alter the two alternatives considered in the DEIS. Without considering the potential impacts that less water in the system will have on the two alternatives, the alternative selection process is incomplete. It is imprudent not to evaluate the two alternatives under reduced flow conditions because the model's results, based on reduced flow, may negate the feasibility of one or even both alternatives. It would be disappointing to complete the entire Flaming Gorge EIS process, select the preferred alternative, and then have it become infeasible because increased diversions and consumption produced insufficient water availability for its implementation.

CONCLUSION

Although the Bureau of Reclamation has made substantial progress in identifying and addressing the many impacts associated with the two alternatives, the Operation of

Flaming Gorge Dam DEIS in its current form was found deficient in three technical areas:

1. Groundwater Impacts

   The alternatives considered in the DEIS will increase the flows of the Green River, resulting in increased infiltration and a potential impact on the groundwater system. Further modeling of the groundwater system, in regard to the Action and No Action Alternatives, will be needed to better understand how the increased flows will likely impact the basin groundwater.

2. Sensitivity Analysis for Models

   Much of the work completed for the Flaming Gorge DEIS involved sophisticated modeling of the Flaming Gorge Dam and downstream reaches. Evaluation of the model's robustness by means of a sensitivity analysis of key parameters was not included in the DEIS. The lack of parameter sensitivity information for any of the models used in the DEIS casts a shadow of uncertainty on the results discussed. Completing and providing a documented sensitivity analysis is necessary not only to help in validating the model's results, but also in supporting the conclusions derived from those results.

3. Impacts of Future Diversions and Increased Consumption

   The need to examine in greater detail scenarios of reduced flow is justified by the Final Biological Opinion on the Operation of Flaming Gorge Dam where the U.S. Fish and Wildlife Service (1992) determined that flow depletions from water resource projects, both up and downstream, would likely jeopardize the continued existence of endangered fish. Further use of the Flaming Gorge Dam model will be needed to adequately explore how future water diversions, increased consumption, and depletions from the Green River will affect the two alternatives considered in the *DEIS*.

I request that the Bureau of Reclamation consider these recommendations and assimilate the needed information into the Final Environmental Impact Statement.

6.0 REFERENCES

World Climate. (2004). Climate Data for 40°N 109°W. Available [Online]: <http://www.worldclimate.com/cgi-bin/grid.pl?gr=N40W109>, September 26, 2004.

U.S. Fish and Wildlife Service. (1992). Final Biological Opinion on the Operation of Flaming Gorge Dam. Fish and Wildlife Service, Mountain-Prairie Region, Denver, Colorado, November 25, 1992.

44. TED E. KULONGOSKI

44a
Reclamation believes that no significant difference exists between Action and No Action Alternatives for groundwater and surface water interactions along the Green River downstream from Flaming Gorge Dam.

44b
Sensitivity analyses with regard to specific parameters were reviewed by the modelers during Flaming Gorge Model development. Sensitivity to forecast errors, depletion schedules, and specific policy rules were evaluated during the formulation of the Action and No Action rulesets. In terms of the presentation of the model results, however, sensitivity analysis was not included in the EIS.

44c
Changing inputs would change the results of the hydropower model, but most inputs are defined by the operations of the powerplant.

44d
The EIS used a discount rate of 5.5 percent to estimate present value of the hydropower analysis with the given results. Use of a lower interest rate would increase the present value of both alternatives by roughly the same amount, and increasing the discount rate would have the opposite effect. The net difference between the two alternatives would be slightly different with another discount rate, but the percent difference would be approximately the same. For example, using a discount rate of 6.125 percent, a difference between alternatives would be $18.3 million; using a discount rate of 4.875 percent, the difference is $21.7 million, with still about 5 percent difference between the two alternatives. Therefore, the hydropower model lacks sensitivity to the interest rate.

The hydropower model used hourly forecasted prices, not average prices. Changing the hourly prices by a given amount would not affect the results as an increase of $5 per megawatthour would have the same effect on both alternatives. However, an asymmetric change to prices would impact the results depending on how the prices were changed. For example, arbitrarily changing prices such that peak prices would be reduced would decrease the net value of the Action Alternative since this alternative generates less energy. An infinite set of prices could be generated, each changing the results in a unique way. The price set that was used was independently generated by a group not connected with the analysis or operation of the powerplant.

44e
Future water development was assumed in the analysis of the Action and No Action Alternatives. The Flaming Gorge Model incorporated increasing future depletions that were equivalent to the rates of depletion projected by the Upper Colorado River Commission (memo: dated December 23, 1999 entitled "Estimates of Future Depletions in the Upper Division States"). Analyzing the impact of future depletions is not within the scope of this EIS.

Memo

To: Mr. Peter Crookston

Flaming Gorge Environmental Impact Statement Manager, PRO 774

Bureau of Reclamation, Provo Area Office

302 East 1860 South

Provo, Utah 84606-7317

From: Heather Kuoppamaki, E.I.T.

Environmental Resources Student

Humboldt State University

1 Harpst St.

Arcata, Ca 95521

Subject: Comments on Flaming Gorge Dam DEIS.

Summary:

The comments on this DEIS are made by Heather Kuoppamaki, an Environmental Resources Engineering senior and E.I.T. at Humboldt State University, California. My emphasis in engineering includes river restoration. Due to this and my continued interest in river health, I have chosen to comment on this DEIS. There are portions of the Draft EIS which overlook important aspects of the project. These portions are summarized below, and presented in further detail later in this memo.

General problems with the DEIR include:

- Formatting –
  - The formatting of the report makes it difficult to locate information. Rewording of section 4 from "Environmental Consequences" to "Impacts" would follow the recommended format for NEPA.
  - As well, there is no section or subsection for "mitigation"; this is a fault that continues throughout the entire DEIS as little to no information on *mitigation is mentioned.*

- Significant jumps of information occur throughout the document. For example, in the "Environmental Consequences" section, the logic which allowed for sediment transport increases to be considered insignificant is not included in the report.
- A summary of abbreviations page, as well as a glossary would, make reading of the document easier. These should be included to meet the average reader comprehension requirement.

- Alternatives - The reasons for having only one action alternative are not convincing. Many alternatives should be addressed before making a final decision on the new flow release schedule of the dam.

- Exclusion of details included in the 1992 and/or 2000 studies - Often throughout the document, statements were made based on the 1992 Biological Opinion Report (BOR) and/or the 2000 Flow and Temperature Recommendations (FTR). It would have been very helpful to include relevant sections, or at least the executive summaries, of these documents in the DEIS appendices.

- Mitigation - There does not appear to be any funding for future mitigation, including increased costs of operation and maintenance, clearly stated in the DEIS. Most impacts are stated as being non-significant but will be addressed if necessary. Who will perform ,and how this mitigation will occur, is not addressed through the DEIS.

- Environmental Consequences – As mentioned above, the "Environmental Consequences" section should be renamed to Impacts. Throughout the environmental consequences section, negative environmental consequences are mentioned briefly without any mitigation measures. This occurs throughout this section of the document and should be addressed prior to finalization.

Purpose and Need Statement:

The purpose and need statement is outlined as follows:

"The purpose of the Proposed Action is to operate Flaming Gorge Dam to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact."

The purpose and need statement limits potential alternatives by stating that **all** authorized purposes of the Flaming Gorge Unit of the CRSP must be maintained. For example, an alternative which is eliminated from further study is the total dismantling of the dam and reservoir system. Because the purpose and need includes the maintenance of all authorized purposes of the Flaming Gorge Unit, dam removal is not examined, when in this case it may be the best alternative for the health of the river and the endangered fish species located within the river.

Alternatives:

- The alternatives section should provide more detail into alternatives that were considered yet not proposed.
- Further detail into varying dam operations (which were as a group, disregarded) would increase the validity of the two alternatives selected. Information regarding what dam operations were examined, and how they fit into the alternative section would be useful.

45a
- In the action alternative, why are flows in Reach 2 met first, with changes to the flow regime if necessary to maintain flows in Reach 1? As mentioned in the FTR, Reach 1 is the most significantly affected by flows from Flaming Gorge Dam, while flows in Reach 2 are significantly affected by its tributary, the Yampa River.

45b
- The Modified Run River Alternative appears to be disregarded without enough analysis, because the inflows are too variable due to agricultural water storage,,

which lets water back in to the river months later. It seems reasonable that with analysis of a few gages upstream of Flaming Gorge Reservoir, actual inflows could be interpolated.

45c
- Timing of the peak flows should be addressed in further detail. Table 2-1 of the DEIS details duration of peak flows. How these peak flows occur relative to each other may be an important issue for fish habitat as well as natural river restoration.

45d
- A study of more than two alternatives would add to the validity of this EIS. The no-action alternative would not meet the Endangered Species Act and is therefore, for the most part, unreasonable. Analysis of further actions which would meet the Endangered Species Act requirements would increase the substance of the EIS. The remainder of the DEIS appears "stunted" due to the limitation of, basically, no alternatives. In the 2000 report, it is suggested that varying flows each year would allow for the best long term improvement of the river. An alternative which addresses altering the patterns used during low, medium, and high flow years, could address this issue. Perhaps further alternatives with altering flow schedules could be addressed in the alternatives section.
- Allowing for changes in the flow regime during the year would allow for more alternatives. This would also increase management options when the incorrect flow regime is put in place for the year. I was raised near the Folsom, California reservoir and remember numerous years when the incorrect flow regime was scheduled, and reservoir levels at the end of the season were drastically low.

45e
- A maximum number of consecutive years where the minimum flow regime is allowed should be included in all alternatives. Numerous sequential years of low flow could drastically alter the downstream aquatic environment.

Affected Environment

The affected environment is discussed in detail; few substantive comments are made in this section of the DEIS. However, on Figures 3-1 and 3-2, a scale is missing but necessary. This would enable further analysis of the figures with respect to algae blooms.
45f Tables 3-2, 3-3, 3-4, 3-6 should include pre-dam temperatures for reference. Figure 3-4 should also include a pre-dam temperature regime for reference.

Environmental Consequences

As mentioned above, this section should be renamed "Impacts" for clarity and to follow the NEPA recommendations. As well, increased usage of the terms "significant impact" and "insignificant impact" would follow NEPA guidelines better. These terms would allow the reader of the document to find conclusions to the findings very easily and understand what the conclusions are.

Sediment Transport

Increased loads of sediment transport are mentioned as an expected effect of the Action alternative. Reach 1 is expected to increase by 13,000 tons; Reach 2 is expected to
45g increase by 100,000 tons; and Reach 3 is expected to increase by 250,000 tons. Without any supporting information, these increases are expected to have no change on the channel morphology. Information on the process by which this conclusion was reached would be very helpful. It is possible that this increase in sediment load would be *beneficial to altering the channel* for increased fish habitat. Mentions of the expected outcomes of this effect should be included, as well as necessary mitigations.

Agriculture

In the agriculture section, numerous negative effects of the Action alternative are mentioned. At the end of this section, these potential effects are disregarded, and no mitigations are initiated. The Action alternative may not be the sole action responsible
45h for economic damages to the agricultural sector, but this does not excuse or exempt that portion of environmental damage that the Action Alternative does cause. Economic

damages by the Action alternative should be mitigated so they can be considered less than significant.

Vegetation

45i More impacts are associated with the possible increased occurrence of non-native as well as invasive species. According to the report, invasive species would likely increase, but mitigation again is not mentioned. These impacts should be addressed in more detail. Are the increased flood occurrences due to the Action alternative mitigatable? Are mitigations a necessary concern for this, and why or why not? Discussion of these questions would be very useful.

Threatened and Endangered Fish

45j This section appears to include strong information for the decisions reached. To aid the average reader in the comprehension of this section, include a figure which depicts the predicted inundated flood plains for each of the flow regimes.

Terrestrial and Avian animals

45k Further analysis of why the action and no action alternatives have no impact on avian or terrestrial creatures would increase the validity of the report. Since variations in vegetation are expected from the action alternative, effects on fauna are probable.

During further analysis of the impacts on terrestrial and avian animals impacts to "terrestrial wildlife" are expected for a period of time which is not defined. A change in species present may occur through this time of re-equilibrium. Mitigations for this period of time should be implemented so that more animals are not added to the endangered species act. During the time of imbalance, measures should be implemented to promote native animal health and diversity.

Other Threatened or Endangered Species

Southwestern Willow Flycatcher

45l The Action alternative may temporarily decrease habitat of the Southwestern Willow Flycatcher. If this species is endangered, any negative effects must be mitigated. Further, if flood flows are large enough, short term effects will be offset by long term habitat development. What happens if the flood flows are not large enough? Are there any mitigation plans for this possibility?

Overall all of the threatened or endangered species should have a plan for habitat mitigation in case the Action alternative does negatively affect their lives. This would decrease the time necessary to determine the mitigation plan once negative effects are noticed.

Cultural Resources

45m In section 4.8.2.2, the effects of the action alternative are stated. Effects from implementation of the new flow regime appear to be minor with the exception to flooding certain historic areas in Reach 1 in the Browns Park Area, which may receive more flooding and longer inundation if the Action alternative is selected. Is it not important to do whatever possible to preserve these historic areas, even though it has experience potentially harmful events in the past?

Addressing Uncertainties through Adaptive Management

45n This was the first section where any mention of mitigation occurred. Further explanation, of the research and adaptive management practices which would occur, would be beneficial. Particularly, what sort of research is going to occur in the near future, who in the dam operations will be responsible for implementing the management plan? Would there be a special team included in the dam operators? Would the people chosen to perform these duties have certain background characteristics to ensure proper research methodology?

Environmental Commitments

This section, as well as the above section, should be renamed to include the word "mitigation measures". This would increase the flow of the document and follow NEPA guidelines a little closer. As well, referencing of this section during analysis of the environmental consequences would allow the reader to examine the "mitigations" to be implemented for the negative impacts.

Specific economic means which Reclamation will use to perform all of the monitoring and adaptive management schemes presented should be discussed.

1992 Biological Opinion Report

This report should be either included in the DEIS as an appendix, or linked to the DEIS. A further analysis of the 1992 Biological Opinion Report would allow me to discuss the significant of the conclusions of the report and analyze the action alternative. Without the inclusion of this report, the DEIS is incomplete as all the determining factors are not accounted for. I would be even more beneficial to the outside person reviewing the report if a summary of the information related in this report were included as a section of the DEIS.

2000 Flow and Temperature Recommendations for the Green River, Downstream of Flaming Gorge Dam

As with the 1992 Biological Opinion Report, numerous references to the 2000 Flow and Temperature Recommendations are made. Often in the document, conclusions are determined. It is assumed that these conclusions are made at least in part due to the findings of the FTR. Whenever applicable, the FTR should be referenced with a section number so that concerned individuals have the opportunity to examine the methodology. Since the action alternative is highly based on the information portrayed in this report, and the report formatting makes writing/reading difficult a concerned individual such as myself cannot fully evaluate the action alternative without the report.

45. HEATHER KUOPPAMAKI

45a

In the 2000 Flow and Temperature Recommendations, the following statements are made which support using Reach 2 as the priority reach:

- Section 5.2.1 "Recommended flows for Reach 1… are those measured at the USGS gauge near Greendale, Utah, and are, for the most part, release patterns from Flaming Gorge Dam needed to achieve the target peak and base flows identified for habitats of the endangered fishes in Reaches 2 and 3."
- Section 5.2.1 "Base flows in Reach 1 should be managed to ensure that within-year and within-day variability targets for Reach 2 are met."
- Table 5.4 General Recommendations: "Peak flows in Reach 1 should be of the magnitude, timing, and duration to achieve recommended peak flows in Reaches 2 and 3."

Throughout the 2000 Flow and Temperature Recommendations document, it is stated that the critical habitat for the endangered fish reside in Reaches 2 and 3. This is also stated in the EIS. Through modeling, Reclamation came to the determination that it was possible to reasonably predict future flows in Reach 2 with enough precision to efficiently augment these flows to achieve the target levels established in the 2000 Flow and Temperature Recommendations for Reach 2.

45b

The Modified Run of the River Alternative releases on a daily basis during the spring would be a percentage of the previous day's unregulated inflow. In this way, the release regime would closely match the inflow regime. By varying the percentage from a low percentage of up to 100%, we could test the reaction of the reservoir in terms of reservoir storage. Because of the narrow scope of this EIS, the Modified Run of the River Alternative had to achieve all of the flow objectives of the 2000 Flow and Temperature Recommendations in Reaches 1 and 2 of the Green River in the same way that the Action Alternative did. The suggestion regarding the use of data from upstream gauges is unclear, but absence of inflow data was not the reason that this alternative failed to meet the purpose and need.

The Modified Run of the River Alternative did include unregulated daily inflows to Flaming Gorge. These values were used to determine what each daily release would be. Perhaps this comment refers to natural flow. It is possible to roughly estimate natural flow from actual measurements; however, the computation of natural flows is a very complex and involved process, and this work has been done on a monthly time scale but not on a daily time scale.

Based on sensitivity analysis of the percentage rate, it was found that the flow objectives could not be met even when the percentage was set to 100%. There were two main reasons for this result. First, water consumption and diversion above Flaming Gorge Reservoir reduced the measurable unregulated inflow. Second, the timing of releases from Flaming Gorge Dam under this regime were not optimally timed with the flows of the Yampa River.

45c

Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group, which will evaluate criteria listed in table 2-5 of the EIS when making recommendations. This allows opportunities to refine flow attributes based on an adaptive management process.

45d
The purpose and need of this EIS is limited to alternatives that implement the 2000 Flow and Temperature Recommendations while maintaining and continuing the authorized purposes of the dam. Reclamation acknowledges that a full range of reasonable alternatives is desirable. However, despite considerable effort to develop additional alternatives that meet the purpose and need of the EIS, additional viable action alternatives could not be identified. Please see sections 1.4.5, 1.4.6, and 2.2 of the EIS.

45e
The target flows and durations to be achieved each year are dependent on the natural hydrograph of that year and the hydrological classification of that year. If 6 consecutive drought years occur in a row, as is currently the case, then only low targets and durations would be achieved. In very wet years, high targets with long durations would be achieved.

45f
The scales are a measurement of Chlorophyll a in micrograms per liter (µg/L). The red scales are for concentrations greater than 27 µg/L; and in fact, they can reach several hundred µg/L or hyper-eutrophic status at times in the red zones. The scale was clarified in the figures and in the text. Pre-dam temperatures below Flaming Gorge reached about 23-24 °C in the summer and near freezing during the winter. The pre-dam temperatures were warmer at the peaks in the summer than now occur.

45g
The resulting changes in average annual sediment transport will likely produce some channel morphological changes in Reach 1. For example, increased local erosion of bank materials could lead to channel widening in some portions of Reach 1. In Reaches 2 and 3, the increases in sediment transport conditions, on a percentage basis, under the Action Alternative relative to No Action conditions, are relatively smaller than the changes anticipated for Reach 1. For these conditions, changes in channel morphology due to increased sediment transport are anticipated to be subtle and will likely be difficult to track. See the Effects of Flaming Gorge Operations Under the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations on Sediment Transport in Green River Techinical Appendix for a description and a discussion of the sediment transport analysis completed for the EIS.

45h
The analysis of potential effects to agriculture (section 4.5) shows that there are not significant differences between the Action and No Action Alternatives.

45i
Recent research findings suggest that the proposed action may encourage a shift in location, but not an increase, in tamarisk establishment (see sections 4.7.5 and 4.19.6 in the EIS). The EIS more clearly reflects these new findings. One of the predicted benefits of this shift in establishment location would be positive changes to fish habitat. As a result of these new findings, Reclamation does not believe that mitigation for this action is warranted. However, unrelated to any effects of this action, Reclamation has recently supported research aimed at defining those microhabitats most likely to remain tamarisk free following mechanical removal. Any improvement in this arena may help Reclamation and other management agencies along the Green River more effectively control tamarisk as per Executive Order 13112 on Invasive Species, 1999.

45j
Please refer to figure 4-16 in the EIS; for more information. See figure 3-1 in Valdez, R.A. and P. Nelson. 2004, *Green River Subbasin Floodplain Management Plan*, Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado, Project No. C-6. This report can be obtained by writing the Recovery Program.

45k
The no effect determination for animals exploiting reservoir or river habitats was made because variations in the vegetative community attributable to dam operations would be slight and occur over a sufficiently long period that mobile terrestrial and avian communities could alter their ranges and habits in such a way that no appreciable change in population size or dynamics would occur to these populations.

Perturbations to the vegetative community (and, consequently, to the habitats of the animals in question) below the dam that are attributable to dam operations would not be extensive enough to cause the presence or absence of a species to change within the entire study area. The total area being discussed is large, and resources for these animals are abundant. Changes in the vegetative communities and associated wildlife habitats would be relatively localized and could contribute to a somewhat different composition of species within these areas.

45l
Flooding of the riparian zone is a important, natural, disturbance mechanism for recharging vegetation and resetting succession and the Action Alternative purposefully attempts to contribute to this process. Loss of vegetation is a part of that process. Reclamation believes that mimicking the natural hydrograph is a positive step in restoring and/or maintaining viable southwestern willow flycatcher habitat. Since the identified territories are located on low elevation surfaces, inundation of nests by large flood flows would occur under either alternative.

Regarding the question of whether flood flows will be large enough to offset short-term effects, section 4.7.8.1.2 in the EIS has been rewritten to more clearly state our intent—that is, if large enough, flood flows should create additional habitat above and beyond that which would develop following any scour and deposition event.

45m
Reclamation recognizes the importance of potential disturbance to historic properties within the project area. Please see section 4.8.2.2 regarding cultural resource data analysis with the relevant land managing agencies.

45n
The adaptive management process described in section 4.20 of the EIS would rely on ongoing or added Recovery Program activities for monitoring and studies to test the outcomes of modifying the flows and release temperatures from Flaming Gorge Dam. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group which will evaluate criteria listed in table 2-5 of the EIS when making recommendations. This allows opportunities to refine flow attributes based on good science in an adaptive management process. See section 2.5.3 of the EIS describing the Technical Working Group and the Flaming Gorge Working Group and how they would work together in planning the flow prescription each year.

From: "Scott Marshall" <SMarshall@miscowater.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 11:26 AM
Subject: Green River flow fluctuations - comments from a fly fisherman

Mr. Peter Crookston,

It has come to my attention that the Bureau of Reclamation is performing a draft Environmental Impact Statement (EIS) on the operation of Flaming Gorge Dam. I wanted to share some thoughts with you regarding my most recent trip to the Green River (below Flaming Gorge Dam) and how my experiences, along with similar stories of other anglers, should be considered before any decisions are made.

I am an avid fly fisherman and do my best to make it to the Green River at least twice per year to enjoy the fabulous trout fishery. My last trip to the Green River below Flaming Gorge was a bit unusual in that fluctuating river flows caused a negative impact on my experience and threatened my individual safety along with the other two fisherman in my party.

Unlike many anglers who visit the area, I prefer to fish the "B" section
of the river and choose to walk in and camp at the USFS camp sites along
the river. In all of my trips to the Green River, my friends and I
enjoy wade fishing both sides of the river. In my most recent trip to
the Green River (late June 2004), we arrived late in the day and barely
fished the evening hatch before we turned in for the night. We woke up
early the next morning to a beautiful sunrise and low water levels. We
decided to cross the river in an attempt to fish the opposite side (west
side) that generally receives less fishing pressure. We started out
having a consistent day of catching trout. After lunch, water levels
began to suddenly rise at which point several things happened: the fish
stopped feeding and the route back across the river started to become
more and more dangerous. If my memory holds, river flows were
approximately 800 cfs in the mornings and increased to 1500 cfs in the
afternoons and evenings. The river flow basically doubled during the
46a early afternoon. The increased flow threatened our individual safety
(if you don't think this is life threatening, cross the river at 800 cfs
and then try and come back across when it is 1500 cfs - I have done it
and it is very dangerous). The fluctuating river flows caused the fish
to stop feeding (which reflected negatively on my experience) and
threatened the physical safety of my entire group. I believe this to be
consistent with all other wade anglers and most other float anglers.
Personally, I will be keeping an eye on any changes in dam (flow)
operation and will base my decision for any future trips on this aspect.

Thousands of anglers visit the Green River below Flaming Gorge Dam each
year and have been doing so for many years. The thousands of dollars
46b fishermen bring to the local economies are crucial to the survival of
most people living in the area not to mention the wonderful experiences
on the river that are shared with each generation.

In general, I support the single daily peak hump restriction but the
46c timing should be in a manner to have no impacts on the river recreation
activities - in my case (and thousands of others), specifically fishing.
As I have witnessed in my last trip, increased flows made the fishing

very poor and threatened my personal safety.

I hope that you can come up with an amiable solution to the operation of Flaming Gorge Dam that will create no significant impacts to the fishery or the experience shared by thousands.

Sincerely,

Scott A. Marshall, P.E.
Misco Intermountain
3033 South Parker Road
Tower I, Suite 350
Aurora, CO 80014
office (303) 309-6150
fax (303) 309-6154
cell (303) 601-5215

46. SCOTT A. MARSHALL

46a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

46b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

46c
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Jeff Martin" <bcstoneram@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 30, 2004 6:26 PM
Subject: Green River Flows

Hello,

My name is Jeff Martin, I know you are probably very busy and I am greatful for your time in reading my email. I visit the Green River several times each year to enjoy the spectacular fishing that many take advantage of in our state.

During this past year I have been very dissapointed in the quality of the fishing there due to the eratic changes in water flows out of the Flaming Gorge Dam. Many morings have started out great and then the
47a water flows kick up and upset the fish, thus creating a very tough fishing situation. I realize that folks have got to have power, but to disrupt such an awesome fishing and outdoor recreation spot so that
47b people can make more money on power generated from the increased water flows seems unfair. It is also a darn shame that a place with such a great reputation for fly fishing and recreation for so many people in this country and abroad is suffering such a huge blow. With the Snake River in Idaho, and so many other waters available in Wyoming, Idaho, and Montana I am afraid that continuing this practice in the future will end up being counter productive for our great state. I and many others will take our dollars to other states so that we don't have to deal with spotty fishing and dangerous conditions experienced on the Green so that people can generate more power.

The really sad thing here is that if you asked fly-fishermen in this state which river had the most fish per square mile, scenic beauty, and overall best fly-fishing for larger fish, you would find the majority would tell you the Green River. This isn't just any river to most fishermen, this is our Crown Jewel fishery. Why compromise this and give our state's fishing and recreation opprotunities a black eye?

I know you have to weigh things out, I just hope that you can sympathize with us in this regards.

Thank you for your time.

Sincerely,

Jeff Martin

Jeff Martin
bcstoneram@earthlink.net

47. JEFF MARTIN

47a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

47b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: Jerry McGarey <bldss15@yahoo.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:38 AM
Subject: Flaming Gorge Reservoir Draft EIS

Sir - I write today to express my dismay over the
48a timing of power generation flow increases during prime fishing hours in the A section of the Green River below Flaming Gorge dam. Over the last couple of years (notably in 2004) the timing of mid-morning flow increases and mid-afternoon flow decreases is disruptive to trout feeding activity and had markedly impacted my enjoyment of this otherwise wonderful fishery.

I have travelled to the Flaming Gorge area several times a year since 1992, spending my money with local lodging, restaurant and fishing establishments. I would strongly urge you to factor the needs of the recreational fishing tourists into your plans and timing for summer power generation in the future.

I believe recreational use of the Flaming Gorge area
48b is supposed to precede that of dam power generation, isn't it?

Respectfully, Jerry McGarey (bldss15@yahoo.com)

48. JERRY MCGAREY

48a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

48b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives.

We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: "Patrick M. Mehle" <smachine@sweetwater.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 10:43 PM
Subject: Comments on Flaming Gorge Dam Operation DEIS

11-14-2004

To: Mr. Peter Crookston

Flaming Gorge EIS Manager, PRO-774

Bureau of Reclamation, Provo Area Office

Dear Mr. Crookston,

The following are my comments on the Flaming Gorge Operation Draft EIS.

49a In reading over the DEIS, it seems that there are two very conflicting assumptions made. On page 189, Section 4.8.1.1, is stated that "Fluctuations of the water levels of the reservoir would not change from what has become a normal, although flexible, operation". Conversely, on page 230, first column, it is seen that "Because of increasing water consumption in the tributaries of the Green River below FG Dam, it is anticipated that releases... will have to be greater in the future." Just two paragraphs after that we see that "Water consumption above FG Dam is also expected to increase, and this could reduce inflows into FG Reservoir." It is clearly impossible to have more water going out, less water coming in, and still maintain a "normal" lake level.

For this reason alone, I feel that there is much more that needs to be done to achieve a workable operations plan. I am a member of the Wyoming Water Development Commission's Green River Basin Advisory Group. Over the course of the last several years and twenty-five or more meetings-I have lost count of how many- our group has been exposed to many diversified points of view, and has had the opportunity to hear from many different expert and credible speakers. From this experience I have come to the conclusion that there are several points that you need to consider in greater detail. First is the issue of drought. As you probably are aware, the Colorado River Compact

annual flow figures, as seen in the original compact agreement, have proven to be lower than reality. Further, recent studies of tree rings going back to about 1200 AD, have conclusively shown that the past 100 years have been exceptionally wet. Also mentioned was yet another study concerning the Wind River Glaciers. These glaciers have been receding rapidly over the past several decades, and assuming continuation of the current drought conditions and warmer mean temperature trends, it is possible that the glaciers could be completely melted in ten years. These glaciers are the primary source of summer stream flow in the upper Green River Basin. The "demise" of these glaciers could realistically lead to the Green River actually running dry-- in the worst case scenario. The Wyoming Water Development Commission considers conditions serious enough to where they feel a need to develop an
49b emergency plan to address issues of continuing severe/ exceptional drought. I think that your EIS should address this possibility also.

Also at issue is the continued increasing demand for water downstream. Lake Powell was at 58% of capacity in October. It is surely even lower now. If current trends continue, the lake elevation will drop to the point where the generators will have to be shut down in mid 2006. It is speculated that upstream dams might be forced to lower their lake levels to supply enough
49c water to forestall that shutdown. I highly oppose a transfer of water under those conditions. There is an old saying among airplane pilots-"The two most useless things to a pilot are runway behind you and altitude above you". For a dam operation, it can be said in the same vein that the two most useless things to power generation are water downstream and dam elevation above lake level. It is fine to send water downstream for power generation since the same water can be used several times to spin several turbines. The issue is efficiency. Any water sent down to Lake Powell will be sent through their power plant at minimum head, hence minimum efficiency. It makes no sense to operate Flaming Gorge at a reduced elevation/reduced efficiency. Keeping Flaming Gorge as full as possible will give the greatest possible gross power production for the system as a whole.

I wish also to express concerns for the implementation of increased flows the endangered fish recovery program. The potential damage to FG Dam caused
49d by increased flows through the spillway is, in my opinion, much underestimated, as are the safety issues that would result. Although the fish recovery efforts are a worthy goal, the flows required to achieve this goal do not justify the costs. The physical damage to the dam, the loss of electrical generation, the erosion damage to downstream infrastructure, and the flood damage to downstream landowners, far outweighs the benefits. It is interesting to note that the water required for a single "flushing" is on the same order of magnitude as the total annual domestic water consumption for the entire state of Wyoming. I am left with the feeling that this proposal will, at best, just serve as a vehicle to benefit the over-allocated lower basin at the expense of the upper basin States. How can these costs be justified?

Finally, I would like to suggest that you consider formulating a priority
49e list for the operation of the dam. First, of course would safety- both for the dam itself and for the public that it serves. Second would be the dam's original purpose-to serve as an instrument to help regulate the Colorado River System per the Compact. Of the several priorities that you might feel would follow these, the endangered fish recovery flows should place well toward the bottom of the list-especially if the hydrological conditions that existed hundreds of years ago should prove to be the true average.

Thank you for the opportunity to express my views on these important issues.

Patrick Mehle

1037 Cypress Circle

Rock Springs, Wyoming

82901

49. PATRICK M. MEHLE

49a
The Action Alternative does not necessarily release more water than the No Action Alternative. In some cases, the Action Alternative would release less water. It is recognized in the EIS (section 4.16.1.1) as water consumption increases through time that it will become more difficult to maintain reservoir storage while also achieving the flow objective of the 2000 Flow and Temperature Recommendations.

49b
Comment noted; there is at present a drought in the Green River Basin. The hydrology that was analyzed for this EIS did include droughts more severe than the present drought.

The Flaming Gorge Model was run with historic hydrology from 1921 through 1985. During this period, several droughts did occur; the worst of which occurred from 1934 to 1938 when the average annual Green River flow (measured at Greendale, Utah) was 550,000 acre-feet. For comparison the average annual flow of the Green River from 2000 to 2004 was 661,000 acre-feet.

49c
Comment noted. Lake Powell operations are outside the scope of this EIS.

49d
Comment noted. As stated in section 2.5.3.2 of the EIS, Reclamation would annually coordinate the decision whether to use the bypass tubes or spillway to meet particular flow targets. That same section, and other sections in the EIS, note uncertainties associated with use of the spillway that will have to be monitored and addressed through the adaptive management process.

49e
As stated in section 1.5 of the EIS, Reclamation's priorities are first, dam safety and then second, meeting project purposes in compliance with ESA. When conflicts in operations arise, Reclamation's approach to conflict resolution and decisionmaking includes accepting input from all stakeholders and formulating a strategy that meets the most needs possible consistent with these established priorities. Reclamation's intent is to continue balancing the needs of all resources when making operational decisions and would continue this practice under both the Action and No Action Alternatives.

From: norman miller <nmillerca@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 6:49 PM
Subject: Flows on Green River

Dear Sir;

50a The high afternoon flows experienced on the Green River this year made what had always been a top fishing destination, an unneeded and unwanted adventure. Please restore sanity and safety to the flows so that the great fishing experience and return once again.

Thank you,

Norman Miller

50. NORMAN MILLER

50a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: <Richardmimms@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:23 AM
Subject: *(no subject)*

51a We support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities, especially fishing.

Richard L. Mimms

51. RICHARD L. MIMMS

51a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Arthur Moeller" <moellerad@comcast.net>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 6:26 PM
Subject: Draft Environmental Impact Statement on Flaming Gorge Dam

I do not favor the proposed fluctuating flows for power generation. I
52a feel it will have a negative impact on the fishing. I fish there
several times a year and if I have to put up with the fluctuating flows
I will consider going elsewhere and spending my money in a different
location. I could support the single daily peak hump restriction if it
52b was timed in a manner that does not impact river recreation activities,
52c especially fishing. I would also feel safer while wading if I did not
have to worry about the river rising suddenly.

A. D. Moeller
4247 W. 4570 So.
West Valley City, UT 84120

52. ARTHUR D. MOELLER

52a and 52b
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

52c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: "Mark" <marco@wfrmls.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 8:24 AM
Subject: Green River at Dutch John River Flow Impact

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

53a I support the single daily peak hump restriction, but its timing should be in a manner that has no impacts on river recreation activities, especially fishing. It is dangerous to the fisherman wading across the river, spoils the fishing and will keep many of us who bring the much needed dollars to the local economy of Dutch John and the State of Utah. In addition it is the recreational users who have priority over the power
53b generation.

Mark Naccarato
Holladay, UT.

53. MARK NACCARATO

53a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

53b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "Sean O'Connor" <SOConnor@sheppardmullin.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 6:01 PM
Subject: Draft Environmental Statement on the Operation of Flaming Gorge Dam

I understand that the Bureau of Reclamation is undergoing a Draft Environmental Statement on the Operation of Flaming Gorge Dam and asking for comments.

I fly fish the Green River often, and it is frustrating how the erratic
54a way flows can suddenly jump up and down while I am fishing. This can often disrupt water quality and upset the fish for set periods of time. The end result is a spoiling of our fishing day. The Draft EIS allows for fluctuating flows for power generation up once a day and then down. In 2004 this was experienced by many of us on the Green as they went from 800 cfs to 1500 cfs every day (at 1:00 pm, right in the middle of the day) after our high flows in early June to the end of September. We hated the reaction from the trout, the fishing could and often did go flat for periods of time. Then they brought the flows down while we were trying to start fishing again and the process started again. The ups and downs and the disruption you caused to our fishing experiences were uncalled for. You have the ability to do the power generation flows in non-fishing hours or maintain a slightly higher steady flow that
54b generates the same amount of electricity.

54c Recreation and fish have a priority over power generation under the authorized purposes of the Flaming Gorge dam. Please recognize this and act accordingly.

Sean P. O'Connor

DD: (714) 424-2846

54. SEAN P. O'CONNOR

54a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

54b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

54c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

MEMORANDUM

TO: PETER CROOKSTON
Flaming Gorge EIS Manager, Pro 774
Bureau Of Reclamation, Provo Area Office
302 East 1860 South
Provo, Utah 84606-7317

FROM: MAURIA PAPPAGALLO,
Environmental Resources Engineering Student
Humboldt State University
1st Harpst St, House 18
Arcata, CA 95521

SUBJECT: COMMENTS ON FLAMING GORGE DAM DRAFT EIS

DATE: 11/13/2004

SUMMARY

This memo is to inform you of my analysis of the Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS). The critique is broken into sections covering overall document suggestions, analysis of alternatives, the affected environment, and environmental consequences. Overall, I found the document to be a good examination of the situation.

DOCUMENT SUGGESTIONS

The beginning of the document should be revised; information in chapter three should come before the alternatives are assessed. The following are examples:

55a
- A summary description of the natural habitat and environment of the endangered fish should be introduced before alternatives are discussed. The summary description should include at least their average water temperature and flow requirements. A description would also inform the reader of vital information needed to assess the flows recommended by the alternatives.

- A thorough description of the Green River System (GRS) should be introduced earlier. A description at the beginning would help the reader become more familiar with the system and point out important details that can not be obtained from glancing at a map. For example, on page 19 of Chapter 1, the Browns Park Highway EIS is discussed, but the document does not indicate why this is relevant information. An earlier GRS description should state where the Browns Park Highway is and why it's important enough to be discussed in relation to the Flaming George Dam project. A full description is given in 3.6.2, this but is too far into the document; a summary should be given in the beginning.

The background of the dam situation includes authorized uses of the FGD project. Due to the authorized uses being an important part of the purpose and needs statement, they should be identified in the Purpose and Needs section and could be put into easy-to-read bullets.

Inclusion of, or reference to, important sections of the 2000 Recommendations report and the 1992 Biological Opinion as appendices to the document, would be helpful in assessing the processes used to determine the recommendations. The important sections should list the criteria used for making decisions in each report, or should list the assumptions used in the modeling analysis. Furthermore, referencing appendices within the text would direct the reader to additional information on important subjects.

The overall language of the DEIS is easy to read. A few words are not defined, but would help the reader to better understand the document. One example is the "bypass
55b tubes"; an explanation of what they are and how exactly they affect power generation is needed. The quantity of bypass tube use is discussed as a comparison between the two alternatives but it is not clear what that means.

On page 142, in the last paragraph, where temperature changes are discussed, data should
55c be re-evaluated and checked; it is not possible for 9°F to equal 5°C. The same mistake is made again on page 144 in the first paragraph.

55d A discussion of the operation and maintenance for the new operating plan should be included in the document. Where will the funding come from, and who is responsible for the maintenance and operation of the operating plan?

SCOPING

From the scoping process, public issues were identified and separated into categories. The process was conducted under the question: "How would operating the Flaming
55e Gorge Dam to meet 2000 flow and temperature recommendations affect..." Conducting the scoping process under this heading defeats the purpose of scoping. Scoping is conducted to look at the issues that should be included in the alternative development and impact analysis. This question limits the scoping process and produces "tunnel vision" in determining the alternatives. To improve this analysis, the scoping process should not have been so narrow and the indicators should include measurable descriptions. For example, an indicator for Issue 8 is "condition of vegetation and species composition of wetlands". Instead it should say "population density of vegetation, acreage and condition of wetlands and their species composition". This wording allows for measurable conclusions. The following additional indicators should be similarly re-worded:

- Issue 9, Effect on vegetation: Number and density of endangered plant species.
- Issue 13, Effects on sediment: Look at the predicted changes in salmonid spawning gravel areas. "Area of spawning gravels before new flows and predicted spawning gravel area after implementing new flows".
- Issue 15, Effects on quantity and quality of water: Changes in temperature

ALTERNATIVES ANALYSIS

The purpose and needs statement discusses two main points: 1) the need to operate the dam to protect and assist in recovery of four endangered fish species and their critical habitat, and 2) to maintain all authorized purposes of the Flaming Gorge Unit of the Colorado River Storage Project (CRSP). To fulfill both points, the only feasible alternative would be to implement the 2000 Recommendations. Thus the alternative formulation for this project should include alternative flow regimes, as well as the 2000

3

Recommendations, with differing alternatives for impact mitigations along with looking at a no action alternative. The alternatives discussed in this analysis focus on the flow regimes instead of mitigations. Two alternatives are discussed, an Action alternative in which the 2000 Recommendations are implemented, and a No Action alternative. The No Action alternative follows flows recommended by the 1992 Biological Opinion.

The action alternative splits the Green River into three different reaches, with each being affected by the FGD flows differently. It is stated on page 24 in the last paragraph that:

> *"The intent of the Action Alternative is first to meet the recommended objectives for reach 2 and then, if necessary, make adjustments to releases so that the recommended objectives for Reach 1 could also be met. It is assumed that the flow objectives in Reach 3 are met whenever the flow objectives in Reach 2 are met."*

55f This statement leaves me with a number of questions; 1) What are the recommended
objectives for each reach, 2) Why are they different? These should be stated in section
55g 2.3.2 before this statement is made. 3) How can the assumption be made that the
55h objectives in Reach 3 are met when the Reach 2 objectives have been met? An
explanation of this assumption needs to be included in this section. The following
paragraph on page 26 goes into further detail of the 2000 Recommendations. This
paragraph then states that the primary focus of the 2000 Recommendations is on the flow
55i regimes in Reaches 2 and 3. The two statements seem to contradict themselves. Why not
focus on Reach 1, the section of the river that is predominantly affected by the dam
releases?

In continued discussion of the action alternative flows, it is mentioned that by trying to
reach 2000 Recommendations for Reach 1, that the minimum 2000 Recommendations
would then be exceeded in the following reaches. Due to agricultural needs, I can
understand why water conservation is an important goal. However, based on the purpose
and needs statement, exceedence of minimum flows is a positive impact and a benefit to
55j the fish.

When comparing the two alternatives under the context of agriculture, the impacts are stated as the same whether the No Action or the Action alternative is used, thus these impacts are dismissed. The DEIS states that under both alternatives, approximately 245 acres of cropland will be flooded each year. The Action alternative will cause the fields to be inundated for 2 days longer which will not cause any more significant impacts thus
55k the effects are the same. Though the impacts will be the same, they should still be addressed within the document.

It is stated that the effectiveness of the action alternative will be measured by the long-term frequency of achieving flow thresholds prescribed by the 2000 Recommendations.
55l The language should be changed to include a quantitative value for long-term. It is also stated that an administrative record of the operational decision making *would* be maintained and that this record *would* include analysis of previous operations and
55m effectives of achieving desired targets on a year by year basis. The word *would* should be changed to *will* to ensure that this practice is done.

GREEN RIVER SYSTEM MODELING

55n The current description of the model analysis used to simulate the GRS doesn't provide enough detail. For example, the model requires natural flow volume inputs and estimates the release volumes and storage volumes. There is no discussion of how the natural inflows were chosen, or what range and number of hydrologic years were used in analysis. The language indicates that the model simulates the system to the USGS stream gauge 93 miles away from the dam, when the system being analyzed is 410 miles long? Is only one gauge used for calibration? Is the rest of the system included in the model? Further explanations should be used in the document. Placing this section within the Affected Environment chapter would increase the flow of the paper.

I liked that the preparers of the 2000 Recommendations were asked to review the document. In most situations, the reviewers found that the model properly simulates the 2000 Recommendations in Reach 2. This would indicate that it does not properly
55o simulate the 2000 Recommendations in Reaches 1 and 3. If this is so, it should be stated

5

and further analysis should be done to find conditions that do meet Reach 2 and 3 goals. Important impacts to the system could be missed or overlooked due to this inaccuracy in modeling.

AFFECTED ENVIRONMENT

As mentioned earlier, sections from the affected environment should come earlier in the document, prior to the discussion of the alternatives.

Under the Potentially affected area (3.2), a section for the Green River needs to be included. Currently there is mention of the Green River downstream of the dam, but it only mentions that the dam is 410 miles before the confluence with the Colorado River.

VEGETATION

The section on vegetation (3.7.1.3) does not fully discuss the current environment in
55p terms of the indicators previously stated in Issue 9 (Pg 14). Further detail on evasive species, numbers of populations including the flooded areas should be included. Further
55q more, in the environmental consequences section, no studies were conducted or references given to backup statements made on vegetation impacts.

ENVIRONMENTAL CONSEQUENCES

55r A value for the average influence of the Dam releases on each Reach of the system should be included in the analysis. An average percentage of overall river flow that comes from the dam releases in each reach would provide a good value. For example, on page 127, the statement "Impacts to flows from Flaming Gorge Dam diminish with distance from the dam", as a reason for not including Reach 3 flows into the model. This statement should be supported with a value indicating that the effects of dam releases are minimal at that location.

TERRESTRIAL AND AVIAN ANIMALS

55s Discussion of terrestrial and avian animals does not include any type of study or analysis to back up the decision of no impact. Further analysis of terrestrial foraging and habitat should be analyzed to see if terrestrial and avian food sources will be impacted.

6

The overall discussion of mitigations is insufficient. It would be easier for the reader if the discussion of impact significance were discussed directly after impacts were presented. There is no discussion of how impacts are rated for significance. I found it hard to find mitigations or final decisions on significance. If there are proposed
55t mitigations for effects caused by the action alternative, I did not find them.

UNCERTAINTIES

This section includes a discussion of the uncertainties included in the models and the assumptions that were required to make the models work. The assumptions and uncertainties with the models should be included earlier in the document with the discussions of information obtained from the model, thus allowing the reader to decide how well they agree with the information presented.

Inclusion of an adaptive management program will be very helpful in mitigating impacts of uncertain significance. The adaptive management program should include measurable and dated results. The wording on the adaptive management goals for numbers 6 through 10 should be changed from *would* to *will*. Using the word *would* indicates that it could happen. Due the number of uncertainties involved in the project the implementation of all aspects of the adaptive management program is very important to insure unrealized impacts are mitigated. A discussion of possible mitigations would further support the documents discussion of adaptive management.

55. MAURIA PAPPAGALLO

55a
Please see section 1.3 for an explanation of the EIS contents. The format is consistent with the CEQ and Interior regulations implementing NEPA.

55b
Comment noted. The term, "bypass tubes," was added to the glossary.

55c
These references are not to specific temperatures, but to changes in temperature; thus a change of 9 °F is equal to a change of 5 °C.

55d
Please see sections 1.5, 2.5, 4.19 and 4.20 for information regarding operations.

55e
Comments noted.

55f
The recommended objectives for each reach are flow and temperature targets defined by the 2000 Flow and Temperature Recommendations. Please see table 2-1 in the EIS.

55g–55i
Throughout the 2000 Flow and Temperature Recommendations document, it is stated that the critical habitat for the endangered fish reside in Reaches 2 and 3. This is also stated in the EIS. Through modeling, Reclamation came to the determination that it was possible to reasonably predict future flows in Reach 2 with enough precision to efficiently augment these flows to achieve the target levels established in the 2000 Flow and Temperature Recommendations for Reach 2. The following statements are made in the 2000 Flow and Temperature Recommendations which support using Reach 2 as the priority reach:

- Section 5.2.1 "Recommended flows for Reach 1… are those measured at the USGS gauge near Greendale, Utah, and are, for the most part, release patterns from Flaming Gorge Dam needed to achieve the target peak and base flows identified for habitats of the endangered fishes in Reaches 2 and 3."
- Section 5.2.1 "Base flows in Reach 1 should be managed to ensure that within-year and within-day variability targets for Reach 2 are met."
- Table 5.4 General Recommendations: "Peak flows in Reach 1 should be of the magnitude, timing, and duration to achieve recommended peak flows in Reaches 2 and 3."

55j
Comment noted.

55k
Please see section 4.5.2 in the EIS which identifies the impacts.

55l
It is difficult to isolate a specific number of years to evaluate the percentage of targets and durations achieved because it is unknown what the natural hydrograph will be in the future. Over the long run when several different natural hydrological years have occurred, Reclamation would be able to determine whether the percentages are consistent with the 2000 Flow and Temperature Recommendations. The target flows and durations to be achieved each year are dependent on the natural hydrograph of that year and the hydrological classification of that year. If 6 consecutive drought years occur in a row, like now, then only low targets and durations would

be achieved. In very wet years, high targets with long durations would be achieved.

55m
Comment noted. Reclamation intends to maintain an administrative record for how decisions are made that will be available to the public. Reclamation is considering use of a web page and other means to keep the public informed on implementation of the proposed action. The administrative record is portrayed in section 2.5.3 in the EIS and will be maintained if the Action Alternative is implemented.

55n
It is recognized that much of the supporting data regarding the Flaming Gorge Model did not appear in the draft EIS. The Hydrologic Modeling Team produced an initial report entitled "Flaming Gorge Environmental Impact Statement Hydrologic Modeling Study Report" issued in October 1, 2001. This report contains much of the information regarding how the Flaming Gorge Model was constructed. This report was added to the Technical Appendices.

The Flaming Gorge Model extends to the stream gauge at Jensen, Utah. It was assumed that if Reach 2 flows were met, Reach 3 flows would also be met. This is described in the October report.

55o
Please refer to section 2.3.2 in the EIS.

55p
Reclamation chose to measure distribution via a focus on those mechanisms exerting the greatest influence on establishment of invasive species. Consequentially, this led Reclamation to focus as well on microhabitats or geomorphic features most associated with those mechanisms. The anticipated small difference between the No Action and Action Alternatives in total acreage of invasive species contributed to Reclamation's decision to focus research on those issues that can best be addressed through adaptive management efforts.

55q
Statements made in this section reflect research discussed (and cited) for vegetation in chapter 3. For clarification, additional citations have been added to section 3.7.2.6.

55r
Information describing flow conditions on the three reaches of the Green River is available in section 3.3.3 of the EIS.

55s
This section of the EIS was written to disclose environmental consequences of the No Action and Action Alternatives affecting terrestrial and avian animals existing on or near Flaming Gorge Reservoir. Text has been added to section 4.7.1.4 to clarify and support the conclusion. Please refer to 46k above.

55t
The EIS analyzed the difference between the Action and No Action Alternative and did not find any adverse impacts that required mitigation. Under the Action Alternative, if there are concerns, they would be addressed through the adaptive management process described in section 4.20 of the EIS. Please refer also to section 4.21 of the EIS which lists environmental commitments.

From: "Park, Edward" <edward.park@IngramMicro.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:34 AM
Subject: Ed Park: Comment on Operation of Flaming Gorge Dam for Draft Environmental Statement

This message is for Mr. Peter Crookston, Flaming Gorge Environmental Impact Statement Manager:

Sir,

I was referred to you by some friends that were advised of the option to participate in submission of comments regarding the impact of flows in the Flaming Gorge/Green River area.

As someone that was recently impacted by the flow management practices, I decided to take a few moments to relate to you an incident that happened a few months ago as well as how that has convinced me of the importance of making my voice heard.

Back in September, a group consisting of myself and a few friends were fishing the gorge on a sandbar in the area. We had reached the sandbar by power boat and were wading in waist deep water.

Unknown to us, the dam started releasing a higher flow and we found ourselves in a situation where the water level was rapidly increasing. . . . we had to beat a hasty retreat into shallow water and then back into the boat. Needless to say, we felt it was not only inconvenient, but
56a downright dangerous as some of our party had quite a way to go to get back to the boat. By the time we retrieved the last of our party, the sandbar was already completely underwater.

56b My comment with regard to this is that while there is an importance with maintaining power generating optimization and water levels above the dam, specific regard to recreation and preservation of human life below the dam is important and any future planning and considerations should, in my opinion, include this.

Not to mention, we spent a considerable amount of time, effort, and money to make this special excursion and not even halfway through the trip, the water quality degraded enough to cancel all additional fishing throughout the remainder of the weekend. I guess the worst aspect about all of this was not the time, money, or driving to get there, but simply how difficult it is to get the "weekend" pass from all of our wives at the same time.

Thanks for lending an ear. I hope my input has been helpful

best regards

Ed Park
AV, CA
949 395 1964

---

56. ED PARK

56a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

56b

The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "Lex Patterson" <lex@dakcs.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 4:30 PM
Subject: Green River Flows

To Whom It May Concern:

57a As an avid fly fisherman and Utah resident who spends time fishing the Blue Ribbon resource we enjoy in Utah, I would like to add my name to the list of taxpayers who would like to see the flows on the river stabilized during the daylight/fishing hours. I'm sure a win/win situation can be worked out that will allow for the power needs, and still keep this valuable resource fishing up to it's full potential. Thanks for taking the time to read my comments.

Lex Patterson

V.P. of Technical Services

<http://www.dakcs.com/> DAKCS Software Systems, Inc.

mailto:lex@dakcs.com

3017 Taylor Ave.

Ogden, UT 84403

(801)394-5791 x242

57. LEX PATTERSON

57a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: Chet Preston <Chet.Preston@paccoast.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 2:19 PM
Subject: green river fishing

Mr. Peter Crookston,

I take 1 to 2 fishing trips a year to the green river and the last trip I took was the worst one yet the fishing was not very good at all it was ok in the morning but by the time the river come up to the peck the fishing stopped and got very slow . I stay at flaming George lodge and float with one of the guides so I spend the money to have a great time fishing that river but it's not wroth my time if I have to worry about the river going up and down and how it will affect the fish. In years past I have done
58a very well fishing the river with at least 30 to 40 fish a day when I float with the guide but this past year I had to work hard just to get about 15 fish so if there is any way that we could get around this it would be great if not it's not worth my time or my money

thanks for your time

green river fisherman

58. CHET PRESTON

58a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Tom Prettyman" <prettyfoto@adelphia.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:15 PM
Subject: Green River

Sirs,

I hope you will understand that my input is intended to be constructive for the Flaming Gorge area. There
59a have been flow fluctuations from the dam over the past several months that have resulted in a
degradation of fishing success and generally turned a lot of fishermen off from visiting the area. I do not
fully understand the reason for these fluctuations, but I do know that the end result must impact the local
59b economy somewhat when fishermen don't return due to a disappointing experience. I would think there
59c would be some way to compromise whatever electrical needs there are, with the recreational value to the
community.

Thanks for your attention to this issue.

Tom Prettyman
140 the Village #409
Redondo Beach, CA. 90277

59. TOM PRETTYMAN

59a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

59b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

59c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "Jairo Ramirez" <jairoram@comcast.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 11:24 PM
Subject: Green River Single Daily Peak Hump Restriction

Mr. Crookston,

I want to voice my concern regarding the timing of the daily flow changes to the Green River below
60a Flaming Gorge Reservoir. Increasing the flows during midday is both dangerous to wading fisherman and very disruptive to the fishing in general. Me and a group of guys routinely travel from Denver to the Green several times a year but have not been going recently because of this practice. I would encourage you to
60b change the peak increases in flow from midday to during the night. If we can be assured that this practice will change to during the night, we will return to the green much more frequently.

Thanks for listening.

Jairo Ramirez
jairoram@comcast.net
Denver, CO

60. JAIRO RAMIREZ

60a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

60b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

From: "Robert Rutkowski" <rutkowski@terraworld.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Oct 11, 2004 9:49 AM
Subject: Flaming Gorge Dam DEIS

Peter Crookston
Bureau of Reclamation
Provo Area Office
302 East, 1860 South
Provo, Utah 84606
Phone: (801) 379-1152
Fax: (801) 379-1159
Email: fgeis@uc.usbr.gov

Ref: Flaming Gorge Dam DEIS Comments

Dear Mr. Crookston:

I ask the Bureau of Reclamation to begin a comprehensive basin-wide approach to the recovery of the endangered fish of the Colorado River and its tributaries. The Bureau's piece-meal, one-dam-at-a-time approach to endangered fish recovery has yet to demonstrate any program success in the Colorado River
61a basin. This approach must thoroughly evaluate how and if dams such as Flaming Gorge should continue to be operated.

Throughout the Colorado River basin, over 40 federal dams have reduced, or truncated, natural fish habitat to the meager miles set between large reservoirs. These altered habitats do not have the conditions necessary to fully recover the native fish from their endangered status. Such altered conditions include: reduced spawning beds, lower spawning temperatures, reduced water flows, reduced sediment and nutrient loads, and isolation from improving their genetic viability.

61b I ask for a basin-wide, programmatic EIS that will truly restore the Colorado River ecosystem. I also ask
61c that the congressional ban on studying the need to decommission Glen Canyon Dam be removed. Finally, I ask that alternatives for reservoir storage, such as recharging the depleted underground aquifers of the
61d basin, be fully considered for study.

Yes, it is possible to restore the original connectivity of the Green, Colorado and San Juan rivers for the benefit of endangered fish and, at the same time, provide water for people.

Thank you for the opportunity to bring these remarks to your attention.

Mindful of the enormous responsibilities which stand before you, I am,

Yours sincerely,
Robert E. Rutkowski

cc:
Nancy Pelosi

2527 Faxon Court
Topeka, Kansas 66605-2086
P/F: 1 785 379-9671
r_e_rutkowski@myrealbox.com

61. ROBERT E. RUTKOWSKI

61a –61d
Comments noted.

From: Peter Sagara <morsaga@cybermesa.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 8:18 AM
Subject: To put it bluntly...please change your tactics

Mr. Peter Crookston:

I fish the Green River below Flaming Gorge Dam and have been doing so *for years. During that time, I have been: with a friend who was* caught across the river when the water was raised, unable to wade back until a guide in his boat stopped and brought him across; I have been there when the fish stopped rising even with the recent hatch of insects still on top....as the water rose up my waders and I had to make a hasty retreat to shore.

Over the years I have been helping to support the economy of that area by staying at the Lodge, or at Red Canyon, and using guides and boats from Trout Creek Flies and of course, getting my Utah fishing license.

62a I support the single daily peak hump restriction but suggest that the timing could be managed so it has little or no impact on fishing activity.

Yours truly,

Peter Sagara
58A Loma Blanca
Santa Fe, NM 87506

62. PETER SAGARA

62a

The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Cris Shiffler" <cmshiffl@nuskin.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:19 AM
Subject: Draft EIS on the Operation of Flaming Gorge Dam

Mr. Crookston,

Good morning! I am writing to you this morning about a very important issue to both my wife Amanda and I that you are involved in. I have been made aware recently of a Draft Environmental Impact Statement on the Operation of Flaming Gorge Dam that you are in charge of. From my understanding of the Draft EIS, it would allow for daily
63a fluctuating flows (once a day) from Flaming Gorge Dam into the Green River.

I am actually intimately familiar with this practice, as both my wife and I fish the Green River below the dam many times each year. This summer in particular, we have experienced these daily fluctuations almost every day we visited this year (approx. 8 different times), and it was quite disturbing. It was disturbing to the fish, which seemed like they would "turn off" like a switch, to the dismay of many fishermen, some of which traveled a long way to experience this magnificent river. I have noticed that this problem happens with minor fluctuations in the river in years past, however this year seemed like quite large fluctuations occurred (from 800cfs-1500cfs or so) frequently throughout the week during the mid part of the day (around noon or so) which would ruin fishing for everyone one the river for the rest of the day. In addition to disturbing the fish, this practice disturbs not only myself, but many other fishermen (and women) as well. It is disturbing to notice that while you are wading in an already swift and large river, the water level begins to rise, sometimes rapidly in a short period of time. There were a few times this past summer where we noticed to our dismay that large sections of river were no longer accessible to us during the afternoon due to higher flows blocking wading access. Between lack of already limited access in some areas and disinterested fish, it can sure put a damper on a fishing trip.

We only travel from Provo to come up to Dutch John, but that still is a 3 hour one-way commitment. We spend a pretty decent amount of time in Dutch John, and a pretty decent amount of money each year supporting the few local businesses. I would suspect that 99% of all fishermen on the Green River below Flaming Gorge Dam are not from Dutch John. These same fishermen are also pretty particular about their fishing locales. Remember back to just a few years ago after the Mustang Ridge fire. Dripping Springs got blown out after those rainstorms and all of that debris got washed into the river. Sure, it affected fishing temporarily, but not that much. Word got out about the fire and the debris and people stopped coming to the river for quite some time because the "word" was that the river was ruined. That definitely was not the case, but many of the local businesses suffered. If these large daily flow fluctuations are allowed to continue, I believe that fishing pressure, and the tourism dollars, will begin to dissipate. Why would someone want to travel all that way to Dutch John only to be able to have a few hours of productive fishing in the morning hours. The flow increases and decreases will render the remainder of the day pointless for fishing.

I believe that power production and recreation can coincide harmoniously if some careful preplanning is done. My wife and I support

the single daily peak hump restriction, but its timing should be in a
63b manner that it has no impacts on river recreation activities, especially fishing. The ideal situation for all recreationalists using the Green River below Flaming Gorge Dam, not just fishermen, would be to time these flow fluctuations to time periods that are not peak river use hours. Late evening or even during the night would be a phenomenal
63c compromise. No one is on the river at that time (or very few people anyhow). It would allow the fish and other river aquatic life time to adjust to their changing habitat, while not receiving additional stress and pressure from fishermen. In addition, from my understanding of the authorized purposes of Flaming Gorge Dam, recreation and the inhabitants
63d of the river (fish, insects, etc.) have priority over power generation. I believe that over the last few years, power generation has seemed to take priority over everything. I believe that this tiny area of the state brings in some serious tourism and recreation dollars not only for the Dutch John area, but for the state of Utah in general.

We urge you to consider all of the options the Bureau of Reclamation has available during this Draft EIS period. We hope that a serious review of what is right for the river will be taken and that a compromise can be worked out that benefits everyone involved, not just for power generation. I would welcome the opportunity to discuss this issue and my views more with you if you would care to. Good luck and I appreciate you time for reading this!

Best regards,

Cris & Amanda Shiffler
Provo, UT
801-345-2709

CC: <dbreer@union-tel.com>

63. Cris and Amanda Shiffler

63a and 63b
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

63c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

63d
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: <Snwrngr@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 11:00 AM
Subject: Green River below the Dam

Mr. Peter Crookston,

Just wanted you to know ...

64a I use to come to the river (below the dam) to fish. I do live in the Denver area and it is a little bit of a drive for me, but usually well worth it. I did experience a high flow increase in the middle of the day, each day, on my last 4 day visit. It really made the fishing bad ... especially in the evenings when the flow came back down.

I now take my vacation money and fish in Wyoming. It's not as pretty but the fishing is consistent. If you could manage your flows better I may come back.

Thank you for your time,

Jay Smith
Denver, CO 303-478-0345

64. JAY SMITH

64a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

FGEIS ZZ401 PRO - Green river fluctuation

From: "les smith" <l683971@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: 11/13/2004 10:02 AM
Subject: Green river fluctuation

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office

I have fished these waters for the last 20 years and have dealt with the fluctuation. It has been something I have excepted.

65a If the time could be moved to the night time Hrs. it would make my quality time a lot better. I live in Ft. Collins, Co. but I consider the Green home. I usually spend $100 a day any time I come to the river. Of course this is spread around to the different businesses. I feel I am the average person so this could be higher or lower.

Thank you for listening.

Les Smith

65. LES SMITH

65a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Kent Spittler" <kspittler@ksl.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 11:08 AM
Subject: Green River flow fluctuations

Dear Mr. Crookston,

I am writing to you because I believe there are mutually agreeable
solutions to the power generation requirements you have to weigh, and
the disruption of the quality fishing experience that the Green has
become famous for due to the dramatic flow changes. First of all,
66a recreation takes priority over power generation according to the Flaming
Gorge use authorization statements and second, power generation and
great fishing can both happen if some common sense is applied. When the
66b flows dramatically change, up or down, it puts the fishing down for
66c hours at a time plus it poses a serious risk of life to those who wade
fish the river when the inflow doubles in the middle of the day. I
would suggest that the timing of the flow changes be altered to non
66d fishing periods (night time) so that the power can be generated and the
fishing can recover by the time anglers get on the water. I visit the
Green both for personal days on the river and I often times bring
clients of mine, (I am an account manager for KSL Radio), and we spend
money on lodging, food, licenses, flies, etc. The last thing I want to
experience on those days is a four to six hour flat spot in the
afternoon when some of the best fishing can be had. This doesn't have
to happen. I'm sure there are issues on both sides to consider but I'm
also sure that good solutions exist so that both needs can be realized.
Please don't discount the effect that fishing has on the local economy
and quality of life in general for those of us who love the Green.
Thanks!

Kent

66. KENT SPITTLER

66a
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

66b
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

66c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

66d
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

From: "Wayne Stewart" <wstewart@csolutions.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:39 PM
Subject: Green River flow fluctuations

Mr. Crookston,

I am a Utah resident and fly fisherman. I've been fishing the river for about 13 years now and would like to request that you make a change in the
67a fluctuations in the future. I wade and float the river when I fish. This last year I noticed that the consistency of my fishing experience has changed. I've noticed it in previous years as well but only became aware of the reason this last year. When water flow is changed the fishing is disrupted as the fish adjust to the new flow. This often happened in the middle of the day. I would like to request that these flows be changed
67b during non-fishing hours, after dark and enough before daylight that it won't effect the fishing experience. I've spoken with a couple of people who've done some research and understand that the change I'm requesting is not only possible, it is appropriate. I have friends and family members from Colorado, Ohio, Michigan, New York and California who come to Utah to fish a couple of times a year and one of our favorite spots is the Green River. They spend a lot of money when they visit and some mentioned their disappointment wit the river this year. One group, my college buddies, have scheduled a trip to Idaho next summer instead of the Green. Please adjust the flow schedule to accommodate the fisherman and other recreational users.

Sincerely,

Wayne Stewart

67. WAYNE STEWART

67a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

67b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

From: Strong <strong@easilink.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 7:47 PM
Subject: Flaming Gorge EIS

68a Dear Sirs, as a Vernal city/Uintah County residentI wish to register my support for the action alternative to release surplus water during high runoff years from the Flaming Gorge dam. I believe the overall positive impacts from the increased flows are more than worth the various other negative impacts from the proposed releases.

Thank you

Steven Strong
Vernal, Utah

68. STEVEN STRONG

68a
Comment noted.

From: Jeff Talus <JTalus@skrco.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 1:06 PM
Subject: Green River Flows

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774

69a I support the single daily peak hump restriction, but its timing should be in a manner so that it has no impacts on river recreation activities, especially fishing and floating. Not withstanding the negative impact to fishing and floating the daily flow changes had last summer, there is the 69b issue of safety, to which I will provide the following personal experience. During the weekend including 6/27/2004 I was part of a group camping on the B section below Flaming Gorge Dam. We left the campsite Sunday the 27th shortly after noon heading for Indian Crossing with the intension of returning home to Colorado Springs. I was rowing my drift boat and a friend was rowing his raft. Since a drift boat had more room than a raft, most of the gear was loaded into my drift boat for the trip down river. At Red Creek rapids, my passenger exited the boat to make the usually walk down the rapids while I rowed through. Unfortunately, as a result of the low flow, heavily loaded boat, and a rowing error on my part my boat ended up stuck on Dragons Thumb rock in Red Creek rapids. The boat was resting on its side on the upstream side of the rock with about 1/3 of the boat underwater. We tried to free it with the ropes we had but the current was too much so we left for Dutch John with the intension of returning later that day with more ropes and/or gear. When we returned later that day we found that the boat was now almost completely covered by the increased flow and pulling it off the rock was no longer an option during the increase flow. We were forced to stay overnight waiting for the flow to subside before we were able to free the boat the next day. Unfortunately, we were unprepared for another night of camping since some of our camping gear had floated down river after the earlier stranding. And it was a very cold and rainy night, probably in the low 40's. Luckily everyone survived the ordeal but it certainly could have ended differently.

69c Therefore, I believe the daily peak hump should be set in a manner so that it has no impact on river recreational activities, especially fishing and floating, and so that it does not endanger river users during recreation nor have a negative impact on the fish, which I understand are suppose to have a priority over power generation under the authorized purposes of the Flaming Gorge dam.

Sincerely

Jeffrey W. Talus, CPA

69. JEFFREY W. TALUS

69a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

69b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

69c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "john & carson taylor" <owlck35@infionline.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 1:51 PM
Subject: comments of John I. Taylor on Flaming Gorge Draft

I thank you for the opportunity to comment on the DEIS for the reoperation of the Flaming Gorge Dam. This comment is submitted from the perspective of a private recreational user (whitewater boating and fishing) of the waters below the dam.

70a I strongly support the action alternative as this will create a more *natural river hydrograph, one that may make it possible for the recovery of* the listed endangered fish. I also support any modifications to the DEIS which would even more closely mimic the natural hydrograph of the Green River that existed prior to the building of the Flaming Gorge Dam. It seems to me that the recovery of the listed species is only possible if we restore to the extent possible the natural hydrograph.

Nor will such an operation of the dam adversely impact the opportunity for whitewater boating. I have had the good fortune to run the Yampa at high flood in May of 1983 (c. 20,000 CFS) and the Gates of Ladore during Fall base flows (c. 800 CFS). Both trips are wonderful, offering different but great recreational experiences. This would not change under the action alternative even if modified to more accurately mimic a pre-dam river.

The same is true for the tail waters fisheries below the dam. Roiling high water is never great for fishing whereas lower base flows are conducive to good fishing. Nothing would change under the action alternative, even if further modified.

In conclusion, this is about more than the survival of the listed species. Rather, the recovery of the listed species will indicate that the riparian and riverine ecosystems are functioning as they did before the dam. It is only under such conditions that the listed species can recover.

Thank you,

John

I. Taylor

CC: <csmith@amrivers.org>, <bmiller@westernresources.org>

70. JOHN I. TAYLOR

70a
Comment noted.

From: Jim & Linda Thompson <lthompson28@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Oct 31, 2004 12:19 PM
Subject: Comments on Operation of Flaming Gorge Dam DEIS

Dear Mr. Crookston,

My purpose in writing is to submit a few comments concerning the recently released DEIS of the "Operation of Flaming Gorge Dam". Please consider the following:

As always, I've been a strong supporter of doing whatever we can to assist wildlife, especially those that are endangered, threatened, or sensitive. I realize there are many demands from many different factions on the dam and reservoir. However, what really ought to come first, are the needs of the native fish and wildlife species that once thrived in the area before the dam's construction. True, it's great that there have been attempts to mitigate or ameleorate some of the negative impacts of the dam and its fluctuating river flows down stream, and that we still are trying. But it seems like a futile battle, in that the endangered populations are still declining--mainly due to the dam's impacts. So, yes, I guess I can
71a support the Proposed Action Alternative, but I'm not convinced anything will really do the job short of decommissioning the dam. So good luck!! I hope something will work--and maybe the proposed action will. Thank you for your attention. Sincerely, James W. Thompson, 3801 Viking Road, Salt Lake City, Utah, 84109, home ph: (801) 272-3683

71. JAMES W. THOMPSON

71a
Comment noted.

From: <PhilH2O@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 4:55 PM
Subject: Flaming Gorge Environmental Impacat Statement

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Dear Mr. Crookston,

72a I write to express my concern that flow management below the Flaming Gorge Dam may not be implemented to the best interests of recreationists, particularly fishermen. If, in fact, power generation can be managed while also coordinating flows that do not negatively impact fish, feeding patterns and the ability to safely navigate the river as well as wade its banks then please see that future policies express this desire.

72b The Green River below Flaming Gorge is an important and desired destination for sportsmen. Should the quality of the fishery be negatively impacted then our fear is that it most definately will negatively impact the economics of the surrounding area including the hamlet of Dutch John.

Sincerely,

Phil Waters
7322 Brook Trout Trail
Evergreen, CO 80439

72. PHIL WATERS

72a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

72b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

From: "bryanhwe" <bryanhwe@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 12:03 PM
Subject: Green River Flows

73a I have experienced the high and low flow rates several time this summer and must express my distaste for
this practice. Not only do I feel it is an unsafe thing to do to wade fishermen, it has spoiled my entire day
73b fishing and puts me off on going to the green if this is going to continue. When I have limited time too
spend fishing I want it to be worthwhile and therefore will go to waters (in Idaho) that do not do this up and
down thing if this continues. I feel that my option and that of others that I know feel the same why should
be seriously considered as not to adversely affect the generation of money spent in the Green River
recreation area lost to other states. Lets even out the flows and have the best of both worlds, a win win
73c situation can be made here.

Bryan Weight

73. BRYAN WEIGHT

73a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

73b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

73c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

From: "Hallie Serazin/Jim Wilson" <robinsnest@midohio.net>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 7:37 PM
Subject: single peak flow management

TO:
Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Greetings Mr. Crookston,
I write from Ohio. Other than the Lake Erie walleye fishery, which is under significant pressures, there is little to be proud of or get excited about in comparison to the magnificent Green River trout fishery. However, there is building momentum in our part of the country to take practical, doable steps to improve natural stream flow and habitat by doing such things as removing unnecessary low head dams on many of our river systems, and incentivizing conservation practices such as grassed filter strips along tributaries located on agricultural use land.

So why do I take the time to correspond from Ohio on the issue of flow management at Flaming Gorge ? I have been dreaming of the times soon to come when I will take my family and our young teen age son to get to know the special places in the American west. Fishing is sure to be a big part of that experience. Flaming Gorge and the Green River are sure to be a target destination. When we arrive will we find the best fishery possible?
74a Or, will management practices respond to some other set of priorities at the expense of the fishery ?

I encourage the Bureau to remain committed and responsive to the order of priority in the responsibilities
74b with which it is charged. Please do all that is within your authority to operate Flaming Gorge in a manner that recognizes the specialness of the Green River fishery.

Warmest regards,

Jim Wilson
Delaware, Ohio

CC: "Denny Breer - Fish Green River" <dbreer@union-tel.com>

74. JIM WILSON

74a
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

74b
As stated in section 1.5 of the EIS, Reclamation's priorities are first, dam safety and then second, meeting project purposes in compliance with ESA.

Long-term negative effects to the tailwater trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 above.

From: "Marshall Wilson" <mswilson33@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 7:13 PM
Subject: Flaming Gorge EIS

Dear Mr. Peter Crookston,

75a I am writing to express my concerns over the continued efforts to fluctuate flows from the Flaming Gorge Dam and hope that you will consider my comments in your decision on the Impact Statement. I have been making on average 3 trips a year to the Dutch John area and contributing to the economy of that area for over a decade now. Two fo these trips ususally fell in the late Spring and Summer. Seeing as I own my own drift boat, I usually bring 2 or more friends with me each time I visit.

I can honestly say that if you continue to advocate and fluctuate flows like you have this past year that I will no longer be making these trips to the Green. The fishing will be better elsewhere. And why would I want to to purchase an out of state fishing license, a Parking Pass! and fishing supplies if the fishing will be
75b nothing short of terrible? I'm sure the economy had to have suffered. I am a professional in the Travel and Leisure industry and I, like you, understand the importance of revenue streams in the economy. You can bet that the status quo will have an impact the you can quantify early.

75c I hope you will consider generating power at a higher, steady flow. Can you not produce the same amount of electricity either way? I would think this would be a great compromise.

All the Best,

Marshall Wilson
P.O. Box 3770
Copper Mountain, CO 80443-3770

CC: <dbreer@union-tel.com>

75. Marshall Wilson

75a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

75b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

75c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

FGEIS ZZ401 PRO

From: "Crista Worthy" <cristaworthy@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: 10/12/2004 10:41 PM

The health of the Colorado River is of great concern to me. I frequently fly to Utah or Arizona for backcountry hiking, and over the years have seen the area change for the worse.

76a The dams, as you know, have completely changed the character of the river. Mitigation below Glen Canyon Dam has not worked. Instead of looking at each section separately, we need a comprehensive, basin-wide approach to the recovery of the fish living in the Colorado and its tributaries.

The congressional ban on studying the decommissioning of the Glen Canyon Dam should certainly be removed! I have spent an enormous amount of time in this area. The side canyons are recovering now that the water is low. Plants, animals and birds are quickly returning.

76b We should study the replenishing of underground aquifers for water storage, instead of the reservoir, which loses so much water each year to evaporation. 30,000 dump truck's worth of silt flows into Lake Powell each day. It should be going into the Grand Canyon. Eventually the Glen Canyon Dam will be useless anyway.

I hope to hear what decisions you make.

Sincerely,
Crista Worthy
16664 Calle Brittany
Pacific Palisades, CA 90272
(310)560-7324

76. CRISTA WORTHY

76a and 76b
Both of the commenter's concerns are outside of the scope of the EIS.

PUBLIC HEARINGS

Moab, Utah – October 12, 2004

1. **John Weisheit, Living Rivers**

Salt Lake City, Utah – October 13, 2004

2. **Enos Bennion**
3. **Leslie James, CREDA**

Rock Springs, Wyoming – October 19, 2004

4. **Janet Hartford, Chamber of Commerce of Green River, Wyoming**

Dutch John, Utah – October 20, 2004

5. **Chad L. Reed, Daggett County Commissioner**
6. **Deloy Adams, Flaming Gorge Lodge**
7. **Dennis Breer**
8. **Jerry Taylor, Lucerne Valley Marina**

Vernal, Utah – October 21, 2004

9. **Steven Romney, Uintah Mosquito Abatement District**
10. **Edmond Wick**
11. **Melissa Trammell, National Park Service**

PUBLIC HEARING
HELD: OCTOBER 12, 2004, 6:00 P.M.
AT: RAMADA INN
182 SOUTH MAIN STREET
MOAB, UTAH

John Weisheit

My name is John Weisheit. I represent Living Rivers. I'm the conservation director. I also represent Colorado Riverkeeper. I'm the program director. The Riverkeepers Alliance—Waterkeeper Alliance, who sponsors my designation in Colorado Riverkeeper, and I also represent 50 groups. I believe those groups are listed in our scoping comments that supported our letter, scoping letter that we wrote back in July of 2000. And I also represent Colorado Plateau River Guides, because they were one of the sign-ons for the letter, and there are about 15 -- well, almost everybody here is a member of Colorado Plateau River Guides.

If I have more time, please let me know.

1a First of all, we do not think that the flows are high enough in Reach One to reduce the encroachment of vegetation which promotes channel narrowing and changes the natural morphology of the river, which is essential for spawning and nursery habitat.

1b We are also not fully convinced that the Bureau will successfully time the high water releases at the most advantageous time for the native fish. We think it is highly possible that the Bureau could inadvertently flush larval fish downstream into inappropriate nursery habitats downstream that would bring diminished recruitment and native fish mortalities.

1c We also think the Bureau should produce higher flows into Reach One to store sediment on the margins of Lodor Canyon and Dinosaur National Monument, with such subsequent improvements to the riparian habitat such as the recruitment of cottonwood trees, which are greatly diminished in this particular National Monument.

1d Most importantly, we believe that the Bureau should take a leadership role in providing a fish ladder at the Tusher Wash Diversion Dam near Green River, Utah. This would also include a device that would stop the incidental take of endangered fish that occurs as they migrate into man-made canals and waters that flow into powerhouse at this Green River.

The Colorado River system is under considerable stress at the present time due to the effects of climate change or extended drought. We feel that the proposed flow and temperature regime could be jeopardized by the circumstances of the changing global climate. We have concerns about a complete draw down at Flaming Gorge Reservoir should there be a compact call by the lower basin states. We are also concerned about lower water quality from the reservoir as it is returned to the river bed below the dam
1e during such an emergency situation. We therefore ask that the issue of climate change be addressed in the final EIS.

1f We are also disappointed that a survey—sediment survey was not done for the following reservoirs: Fontenelle, Flaming Gorge on the Green River and the Taylor Draw on the White River. To our knowledge, no sediment study has ever been formally completed on any of these reservoirs. We feel that it is not only essential, but it is also the responsibility to monitor the rate of reservoir sedimentation so that the Bureau can effectively manage the dam and reservoir for the purposes and needs for which it was built, and for the safety of the general public.

This is my big picture testimony.

We are not convinced that the Bureau of Reclamation is providing the necessary leadership that is truly required to improve the critical habitat of the Colorado River Basin for the benefit of the endangered fish species. Nor for that matter, the benefit of human beings.

In 1979 the General Accounting Office reported that unless substantial management changes were completed by the year 2000, the Colorado River plumbing system would fail the needs of both the environment and for human consumption. Their caution has since become a promise fulfilled.

The Bureau must stop this piecemeal, one-dam-at-a-time approach to Colorado River management. We need solutions to our problems throughout the basin and not the
1g standard maintenance of the status quo. A basin-wide programmatic EIS must begin as soon as possible for the entire Colorado River Basin.

This programmatic EIS must be willing to accept all alternatives, especially those which are politically uncomfortable and unpalatable, such as dam decommissioning. We need to get rid of some of the infrastructure immediately to bring about better water efficiency for both human needs and for the endangered fish.

1h That alternative is the recharging of the depleted aquifers throughout the Colorado River Basin.

These aquifers can hold more water than the 62 million acre-feet of storage the Bureau has constructed since the 1902. These aquifers were already dangerously—are already dangerously depleted and need to be refilled before they close or subside more than they already have. By recharging our underground storage sites near cities and farms, we have no more reason to depend on wasteful reservoirs that evaporate precious water, reduce the water of—quality of the water, particularly the reduction of salt, nor do we have to worry about the consequences of dam failure.

I just wanted to say that we will be writing some more significant comments. I still have yet to read the entire document. I have comments in support to look at the biological opinion, which I haven't been able to find.

I also need to interview U.S. Fish and Wildlife and biologists and get more information, so I just wanted to let you know that thanks for having—letting us have another six days. I might need it. And so I look forward to learning more about what some of the other people are saying about this and promise to include them in future letters in the form of our final—our letter for the final EIS.

1. JOHN WEISHEIT, LIVING RIVERS

1a
Comment noted.

1b
Reclamation will develop an annual operational plan with substantial input from the Technical Working Group. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made using the criteria listed in table 2-5 of the EIS. Additional input from the Flaming Gorge Working Group would also be considered in planning operations. This allows opportunities to refine flow attributes based on an adaptive management process.

Also, the Recovery Program has monitored and likely will continue to closely monitor timing of endangered fish larval drift for the purposes of contributing to the flow planning process. Studies occurred in May-June 2005 to monitor dynamics of larval drift and entrainment over a range of flow elevations. The 2000 Flow and Temperature Recommendations recommend use of such real-time information gathered by the Recovery Program in determining the specific magnitude, duration, and timing of flows within any given year; and the EIS further recognizes the role(s) of continued research and monitoring in refinement of flow recommendations through an adaptive management process.

1c
The commenter speaks to establishing cottonwood in the national monument, part of which is in Reach 2. For example, the cottonwood forest in Island Park was studied in conjunction with hydraulic modeling of flows of the Green River completed by the National Park Service in 2001. Channel aggradation was noted for that portion of the Green River. It was also noted that growth of vegetation in the channel would increase the rate of sediment deposition locally in this area (*Two Dimensional Computer Modeling of the Green River at Dinosaur National Monument and Canyonlands National Park,* Gessler and Moser, July 2001).

1d
A decision as to the necessity and feasibility of a fish passage at Tusher Wash Diversion is a responsibility of the Recovery Program and is outside the scope of the Flaming Gorge EIS.

1e
Reclamation did not attempt to project specific climate changes into the future as these projections are considered speculative and difficult to quantify from a hydrologic standpoint. If climate change does occur, it will impact the inflow statistics and the hydrological year classification that will be used for making decisions about how to operate in a given year.

1f–1h
The commenter's concerns are outside of the stated scope of the EIS.

PUBLIC HEARING
HELD: OCTOBER 13, 2004, 6:00 P.M.
AT: MARRIOTT HOTEL
75 SOUTH WEST TEMPLE
SALT LAKE CITY, UTAH

Enos Bennion

I came unprepared tonight. I was looking to have an opportunity to review this draft copy. And my only comment on this is I've had a hard time finding this document. I really think that you could do a better job advertising some way so that the public would have an opportunity to review this before this type of meeting. I don't know how we do that. I'm sure if I was not so ignorant, I would know what office I could go to, because you did mention you had sent a number of these things out. And they were available to the public.

I attended a meeting that was held in Vernal several years ago, and it was a discussion of the operations of Flaming Gorge itself, the water flow, fish management, recreational management and the whole schmear, and it was a public meeting, and maybe some of you people were in attendance at that meeting. But I got—I signed up for feedback on the information that was presented that night, and I did not receive it. So I know this is rather negative, but this has been my concern.

And I really can't comment on this tonight because I haven't had an opportunity to review it. But I would like to say that I have a concern over the total operation of the Flaming Gorge recreational area and the downstream area. From the standpoint that the objectives of the project itself, which started out early on as a flood control, a recreational area and power, economic power to pay for the project.

Later on, I guess, in the—after the completion of the dam, we got into the—the—you know, the law that cranked in protection of the fish and so forth, and since then I figure that—from what I can find out, that that's the primary reason for the dam at this point, number one priority, rather than the power or the recreational area that is often at the Flaming Gorge facility.

And I think it's a little out of balance. And that's probably because I haven't had an opportunity to see what kind of progress we've made here. I know that two or three years ago, of the four fish that were identified here, it was reported that one of them was basically extinct, and we hadn't had very much success in—in, you know, recovering the fish.

I can probably read this and find out how that progress is coming. Are we enhancing the environment for the fish by what we're doing? And I hope this will answer that. Or are we trying to do something else now to enhance it further?

2a In my simple way of thinking, it would seem to me like the best way to duplicate the environment that these fish should see when they were flourishing would be to fill the dam all the way up and let the high water take care of the overflow and just basically create an environment that was there before the dam was there to start with.

I can't see what is the matter with that plan or why it would be any different than the way it was before the dam was in place. We'd have high water in the springtime when the dam was overflowing and it would be a natural way of providing the environment that these fish once had.

And that's about all I have to say, but I—I do appreciate getting this information. And I plan on making some comment once I have an opportunity.

Leslie James

My name is Leslie James, representing the Colorado River Energy Distributors Association, CREDA. Our—my address is 4625 South Wendler Drive, Suite 111, Tempe, Arizona, 85282.

I'd just like to make a few remarks and we will submit some written comments within the time period.

CREDA is an organization, nonprofit, that represents the majority of the CRSP, our customers in the six western states. Our members serve about three million citizens in these six states.

I'd like to just point—make a couple of general statements. We fully appreciate the efforts that Reclamation has undertaken in developing this draft EIS. We recognize the difficulty is to balance all of the comments and all of the interested party information.

3a I'd like to point out two things, though. The Colorado River Basin Project Act expressly provides in it that nothing shall amend or modify the compacts, the treaty with Mexico or the Colorado River Storage Project.

And I make that comment with regard to the purpose and need section of the draft EIS.

3b A second general comment. Endangered fish recovery efforts are the express purview of the Endangered Fish Recovery Implementation Program, and to impose a standard other than to avoid jeopardy in our view is inconsistent with NEPA and the ESA.

We will submit, as I said, some detailed comments on some of the following areas of the draft EIS: the cumulative impact section, the hydropower section, environmental consequences with regard to the spillway use, financial analysis results. And we will also recommend that cash flow analysis also be incorporated into this draft EIS, particularly with regard to the current basin fund situation related to the drought conditions. And also flow recommendations and flooding section.

We are a participant in the Upper Basin Endangered Fish Recovery Program, and working through our biologist in that program, who was very involved in developing the
3c full recommendations, it's our opinion that the intent of those recommendations is to obtain an average of flows and not to meet specific flows.

3d These are recommendations, they are not mandates. And we also understand that there is significant new scientific information which has been discussed by the biology committee of that program as late as August that information should be incorporated into this draft EIS.

Thank you for the time.

2. ENOS BENNION

2a
The commenter's suggestion is a run of the river alternative. Please refer to section 2.2 of the EIS for related information.

3. LESLIE JAMES, CREDA

3a
The purpose and need is consistent with all applicable Federal laws, and Reclamation agrees that nothing in the CRBPA amends or modifies the compact or international treaty with Mexico.

3b
Development of water resources was highlighted in the EIS narrative to illustrate the close connection between this authorized project purpose, the proposed action, and the Recovery Program. Avoiding jeopardy to listed species and assisting in their recovery is consistent with both statute and the agreements of the Recovery Program.

3c
The intent of the proposed action (Action Alternative) is to achieve the 2000 Flow and Temperature Recommendations while maintaining and continuing all authorized purposes of the dam. Both the 2000 Flow and Temperature Recommendations and the EIS describe spring peak flows as "greater-than-or-equal-to" a given flow, indicating a minimum peak flow, not an average.

3d
The EIS was prepared using the best available information, and updates were included where appropriate in preparing the final EIS. The EIS acknowledges the flexibilities and uncertainties of implementing the 2000 Flow and Temperature Recommendations, and adaptive management will be used to address uncertainties as explained in the EIS.

PUBLIC HEARING
HELD: OCTOBER 19, 2004, 6:00 P.M.
AT: HOLIDAY INN
1675 SUNSET DRIVE
ROCK SPRINGS, WYOMING

Janet Hartford

I'm Janet Hartford. I'm the director for the Chamber of Commerce of Green River, Wyoming, located at 541 East Flaming Gorge Way in Green River, Wyoming, 82935.

At the September Board of Directors meeting I brought up and passed out a copy of a basic statement about the EIS and your folks asking for comments. The Board of Directors unanimously voted for me to write a letter to you—and so I will read that letter to you—in regards to your EIS, and their unanimous action or support is to take no action. So I will read that letter and then I will give it to you.

"Dear Mr. Crookston,

"I am writing you in regard to the EIS that will affect the Flaming Gorge Dam and the proposed flow regulations. The Green River Chamber of Commerce would like to strongly express its recommendation and support to the NO ACTION plan. The Chamber feels that any change in flow would dramatically affect several aspects of the Flaming Gorge area.

4a "Sweetwater County looks upon Flaming Gorge Lake as a great tourist attraction that funnels over 90,000 tourists (sic) to the area a year. That translates into dollars that are spent not only at marinas but also at the service industries, in other words, the gas stations, sporting goods stores, grocery stores, restaurants, hotels. We also rely on the lake as a recreation for our local residents. Our youth, as well as the rest of the Sweetwater County community, spend many days of the summer at the lake.

4b "The lower level would be detrimental to the economy as well as our way of life. Sometimes change is good, but in this case, we do not feel this kind of change is beneficial. There is no guarantee that by changing the flows, the endangered fish in question will prosper, but it is a guarantee that game fish, recreation, quality of life and the economy will become endangered.

"Thank you for the opportunity to express our opinion."

And it's signed by myself and it is in support from the Board of Directors.

Thank you.

4. JANET HARTFORD, CHAMBER OF COMMERCE OF GREEN RIVER, WYOMING

4a
Comment noted.

4b
There are no requirements of the 2000 Flow and Temperature Recommendations or the 1992 Biological Opinion which specify particular reservoir elevations. Reservoir elevations are a product of dam safety and water storage. The EIS shows that the reservoir elevation would be more stable under the Action Alternative. See figure 4-1 in the EIS for a comparison between alternatives of the mean monthly reservoir elevation.

PUBLIC HEARING
HELD: OCTOBER 20, 2004, 6:00 P.M.
AT: DUTCH JOHN CONFERENCE CENTER
SOUTH BOULEVARD
DUTCH JOHN, UTAH

Chad L. Reed

I am Chad L. Reed, representing Daggett County as a county commissioner. We will be submitting written comment, but we wanted the opportunity to make verbal comment at this time.

In reviewing the EIS and in participating in past meetings dealing with the flows of Flaming Gorge Dam, we are somewhat pleased with some of the outcome of what is at least in the proposed EIS, but we would like to refer to at the inception of the Flaming Gorge Dam, there was assurances that were given to the county commissioners at that time that the process was of a national recreation area being developed, and those areas of recreation, management and utilization of the natural resources and the promotion of the area would not negatively affect the overall economic development of Daggett County.

And to refer to page S-4 of the Executive Summary, it gives some statements referring to the National Recreation Area Act of 1968 that gives some three specific reasons or purposes that a creation of Flaming Gorge Recreation Area and the Flaming Gorge Dam.

I'm going to comment on more than three but they state that the purposes for the area was to—and the development was for the public—public outdoor recreation benefits, conservation of scenic, scientific, historic and other values contributing to enjoyment and such management, utilization and disposal of natural resources that would promote or are capable—compatible with and do not significantly impair the purposes for which the recreation area was established.

Furthermore, there has been other information provided through—information has been given to the public and through the creation of the legislation of Flaming Gorge Dam that one of its sole purposes was for the creation of hydroelectric power.

5a With these statements that we've made, it's of grave concern to the county officials of Daggett County that all economic impacts of this state would be protected in the future dealing with the study that has been done for the stability of those businesses that are already in the area and those in which we are trying to also bring to the area through the development of Dutch John, Utah, and the privatization of Dutch John and the resources that was transferred to Daggett County with the purpose of further development, which was—transferred to approximately 25 hundred acres for further development of the public area to enjoy.

The main three reasons that the—you know, dealing with three reasons that I mentioned earlier, mainly they're recreation benefits. We appreciate the opportunity to comment and we'll make written comments also.

Deloy Adams

My name is Deloy Adams. I'm one of the owners of Flaming Gorge Lodge. We are—we actually own two of the outfitter permits on the Green River from the dam to the Colorado border. And basically I do have some concerns about the action plan, but I will consolidate those in writing.

6a One of—in a conversation I had earlier today with Roger Schneidervin from Utah Division of Wildlife Resources, one of the items he touched on was ramping the flows. And I think as an outfitter that's an area of deep concern not only for the benefit and
6b welfare of the trout fishery, but one of safety for the public, especially the wade fishermen that are wading at flows of 800 cfs to—there's really nothing that I could see in writing and no specific written agreements to control the amount of flow that could be taken up for generation of power or for an emergency of any kind. Of course, probably in an emergency, it would probably be going the other way from some flow down.

But just this past summer we had several fishermen that were wade fishing down around Little Hole that got stranded with just the flows of going from 800 cfs to 1600 cfs. It would be nice if we could give some kind of notice, even though we have been
6c announcing to everyone that the flows did come up in the afternoon, but if—at 800 cfs, I don't think there's much—as much problem with somebody getting into trouble as if maybe we jumped from 800 to 24 cfs -- 2400 cfs.

That could certainly put some people in some real jeopardy if they were out in the middle of the river at Little Hole. They would not only would not able—be able to get back to the shore, they would basically be stranded with money—with water coming up at a level that they wouldn't be able to move, and at some point in time being washed down and possibly having a serious accident. So I did want to touch on that.
Other than that, probably the biggest concern that I see with the action plan is the
6d temperature requirements and what is of most benefit for the trout fishery on Reach One.

And having said that, I will be putting in a written comment and I appreciate the opportunity of letting me speak, even though I wasn't planning on it.

Dennis Breer

I'm Dennis Breer, B-r-e-e-r. Okay. I planned to sit down today and put my thoughts together on some paper but didn't—didn't get everything done because I got involved in this thing and got carried away and realized it was deeper than what I wanted to get involved in, but.

The first thing I want to do is thank the—for the opportunity to comment on the operation of the Flaming Gorge Dam and the draft EIS and its appendages.

I'm here as a couple of different positions, one as a resident of Dutch John and also secondly as a business owner who lives three miles from the dam and whose livelihood depends on the Green River and consequently is—you know, how the dam is operated affects how my business would be affected as well, so we—you know, thanks for including Dutch John in this process, because I know originally it was not a part of your programming and—which kind of surprised me, because you had Moab on there and yet the place where the most severe impact is right here in Dutch John and it wasn't included, and so I thank you for putting us on the map for your meeting tonight.

I've been a part of the Flaming Gorge Work Group since its beginnings in '93. So I've got a little more perspective than many folks in that. I've sat through the process of all the efforts that the Bureau of Reclamation has made in order to bring all the interested groups together and really try to form a consensus of, you know, all the—all the various interests that have—that have developed around the Flaming Gorge asset, and—and now the dam has been operated and all the values that that has created.

And so I think I have a good understanding of a lot of the issues, and certainly I think the Flaming Gorge Work Group and I have to say I have to commend the Bureau for making that Flaming Gorge Work Group such an effective organization. So thanks to the Bureau for providing that—that window where everybody can get together and express and exchange values and ideas and try to develop some kind of consensus.

I have two approaches that I want to talk about tonight. In fact, I'm going to have to extend the other one and probably come to the Vernal meeting tomorrow night to make another comment on the economic part of the DEIS, but.

In the biological aspect, I think I've come to support most of the aspects of the biological opinion, and in particular what I'm looking at is that, you know, the flow and temperature recommendations for the threatened and endangered species, as long as they're consisted with the maintaining of and whenever possible the enhancement of the Flaming Gorge Tail water Sport Fishery are certain things that I have interest in. And I think that we have seen a lot of common ground in those work groups where the interest of trout and the interest of T and E fish have had a commonality.

In particular, the recommendations that were made in the DIS—EIS is—that I support are the recommendation of flow limitations, fluctuation limitations, which includes a single daily hump fluctuation. In other words, the absence of multiple fluctuations during the day, and that they be done in a reasonable manner, which the recommendation is 800 cfs on the ascending and descending ramp rates, which I think are extremely important as well so we're not jumping the flows up and down and displacing fish in that effort.

And that's in—basically in line with a lot of the historic operations that have occurred over the last ten years during this interim.

The recommendation also for the 55 degree water—Fahrenheit water temperature releases, you know, really help us maintain water trout temperatures down to the Colorado/Utah state line, and—which, you know, keeps the range of trout from the tail water—in the tail water section extremely valuable to us. So, you know, the further the trout can survive down the river, and that 55 degree Fahrenheit water temperature certainly does that.

Those—those things we can agree on because it's—it's things that I think we share with the T and E fish downriver and—and—in their attempt to effect change and help the T and E fish in their effort for recovery. So, you know, anything—and while my basis is on trout fishing, and the reason that is because I'm tied to the trout fishery here, as a guide and outfitter and also as a sport fisher, having been to this river for many years.

And it's been about—since about 1975, so I have a great deal of interest in the river.

I'm going to probably make some comments tomorrow night. I'm going to show up to the Vernal meeting and make some comments, but the first things that I'd like to say about the economic part of this, and when looking at recreation, recreation in Daggett County and in Dutch John is—is probably keen in terms of economics.

7a And in some of the things that were put into the economic aspects and looking at the consequences of the action or no action alternatives, it really stuck out to me in terms of talking about losses of jobs and declines under certain scenarios, which would be the average dry and wet years, and having seen the last four or five years be extremely dry, you know, and I have to wonder what average is anymore. You know, it just—it is—there's no average anymore that really fits that criteria, and so it's kind of hard to really look at it.

7b But anything that affects jobs in Daggett County is generally affecting—being affected by changes in recreation. And so I'm kind of concerned about some of the aspects that are in the biological opinion, in particular when it comes to the recreation industry, because where I'm seeing the most changes are when it comes not to the Flaming Gorge Reservoir, but to the Green River. And so the impacts on that seem to be the most affected area.

7c Well, then that puts Dutch John itself in the most jeopardy and the Green River activities being in the most jeopardy of having economic consequences, and so that's why I'm very, very concerned if the recreation or the guides and outfitters here are taking the brunt of the change—I read a fact or a statement in here that in the tri-county area that recreational services and also car rentals were a small sector of—very small, only like 2 or 3 percent affecting the numbers of jobs. Well, 2 or 3 percent spread over three counties isn't that much, but 2 or 3 percent really equates into 30 or 40 percent in Dutch John, because we are recreation.

So those aspects I think really need to be evaluated and looked at. And some of the bases for some of the information in here, there's parts of it that just does not make sense to me and I think it's too easy to get into voodoo economics. You can prove or disprove anything by, you know, the facts. And one of the things that I did notice in the—in addressing recreation in here was that a lot of the language is skewed towards the positive side of it.

So I'm going to make written and possibly show up for the meeting tomorrow night about the economics, and I think that our county commissioners should be extremely concerned about the loss of jobs and recreation opportunities on the river under these different scenarios and be very concerned and at least have some idea of what's going to happen as these things move forward.

Biologically I'm very much in favor of the steps that the Bureau has taken in terms of T and E fish and with the trout fishery, but it comes as an economic cost to the local community, and I'm concerned about that.

Thank you.

Jerry Taylor

My name is Jerry Taylor. I am owner and operator of Lucerne Valley Marina and Flaming Gorge Corporation. We're concessionaires with the Forest Service. We've been on the lake in operation since 1965. We put Buckboard Marina in originally and sold it to Les Tanner, who still operates it.

And basically we're here to make sure that the infrastructures that are operating on the lake, the marina operations and stuff are represented with their concerns about the economic viability of those operations.

All of the marine operations around Flaming Gorge essentially are marginal marine operations in inland-water waters. They're seasonal in nature, they are—if you look at the economy of scales and if you check with a Ph.D. at Western Illinois University who does inland water marina studies, he will tell you that the economy of scale for marine operations is 300 slips.

None of the operations on Flaming Gorge meet that criteria. So if you look at the economies of scale, you're talking about a system that has operating expenses right on the back end of their income on a—on a regular basis, a seasonal basis, and a yearly
8a basis. Because we can't—we haven't achieved the economies of scale that would allow us to have a larger margin to work with.

Because we're working on such short margins, our operations are very sensitive
8b to fluctuation of water levels and those kinds of things. Currently all three marinas are going through some transition with the current water levels.

We probably spent an additional $23,000 in expenses for the '04 operations of Lucerne Valley Marina this year, relative to moving fuel lines, power systems, water systems, communications systems to operate our fuel dock on the other side of the ramp at Lucerne.

Those are things that have a major impact on our—our overall income for this operating season. Coupled with some of the other things that's going on, so what I'm saying is that the operations and the marina operations that are on Flaming Gorge are very sensitive to economic impact. And fluctuating waters is a major thing to deal with.

Our situations are somewhat unique and we do operate on very steep inclines on the lake, except for Buckboard, which has some shallow water warnings. And of course, when they lose the shallow water warnings, then they have to move the facilities even farther to facilitate enough floatation to facilitate the slips in the location on the water, so. They can actually have more impact up there in the shallow operations.

The Forest Service has considered additional marina operations on the lake, which would be Firehole. That's not even feasible under current water conditions for that operation to either be established or to operate under current water levels.

So those are some of our concerns. I have attended the flow meetings for this process historically from the time that it first started and will be there each time they talk about the annual flows, and those should reflect the amount of water that's available for
8c Mother Nature for each year's releases.

Thank you.

5. CHAD L. REED, DAGGETT COUNTY COMMISSIONER

5a
Comment noted.

6. DELOY ADAMS, FLAMING GORGE LODGE

6a
Ramping the flows is outside the scope of the EIS. However, it is noted that the changes in flows, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Meeting peak demands is currently tempered by environmental and other concerns. This operational detail would be the same under either the Action or No Action Alternative. Please see section 4.4.1 in the EIS which accurately describes the limitations of ramp rates.

6b and 6c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. Currently, through efforts of the Flaming Gorge Working Group, the agreed upon ramping rate is established at 800 cfs per hour. This ramping rate has been the agreed upon standard since the Flaming Gorge Working Group meeting of April 11, 1994. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

6d
See section 4.7.2.4.1.2 in the EIS. In dry and moderate years, 55 °F (13 ºC) water would continue to be released from the dam as it is currently, resulting in no more impacts to trout during summer months than are currently sustained. Long-term negative effects to the trout fishery are not expected under the Action Alternative.

7. DENNIS BREER

7a
Average, wet, and dry flows and reservoir water levels by alternative were estimated by the hydrologic model by superimposing Action and No Action Alternative operations on conditions experienced across a hydrologic period of record.

7b
The EIS shows that Green River recreation visitation could be negatively affected, particularly during wet and dry conditions.

7c
While lack of county specific recreation expenditure data precluded a county by county socioeconomic analysis, the loss of Green River recreation visitation and expenditures during wet and dry conditions (each estimated to occur 10 percent of all years) may suggest adverse impacts to Dutch John. Gains on the reservoir may outweigh losses on the river for certain businesses, while others (e.g., commercial guide operations) may be disproportionately affected. The point that a relatively small loss within the

three-county area, if concentrated within a single county or community, could occur is well taken. Clarifying text was added to section 4.12 in the EIS.

8. JERRY TAYLOR, LUCERNE VALLEY MARINA

8a–8c
Comments noted.

PUBLIC HEARING
HELD: OCTOBER 21, 2004, 6:00 P.M.
AT: WESTERN PARK CONVENTION CENTER
300 EAST 200 SOUTH
VERNAL, UTAH

Steven Romney

I've already left a copy of my oral record with your recorder. This will be surely less than five minutes, but I'll just read it off quickly.

I am Steve Romney, director of the Uintah Mosquito Abatement District that's located now coming up on 30 years in Vernal, Utah. And I'll present my commentary.

This is specifically as per the Green River Bottomlands Reach 2 of Project Area That's fundamentally our major operating area as far as the river drainage goes.

All right. I'll just quickly read this and go from there.

"When seasonally flooded with river sub-up or overflow water, the Green River bottomlands region in question presents enormous acreages of some of the most productive aquatic mosquito habitat in western North America. Literally millions of mosquitoes per acre can be produced. Many thousands of acres of such habitat are involved. The most important mosquito species are of the genera Aedes, Ochlerotatus, Culex and Anopheles. Some floodwater species can and often do migrate in staggering numbers as far as 20 or more miles from their bottomlands points of origin and present a substantial threat to the public health, veterinary health, ranching and agriculture, outdoor recreation, outdoor commerce and the economically vital tourist industry in Uintah County.

"Of new and greatest concern is the ongoing potential for the large scale river bottomlands production of the mosquito species Culex tarsalis, an extremely abundant and highly competent local vector of West Nile Virus. Ecologically, the additional and superbly productive mosquito habitat to be activated with the artificially enhanced and prolonged flooding of the Green River periphery presents a reproductive bonanza for this now critically important species. Due to the flattened, almost level contour of much of the Green River bottomlands topography, even minor increases in river elevation at high water can translate into huge additional acreages of sub-up and overflow mosquito habitat.

"The presence of mosquito-borne West Nile Virus in Utah was first documented in the late summer of 2003. That year the first human and equine West Nile Virus infections ever recorded in Utah were acquired in Uintah County"—not too many feet from this building. "Our neighbor state of Colorado suffered an incredible 2,947 human West Nile Virus infections in 2003. 63 were fatal. At season's end, 2004, ten human West Nile infections had been recorded in Utah. Two cases were acquired in Duchesne County. The newly arrived virus is now permanently established in the Uintah Basin and many other regions of Utah. The 2005 and future seasons will thus undeniably present every real possibility of severe outbreaks of mosquito-borne West Nile Virus in local human, equine and reservoir bird populations.

"The above is a far too brief but absolutely valid account of the circumstance at hand. I struggle with what would seem to be a lack of meaningful onsite field
9a observations having been conducted for the EIS assessment of the potential impact of various Flaming Gorge operational scenarios on bottomlands mosquito production. Over some thirty years of very personal interactions with Green River mosquitoes I have repeatedly found that far more can be learned by wading in their habitat rather than flying over it in the course of aerial surveys of the same.

"Some Fair Questions:

"Are the hoped for research benefits which might be gained by way of the
9b controlled release of Green River flows so as to both substantially increase and artificially prolong the flooding of the river periphery worth the for certain harmful public health and economic impact which would be forced upon the citizens of Uintah County? Simply put, more water in this case means far more mosquitoes, some of which the next time around may be able to kill you.

"Large scale Green River bottomlands mosquito control is extremely expensive and, for numerous logistical and biological reasons, is immensely challenging. It demands perfectly timed and repeated low-level aerial applications of degradable biological control mosquito larvicides to aquatic mosquito sources dispersed throughout some 50 linear miles of remote, often densely vegetated, nearly impenetrable river periphery. The Uintah Mosquito Abatement District is funded by local property taxes.
9c Should Uintah County citizens be the only ones to pay for the best possible and utterly essential control of what will be much larger and medically important mosquito populations when their otherwise simple prevention is wholly dependent on the whim of the Recovery Program for Endangered Fish Species?

"When the Operation Of Flaming Gorge Dam EIS 'Action Alternative' is inevitably implemented, I will be requesting that the Uintah Mosquito Abatement District
9d (and thus the taxpayers of Uintah County) at least be awarded full and fair federal compensation for those additional, much higher public health mosquito control expenses which will ultimately result from that policy decision.

"Such supplemental federal funding for Uintah County public health mosquito/disease vector control, though in no way fair compensation for the true extent of the adverse consequences of the 'Action Alternative,' would at least to some limited extent serve to elevate our citizens above the status of hapless victims in this matter. From a mosquito's perspective, federal funds in exchange for Uintah County's blood may seem like a good deal.

"Thank you for your valuable time and attention.

"Steven V. Romney, Ph.D., Director, Uintah Mosquito Abatement District."

Thank you, gentlemen.

Edmond Wick

Yeah, I think—I will not be submitting written comments, but I was over here working on a field project and heard about the meeting, decided I'd come in and comment a little bit.

I'm just a consultant at the present time and I've worked for the National Park Service, the U.S. Fish and Wildlife Service, and Colorado Division of Wildlife on endangered fishes for about 25 years, and would like to just point out a few areas of the report that I thought were a little bit inconsistent and might need some rewriting.

And my main concerns center around the timing of flows. In other words, I agree quite a bit with the magnitude levels of the flows that you're proposing, but the work that we've been doing on sediment issues in particular have brought up a lot of issues concerning the timing of flows.

And on page S-30 of your summary report here, on Table S-7, a lot of the flow *timing* of the releases from Flaming Gorge are based on the Yampa River peak flows. And what we've found over the years is the Green River and the Yampa River often do not coincide with the peaks.

And I understand that the reason we try to time the releases of Flaming Gorge to coincide with the Yampa is obviously to—you know, to get the maximum peak flow.
10a But in reality, these peaks have not coincided often and the Green River many times peaks a lot later.

10b And the work we've been doing with razorback suckers in particular show it's problematic in terms of sedimentation on the spawning bar when the flows from Flaming Gorge are released early coinciding with the Yampa, because we initiate sediment transport in the river, which tends to deposit sediment over the spawning bar.

So I see here that on page, I guess it's S-25 -- or 24 -- 24 and 25, you have a table called S-4. And I understand that during average years that we have a set of criteria on which we'll initiate the onset of peak flows. And some of those criteria are, for instance, the initial appearance of larval razorback suckers in the river and the condition of habitat for razorback sucker adults on the spawning bar and young.

And you'd find that in many cases what you need to do perhaps is reference back to your different tables and so forth and clarify that on the years you're indicating that one out of three years, particularly on average years, that you would have flows that would be relatively high that would help the razorback sucker. That's what that's for. So that in many cases you have to override your one statement of coinciding with the Yampa
10c should be overridden by the factors concerning the life history of the razorback sucker to make sure that the spawning habitat is protected.

So I think what I see here is kind of a conflict of one table versus a general statement of matching Yampa River flows. It kind of conflicts because very seldom do
10d the appearance of larval razorback suckers coincide with the flows of the Yampa River.

So that's my main concern, and I guess from our work that we've seen over the years, we've seen a lot of problems with flow timing, for instance, in wet years the tendency is to release flows early in May and wet years prior to even the Yampa peaking. So what's happening is the Flaming Gorge initiates large releases prior to the Yampa even peaking. And that combining with the Yampa flows initiates tremendous sediment transport and problems.

So what's happening is a lot of times during wet years when we could maximize production of razorbacks because the flood plains are available, we see poor production. So in order to improve the situation long term, we need to go ahead and probably do

10e more management in average years for razorback, because that's when we get the best production. So we need to clarify those tables that I mentioned and clarify those statements.

Melissa Trammell

I'm Melissa Trammell and I'm representing the National Park Service, and I'd like to say that basically and in general we think that the flow and temperature recommendations and the way that the EIS has been laid out represents an improvement in the situation on the Green River and probably additionally protect resources in Dinosaur National Monument.

11a Having said that, I will go on to say that we don't necessarily think that the EIS has gone far enough in the right direction, particularly in terms of peak magnitude of spring flows. And we hope to work within the adapted management system after the EIS is implemented to encourage more variability, annual variability with flows in the upper end of the range.

And that's all I have.

9. Steven Romney, Uintah Mosquito Abatement District

9a
The EIS uses the best available information as called for by the CEQ regulations implementing NEPA. Reclamation relied heavily on Dr. Romney's input to ensure valid data. In site visits along the Green River near Jensen during June and July 2005, Reclamation staff discovered the greatest concentrations of mosquitoes in and adjacent to irrigated crops rather than in or near standing water in the flood plain.

9b
We do not anticipate adverse consequences to humans if the 2000 Flow and Temperature Recommendations are implemented. The river flood plain is likely to be inundated in wet years under either alternative.

9c and 9d
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

Reclamation notes that the issue of mosquito control along the Green River has been discussed annually at the Flaming Gorge Working Group meetings, and we expect such dialogue to continue in the future, whether or not the proposed action is implemented. As noted in section 4.21 of the EIS, Reclamation is committed to continuing dialogue with county officials to explore the potential to assist with mosquito control.

10. Edmond Wick

10a
It is true that the Green River peak flows naturally occur later than those for the Yampa River. In order to minimize impacts to the authorized purposes of Flaming Gorge, however, the most optimal timing of peak releases is when the Yampa River peak flows occur. If releases from Flaming Gorge Dam are timed to be later than the peak flows of the Yampa River, the releases from Flaming Gorge Dam would have to be greater in magnitude and duration to achieve the flow objectives.

10b–10e
The 2000 Flow and Temperature Recommendations are intended to aid in recovery of four endangered fish species by restoring a more natural flow regime to the Green River. The authors of the 2000 Flow and Temperature Recommendations recognized that certain aspects of the flows may affect certain species differently than others. Razorback sucker historically have spawned on increasing and peak runoff flows. One objective of spring peak flows is to entrain razorback sucker larvae in flood plain depressions, so it is possible that dam-release augmentation of the Yampa River peak flow would occur after spawning activity. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group which will evaluate criteria listed in table 2-5 when

making recommendations. Additionally, the Recovery Program has and likely will continue to monitor both timing of endangered fish reproductive activity and geomorphic processes for the purposes of contributing to the flow planning process. The 2000 Flow and Temperature Recommendations recommend use of such information gathered by the Recovery Program in determining the specific magnitude, duration, and timing of flows within any given year; and the EIS further recognizes the role(s) of continued research and monitoring in refinement of flow recommendations through an adaptive management process.

11. MELISSA TRAMMELL, NATIONAL PARK SERVICE

11a
Comment noted.

INDIVIDUALS

1. G. Howard Abplanalp
2. Lew Albright
3. Mark Allen
4. John and Mickey Allen
5. Dick Apedalle
6. Justin Barker
7. Lynn Barlow
8. Nancy Bostick-Ebbert
9. Allen Brisk
10. Alan Bronston
11. Michael Brown
12. Bob Brownlee
13. Scott Brunk
14. Ted Butterfield
15. Reneé Buzarde
16. Bryan Campbell
17. Jay P. Carlson
18. Mel Cisneros
19. Randall M. Connett
20. Robert W. Day
21. James DeSpain
22. Frank Doyle
23. Paul J. Ebbert
24. Bryan Eldredge
25. Jeff Erkenbeck
26. Kurt Finlayson
27. Richard Fitzgerald
28. Robert Freestone
29. Bruce Gibbs
30. Kerry M. Gubits
31. J. Dean Hansen
32. Virginia L. Harrington
33. Corey Harris
34. Craig W. Hauser
35. Rick Hayes
36. Jeffrey Himsl
37. Jack Hunter
38. Dale Huskey
39. Bob Johnston
40. Don E. Jorgensen
41. Dora J. Jorgensen
42. Wade Kafkaloff
43. Bruce Kautz
44. Ted E. Kulongoski
45. Heather Kuoppamaki
46. Scott A. Marshall
47. Jeff Martin
48. Jerry McGarey
49. Patrick Mehle
50. Norman Miller
51. Richard L. Mimms
52. Arthur D. Moeller
53. Mark Naccarato
54. Sean P. O'Connor
55. Mauria Pappagallo
56. Edward Park
57. Lex Patterson
58. Chet Preston
59. Tom Prettyman
60. Jairo Ramirez
61. Robert Rutkowski
62. Peter Sagara
63. Cris and Amanda Shiffler
64. Jay Smith
65. Les Smith
66. Kent Spittler
67. Wayne Stewart
68. Steven Strong
69. Jeffrey W. Talus
70. John I. Taylor
71. James W. Thompson
72. Phil Waters
73. Bryan Weight
74. Jim Wilson
75. Marshall Wilson
76. Crista Worthy

November 14, 2004

Mr. Peter Crookston
Flaming Gorge EIS Manager
PRO-774 Bureau of Reclamation
Provo Area Office
302 E. 1860 So. Provo UT
84606-7317

Dear Sir,

After reading the newspaper article in the Vernal Express dated 11-4-04, I would like to submit
1a my comments: I fully Support Dr. Steven Romney's concerns of creating excess flood plain to promote increased endangered fish populations - I witnessed the hard work Dr. Romney and his crew did this year to keep mosquito populations in check as they were continually checking and eradicating larvae throughout the area.

1b It also doesn't make sense to flood usable fields, irrigation systems & to lose power generation when the endangered fish are
1c making a comeback anyway. there's a good chance the Yampa River will provide a extremely
1d large flow this year & provide some of the

benefits you are hoping for. I think the desire to increase the endangered species is one we all support.

I also feel that we need to increase the storage capacity of the Green River at higher elevations such as Fontenelle &
1e flaming Gorge for future use since we've been experiencing a 6 year drought.
1f Water is too valuable a commodity to use for just one reason.

Respectfully,

G Howard Alyslewaly

1. G. HOWARD ABPLANALP

1a
Please see responses to the Uintah Mosquito Abatement District letter 6 and public hearing speaker 9 (Dr. Steve Romney).

1b
Under either alternative, higher flows will inundate the historic flood plain. Any improvements by landowners in the flood plain have always been at the landowners' risk.

1c
There are few data suggesting that the four endangered species are making a comeback; in fact, most data suggest that populations of four species are either stable at dangerously low levels or declining in some cases. At best, all four species currently exist at diminished population levels which preclude removing them from the Endangered Species Act (ESA) or improving their ESA status. See the Recovery Program website <http://www.r6.fws.gov/crrip/rea.htm> or call the Recovery Program at 303-969-7322, ext. 227 for more information.

1d
As stated in the EIS, Yampa River flows have a greater influence on the flows in Reaches 2 and 3, and the Action Alternative takes this into account.

1e
Comment noted; increasing storage capacity is outside the scope of the EIS.

1f
Reclamation's intent is to continue balancing the needs of all resources when making operational decisions and not focus on just one resource. Reclamation would continue this practice under both the Action and No Action Alternatives.

From: "lew" <albrightlr@iwvisp.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 5:27 PM
Subject: Water Flows on the Green

Dear Mr.. Crookston,

I have been fishing the Green River for at least 12 years. The last 6 years I have fished it twice a year. This last year, especially October, the flows really disrupted the fishing. It seems that the flows were changed during prime time, during the middle of the day. It was the worst fishing that we have ever had on
2a the Green. We spend over a $1000.00 to the Utah merchants for every trip that we make but if the flows stay like they are, we plan on fishing in Oregon and Colorado. We do love the Green River fishery, but why fish it if the flows keep changing during the day and cutting hours of fishing out of our day. It is very
2b discouraging. It wouldn't it be better for everyone if the flows were changed during the late evening and not
2c during the day when the river is full of anglers, boats and rafters?? It is also a safety hazard because many wade fishers cross over to the opposite bank to fish and when the water rises it is almost impossible to get back, unless you are a good wader. I hope that an agreement can be reached that will not disrupt the fishing during prime time.

Thank you for your support.

Lew Albright

2. LEW ALBRIGHT

2a and 2b
Fluctuating releases during the day have been the normal operations of the powerplant since it began power generation 40 years ago and would continue under either alternative. The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

2c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38.

From: "Mark Allen" <markallen2@qwest.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 7:28 PM
Subject: Green River Problems

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152
801-379-1159 FAX

Mr. Crookston,

I have been fishing on the Green River for many years. There are a
number of things which are of grave concern to me. The past several
times I have been fishing out there I catch many fish that seem to have
health issues. I am not sure of all the things that disrupt the
3a feeding cycles of the fish, but I think the change of flows in a quick
manner does in fact impact the fish in negative fashion.

3b It is difficult to know if I wade to the far side of the river if I
will be stranded by high releases or if I will be able to safely return
at the end of a fishing day.

The reputation of the Green River as being a world class fishery has
come into question when I find the disruption that high water brings to
my personal experience. If water flows need to be ramped up I would
3c suggest this happen from midnight until 4am, so things can settle back
down during the day hours. If the flows are ramped up during the night
3d the electricity generated could be sold to those in the East at a
premium.

3e Please consider the issues which affect the fishing, which result in
economic gains or losses to the area as they are directly tied to
individuals fishing experiences and word of mouth as to how the fishery
is doing. It has been quite sometime since fishing has been splendid.
I would guess that if an environmental and biological study were done
on the disruption of feed in the river channels due to rapid increase
of water flows, we would find that much of the food sources for fish
3f are being blasted downstream and hence those fish that remain have
undue competition, this results in marginally healthy fish.

I would like to get an update as to the solutions you deem appropriate
for this wonderful resource. Please protect it. As a former river
guide in the Grand Canyon we experienced dramatic flow changes. There
is great safety issues here that need to be considered. High water and
3g swift currents can consume lives. It is common sense that if flows are
to be increased that it is done prudently and at a time which presents
the lowest opportunity to affect fisherman frequenting the area.

Thank you,

Mark Allen
1729 North 80 West
Orem, Utah 84057

3. MARK ALLEN

3a and 3f
Comment noted.

3b and 3g
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

3c
Fluctuating releases during the day have been the normal operations of the powerplant since it began power generation 40 years ago and would continue under either alternative. The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

3d
Electricity in the East is provided by separate transmission systems that are not connected or synchronized with the Western network, so the power could not be sent directly to the East.

3e
The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of fluctuating releases, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery. Please see response to individual letter 38.

From: "Mary Allen" <jackpinesavageco@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 11:52 PM
Subject: Increased Flows from Flaming Gorge Dam

To whom it may concern:

4a We are residents of Rangely, and take much pleasure from the rivers of Dinosaur National Monument. We strongly support the Action Alternative.

John and Mickey Allen
Rangely, CO

Mary Allen
jackpinesavageco@earthlink.net
Why Wait? Move to EarthLink.

4. JOHN AND MICKEY ALLEN

4a
Comment noted.

From: "Dick" <flyfishing@readytek.net>
To: <fgeis@uc.usbr.gov>
Date: *Fri, Nov 12, 2004 6:47 PM*
Subject: Operation of Flaming Gorge Dam

5a I support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities,
5b especially fishing. An issue of safety, wadding fishermen's safety is affected negatively when river flows change abruptly during peak fishing hours of the day.

Please take in consideration my notes

Thank you

Dick Apedaile

flyfishing@readytek.net

5. DICK APEDALLE

5a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

5b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: <Jlbarker5@cs.com>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 23, 2004 11:48 PM
Subject: Flaming Gorge Dam Flows

Mr. Peter Crookston

Flaming Gorge Environmental Impact Statement Manager

PRO-774

Bureau of Reclamation, Provo Area Office

302 East 1860 South

Provo, UT. 84606-7317

801-379-1152

I am writing in regard to the changing flows on the Green River below Flaming Gorge Dam this last summer. I come to the area about every other month to fish and stay in Vernal for the duration of the trip. I usually come with at least one friend.

6a I wade fish on the Green and the flows are particularly important to me. Changing the water flows during the day is a safety issue for many fishermen that wade like myself. I know the river changes and plan accordingly, but the river is constantly full of newcomers and they are rarely ready for a large increase in the amount of water being let out of the dam.

6b I support the single daily peak hump restriction, but it could be done at a time when it would not impact the fishing. The daily changes this last summer killed the fishing during most of the day. It takes the fish a while after the increased flow to calm down and begin feeding. By this time, the flow was decreased and the fishing was again thrown off. I know the Green River is a national destination river for fly fishermen and this summer was a disappointing experience for many of them. We need to keep the flows as constant as possible during the day in order to maintain the excellent fishing and keep tourist dollars flowing in to this region. Thank you for you time.

Justin Barker
1911 W 800 N
Pleasant Grove, UT 84062
801-785-7811

6. JUSTIN BARKER

6a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

6b
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Lynn" <lynn@kathyquilts.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 10:58 PM
Subject: Power generation impact on Green River fishing

To: Peter Crookston
From: Lynn Barlow

Dear Sir,

I would like to mention to you how I enjoy visiting the Green River, especially the A section below the Flaming Gorge Dam. I have visited numerous times and had different experiences each time. Out of all the places I like to fish, the Green River can be the most fun and the most frustrating. There have been times when the raising of the river has severely affected the fish. Since I live about 4 hours away from Dutch John, in Brigham City, Utah, the time investment is quite significant. When I visit the Green River I am rewarded with the beauty and awesome canyon view as I float serenely down the river. The opportunity to catch fish makes the trip all the more enjoyable.

7a It is come to my attention that the power generation can occur during time periods when fishing will not be affected. This could make for more enjoyable trips to the river as well as safer fishing. Not knowing whether
7b the river will be raised or lowered without warning really is a cause for concern. It is my hope that a time frame can be reached for power generation that will not affect the fishing.

Better fishing conditions will affect the amount of dollars for local merchants as well as for Utah in general.

I thank you for reading this message,

Lynn Barlow

7. LYNN BARLOW

7a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

7b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Nancy Bostick-Ebbert" <nancyb@sbtnet.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:39 AM
Subject: Comment Addendum

Below you will find a duplicate comment to which I have added my contact information that I inadvertantly left off earlier.

Thanks,

Nancy Bostick-Ebbert

To Whom it May Concern:

8a My name is Nancy Bostick-Ebbert. I am a fifth generation Utah resident and was born and raised in Vernal. I very strongly support the action alternative for increasing flows every 10 years on the Green River below the dam. I think it is critical that we do everything we can to mimic conditions favorable for the endangered species of fish in the Colorado River drainage. In addition, these releases help improve the riparian ecosystems along the river and provide better habitat for the birds and animals who inhabit those environs.

I appreciate the opportunity to comment on this and encourage you to make a decision based on good science not fears and misinformation.

Sincerely Yours,

Nancy Bostick-Ebbert
1 North 2500 West
Vernal, UT 84078
(435) 781-1518

"If you want another to adopt your beliefs, you must first
become someone they wish to emulate..."

---nancy bostick-ebbert---
nancyb@sbtnet

8. NANCY BOSTICK-EBBERT

8a
Comment noted.

From: Allen Brisk <Allen.Brisk@paccoast.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:06 PM
Subject: Green River

I am a 64 year old man who has fished the Green River for the past 25 years. I take an average of 4 guided trips per year. I have fished when the water is high and when it is low. I have fished and been caught in high water when the water levels have flucuated. I have seen trees and debris washed downstream when the water is increased.

In all cases when the level increases or decreases during normal fishing hours, the experience decreases and is not so enjoyable.

9a Please do not change the flow pattern. Increase the volume at night if more water is required.

From a financial point, my Green river float trips would cease and so would the lodging.

I do not necessarly want to go to Montana to fish.

Please.

Allen Brisk allen.brisk@paccoast.com

9. ALLEN BRISK

9a

The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Bronston, Alan" <Alan.Bronston@USFOOD.COM>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 10:57 AM

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152

Dear Mr. Crookston,

I am writing this note in regard to the review of the Environmental Impact Statement of the Flaming Gorge Dam that is underway. I would like to comment on how the flows were managed this last year from two separate perspectives.

First, let me say that I live in Utah, do business in Utah, recreate in Utah, and do as much as possible of all three at Flaming Gorge. Flaming Gorge has not only been the best place in the west for a top quality fishing experience, it is also the most convenient. This year, however, with the
10a daily rise and fall of the water levels; the fishing was so suppressed that it was hardly worth the effort and expense to come, other than for the scenery. It is inevitable that if the flows are managed in the same way in the future, I, and others like me, will have no alternative than to find other places to go. This would be a real shame since Flaming Gorge by all rights aught to stand alone as the prime fishing destination in the United States, if not the world. The impact on the local economy cannot be
10b overstated.

Secondly, this is a serious safety hazard. Let me relate an experience that
10c I myself had this summer, which I understand was not unique from what others have told me. We launched just after midday from the put in below the dam. On board my drift boat was a young child and older man. Just after the second or third bend we encountered a wading fisherman who had become stranded in the middle of the river when the levels began to rise. He was very close to loosing his footing when we came along. We had no choice but to attempt to rescue him, of course. However, due to where he was, the current, and our having to ferry across to get to him, in the end the only way we could get him was for him to grasp hold of the upriver side of the boat by the oarlock. This crippled the maneuverability of the boat since I no longer had the use of one oar, and the additional weight and dragging effect to the upriver side of the boat nearly swamped us. This was not an event I would enjoy repeating.

I hope that when the Environmental Impact Statement is complete it will be discovered that there is a way to accomplish whatever it is that is required from the dam without having such a dramatic impact on those who are trying to enjoy the river.

Thank You,

Alan Bronston
Territory Manager

888-295-4803 Ext. 502
435-901-3138 Mobile
alan.bronston@usfood.com

10. ALAN BRONSTON

10a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

10b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

10c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Michael Brown" <mike_utdairy@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 8:36 AM
Subject: Daily Peak Restriction

Dear Mr. Crookston,

11a As a frequent visitor to the Flaming Gorge recreation area, primarily to fish the Green River below the dam, I would like to voice my support of a single daily peak hump restriction, but I believe its timing should be in a manner that it has no impact on river recreation activities, especially fishing.

I know I am preaching to the choir when I talk about the revenue generated by those who fish the river, but I think the drastic change in flows has the possibility of reducing that revenue. I know my frequency has decreased since I was stranded on the West side of the river during a high flow.

11b Again, I understand the need to maximize the usefulness of the dam, but not at the expense of the purpose for which the dam was authorized.

Respectfully,

Mike Brown
Riverton, Utah

11. MICHAEL BROWN

11a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

11b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: "Bob Brownlee" <brwnle@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:27 PM
Subject: Flaming Gorge Discharge Rates

12a Dear Mr. Crookston, I am writing to encourage use of the single daily peak hump restriction but in a manner which does not impact fishermen. I have fished the Green River extensively and have been negatively surprised by the flow changes more than once. Not only does the flow change turn the fish bite off for a time but it also has some potentially dangerous consequences. I have been trapped twice by
12b rising flows and had to fill my waders to reach shore when I realized what was happening. People who are not aware of the possible flow changes could be trapped on a shallow bar for an extended time, or worse. If there are ways of preventing this potential I would certainly like to encourage the consideration of those actions.

Thanks for your consideration. Bob Brownlee, Golden, Colorado.

12. BOB BROWNLEE

12a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

12b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "scott brunk" <bighorn1478@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 12:24 PM
Subject: Flaming Gorge water flows.

13a I have found that the fishing experience at Flaming Gorge can be dangerous as well as frustrating do to the peaks and valleys of water releases for power generation. Please try to do a better job of managing the flows.

Scott Brunk
303-665-3261

13. SCOTT BRUNK

13a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Ted Butterfield" <buttuhs@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 6:10 PM
Subject: In regards to flaming gorge dam.

I'm writing in regards to the flow changes at flaming gorge in order to produce electricity. I beleive that a
14a constant flow is preferable to fluctuating flows. This is due to experiences which I had in early july of this year while fishing the Green just below flaming gorge. The fishing was severely affected by the flow changes and i know of several men on that day who were stranded on the other side of the river as they did not know that the flows would rise later in the day. One man even lost his driftboat when the river rose and picked it up off the rocks. This causes personal loss and distasteful memories of what could have been a long anticipated trip to a one off America's top rivers. Therefore I support the single daily peak
14b hump restriction, and hope that the timing off the paeked flow will be such that it will not disturb fishing or
14c place fishermen in needless danger. Thank you for your time.

Ted Butterfield
buttuhs@hotmail.com

14. TED BUTTERFIELD

14a and 14b
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

14c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: "Renee Buzarde" <rbuzarde@union-tel.com>
To: <fgeis@uc.usbr.gov>
Date: Thu, Nov 4, 2004 2:26 PM
Subject: Flaming Gorge EIS

I would like to join Dr. Romney in opposition to changes in operations of the Flaming Gorge Dam. I live near the dam and love this area and hope we can protect it.

15a With the huge threat of the West Nile Virus and possible danger to our fishing industry, I strongly oppose proposed changes in water flow.

15b We need to protect the trout in the Green River.

Please leave things the way they are.
A concerned citizen of Daggett/Uintah County.

Reneé Henderson Buzarde
670 Flaming Gorge Acres
Dutch John, Utah 84023
rbuzarde@union-tel.com

15. RENEÉ HENDERSON BUZARDE

15a
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and a threat from West Nile virus or other mosquito-borne diseases.

15b
Long-term negative effects to the tailwater trout fishery are not expected under the Action Alternative.

From: "BRYAN CAMPBELL" <BCAMPBELL@wmccat.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:19 PM
Subject: flaming gorge dam...

It has come to my attention that the Bureau of Reclamation is
undergoing a Draft Environmental Statement on the Operation of Flaming
Gorge Dam and asking for comments. I was only able to fish my favorite
river, the Green River twice this summer. Both times the trip was
dramatically effected by fluctuating flows coming from the dam. On the
first occasion, our group crossed the river early in the morning, and we
underestimated the effect of the increase in flow, that evening we tried
several times to cross back over, but it was impossible. Finally we had
to return to little hole to cross where two of us took water over the
top of our waders, and a younger member of our group barely made it
across. On the second ocassion, we left very early in the morning to
make it to the river in time to fish, we were having a great day until
again the flow increased and the fishing came to a screaching halt
forcing us to leave earlier than we had hoped. I understand the purpose
16a of the dam, but I also feel that dramatic fluctuations during daylight
hours not only affects fishing, but affects the safety of people on the
river. Please change the fluctuation times to a time when people aren't
16b negatively affected.

Thank you,
Bryan Campbell

CC: fishgreenriver <dbreer@union-tel.com>

16. BRYAN CAMPBELL

16a

The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

16b

The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 below.

FGEIS ZZ401 PRO

From: "Jay Carlson" <jpcvail@msn.com>
To: <fgeis@uc.usbr.gov>
Date: 11/15/2004 8:49 AM

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152
801-379-1159 FAX

I would like to share something that frustrates many of us who fish below dams especaily the Flaming Gorgre Damn is the erratic way flows can suddenly jump up and down while we are fishing. This can often disrupts water quality and upset the fish for set periods of time. The end result
17a is a spoiling of our fishing day. know this is occurring, I would like to mention how my fishing dollars impact local businesses and Utahs overall economy. I support the single daily peakhump restriction, but its timing should bein a manner that it has no impacts on river
17b recreation activities, especiallyfishing. I would also like to address the issues of safety, a waders safety is effectednegatively when river
17c flows change abruptly.

17d You have the ability to do the power generation flows in non-fishing hours
or maintain a slightly higher steady flow that generates the same amount of electricity.

Please rectify this situation.

Jay P. Carlson
jpcvail@msn.com

17. JAY P. CARLSON

17a
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

17b
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

17c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

17d
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 below.

From: "mel cisneros" <mel_cisneros@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 5:06 PM
Subject: Green River Flows

I support the single daily peak hump restriction, but its timing should be
18a in a manner that it has no impacts on river recreation activities,
especially
fishing.
Is their not a way to meet the needs for power in a maner allowing both
sportsman and consumers to enjoy their day?

Mel Cisneros

18. MEL CISNEROS

18a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Connett, Randy" <Randy.Connett@VECO.COM>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 7:29 AM
Subject: Flaming Gorge Environmental Impact Statement Comments

Mr Peter Crookston

Dear Sir:

19a I am forwarding my comments regarding the desire of the operators of Flaming Gorge Dam to respond to peak power requirements by varying the flows from Flaming Gorge Reservoir. I am very concerned about the impact that this has on this world class fishery, and the safety of those who are wading the river.

19b Sudden increases in flow can lead to unobservant or unfamiliar river users to wad water which becomes unwadable at higher flows, thus presenting a safety risk to the public.

19c I am very opposed to allowing fluctuating flows to negatively impact the
19d fishing of this magnificent river. I do support the daily single hump restriction, but encourage the Bureau to require the timing of the fluctuating flows to avoid unnecessary impact to fishing or other river use.

Thank you

Randall M. Connett, PE
VECO USA, Inc
9000 E Nichols, Suite 250
Centennial, CO 80112
(303) 268-3499
(800) 292-1012
(303) 549-3227 (cell)

19. RANDALL M. CONNETT

19a and 19d
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative.

19b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

19c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative.

From: "Robert W. Day" <abqbob@ix.netcom.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 12:07 AM
Subject: Green River Flow changes

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
Bureau of Reclamation, Provo Area Office

Sir:

I have fished the Green River below Flaming Gorge for over 10 years and have considered it as one of the greatest trout rivers in the world. As in all tail water fisheries the change of water flow materially
20a deteriorates the the quality of the fishing as well as providing a serious item of safety to the fishermen. It would seem that if these flow changes were to be made during the time that fishermen are not on the river it would add to the attraction of fishing the area. It is discouraging to travel a good distance and then find
20b that the fishing is artificially manipulated and so diminished.

The local economy, I am sure, would benefit from this change as well as Utah and Wyoming. I
20c understand also that fishing and recreation have a priority in the operation of the dam and this priority is not always considered. I don't know what considerations are met by having the flow at mid-day but if there
20d are no overriding reasons for mid-day then it would seem the fishing and recreation priorities could be used in having the flow changes at non fishing and recreation times.

Thank you for your attention.

Robert W. Day
2924 Cagua NE
Albuquerque, NM 87110

Robert W. Day
abqbob@ix.netcom.com
EarthLink Revolves Around You.

20. ROBERT W. DAY

20a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

20b and 20d
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 below.

20c
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

From: "James DeSpain" <despainjames@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 5:30 PM
Subject: Draft Environmental Statement

Dear Mr. Crookston,

I am a native Utahn, living in Pennsylvania. I make three fishing trips every year to the Flaming Gorge recreation area, specifically to fish the Green River. There is a group of 5 that go, and generally have a great time. It can be disappointing though when river flows change dramatically, and we experience periods of bad fishing. It makes us re-think the money we spend, and how we could have experiences in other parts of the country that are not interupted by water changes. We love the area, and want to continue our
21a tradition. We support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities, especially
fishing. I'm sure you've also heard many times the risky situations sudden
21b changes present to waders and other fisherman. I hope you can take these comments, and use them contructively as the draft environmental statement is being created, and know that these views are possessed by almost all fishermen I encounter on the green. We love the river, and obviously want our experience enriched, but at the same time understand the need of electrical production. We just feel like it could be done in a more controlled and predictable environment.

Thank you for your time,

James DeSpain
Telford, PA

21. JAMES DESPAIN

21a

The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

21b

Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Franc Doyle" <francd1999@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 16, 2004 4:15 PM
Subject: Flaming Gorge Dam

To Whom It May Concern:

22a I would like to express my displeasure with the fluctuations in the river levels that have been occurring on the Green River during the summer months. I understand that demand for electricity goes up in the summer to provide air conditioning to the millions of people that have made a choice to live in a desert environment and can't handle the heat, but I have my interests as well. During the summer months, fishing and floating on rivers is my main pastime. I am a teacher and have plenty of time to pursue my interests.

22b The awesome fishing on the Green for years past prompted me to buy a fishing boat to use on the rivers. I fished over 30 days on the Green for 3 years in a row, but I noticed a sharp decline this past year with the flow fluctuations, so this year I only was up there for about 12 days. The fishing was lousy when normally it is spectacular. I believe that the fluctuations not only affect fish behavior but the timing of the bug hatches as well. Due to this, I fished more in Colorado this year, but was unable to use my boat as much because most of our rivers are too small to float.

22c I urge you to consider providing electricity by raising the flows to a level that would allow the flow to be more constant and deliver the power you need for electric demand. This would create a win-win situation, you would generate electricity, fishing would be more fun, and people wading the river would be in less danger of getting stuck on the opposite bank.

Your engineers can certainly create a model that would average the flows to equal the generating capacity of raising the flows with such a steep peak and drop every day.

Frank Doyle
Denver, CO

22. FRANK DOYLE

22a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

22b
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative.

22c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

From: "Nancy Bostick-Ebbert" <nancyb@sbtnet.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:36 AM
Subject: Action Alternative

To Whom it May Concern:

23a My name is Paul Ebbert. I am a resident of Vernal and a member of the UDWR Regional Advisory Council. I am writing to express my support for the Action Alternative which allows for increased flows down the Green River during the 10th wet year. The best information available indicates that this is important for the recovery of the endangered fish in the Colorado River system as well as improving habitat along the river corridor.

Thank you for this opportunity to comment.

Sincerely Yours,

Paul J. Ebbert
1 North 2500 West
Vernal, UT 84078

(435) 722-5122 (work)

23. PAUL J. EBBERT

23a
Comment noted.

From: "Bryan Eldredge" <bryeld@zcloud.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 7:45 PM
Subject: Green River Water Flows

Dear Mr. Crookston,

It is my understanding that you are asking for comments in regards to the operation of the Green River Dam at Flaming Gorge. I am an avid flyfisherman who very much enjoys the recreational opportunities available below the dam, of fly fishing the River. This Past September I was part of a group of 5 men who took valuable time off from our jobs to spend a few days fishing in the Little Hole area. We were very disappointed to find the fishing so slow. None of us are very well off and it was quite some sacrifice financially for all of us, not only to take the time off work but the cost of travel and fishing tackle as well. I think we all left the river feeling that the sacrifice of time and money was not worth it. I feel that the high flows of the river in the middle of the afternoon were a big reason for the fishing to be so slow. Further I would like you to know that I support the single daily peak hump restriction, but its timing should be in a
24a manner that it has no impacts on river recreation activities, especially fishing.

Thank you for listening, Bryan Eldredge

24. BRYAN ELDREDGE

24a

The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please seen response to individual letter 38 below.

From: <erkpsyd@cox.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 2:18 PM
Subject: Green River Flows at Flaming Gorge

Dear Mr. Crookston,
25a I would like to express my thoughts regarding the fluctuating flows at Flaming Gorge I experienced while
fishing the Green River this past season. Because of these flow changes, I chose not to fish the Green
after flying into Salt Lake because it ruins the dry fly fishing at mid day. Instead, I spent my vacation
25b dollars that day in the Heber area. Regarding safety, nothing gets one's attention like having the river rise
while one is wading near the opposite bank, leaving one to contemplate fording the river at waist to chest
25c deep levels! We support the single daily peak hump restriction, but its timing should be
in a manner that it has no impacts on river recreation activities, especially
fishing.

Respctfully,

Jeff Erkenbeck, Psy.D.
San Diego, CA

25. JEFF ERKENBECK

25a and 25c
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

25b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

.

From: "Kurt Finlayson" <KFinlayson@iconfitness.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 8:29 AM
Subject: flow changes

26a I am an angler and I enjoy fishing the green River. I am strongly against mid day flow changes. It is my understanding these can be done once a day, possibly at night. Flow changes are bad for fishing and are
26b unsafe for wading anglers.

Thanks

Kurt Finlayson

26. KURT FINLAYSON

26a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

26b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below.

From: "Fitz Fitzgerald" <troutbum@colorado.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:22 PM
Subject: green river flows

27a If possible please keep the green river flows constant during the day light fishing hours.

Thank you,

Richard Fitzgerald

27. RICHARD FITZGERALD

27a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "Robert Freestone" <rafreestone@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 9:29 PM
Subject: Flaming Gourge Environmental Impact Statement

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Dear Mister Cookston

I was born and raised in Utah. I now live in the Chicago area. The highlight of my vacation each year to Utah is going fishing in the Green River below Flaming Gorge Dam.

This past June was a disappointing fishing trip. The low flows in the morning followed by the high flows in the afternoon moved the fish from where they had been in past years. I prefer to fish from the bank of the river. I have never seen so few visible fish as there was this year during the low flows. The fish would appear with the higher waters but were not interested in feeding.

Some fisherman who waded across the river at the Little Hole boat ramp would have had a real surprise when they tried to get back across the river.

28a I realize that the purpose of the dam is more than to provide a place to fish. I support the single daily peak hump restriction. Any daily peak hump should be in hours where the recreation activities of the river are affected the least.

Thank you,
Robert Freestone
5S400 Stewart
Naperville, IL 60563

Robert Freestone
rafreestone@earthlink.net
Why Wait? Move to EarthLink.

28. ROBERT FREESTONE

28a

The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: "bruce.gibbs@juno.com" <bruce.gibbs@juno.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:00 AM
Subject: Green River flows

29a I received an email saying that you are considering jacking with the flows on the Green River at Flaming Gorge. Please don't! This bouncing the flows makes it much less attractive to fish and raft. My kids and I
29b would like to use this river and enjoy this canyon and I don't want to worry about flows and related safety questions.

Thanks!
Bruce Gibbs
8425 Wright St
Arvada CO 80005
(303) 467-2656

29. BRUCE GIBBS

29a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

29b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: <KMGSage@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:36 AM
Subject: Green River flows

Dear Mr. Crookston,

I am a resident of the Denver metropolitan area. I have been fishing the tailwater below Flaming Gorge for the last twelve years. I make an average of three trips per year to Dutch John to pursue my passion for fishing, and I also visit locations in New Mexico, Colorado and Montana with the same frequency. I seldom travel alone. My two sons and my wife also fish, and we enjoy the beauty of the Green and the hospitality of the local tourism industry.

On a September trip to the Green this year, my wife and I fished the A section for three days. On the second day, we particularly noticed the flow fluctuation during the day. As we stopped for a late lunch, we noticed the rise in stream flow. Our boat, which had been partially beached, became buoyant. We adjusted the anchor line and continued to picnic and fish without incident. However, we noticed that just downstream a large raft had become riverborne without an oarsman. We watched helplessly as the party below us called out to fishermen below them to save their raft. Miraculously, a rescue was mounted and the raft was saved at the last moment. The runaway raft was commandeered and the grateful boaters were reunited with their craft without mishap.

30a Did such an incident need to occur? No. Extreme flow fluctuations can occur naturally on freestone rivers, but do not need to happen on "managed" rivers. At least, not during the afternoon hours on a popular flyfishing and rafting tailwater that is supposed to be "managed" for recreation. As an experienced fisherman, I can state unequivocally that extreme fluctuations in flow also have a deleterious effect on fishing. The fish simply stop feeding in reaction to the drastic change in their environment. In freestone rivers, where
30b fluctuations occur normally, it often will take days for fish to resume their "normal" feeding behavior. Drastic daily flow fluctuations simply can not be good for the fish population. Certainly, flow fluctuations during the daylight hours are terrible for the fsherman as well.

I am writing to ask you to reconsider this policy. The rivers in the West (and the resident fish populations) are in serious trouble from a variety of influences: de-watering due to drought and agricultural diversion; pollution from mining, agriculture, and industrial runoff; whirling disease; non-native species introduction; and erosion from wildfires. It is unconscionable to continue
30c a policy that creates further stress on this important resource.

Thank you for your consideration of this request. It is my fondest hope that I can continue to visit the Green River with my friends and family for many years to come, and that the experience will remain as enjoyable as it has always been.

Sincerely,

Kerry M. Gubits
1 Meadow Rose Lane
Littleton, CO 80127
303 972-8153

30. KERRY M. GUBITS

30a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

30b and 30c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 below.

From: "uela" <uela@ubtanet.com>
To: <fgeis@uc.usbr.gov.>
Date: Fri, Nov 12, 2004 11:50 AM
Subject: Flaming Gorge Dam Proposed Change of Water Flow

Bureau of Reclamation
Provo Area Office
302 E. 1860 S.
Provo, Utah 84606-7317

Attention: Peter Crookston
Flaming Gorge EIS Manager
PRO-774

Dear Sir:

I believe one of the prime purposes for building the Flaming Gorge Dam
31a was to ameliorate the Ravages of flooding, not to enhance them. Speaking as one who has had to deal with the high water surges along the Green River, the idea of increasing the flow from "the dam" to correspond with the flow of the Yampa borders on insanity. The liabilities certainly
31b outweigh the benefits of such an action. Given the likelihood of above normal precipitation, flooding will be severe enough, without making it worse.

Signed,
J. Dean Hansen
2631 E 2500 S
Vernal, Utah 84078

31. J. DEAN HANSEN

31a
The presence of the dam for over 40 years has indeed served to moderate flooding. However, this was never intended to mean that the flood plain would remain permanently dry. It means only that there is increased ability to moderate potentially catastrophic flows. Since the dam was built, there have been a number of wet years where high flows have occurred, such as 1983. Whether or not the proposed action is implemented, high flows would be expected in the future; and none of the high flow targets in the Action Alternative exceed the very high natural flows that have occurred historically.

31b
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

From: Virginia Harrington <vernalwriter@yahoo.com>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 9, 2004 3:17 PM
Subject: EIS for Flaming Gorge

I am a Ph.D. medical anthropologist and former teacher with the University of Utah and Weber State University as well as the University of Maryland. I have a thorough understanding of the evolutionary relationship between the environment, disease pathogens and resident mammal species, including humans.
With this background, I am totally opposed to the proposed change in the operation of Flaming Gorge Dam to match the flow and temperature of water in the Green River and the Yampa River at their point of confluence. The flat bottomlands of the Green River would cause a massive increase in the breeding grounds for all species of mosquitoes if this flooding is allowed to take place.
32a The mosquitoes would rapidly spread West Nile virus to people, horses and other animals. In addition, the spread of heart worm to family pets and working farm dogs would be dramatic.
Dr. Steven Romney of the Uintah Basin Mosquito Abatement District does an admirable job. However, he cannot be expected to protect our health with his limited funds if thousands of additional acres of mosquito breeding grounds are created.
In addition, there are serious problems with trying to match the flow of the two rivers. It is apparent from statements made by local experts, including the Department of Fish and Wildlife, that there is the
32b potential for damaging spawning bars used by at least one of the four species of endangered fish that this
32c proposed change is supposed to protect. The fish are making a comeback, granted a slow one, without this change. Why take the chance on harming them while at the same time endangering the health of Uintah County residents and their animals?
I have one last concern with the proposed change. The farmers and ranchers in this area already struggle
32d with noxious weeds damaging their crops and interfereing with grazing. (These noxious weeds also damage the grazing grounds for deer, elk, etc.) Increased flooding would spread the weed seeds across many acres of farm land. The land would be unusable in wet seasons and covered with weeds in dry seasons.
Please put the people of Uintah County first as you make your decision on this proposed change.
Thank you for your consideration,
Virginia L. Harrington, Ph.D.
PO Box 3
Vernal, UT, 84078

32. VIRGINIA HARRINGTON

32a
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and a threat from West Nile virus or other mosquito-borne diseases.

32b
The 2000 Flow and Temperature Recommendations are intended to aid in recovery of four endangered fish species by restoring a more natural flow regime to the Green River. The uncertainties associated with operating Flaming Gorge Dam under the Action Alternative, summarized in section 4.19, would be monitored and addressed through an adaptive management process if the Action Alternative is implemented. This adaptive management process would consist of an integrated method for addressing uncertainty in natural resource management. It is an ongoing, interactive process that reduces uncertainty and continually incorporates new information in the decisionmaking process.

Damage to spawning bars due to the proposed action is not anticipated but would likely be addressed through adaptive management projects designed to evaluate channel maintenance and endangered fish spawning activities.

32c
There are few data suggesting that the four endangered species are making a comeback; in fact, most data suggest that populations of four species are either stable at dangerously low levels or declining in some cases. At best, all four species currently exist at diminished population levels which preclude removing them from the ESA or improving their ESA status. Implementing the 2000 Flow and Temperature Recommendations is one measure which is expected to substantially aid in their recovery. See the Recovery Program website <http://www.r6.fws.gov/crrip/rea.htm> or call the Recovery Program at 303-969-7322, ext. 227 for more information.

32d
Reclamation is not responsible for damages to improvements or property in the flood plain. Any improvements have always been made by property owners at their own risk. Since the arrival of invasive species in the Unitah Basin (tamarisk was probably present by the 1930s), flooding has facilitated their spread. Flood plain inundation has always occurred along the Green River, though less frequently since Flaming Gorge Dam was built. Nevertheless, though the frequency has declined since the dam has been in place, there has always remained the potential for significant flood plain inundation in wet years and for the spread of invasive species, and that potential will continue under either alternative.

From: "Corey Harris" <corey@big3consulting.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 11:25 AM
Subject: Green River Flows

Peter,

33a Please accept my opinion about the proposed fluctuation of flows on the Green River at Flaming Gorge Dam during peak fishing hours. As an avid flyfisherman, I make numerous trips to the Green River each year to float and fish the Green River and camp in local campgrounds.

Last summer the flow fluctuations during mid-day really impacted not only the fishing but the overall experience on the Green River. We had to be conscious of where we could anchor our boat while eating lunch or
33b wade fishing and where we could wade safely. The flow changes also dramatically impact the quality of fishing.

As fisherman and outdoor enthusiasts, we spend a lot of money on fishing licenses, fishing equipment, boats and registration, fuel, lodging, campground reservations and supporting local restaurants and gas stations. The flow fluctuations on the Green continuing (especially during peak fishing hours) will seriously affect my decision to own a drift boat and make fishing trips from the Salt Lake valley to the Green River. If the quality of fishing is not the same and we have to deal with the flow fluctuations, I will drive the other direction and spend my time and dollars in Idaho on the Henry's Fork.

Please accept our comments and help us find "middle ground" between power generation and fishing opportunities.

Regards,

Corey Harris, Managing Partner
Big 3 Consulting
724 West 500 South, Suite 700B
Bountiful, Utah 84087
801-677-6006 x2
801-677-6007 Fax
801-856-6795 cell
<mailto:Corey@big3consulting.com> Corey@big3consulting.com
<http://www.big3consulting.com> www.big3consulting.com

33. Corey Harris

33a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

33b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns. Please see response to individual letter 38 below

From: "Craig W. Hauser" <chauser@rockymountainfoodsinc.com>
To: '"fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:24 AM
Subject: Green River/Flaming gorge dam

I understand you have the issue of the change flow out of the Flaming Gorge
Dam before you at this time. It is my opinion that the flow should either
be changed during none fishing hours, or regulated though out the day so
34a that we do not experience the big changes that occurred this year. It had a
very negative impact on many of my trips to the Green River this year. The
changing flow has a negative impact on the fishing often putting the fish
down for hour during the peak of the day. It also is dangerous for those of
34b who are wading to have the sudden increased flow while we are in the river.
I make many trips a year to the Green River and spend several $ on lodging,
food , gas, tackle etc. Please do all in your power to control the flow and
34c keep the Green River a great fishing experience.

Craig W. Hauser

34. CRAIG W. HAUSER

34a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

34b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

34c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 below.

From: "Rick Hayes" <eps@sopris.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:18 AM
Subject: Flaming Gorges Releases of water

Dear Sirs,

As a concerned fisherman I would like to comment on the releases of water from Flaming Gorge Dam. I feel strongly that the releases could be timed
35a better so that the flows do not effect the safety of fisherman during daylight hours. As well the fish do not respond well to fluctuations and it sets them off. Thus, making the sport even more difficult. I love the Green River and spend many dollars there each year along with my family and friends. Please try to set the fluctuations for nighttime hours. Thank You
35b for your help in this matter.

Sincerely,

Rick Hayes

257 Cheyenne Ave.

Carbondale, CO 81623

970-704-1154

CC: <dbreer@union-tel.com>

35. RICK HAYES

35a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

35b
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

From: <Jeb.Himsl@RxAmerica.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 3:52 PM
Subject: DEIS on the Operation of Flaming Gorge Dam

Mr. Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office

Dear Mr. Crookston:

The following is a comment regarding the operation of the Flaming Gorge Dam.
36a Specifically, I oppose daily release fluctuations during daylight hours.
The reasons for my opposition are due to impacts on safety and environment.

I have been an avid floater of the Green River since becoming a resident of Utah in 1986. Since that time, I have witnessed many dangerous activities that are only complicated with increased flows. These range from waders being stranded and attempting a crossing that had been previously safe, to floaters that are simply unprepared to deal with the dangers of increased
36b hydraulics. Changing flow conditions during peak daily use puts users in unanticipated situations. While there is no substitute for common sense, changing flows and limited access points through the Green River corridor actually increases the risks that users must confront. Inexperienced users, which are the overwhelming majority on the Green, often make poor decisions when confronted with the changing conditions.

Keeping flow constant during peak daily use periods minimizes risk and improves safety.

As for the environment, changing flows during daylight hours also has an
36c adverse affect on the fishing resources of the Green. It changes the distribution patterns of anglers, causing congestion and overuse during certain periods of the day. It also affects daytime food availability to the fish. Although I do not know the biological implications on a river that is so dependent on terrestrial food sources, I do know the impact on the recreational use of the fishery.

Please be sure to address these concerns in the DEIS and oppose ongoing daily flow fluctuations.

Thank you,

Jeffrey Himsl
2441 Cliff Swallow Dr.
Sandy, UT 84093

36. JEFFREY HIMSL

36a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

36b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

36c
The world class trout fishery was established 40 years ago within the context and limitations of dam operations. Long-term negative effects to the trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 below.

From: "Hunter, Jack" <jack.hunter@hp.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 9:16 PM
Subject: Green River Flows below Flaming Gorge Dam

To: Mr Peter Crookston

RE: Flaming Gorge Environmental Impact Statement Manager

Dear Mr. Crookston,

As an avid sportsman and a frequent visitor to the Flaming Gorge area I am concerned about the recent Draft Environmental Statement being considered but the Bureau of Reclamation. Specifically, I am concerned about the apparent disregard for maintaining consistent flows from the
37a flaming gorge dam in support of fishing conditions below the dam.
37b Clearly this draft statement favors power production over the needs of the fish and the fisherman. Last year I experienced the major change in flows from 800 cfs to 1500 cfs during mid-day fishing. It completely shuts down the fishing below the dam and negatively impacts both the fish and the fisherman. If this plan is implemented again this year it is fair to say that I will not visit the area because I will not be able count of the consistent fishing and river flows of the past. Please consider this input and that of other fisherman in making your decision on this matter...

Best Regards,

Jack Hunter

37. JACK HUNTER

37a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 below.

37b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: "Dale Huskey" <kayceejake@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 7:23 AM
Subject: Fw: Green River Alert- Please Read This!

If this is accurate, and you can increase the flows during "non recreational" hours, why not? I have spent a lot of money in the local economy for fishing trips. I take two annual trips with my customers. I may look elsewhere if the fishing was not so good and predictable.

Please take this into consideration when making your decision.

Thank you,

Dale Huskey
Signode Western Operations
----- Original Message -----
From: Allen Brisk<mailto:Allen.Brisk@paccoast.com>
To: 'kayceejake@msn.com'<mailto:'kayceejake@msn.com'>
Sent: Friday, November 12, 2004 4:51 PM
Subject: FW: Green River Alert- Please Read This!

-----Original Message-----
From: fishgreenriver [mailto:dbreer@union-tel.com]
Sent: Friday, November 12, 2004 2:01 PM
To: Allen Brisk
Subject: Green River Alert- Please Read This!

GREEN RIVER ACTION ALERT!

Dear Green River fishers. We need your help! November 12, 2004

The Bureau of Reclamation is undergoing a Draft Environmental Statement on the Operation of Flaming Gorge Dam and asking for comments.

One of the things that frustrates many of us who fish below dams is the erratic way flows can suddenly jump up and down while we are fishing. This can often disrupt water quality and upset the fish for set periods of time.
38a The end result is a spoiling of our fishing day. The Draft EIS allows for fluctuating flows for power generation up once a day and then down. In 2004 this was experienced by many of us on the Green as they went from 800 cfs to 1500 cfs every day (at 1:00 pm, right in the middle of the day) after our high flows in early June to the end of September. We hated the reaction from the trout, the fishing could and often did go flat for periods of time. Then they brought the flows down while we were trying to start fishing again and the process started again. The ups and downs and the disruption they caused to our fishing experiences were uncalled for. They have the ability to do the power generation flows in non-fishing hours or maintain a slightly
38b higher steady f
low that generates the same amount of electricity.

38c Recreation and fish have a priority over power generation under the authorized purposes of the Flaming Gorge dam. They never advertise this. They have hoodwinked us into never protesting their exploitation of your rights. Make your views known.

If you can share our frustration with this, e-mail or fax these guys and tell them. Relate to them your experiences with changes in flows while you were fishing. What happened and whether or not you are likely visit rivers where you know this is occurring. You might mention how your fishing dollars impact local businesses and Utahs overall economy. The technical sentence
38d you might include is- We support the single daily peak hump restriction, but
38e its timing should be in a manner that it has no impacts on river recreation
38f activities, especially fishing. You can also address the issues of safety, a waders safety is effected negatively when river flows change abruptly.

We need note writers and fast. These don't have to be extended notes unless you feel compelled to do so. Just give your feelings on the subject, if you have experiences that you can relate to them, even better. Anything will help. This is your chance to be heard. Time is unfortunately an issue. We are nearing the comment periods ending, it closes next Monday, November 15, 2004. That's why we suggest e-mail or faxes.

Help us if you can, pass this note onto others that you know fish or that appreciates the world class trout fishery at Flaming Gorge that might add their voices as well. We know we are late in requesting your help, the document is large and we have had to spend a lot of time determining issues and their impacts on fishing. We would appreciate all the assistance we can get. Denny. dbreer@union-tel.com<mailto:dbreer@union-tel.com>

Address your comments to-
Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317
801-379-1152
801-379-1159 FAX
E-MAIL- fgeis@uc.usbr.gov<mailto:fgeis@uc.usbr.gov>

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ast.com&p=8026

Click this link, or copy and paste the address into your browser.

38. DALE HUSKEY

38a
Daily fluctuating releases are permitted under both the Action and No Action Alternatives.

38b
Fluctuating releases during the day have been the normal operations of the powerplant since it began power generation 40 years ago and would continue under either alternative. The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

38c
Reclamation seeks to meet all of the requirements placed upon the reservoir and dam and seeks to balance the benefits among all authorized purposes of the facility. The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. Please see section 1.4 of the EIS for authorized purposes of the dam.

38d
The single daily peak hump restriction is outside the scope of the EIS; however, it is noted that the changes in flows, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Hydropower is the best source available for meeting peak demands. Meeting peak demands is currently tempered; however, by the need to meet environmental concerns and safety of anglers.

38e
Reclamation is well aware of the recreation value created by the construction of Flaming Gorge Dam, including the trout fishery which did not previously exist. The EIS acknowledges the possibility of both positive and negative effects under differing conditions if the Action Alternative is implemented. It should be noted that the nature and timing of fluctuating releases, and other daily operational details, would remain substantially the same under either the Action or No Action Alternative. The trout fishery was established 40 years ago within the context and limitations of dam operations; and over time, certain operational changes have benefited the trout fishery.

38f
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: <BISON1BOB@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:07 PM
Subject: Green River Flow Management

Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO 774
BuRec, Provo, UT

For safety, economic and recreation purposes, please do not allow the erratic
39a flow changes from Flaming Gorge Dam. Please find a flow pattern which does
not disrupt water quality and still permits adequate power generation. Please
uphold the priority that recreation and fish have over power generation. Past
39b behavior suggests that your agency has little regard ro these priorities.

Bob Johnston
p.o. box 50872
Henderson, NV 89016

bison1bob@aol.com

CC: <BISON1BOB@aol.com>, <dbreer@union-tel.com>

39. BOB JOHNSTON

39a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

39b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives.

We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: <DonxJane@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Thu, Nov 4, 2004 9:09 PM
Subject: EIS report on flooding the Green River bottoms

Mr. Peter Crookston:
40a I would like to express my strong opposition to the flooding of green river bottoms.
I live within one mile of Green River, and when the bottoms are flooded, the bugs come
40b out in the millions. With West Nile probllem, it could be deadly.
To suggest a fish if more important than my family is very wrong. We know the West
Nile will kill, and we don't know what the endangered will do, or if they have any
benifit
Please give this more and serious throught doing something that would kill people

Thank You....Don E. Jorgensen

40. DON E. JORGENSEN

40a
Flood plain inundation has occurred along the Green River in the past, though less frequently since Flaming Gorge Dam was built. There has always remained the potential for significant flood plain inundation in wet years, and that potential will continue under either alternative. The presence of the dam for over 40 years has indeed served to moderate flooding. However, this was never intended to mean that the flood plain would remain permanently dry. It means only that there is increased ability to moderate potentially catastrophic flows. Since the dam was built, there have been a number of wet years where high flows have occurred, such as 1983. Whether or not the proposed action is implemented, high flows would be expected in the future, and none of the high flow targets in the Action Alternative exceed the very high natural flows that have occurred historically.

As part of its operation of Flaming Gorge Dam, Reclamation has in the past and will under either alternative continue to provide public notification when flows are expected to increase, to enable property owners along the river to remove or secure equipment and livestock.

40b
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

Reclamation notes that the issue of mosquito control along the Green River has been discussed annually at the Flaming Gorge Working Group meetings, and we expect such dialogue to continue in the future, whether or not the proposed action is implemented. As noted in section 4.21 of the EIS, Reclamation is committed to continuing dialogue with county officials to explore the potential to assist with mosquito control.

From: <DonxJane@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 5, 2004 2:15 PM
Subject: EIS report on flooding the Green River bottoms

Mr. Peter Crookston:

41a I would like to express my strong opposition to the flooding of Green River bottoms.

41b I live within one mile of Green River, and when the bottoms are flooded, the bugs come out in the millions. With West Nile Virus on the move, it could be a great problem for those who live near by. I have esperienced some health problems with severe bronchitis and other resporitory infections. I would strongly suggest that you take another look at this issue.

Thank You, Dora J. Jorgensen

41. DORA J. JORGENSEN

41a and 41b
Please see response to individual letter 40 above.

From: Wade Kafkaloff <wade.kafkaloff@jpl.nasa.gov>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 8:55 AM

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Mr. Crookston, I have visited the Green River several times over the last few years. This year I have been fishing in Northern California in part because of the variable flows being experienced on the Green this year. I urge you to consider increasing/decreasing the flows during non-fishing hours on the Green. Although my fly fishing buddy and I are only two people, I'm sure their are many others with the same concerns. You're competing directly with the city of Redding California. It's an easy flight from Southern California (I fly a small plane to my fly fishing destinations). The Redding Airport, The Fly Shop, its guides, and the State of California will be happy to continue receiving my fly fishing dollars if you continue to adversely affect the fishing on the Green by varying flows
42a during the day.
Thank you for listening to my concerns.
Sincerely,
Wade Kafkaloff
South Pasadena, Ca.
818-354-4769

42. WADE KAFKALOFF

42a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Bruce Kautz" <blkautz@adelphia.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 7:18 AM
Subject: Green River flows

Dear Mr. Peter Cookson,

I, my family and my friends frequently come to north eastern Utah to fish the Green River below the Flaming Gorge Reservoir. The only reason we drive 8 hours is to fish. We always hire a guided drift boat for at least 2 days of our trip. We spent 4 days there this past May and had an enjoyable time for the most part. We did notice that because of the way the outlet flow from the dam had been ramped up and then turned down, the fishing was off a couple days. That made it very difficult for our guide and made the trip less enjoyable as in the past. Again, our trips there are for 1 reason - to fish. Losing us and others
43a because of poor fishing due to sporadic flow changes will potentially send us to other rivers in Colorado,
43b New Mexico, Wyoming and Idaho in our pursuit of great fishing. That will affect the financial economy of the Flaming Gorge / Dutch John, Utah area.

I would like to encourage you and your division to do whatever you can to keep flow adjustments in a realm that continues to give the electrical power needed, yet maintain a great fishery every day of the year.

Sincerely,

Bruce Kautz

43. BRUCE KAUTZ

43a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

43b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

MEMO

TO: Mr. Peter Crookston, *Flaming Gorge Environmental Impact Manager*
PRO-774, Bureau of Reclamation, Provo Area Office,
302 East 1860 South
Provo, Utah 84606-7317

FROM: Mr. Ted E. Kulongoski, E.I.T.
Graduate Student
Environmental Resources Engineering Department
Humboldt State University
1 Harpst Street
Arcata, CA 95521

DATE: Wednesday, October 06, 2004

SUBJECT: Comment on Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS) ending November 15, 2004.

1.0 SUMMARY

To protect and assist in the recovery of four endangered fish species currently listed as threatened by the Endangered Species Act, the Bureau of Reclamation is considering whether to implement a Proposed Action under which the Flaming Gorge Dam would be operated to meet specified peak flows, water temperatures, flow durations, and base flow levels on the Green River. Alternatives will require greater variation in annual river flow as a means to recreate and reestablish a more historic riverine ecosystem conducive to the endangered fish populations.

Although the Bureau of Reclamation has made substantial progress in identifying and addressing the many impacts associated with the two alternatives, the DEIS in its current form was found incomplete in three technical areas:

1. Groundwater Impacts

   Both of the alternatives considered in the DEIS will increase the flows of the Green River, resulting in increased infiltration and a potential impact on the groundwater system. Further modeling of the groundwater system, in regard to the Action and No Action Alternatives, will be needed to better understand how the increased flows will likely impact the basin groundwater.

2. Sensitivity Analysis for Models

   The lack of parameter sensitivity information for any of the models used in the DEIS casts a shadow of uncertainty on the results discussed. Much of the work completed for the Flaming Gorge DEIS involved sophisticated modeling of the Flaming Gorge Dam and downstream reaches. Evaluation of the model's robustness by means of a sensitivity analysis of key parameters was not included in the DEIS. Completing and providing a documented sensitivity analysis is necessary in validating the model's results and supporting the conclusions derived from those results.

3. Impacts of Future Diversions and Increased Consumption

   The need to examine in greater detail scenarios of reduced flow is justified by the Final Biological Opinion on the Operation of Flaming Gorge Dam where the U.S. Fish and Wildlife Service (1992) determined that flow depletions from water resource projects, both up and downstream, would likely jeopardize the continued existence of endangered fish. Further use of the Flaming Gorge Dam model will be needed to adequately explore how future water diversions, increased consumption, and depletions from the Green River will alter the flow regimes considered by the two alternatives considered in the DEIS.

I request the Bureau of Reclamation to consider these recommendations and to assimilate the needed information for the Final Environmental Impact Statement.

BACKGROUND

The Bureau of Reclamation is considering whether to implement a Proposed Action under which the Flaming Gorge Dam would be operated to achieve the flow and temperature regimes recommended in the September 2000 report *Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam*, published by the Upper Colorado River Endangered Fish Recovery Program. The 2000 Flow and Temperature Recommendations specifically describe the recommended peak flows, durations, water temperatures, and base flow criteria on the

Green River, to protect and assist in the recovery of four endangered fish species currently listed as threatened by the Endangered Species Act. The four endangered fish species are the humpback chub (*Gila cypha*), the Colorado pikeminnow (*Ptychocheilus lucius*), the razorback sucker (*Xyrauchen texanus*), and the bonytail (*Gila elegans*).

DEIS TECHNICAL POINTS NEEDING FURTHER ATTENTION

Although the Bureau of Reclamation has made substantial progress in identifying and addressing the many impacts associated with the Proposed Action, the DEIS in its current form was found incomplete in three technical areas.

Groundwater Impacts

The Proposed Action Alternative and the No Action Alternative outlined in the DEIS will increase river flows for the 410 river miles of the Green River below Flaming Gorge Dam and inundate the historic flood plain. The increase in available surface water will influence the groundwater of the Green River Basin. Although analysis and discussion were presented in Chapter 4, Section 4.3.2, that "addresses impacts to water resources within the affected environment downstream from Flaming Gorge Dam," the DEIS failed
44a to identify groundwater as a hydrological impact. A search of the DEIS document reveals that no consideration was made to groundwater impacts. The only mention of groundwater is in Chapter 3, Section 3.3.2, regarding water salinity where drawdown of the reservoir may result in bank storage (groundwater) flowing into the reservoir. Neglecting to introduce the impact of the two Alternatives on the groundwater system of the Green River Basin was a gross oversight and should be given due consideration.

Hydrology for a riverine system where there is an increase in flood plain surface water will commonly result in an increase in groundwater infiltration. The quantity of water infiltrating depends on the soil texture, soil structure, vegetation, and soil moisture status. Because soil characteristics vary over the 410 river miles of the lower Green River, the amount of groundwater infiltration occurring from the proposed flow regimes is unknown. Further modeling of the groundwater system, in regard to the Action and No Action Alternatives, will be needed to better understand how the increased flows will likely impact the basin groundwater. This is an important consideration given the geographic location and environment of the Green River Basin.

The Green River Basin is classified as a high desert environment and has an average annual rainfall of less than ten inches (World Climate, 2004). Given the limited annual precipitation, water rights and the development of water resources is critical to the economic and recreational vitality of the area and is subject to numerous federal, state, and county laws and regulations. Because the region can be described as water poor, an increase in available groundwater will qualify as a significant impact to the Green River Basin. Higher groundwater levels would significantly impact agriculture, ecology, and land use around the Green River. If larger quantities of groundwater became available due to the increased flows on the Green River (as a result of the Action and No Action Alternatives) and that water was allocated for beneficial use through water rights, it would be very difficult to substantially modify the Flaming Gorge Dam discharge program in the future. A groundwater study of the Lower Green River Basin is therefore necessary to evaluate and consider the possible impacts of the Action and No Action Alternatives.

Sensitivity Analysis for Models

An important tool to assist in developing any model is a sensitivity analysis. The sensitivity analysis illustrates the model's response to slight changes in model parameters. For a model to prove robust, it must produce similar results (output) when small changes to key parameter values are made. If the model's results vary significantly after slight variation of the key parameter values, then the model may require further calibration, or in some cases, the parameter values used will need to be documented and/or tested to assure model validity.

Completing and providing a documented sensitivity analysis is necessary not only to help in validating the model's results, but also to support the conclusions derived from those results. Much of the work completed for the Flaming Gorge DEIS involved sophisticated modeling of the Flaming Gorge Dam and downstream reaches. Documentation of the model building, calibration, and validation process was included in Appendix 2 –
44b Hydrologic Modeling. Unfortunately, no results of a sensitivity analysis on the Flaming Gorge Dam model could be found in the Appendices or main DEIS. The same was true

for the hydroelectric power model developed to compare electricity generation capacities of the two alternatives (Appendix 5). The lack of parameter sensitivity information for any of the models used in the DEIS casts a shadow of uncertainty on the results discussed.

44c

The inclusion of a sensitivity analysis will also allow the opportunity to document "What if" scenarios. A "What if" scenario will document the model's results when realistic changes are made to the model's parameters or input values. An example of a "What if" scenario for the Flaming Gorge DEIS is the economics of electricity generation using the power model. The economics of the No Action and Action Alternatives are based on net present value (NPV) calculations of the hourly value of Flaming Gorge electricity generation over the 25-year study period. The value of generation is computed by multiplying hourly electricity production by the hourly spot market price. All NPV calculations are based on an annual discount rate of 5.5 percent. The model results presented in the DEIS indicated no significant difference in electricity generated revenue
44d among the two alternatives, but that was for only the 5.5 percent discount rate. What if the model was run again but the discount rate was changed by ±0.5 percent? Are the results, the difference between NPVs of each alternative, still insignificant? What if the discount rate were changed by ±1.0 percent? What if the Average Spot Market Price was changed by ±$5/MWh? The sensitivity analysis would document the nuances of these different variations and any significant findings they revealed.

Impacts of Future Diversions and Increased Consumption

44e Future water demands need to be considered in the Flaming Gorge Dam model. In Chapter 4, Section 4.19.1, the Flaming Gorge Dam DEIS (2004) states, "The Flaming Gorge Model assumed that water development in the Upper Green River Basin and the Yampa River Basin would continue at the rate projected by the Upper Colorado River Commission." The DEIS then continues, "it is uncertain what resource impacts would occur as a result of future water development in the Green River Basin above and below Flaming Gorge Reservoir." Considering that the Affected Environment (Chapter 3) and the Environmental Consequences (Chapter 4) depicted in the DEIS are based on the results of the Flaming Gorge Dam model, it is disconcerting to read that no "What if" scenarios were performed to examine impacts from future water diversions and increased consumption.

The need to examine reduced flow scenarios is justified by the Final Biological Opinion on the Operation of Flaming Gorge Dam where the U.S. Fish and Wildlife Service (1992) determined that flow depletions from the Duchesne and Green Rivers caused by the Strawberry Aqueduct and Collection System, "would likely jeopardize the continued existence of the endangered Colorado pikeminnow and humpback chub." This Biological Opinion included a Reasonable and Prudent Alternative stating that, "Flaming Gorge Dam and Reservoir would compensate for those depletions and be operated for the benefit of the endangered fishes in conjunction with its other authorized purposes." The concern raised by the Biological Opinion is, "What happens if the water in the reservoir isn't enough to compensate for depletions?"

A wider range of flow scenarios for modeling must be considered to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes. Further use of the Flaming Gorge Dam model will be needed to adequately explore how future water diversions, increased consumption, and depletions from the Green River will alter the two alternatives considered in the DEIS. Without considering the potential impacts that less water in the system will have on the two alternatives, the alternative selection process is incomplete. It is imprudent not to evaluate the two alternatives under reduced flow conditions because the model's results, based on reduced flow, may negate the feasibility of one or even both alternatives. It would be disappointing to complete the entire Flaming Gorge EIS process, select the preferred alternative, and then have it become infeasible because increased diversions and consumption produced insufficient water availability for its implementation.

CONCLUSION

Although the Bureau of Reclamation has made substantial progress in identifying and addressing the many impacts associated with the two alternatives, the Operation of

Flaming Gorge Dam DEIS in its current form was found deficient in three technical areas:

1. Groundwater Impacts

   The alternatives considered in the DEIS will increase the flows of the Green River, resulting in increased infiltration and a potential impact on the groundwater system. Further modeling of the groundwater system, in regard to the Action and No Action Alternatives, will be needed to better understand how the increased flows will likely impact the basin groundwater.

2. Sensitivity Analysis for Models

   Much of the work completed for the Flaming Gorge DEIS involved sophisticated modeling of the Flaming Gorge Dam and downstream reaches. Evaluation of the model's robustness by means of a sensitivity analysis of key parameters was not included in the DEIS. The lack of parameter sensitivity information for any of the models used in the DEIS casts a shadow of uncertainty on the results discussed. Completing and providing a documented sensitivity analysis is necessary not only to help in validating the model's results, but also in supporting the conclusions derived from those results.

3. Impacts of Future Diversions and Increased Consumption

   The need to examine in greater detail scenarios of reduced flow is justified by the Final Biological Opinion on the Operation of Flaming Gorge Dam where the U.S. Fish and Wildlife Service (1992) determined that flow depletions from water resource projects, both up and downstream, would likely jeopardize the continued existence of endangered fish. Further use of the Flaming Gorge Dam model will be needed to adequately explore how future water diversions, increased consumption, and depletions from the Green River will affect the two alternatives considered in the *DEIS*.

I request that the Bureau of Reclamation consider these recommendations and assimilate the needed information into the Final Environmental Impact Statement.

6.0 REFERENCES

World Climate. (2004). Climate Data for 40°N 109°W. Available [Online]: <http://www.worldclimate.com/cgi-bin/grid.pl?gr=N40W109>, September 26, 2004.

U.S. Fish and Wildlife Service. (1992). Final Biological Opinion on the Operation of Flaming Gorge Dam. Fish and Wildlife Service, Mountain-Prairie Region, Denver, Colorado, November 25, 1992.

44. TED E. KULONGOSKI

44a
Reclamation believes that no significant difference exists between Action and No Action Alternatives for groundwater and surface water interactions along the Green River downstream from Flaming Gorge Dam.

44b
Sensitivity analyses with regard to specific parameters were reviewed by the modelers during Flaming Gorge Model development. Sensitivity to forecast errors, depletion schedules, and specific policy rules were evaluated during the formulation of the Action and No Action rulesets. In terms of the presentation of the model results, however, sensitivity analysis was not included in the EIS.

44c
Changing inputs would change the results of the hydropower model, but most inputs are defined by the operations of the powerplant.

44d
The EIS used a discount rate of 5.5 percent to estimate present value of the hydropower analysis with the given results. Use of a lower interest rate would increase the present value of both alternatives by roughly the same amount, and increasing the discount rate would have the opposite effect. The net difference between the two alternatives would be slightly different with another discount rate, but the percent difference would be approximately the same. For example, using a discount rate of 6.125 percent, a difference between alternatives would be $18.3 million; using a discount rate of 4.875 percent, the difference is $21.7 million, with still about 5 percent difference between the two alternatives. Therefore, the hydropower model lacks sensitivity to the interest rate.

The hydropower model used hourly forecasted prices, not average prices. Changing the hourly prices by a given amount would not affect the results as an increase of $5 per megawatthour would have the same effect on both alternatives. However, an asymmetric change to prices would impact the results depending on how the prices were changed. For example, arbitrarily changing prices such that peak prices would be reduced would decrease the net value of the Action Alternative since this alternative generates less energy. An infinite set of prices could be generated, each changing the results in a unique way. The price set that was used was independently generated by a group not connected with the analysis or operation of the powerplant.

44e
Future water development was assumed in the analysis of the Action and No Action Alternatives. The Flaming Gorge Model incorporated increasing future depletions that were equivalent to the rates of depletion projected by the Upper Colorado River Commission (memo: dated December 23, 1999 entitled “Estimates of Future Depletions in the Upper Division States”). Analyzing the impact of future depletions is not within the scope of this EIS.

Memo

To: Mr. Peter Crookston

Flaming Gorge Environmental Impact Statement Manager, PRO 774

Bureau of Reclamation, Provo Area Office

302 East 1860 South

Provo, Utah 84606-7317

From: Heather Kuoppamaki, E.I.T.

Environmental Resources Student

Humboldt State University

1 Harpst St.

Arcata, Ca 95521

Subject: Comments on Flaming Gorge Dam DEIS.

Summary:

The comments on this DEIS are made by Heather Kuoppamaki, an Environmental Resources Engineering senior and E.I.T. at Humboldt State University, California. My emphasis in engineering includes river restoration. Due to this and my continued interest in river health, I have chosen to comment on this DEIS. There are portions of the Draft EIS which overlook important aspects of the project. These portions are summarized below, and presented in further detail later in this memo.

General problems with the DEIR include:

- Formatting –
  - The formatting of the report makes it difficult to locate information. Rewording of section 4 from "Environmental Consequences" to "Impacts" would follow the recommended format for NEPA.
  - As well, there is no section or subsection for "mitigation"; this is a fault that continues throughout the entire DEIS as little to no information on mitigation is mentioned.

- Significant jumps of information occur throughout the document. For example, in the "Environmental Consequences" section, the logic which allowed for sediment transport increases to be considered insignificant is not included in the report.
- A summary of abbreviations page, as well as a glossary would, make reading of the document easier. These should be included to meet the average reader comprehension requirement.

- Alternatives - The reasons for having only one action alternative are not convincing. Many alternatives should be addressed before making a final decision on the new flow release schedule of the dam.

- Exclusion of details included in the 1992 and/or 2000 studies - Often throughout the document, statements were made based on the 1992 Biological Opinion Report (BOR) and/or the 2000 Flow and Temperature Recommendations (FTR). It would have been very helpful to include relevant sections, or at least the executive summaries, of these documents in the DEIS appendices.

- Mitigation - There does not appear to be any funding for future mitigation, including increased costs of operation and maintenance, clearly stated in the DEIS. Most impacts are stated as being non-significant but will be addressed if necessary. Who will perform ,and how this mitigation will occur, is not addressed through the DEIS.

- Environmental Consequences – As mentioned above, the "Environmental Consequences" section should be renamed to Impacts. Throughout the environmental consequences section, negative environmental consequences are mentioned briefly without any mitigation measures. This occurs throughout this section of the document and should be addressed prior to finalization.

Purpose and Need Statement:

The purpose and need statement is outlined as follows:

"The purpose of the Proposed Action is to operate Flaming Gorge Dam to protect and assist in recovery of the populations and designated critical habitat of the four endangered fishes, while maintaining all authorized purposes of the Flaming Gorge Unit of the CRSP, particularly those related to the development of water resources in accordance with the Colorado River Compact."

The purpose and need statement limits potential alternatives by stating that **all** authorized purposes of the Flaming Gorge Unit of the CRSP must be maintained. For example, an alternative which is eliminated from further study is the total dismantling of the dam and reservoir system. Because the purpose and need includes the maintenance of all authorized purposes of the Flaming Gorge Unit, dam removal is not examined, when in this case it may be the best alternative for the health of the river and the endangered fish species located within the river.

Alternatives:

- The alternatives section should provide more detail into alternatives that were considered yet not proposed.
- Further detail into varying dam operations (which were as a group, disregarded) would increase the validity of the two alternatives selected. Information regarding what dam operations were examined, and how they fit into the alternative section would be useful.

45a
- In the action alternative, why are flows in Reach 2 met first, with changes to the flow regime if necessary to maintain flows in Reach 1? As mentioned in the FTR, Reach 1 is the most significantly affected by flows from Flaming Gorge Dam, while flows in Reach 2 are significantly affected by its tributary, the Yampa River.

45b
- The Modified Run River Alternative appears to be disregarded without enough analysis, because the inflows are too variable due to agricultural water storage,,

which lets water back in to the river months later. It seems reasonable that with analysis of a few gages upstream of Flaming Gorge Reservoir, actual inflows could be interpolated.

45c
- Timing of the peak flows should be addressed in further detail. Table 2-1 of the DEIS details duration of peak flows. How these peak flows occur relative to each other may be an important issue for fish habitat as well as natural river restoration.

45d
- A study of more than two alternatives would add to the validity of this EIS. The no-action alternative would not meet the Endangered Species Act and is therefore, for the most part, unreasonable. Analysis of further actions which would meet the Endangered Species Act requirements would increase the substance of the EIS. The remainder of the DEIS appears "stunted" due to the limitation of, basically, no alternatives. In the 2000 report, it is suggested that varying flows each year would allow for the best long term improvement of the river. An alternative which addresses altering the patterns used during low, medium, and high flow years, could address this issue. Perhaps further alternatives with altering flow schedules could be addressed in the alternatives section.
- Allowing for changes in the flow regime during the year would allow for more alternatives. This would also increase management options when the incorrect flow regime is put in place for the year. I was raised near the Folsom, California reservoir and remember numerous years when the incorrect flow regime was scheduled, and reservoir levels at the end of the season were drastically low.

45e
- A maximum number of consecutive years where the minimum flow regime is allowed should be included in all alternatives. Numerous sequential years of low flow could drastically alter the downstream aquatic environment.

Affected Environment

45f The affected environment is discussed in detail; few substantive comments are made in this section of the DEIS. However, on Figures 3-1 and 3-2, a scale is missing but necessary. This would enable further analysis of the figures with respect to algae blooms. Tables 3-2, 3-3, 3-4, 3-6 should include pre-dam temperatures for reference. Figure 3-4 should also include a pre-dam temperature regime for reference.

Environmental Consequences

As mentioned above, this section should be renamed "Impacts" for clarity and to follow the NEPA recommendations. As well, increased usage of the terms "significant impact" and "insignificant impact" would follow NEPA guidelines better. These terms would allow the reader of the document to find conclusions to the findings very easily and understand what the conclusions are.

Sediment Transport

45g Increased loads of sediment transport are mentioned as an expected effect of the Action alternative. Reach 1 is expected to increase by 13,000 tons; Reach 2 is expected to increase by 100,000 tons; and Reach 3 is expected to increase by 250,000 tons. Without any supporting information, these increases are expected to have no change on the channel morphology. Information on the process by which this conclusion was reached would be very helpful. It is possible that this increase in sediment load would be beneficial to altering the channel for increased fish habitat. Mentions of the expected outcomes of this effect should be included, as well as necessary mitigations.

Agriculture

45h In the agriculture section, numerous negative effects of the Action alternative are mentioned. At the end of this section, these potential effects are disregarded, and no mitigations are initiated. The Action alternative may not be the sole action responsible for economic damages to the agricultural sector, but this does not excuse or exempt that portion of environmental damage that the Action Alternative does cause. Economic damages by the Action alternative should be mitigated so they can be considered less than significant.

Vegetation

45i More impacts are associated with the possible increased occurrence of non-native as well as invasive species. According to the report, invasive species would likely increase, but mitigation again is not mentioned. These impacts should be addressed in more detail. Are the increased flood occurrences due to the Action alternative mitigatable? Are mitigations a necessary concern for this, and why or why not? Discussion of these questions would be very useful.

Threatened and Endangered Fish

45j This section appears to include strong information for the decisions reached. To aid the average reader in the comprehension of this section, include a figure which depicts the predicted inundated flood plains for each of the flow regimes.

Terrestrial and Avian animals

45k Further analysis of why the action and no action alternatives have no impact on avian or terrestrial creatures would increase the validity of the report. Since variations in vegetation are expected from the action alternative, effects on fauna are probable.

During further analysis of the impacts on terrestrial and avian animals impacts to "terrestrial wildlife" are expected for a period of time which is not defined. A change in species present may occur through this time of re-equilibrium. Mitigations for this period of time should be implemented so that more animals are not added to the endangered species act. During the time of imbalance, measures should be implemented to promote native animal health and diversity.

Other Threatened or Endangered Species

Southwestern Willow Flycatcher

45l The Action alternative may temporarily decrease habitat of the Southwestern Willow Flycatcher. If this species is endangered, any negative effects must be mitigated. Further, if flood flows are large enough, short term effects will be offset by long term habitat development. What happens if the flood flows are not large enough? Are there any mitigation plans for this possibility?

Overall all of the threatened or endangered species should have a plan for habitat mitigation in case the Action alternative does negatively affect their lives. This would decrease the time necessary to determine the mitigation plan once negative effects are noticed.

Cultural Resources

45m In section 4.8.2.2, the effects of the action alternative are stated. Effects from implementation of the new flow regime appear to be minor with the exception to flooding certain historic areas in Reach 1 in the Browns Park Area, which may receive more flooding and longer inundation if the Action alternative is selected. Is it not important to do whatever possible to preserve these historic areas, even though it has experience potentially harmful events in the past?

Addressing Uncertainties through Adaptive Management

45n This was the first section where any mention of mitigation occurred. Further explanation, of the research and adaptive management practices which would occur, would be beneficial. Particularly, what sort of research is going to occur in the near future, who in the dam operations will be responsible for implementing the management plan? Would there be a special team included in the dam operators? Would the people chosen to perform these duties have certain background characteristics to ensure proper research methodology?

Environmental Commitments

This section, as well as the above section, should be renamed to include the word "mitigation measures". This would increase the flow of the document and follow NEPA guidelines a little closer. As well, referencing of this section during analysis of the environmental consequences would allow the reader to examine the "mitigations" to be implemented for the negative impacts.

Specific economic means which Reclamation will use to perform all of the monitoring and adaptive management schemes presented should be discussed.

1992 Biological Opinion Report

This report should be either included in the DEIS as an appendix, or linked to the DEIS. A further analysis of the 1992 Biological Opinion Report would allow me to discuss the significant of the conclusions of the report and analyze the action alternative. Without the inclusion of this report, the DEIS is incomplete as all the determining factors are not accounted for. I would be even more beneficial to the outside person reviewing the report if a summary of the information related in this report were included as a section of the DEIS.

2000 Flow and Temperature Recommendations for the Green River, Downstream of Flaming Gorge Dam

As with the 1992 Biological Opinion Report, numerous references to the 2000 Flow and Temperature Recommendations are made. Often in the document, conclusions are determined. It is assumed that these conclusions are made at least in part due to the findings of the FTR. Whenever applicable, the FTR should be referenced with a section number so that concerned individuals have the opportunity to examine the methodology. Since the action alternative is highly based on the information portrayed in this report, and the report formatting makes writing/reading difficult a concerned individual such as myself cannot fully evaluate the action alternative without the report.

45. HEATHER KUOPPAMAKI

45a
In the 2000 Flow and Temperature Recommendations, the following statements are made which support using Reach 2 as the priority reach:

- ❖ Section 5.2.1 "Recommended flows for Reach 1… are those measured at the USGS gauge near Greendale, Utah, and are, for the most part, release patterns from Flaming Gorge Dam needed to achieve the target peak and base flows identified for habitats of the endangered fishes in Reaches 2 and 3."
- ❖ Section 5.2.1 "Base flows in Reach 1 should be managed to ensure that within-year and within-day variability targets for Reach 2 are met."
- ❖ Table 5.4 General Recommendations: "Peak flows in Reach 1 should be of the magnitude, timing, and duration to achieve recommended peak flows in Reaches 2 and 3."

Throughout the 2000 Flow and Temperature Recommendations document, it is stated that the critical habitat for the endangered fish reside in Reaches 2 and 3. This is also stated in the EIS. Through modeling, Reclamation came to the determination that it was possible to reasonably predict future flows in Reach 2 with enough precision to efficiently augment these flows to achieve the target levels established in the 2000 Flow and Temperature Recommendations for Reach 2.

45b
The Modified Run of the River Alternative releases on a daily basis during the spring would be a percentage of the previous day's unregulated inflow. In this way, the release regime would closely match the inflow regime. By varying the percentage from a low percentage of up to 100%, we could test the reaction of the reservoir in terms of reservoir storage. Because of the narrow scope of this EIS, the Modified Run of the River Alternative had to achieve all of the flow objectives of the 2000 Flow and Temperature Recommendations in Reaches 1 and 2 of the Green River in the same way that the Action Alternative did. The suggestion regarding the use of data from upstream gauges is unclear, but absence of inflow data was not the reason that this alternative failed to meet the purpose and need.

The Modified Run of the River Alternative did include unregulated daily inflows to Flaming Gorge. These values were used to determine what each daily release would be. Perhaps this comment refers to natural flow. It is possible to roughly estimate natural flow from actual measurements; however, the computation of natural flows is a very complex and involved process, and this work has been done on a monthly time scale but not on a daily time scale.

Based on sensitivity analysis of the percentage rate, it was found that the flow objectives could not be met even when the percentage was set to 100%. There were two main reasons for this result. First, water consumption and diversion above Flaming Gorge Reservoir reduced the measurable unregulated inflow. Second, the timing of releases from Flaming Gorge Dam under this regime were not optimally timed with the flows of the Yampa River.

45c
Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group, which will evaluate criteria listed in table 2-5 of the EIS when making recommendations. This allows opportunities to refine flow attributes based on an adaptive management process.

45d
The purpose and need of this EIS is limited to alternatives that implement the 2000 Flow and Temperature Recommendations while maintaining and continuing the authorized purposes of the dam. Reclamation acknowledges that a full range of reasonable alternatives is desirable. However, despite considerable effort to develop additional alternatives that meet the purpose and need of the EIS, additional viable action alternatives could not be identified. Please see sections 1.4.5, 1.4.6, and 2.2 of the EIS.

45e
The target flows and durations to be achieved each year are dependent on the natural hydrograph of that year and the hydrological classification of that year. If 6 consecutive drought years occur in a row, as is currently the case, then only low targets and durations would be achieved. In very wet years, high targets with long durations would be achieved.

45f
The scales are a measurement of Chlorophyll a in micrograms per liter (µg/L). The red scales are for concentrations greater than 27 µg/L; and in fact, they can reach several hundred µg/L or hyper-eutrophic status at times in the red zones. The scale was clarified in the figures and in the text. Pre-dam temperatures below Flaming Gorge reached about 23-24 °C in the summer and near freezing during the winter. The pre-dam temperatures were warmer at the peaks in the summer than now occur.

45g
The resulting changes in average annual sediment transport will likely produce some channel morphological changes in Reach 1. For example, increased local erosion of bank materials could lead to channel widening in some portions of Reach 1. In Reaches 2 and 3, the increases in sediment transport conditions, on a percentage basis, under the Action Alternative relative to No Action conditions, are relatively smaller than the changes anticipated for Reach 1. For these conditions, changes in channel morphology due to increased sediment transport are anticipated to be subtle and will likely be difficult to track. See the Effects of Flaming Gorge Operations Under the 1992 Biological Opinion and the 2000 Flow and Temperature Recommendations on Sediment Transport in Green River Techinical Appendix for a description and a discussion of the sediment transport analysis completed for the EIS.

45h
The analysis of potential effects to agriculture (section 4.5) shows that there are not significant differences between the Action and No Action Alternatives.

45i
Recent research findings suggest that the proposed action may encourage a shift in location, but not an increase, in tamarisk establishment (see sections 4.7.5 and 4.19.6 in the EIS). The EIS more clearly reflects these new findings. One of the predicted benefits of this shift in establishment location would be positive changes to fish habitat. As a result of these new findings, Reclamation does not believe that mitigation for this action is warranted. However, unrelated to any effects of this action, Reclamation has recently supported research aimed at defining those microhabitats most likely to remain tamarisk free following mechanical removal. Any improvement in this arena may help Reclamation and other management agencies along the Green River more effectively control tamarisk as per Executive Order 13112 on Invasive Species, 1999.

45j
Please refer to figure 4-16 in the EIS; for more information. See figure 3-1 in Valdez, R.A. and P. Nelson. 2004, *Green River Subbasin Floodplain Management Plan*, Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado, Project No. C-6. This report can be obtained by writing the Recovery Program.

45k
The no effect determination for animals exploiting reservoir or river habitats was made because variations in the vegetative community attributable to dam operations would be slight and occur over a sufficiently long period that mobile terrestrial and avian communities could alter their ranges and habits in such a way that no appreciable change in population size or dynamics would occur to these populations.

Perturbations to the vegetative community (and, consequently, to the habitats of the animals in question) below the dam that are attributable to dam operations would not be extensive enough to cause the presence or absence of a species to change within the entire study area. The total area being discussed is large, and resources for these animals are abundant. Changes in the vegetative communities and associated wildlife habitats would be relatively localized and could contribute to a somewhat different composition of species within these areas.

45l
Flooding of the riparian zone is a important, natural, disturbance mechanism for recharging vegetation and resetting succession and the Action Alternative purposefully attempts to contribute to this process. Loss of vegetation is a part of that process. Reclamation believes that mimicking the natural hydrograph is a positive step in restoring and/or maintaining viable southwestern willow flycatcher habitat. Since the identified territories are located on low elevation surfaces, inundation of nests by large flood flows would occur under either alternative.

Regarding the question of whether flood flows will be large enough to offset short-term effects, section 4.7.8.1.2 in the EIS has been rewritten to more clearly state our intent—that is, if large enough, flood flows should create additional habitat above and beyond that which would develop following any scour and deposition event.

45m
Reclamation recognizes the importance of potential disturbance to historic properties within the project area. Please see section 4.8.2.2 regarding cultural resource data analysis with the relevant land managing agencies.

45n
The adaptive management process described in section 4.20 of the EIS would rely on ongoing or added Recovery Program activities for monitoring and studies to test the outcomes of modifying the flows and release temperatures from Flaming Gorge Dam. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group which will evaluate criteria listed in table 2-5 of the EIS when making recommendations. This allows opportunities to refine flow attributes based on good science in an adaptive management process. See section 2.5.3 of the EIS describing the Technical Working Group and the Flaming Gorge Working Group and how they would work together in planning the flow prescription each year.

From: "Scott Marshall" <SMarshall@miscowater.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 11:26 AM
Subject: Green River flow fluctuations - comments from a fly fisherman

Mr. Peter Crookston,

It has come to my attention that the Bureau of Reclamation is performing a draft Environmental Impact Statement (EIS) on the operation of Flaming Gorge Dam. I wanted to share some thoughts with you regarding my most recent trip to the Green River (below Flaming Gorge Dam) and how my experiences, along with similar stories of other anglers, should be considered before any decisions are made.

I am an avid fly fisherman and do my best to make it to the Green River at least twice per year to enjoy the fabulous trout fishery. My last trip to the Green River below Flaming Gorge was a bit unusual in that fluctuating river flows caused a negative impact on my experience and threatened my individual safety along with the other two fisherman in my party.

Unlike many anglers who visit the area, I prefer to fish the "B" section of the river and choose to walk in and camp at the USFS camp sites along the river. In all of my trips to the Green River, my friends and I enjoy wade fishing both sides of the river. In my most recent trip to the Green River (late June 2004), we arrived late in the day and barely fished the evening hatch before we turned in for the night. We woke up early the next morning to a beautiful sunrise and low water levels. We decided to cross the river in an attempt to fish the opposite side (west side) that generally receives less fishing pressure. We started out having a consistent day of catching trout. After lunch, water levels began to suddenly rise at which point several things happened: the fish stopped feeding and the route back across the river started to become more and more dangerous. If my memory holds, river flows were approximately 800 cfs in the mornings and increased to 1500 cfs in the afternoons and evenings. The river flow basically doubled during the
46a early afternoon. The increased flow threatened our individual safety (if you don't think this is life threatening, cross the river at 800 cfs and then try and come back across when it is 1500 cfs - I have done it and it is very dangerous). The fluctuating river flows caused the fish to stop feeding (which reflected negatively on my experience) and threatened the physical safety of my entire group. I believe this to be consistent with all other wade anglers and most other float anglers. Personally, I will be keeping an eye on any changes in dam (flow) operation and will base my decision for any future trips on this aspect.

Thousands of anglers visit the Green River below Flaming Gorge Dam each year and have been doing so for many years. The thousands of dollars
46b fishermen bring to the local economies are crucial to the survival of most people living in the area not to mention the wonderful experiences on the river that are shared with each generation.

In general, I support the single daily peak hump restriction but the
46c timing should be in a manner to have no impacts on the river recreation activities - in my case (and thousands of others), specifically fishing. As I have witnessed in my last trip, increased flows made the fishing

very poor and threatened my personal safety.

I hope that you can come up with an amiable solution to the operation of Flaming Gorge Dam that will create no significant impacts to the fishery or the experience shared by thousands.

Sincerely,

Scott A. Marshall, P.E.
Misco Intermountain
3033 South Parker Road
Tower I, Suite 350
Aurora, CO 80014
office (303) 309-6150
fax (303) 309-6154
cell (303) 601-5215

46. Scott A. Marshall

46a
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

46b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

46c
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Jeff Martin" <bcstoneram@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Tue, Nov 30, 2004 6:26 PM
Subject: Green River Flows

Hello,

My name is Jeff Martin, I know you are probably very busy and I am greatful for your time in reading my email. I visit the Green River several times each year to enjoy the spectacular fishing that many take advantage of in our state.

During this past year I have been very dissapointed in the quality of the fishing there due to the eratic
47a changes in water flows out of the Flaming Gorge Dam. Many morings have started out great and then the water flows kick up and upset the fish, thus creating a very tough fishing situation. I realize that folks have got to have power, but to disrupt such an awesome fishing and outdoor recreation spot so that
47b people can make more money on power generated from the increased water flows seems unfair. It is also a darn shame that a place with such a great reputation for fly fishing and recreation for so many people in this country and abroad is suffering such a huge blow. With the Snake River in Idaho, and so many other waters available in Wyoming, Idaho, and Montana I am afraid that continuing this practice in the future will end up being counter productive for our great state. I and many others will take our dollars to other states so that we don't have to deal with spotty fishing and dangerous conditions experienced on the Green so that people can generate more power.

The really sad thing here is that if you asked fly-fishermen in this state which river had the most fish per square mile, scenic beauty, and overall best fly-fishing for larger fish, you would find the majority would tell you the Green River. This isn't just any river to most fishermen, this is our Crown Jewel fishery. Why compromise this and give our state's fishing and recreation opprotunities a black eye?

I know you have to weigh things out, I just hope that you can sympathize with us in this regards.

Thank you for your time.

Sincerely,

Jeff Martin

Jeff Martin
bcstoneram@earthlink.net

47. JEFF MARTIN

47a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

47b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: Jerry McGarey <bldss15@yahoo.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:38 AM
Subject: Flaming Gorge Reservoir Draft EIS

48a Sir - I write today to express my dismay over the timing of power generation flow increases during prime fishing hours in the A section of the Green River below Flaming Gorge dam. Over the last couple of years (notably in 2004) the timing of mid-morning flow increases and mid-afternoon flow decreases is disruptive to trout feeding activity and had markedly impacted my enjoyment of this otherwise wonderful fishery.

I have travelled to the Flaming Gorge area several times a year since 1992, spending my money with local lodging, restaurant and fishing establishments. I would strongly urge you to factor the needs of the recreational fishing tourists into your plans and timing for summer power generation in the future.

48b I believe recreational use of the Flaming Gorge area is supposed to precede that of dam power generation, isn't it?

Respectfully, Jerry McGarey (bldss15@yahoo.com)

48. JERRY MCGAREY

48a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

48b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives.

We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: "Patrick M. Mehle" <smachine@sweetwater.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 10:43 PM
Subject: Comments on Flaming Gorge Dam Operation DEIS

11-14-2004

To: Mr. Peter Crookston

Flaming Gorge EIS Manager, PRO-774

Bureau of Reclamation, Provo Area Office

Dear Mr. Crookston,

The following are my comments on the Flaming Gorge Operation Draft EIS.

49a In reading over the DEIS, it seems that there are two very conflicting assumptions made. On page 189, Section 4.8.1.1, is stated that "Fluctuations of the water levels of the reservoir would not change from what has become a normal, although flexible, operation". Conversely, on page 230, first column, it is seen that "Because of increasing water consumption in the tributaries of the Green River below FG Dam, it is anticipated that releases... will have to be greater in the future." Just two paragraphs after that we see that "Water consumption above FG Dam is also expected to increase, and this could reduce inflows into FG Reservoir." It is clearly impossible to have more water going out, less water coming in, and still maintain a "normal" lake level.

For this reason alone, I feel that there is much more that needs to be done to achieve a workable operations plan. I am a member of the Wyoming Water Development Commission's Green River Basin Advisory Group. Over the course of the last several years and twenty-five or more meetings-I have lost count of how many- our group has been exposed to many diversified points of view, and has had the opportunity to hear from many different expert and credible speakers. From this experience I have come to the conclusion that there are several points that you need to consider in greater detail. First is the issue of drought. As you probably are aware, the Colorado River Compact

annual flow figures, as seen in the original compact agreement, have proven to be lower than reality. Further, recent studies of tree rings going back to about 1200 AD, have conclusively shown that the past 100 years have been exceptionally wet. Also mentioned was yet another study concerning the Wind River Glaciers. These glaciers have been receding rapidly over the past several decades, and assuming continuation of the current drought conditions and warmer mean temperature trends, it is possible that the glaciers could be completely melted in ten years. These glaciers are the primary source of summer stream flow in the upper Green River Basin. The "demise" of these glaciers could realistically lead to the Green River actually running dry-- in the worst case scenario. The Wyoming Water Development Commission considers conditions serious enough to where they feel a need to develop an
49b emergency plan to address issues of continuing severe/ exceptional drought. I think that your EIS should address this possibility also.

Also at issue is the continued increasing demand for water downstream. Lake Powell was at 58% of capacity in October. It is surely even lower now. If current trends continue, the lake elevation will drop to the point where the generators will have to be shut down in mid 2006. It is speculated that upstream dams might be forced to lower their lake levels to supply enough
49c water to forestall that shutdown. I highly oppose a transfer of water under those conditions. There is an old saying among airplane pilots-"The two most useless things to a pilot are runway behind you and altitude above you". For a dam operation, it can be said in the same vein that the two most useless things to power generation are water downstream and dam elevation above lake level. It is fine to send water downstream for power generation since the same water can be used several times to spin several turbines. The issue is efficiency. Any water sent down to Lake Powell will be sent through their power plant at minimum head, hence minimum efficiency. It makes no sense to operate Flaming Gorge at a reduced elevation/reduced efficiency. Keeping Flaming Gorge as full as possible will give the greatest possible gross power production for the system as a whole.

I wish also to express concerns for the implementation of increased flows the endangered fish recovery program. The potential damage to FG Dam caused
49d by increased flows through the spillway is, in my opinion, much underestimated, as are the safety issues that would result. Although the fish recovery efforts are a worthy goal, the flows required to achieve this goal do not justify the costs. The physical damage to the dam, the loss of electrical generation, the erosion damage to downstream infrastructure, and the flood damage to downstream landowners, far outweighs the benefits. It is interesting to note that the water required for a single "flushing" is on the same order of magnitude as the total annual domestic water consumption for the entire state of Wyoming. I am left with the feeling that this proposal will, at best, just serve as a vehicle to benefit the over-allocated lower basin at the expense of the upper basin States. How can these costs be justified?

Finally, I would like to suggest that you consider formulating a priority
49e list for the operation of the dam. First, of course would safety- both for the dam itself and for the public that it serves. Second would be the dam's original purpose-to serve as an instrument to help regulate the Colorado River System per the Compact. Of the several priorities that you might feel would follow these, the endangered fish recovery flows should place well toward the bottom of the list-especially if the hydrological conditions that existed hundreds of years ago should prove to be the true average.

Thank you for the opportunity to express my views on these important issues.

Patrick Mehle

1037 Cypress Circle

Rock Springs, Wyoming

82901

49. PATRICK M. MEHLE

49a
The Action Alternative does not necessarily release more water than the No Action Alternative. In some cases, the Action Alternative would release less water. It is recognized in the EIS (section 4.16.1.1) as water consumption increases through time that it will become more difficult to maintain reservoir storage while also achieving the flow objective of the 2000 Flow and Temperature Recommendations.

49b
Comment noted; there is at present a drought in the Green River Basin. The hydrology that was analyzed for this EIS did include droughts more severe than the present drought.

The Flaming Gorge Model was run with historic hydrology from 1921 through 1985. During this period, several droughts did occur; the worst of which occurred from 1934 to 1938 when the average annual Green River flow (measured at Greendale, Utah) was 550,000 acre-feet. For comparison the average annual flow of the Green River from 2000 to 2004 was 661,000 acre-feet.

49c
Comment noted. Lake Powell operations are outside the scope of this EIS.

49d
Comment noted. As stated in section 2.5.3.2 of the EIS, Reclamation would annually coordinate the decision whether to use the bypass tubes or spillway to meet particular flow targets. That same section, and other sections in the EIS, note uncertainties associated with use of the spillway that will have to be monitored and addressed through the adaptive management process.

49e
As stated in section 1.5 of the EIS, Reclamation's priorities are first, dam safety and then second, meeting project purposes in compliance with ESA. When conflicts in operations arise, Reclamation's approach to conflict resolution and decisionmaking includes accepting input from all stakeholders and formulating a strategy that meets the most needs possible consistent with these established priorities. Reclamation's intent is to continue balancing the needs of all resources when making operational decisions and would continue this practice under both the Action and No Action Alternatives.

From: norman miller <nmillerca@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 6:49 PM
Subject: Flows on Green River

Dear Sir;

50a The high afternoon flows experienced on the Green River this year made what had always been a top fishing destination, an unneeded and unwanted adventure. Please restore sanity and safety to the flows so that the great fishing experience and return once again.

Thank you,

Norman Miller

50. NORMAN MILLER

50a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: <Richardmimms@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:23 AM
Subject: *(no subject)*

51a We support the single daily peak hump restriction, but its timing should be in a manner that it has no impacts on river recreation activities, especially fishing.

Richard L. Mimms

51. RICHARD L. MIMMS

51a

The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Arthur Moeller" <moellerad@comcast.net>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 6:26 PM
Subject: Draft Environmental Impact Statement on Flaming Gorge Dam

I do not favor the proposed fluctuating flows for power generation. I
52a feel it will have a negative impact on the fishing. I fish there
several times a year and if I have to put up with the fluctuating flows
I will consider going elsewhere and spending my money in a different
location. I could support the single daily peak hump restriction if it
52b was timed in a manner that does not impact river recreation activities,
52c especially fishing. I would also feel safer while wading if I did not
have to worry about the river rising suddenly.

A. D. Moeller
4247 W. 4570 So.
West Valley City, UT 84120

52. ARTHUR D. MOELLER

52a and 52b
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

52c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

From: "Mark" <marco@wfrmls.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 8:24 AM
Subject: Green River at Dutch John River Flow Impact

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

53a I support the single daily peak hump restriction, but its timing should be in a manner that has no impacts
on river recreation activities, especially fishing. It is dangerous to the fisherman wading across the river,
spoils the fishing and will keep many of us who bring the much needed dollars to the local economy of
Dutch John and the State of Utah. In addition it is the recreational users who have priority over the power
53b generation.

Mark Naccarato
Holladay, UT.

53. MARK NACCARATO

53a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

53b
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "Sean O'Connor" <SOConnor@sheppardmullin.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 6:01 PM
Subject: Draft Environmental Statement on the Operation of Flaming Gorge Dam

I understand that the Bureau of Reclamation is undergoing a Draft Environmental Statement on the Operation of Flaming Gorge Dam and asking for comments.

I fly fish the Green River often, and it is frustrating how the erratic
54a way flows can suddenly jump up and down while I am fishing. This can often disrupt water quality and upset the fish for set periods of time. The end result is a spoiling of our fishing day. The Draft EIS allows for fluctuating flows for power generation up once a day and then down. In 2004 this was experienced by many of us on the Green as they went from 800 cfs to 1500 cfs every day (at 1:00 pm, right in the middle of the day) after our high flows in early June to the end of September. We hated the reaction from the trout, the fishing could and often did go flat for periods of time. Then they brought the flows down while we were trying to start fishing again and the process started again. The ups and downs and the disruption you caused to our fishing experiences were uncalled for. You have the ability to do the power generation flows in non-fishing hours or maintain a slightly higher steady flow that
54b generates the same amount of electricity.

54c Recreation and fish have a priority over power generation under the authorized purposes of the Flaming Gorge dam. Please recognize this and act accordingly.

Sean P. O'Connor

DD: (714) 424-2846

54. SEAN P. O'CONNOR

54a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

54b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

54c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

MEMORANDUM

TO:	PETER CROOKSTON Flaming Gorge EIS Manager, Pro 774 Bureau Of Reclamation, Provo Area Office 302 East 1860 South Provo, Utah 84606-7317
FROM:	MAURIA PAPPAGALLO, Environmental Resources Engineering Student Humboldt State University 1st Harpst St, House 18 Arcata, CA 95521
SUBJECT:	COMMENTS ON FLAMING GORGE DAM DRAFT EIS
DATE:	11/13/2004

SUMMARY

This memo is to inform you of my analysis of the Operation of Flaming Gorge Dam Draft Environmental Impact Statement (DEIS). The critique is broken into sections covering overall document suggestions, analysis of alternatives, the affected environment, and environmental consequences. Overall, I found the document to be a good examination of the situation.

DOCUMENT SUGGESTIONS

The beginning of the document should be revised; information in chapter three should come before the alternatives are assessed. The following are examples:

55a

- A summary description of the natural habitat and environment of the endangered fish should be introduced before alternatives are discussed. The summary description should include at least their average water temperature and flow requirements. A description would also inform the reader of vital information needed to assess the flows recommended by the alternatives.

- A thorough description of the Green River System (GRS) should be introduced earlier. A description at the beginning would help the reader become more familiar with the system and point out important details that can not be obtained from glancing at a map. For example, on page 19 of Chapter 1, the Browns Park Highway EIS is discussed, but the document does not indicate why this is relevant information. An earlier GRS description should state where the Browns Park Highway is and why it's important enough to be discussed in relation to the Flaming George Dam project. A full description is given in 3.6.2, this but is too far into the document; a summary should be given in the beginning.

The background of the dam situation includes authorized uses of the FGD project. Due to the authorized uses being an important part of the purpose and needs statement, they should be identified in the Purpose and Needs section and could be put into easy-to-read bullets.

Inclusion of, or reference to, important sections of the 2000 Recommendations report and the 1992 Biological Opinion as appendices to the document, would be helpful in assessing the processes used to determine the recommendations. The important sections should list the criteria used for making decisions in each report, or should list the assumptions used in the modeling analysis. Furthermore, referencing appendices within the text would direct the reader to additional information on important subjects.

The overall language of the DEIS is easy to read. A few words are not defined, but would help the reader to better understand the document. One example is the "bypass
55b tubes"; an explanation of what they are and how exactly they affect power generation is needed. The quantity of bypass tube use is discussed as a comparison between the two alternatives but it is not clear what that means.

On page 142, in the last paragraph, where temperature changes are discussed, data should
55c be re-evaluated and checked; it is not possible for 9°F to equal 5°C. The same mistake is made again on page 144 in the first paragraph.

2

55d A discussion of the operation and maintenance for the new operating plan should be included in the document. Where will the funding come from, and who is responsible for the maintenance and operation of the operating plan?

SCOPING

From the scoping process, public issues were identified and separated into categories. The process was conducted under the question: "How would operating the Flaming
55e Gorge Dam to meet 2000 flow and temperature recommendations affect..." Conducting the scoping process under this heading defeats the purpose of scoping. Scoping is conducted to look at the issues that should be included in the alternative development and impact analysis. This question limits the scoping process and produces "tunnel vision" in determining the alternatives. To improve this analysis, the scoping process should not have been so narrow and the indicators should include measurable descriptions. For example, an indicator for Issue 8 is "condition of vegetation and species composition of wetlands". Instead it should say "population density of vegetation, acreage and condition of wetlands and their species composition". This wording allows for measurable conclusions. The following additional indicators should be similarly re-worded:

- Issue 9, Effect on vegetation: Number and density of endangered plant species.
- Issue 13, Effects on sediment: Look at the predicted changes in salmonid spawning gravel areas. "Area of spawning gravels before new flows and predicted spawning gravel area after implementing new flows".
- Issue 15, Effects on quantity and quality of water: Changes in temperature

ALTERNATIVES ANALYSIS

The purpose and needs statement discusses two main points: 1) the need to operate the dam to protect and assist in recovery of four endangered fish species and their critical habitat, and 2) to maintain all authorized purposes of the Flaming Gorge Unit of the Colorado River Storage Project (CRSP). To fulfill both points, the only feasible alternative would be to implement the 2000 Recommendations. Thus the alternative formulation for this project should include alternative flow regimes, as well as the 2000

3

Recommendations, with differing alternatives for impact mitigations along with looking at a no action alternative. The alternatives discussed in this analysis focus on the flow regimes instead of mitigations. Two alternatives are discussed, an Action alternative in which the 2000 Recommendations are implemented, and a No Action alternative. The No Action alternative follows flows recommended by the 1992 Biological Opinion.

The action alternative splits the Green River into three different reaches, with each being affected by the FGD flows differently. It is stated on page 24 in the last paragraph that:

> *"The intent of the Action Alternative is first to meet the recommended objectives for reach 2 and then, if necessary, make adjustments to releases so that the recommended objectives for Reach 1 could also be met. It is assumed that the flow objectives in Reach 3 are met whenever the flow objectives in Reach 2 are met."*

55f This statement leaves me with a number of questions; 1) What are the recommended
objectives for each reach, 2) Why are they different? These should be stated in section
55g 2.3.2 before this statement is made. 3) How can the assumption be made that the
55h objectives in Reach 3 are met when the Reach 2 objectives have been met? An
explanation of this assumption needs to be included in this section. The following
paragraph on page 26 goes into further detail of the 2000 Recommendations. This
paragraph then states that the primary focus of the 2000 Recommendations is on the flow
55i regimes in Reaches 2 and 3. The two statements seem to contradict themselves. Why not
focus on Reach 1, the section of the river that is predominantly affected by the dam
releases?

In continued discussion of the action alternative flows, it is mentioned that by trying to reach 2000 Recommendations for Reach 1, that the minimum 2000 Recommendations would then be exceeded in the following reaches. Due to agricultural needs, I can understand why water conservation is an important goal. However, based on the purpose and needs statement, exceedence of minimum flows is a positive impact and a benefit to
55j the fish.

When comparing the two alternatives under the context of agriculture, the impacts are stated as the same whether the No Action or the Action alternative is used, thus these impacts are dismissed. The DEIS states that under both alternatives, approximately 245 acres of cropland will be flooded each year. The Action alternative will cause the fields to be inundated for 2 days longer which will not cause any more significant impacts thus
55k the effects are the same. Though the impacts will be the same, they should still be addressed within the document.

It is stated that the effectiveness of the action alternative will be measured by the long-term frequency of achieving flow thresholds prescribed by the 2000 Recommendations.
55l The language should be changed to include a quantitative value for long-term. It is also stated that an administrative record of the operational decision making *would* be maintained and that this record *would* include analysis of previous operations and
55m effectives of achieving desired targets on a year by year basis. The word *would* should be changed to *will* to ensure that this practice is done.

GREEN RIVER SYSTEM MODELING

55n The current description of the model analysis used to simulate the GRS doesn't provide enough detail. For example, the model requires natural flow volume inputs and estimates the release volumes and storage volumes. There is no discussion of how the natural inflows were chosen, or what range and number of hydrologic years were used in analysis. The language indicates that the model simulates the system to the USGS stream gauge 93 miles away from the dam, when the system being analyzed is 410 miles long? Is only one gauge used for calibration? Is the rest of the system included in the model? Further explanations should be used in the document. Placing this section within the Affected Environment chapter would increase the flow of the paper.

I liked that the preparers of the 2000 Recommendations were asked to review the document. In most situations, the reviewers found that the model properly simulates the 2000 Recommendations in Reach 2. This would indicate that it does not properly
55o simulate the 2000 Recommendations in Reaches 1 and 3. If this is so, it should be stated

5

and further analysis should be done to find conditions that do meet Reach 2 and 3 goals. Important impacts to the system could be missed or overlooked due to this inaccuracy in modeling.

AFFECTED ENVIRONMENT

As mentioned earlier, sections from the affected environment should come earlier in the document, prior to the discussion of the alternatives.

Under the Potentially affected area (3.2), a section for the Green River needs to be included. Currently there is mention of the Green River downstream of the dam, but it only mentions that the dam is 410 miles before the confluence with the Colorado River.

VEGETATION

55p The section on vegetation (3.7.1.3) does not fully discuss the current environment in terms of the indicators previously stated in Issue 9 (Pg 14). Further detail on evasive species, numbers of populations including the flooded areas should be included. Further

55q more, in the environmental consequences section, no studies were conducted or references given to backup statements made on vegetation impacts.

ENVIRONMENTAL CONSEQUENCES

55r A value for the average influence of the Dam releases on each Reach of the system should be included in the analysis. An average percentage of overall river flow that comes from the dam releases in each reach would provide a good value. For example, on page 127, the statement "Impacts to flows from Flaming Gorge Dam diminish with distance from the dam", as a reason for not including Reach 3 flows into the model. This statement should be supported with a value indicating that the effects of dam releases are minimal at that location.

TERRESTRIAL AND AVIAN ANIMALS

55s Discussion of terrestrial and avian animals does not include any type of study or analysis to back up the decision of no impact. Further analysis of terrestrial foraging and habitat should be analyzed to see if terrestrial and avian food sources will be impacted.

The overall discussion of mitigations is insufficient. It would be easier for the reader if the discussion of impact significance were discussed directly after impacts were presented. There is no discussion of how impacts are rated for significance. I found it hard to find mitigations or final decisions on significance. If there are proposed
55t mitigations for effects caused by the action alternative, I did not find them.

UNCERTAINTIES

This section includes a discussion of the uncertainties included in the models and the assumptions that were required to make the models work. The assumptions and uncertainties with the models should be included earlier in the document with the discussions of information obtained from the model, thus allowing the reader to decide how well they agree with the information presented.

Inclusion of an adaptive management program will be very helpful in mitigating impacts of uncertain significance. The adaptive management program should include measurable and dated results. The wording on the adaptive management goals for numbers 6 through 10 should be changed from *would* to *will*. Using the word *would* indicates that it could happen. Due the number of uncertainties involved in the project the implementation of all aspects of the adaptive management program is very important to insure unrealized impacts are mitigated. A discussion of possible mitigations would further support the documents discussion of adaptive management.

55. Mauria Pappagallo

55a
Please see section 1.3 for an explanation of the EIS contents. The format is consistent with the CEQ and Interior regulations implementing NEPA.

55b
Comment noted. The term, "bypass tubes," was added to the glossary.

55c
These references are not to specific temperatures, but to changes in temperature; thus a change of 9 °F is equal to a change of 5 °C.

55d
Please see sections 1.5, 2.5, 4.19 and 4.20 for information regarding operations.

55e
Comments noted.

55f
The recommended objectives for each reach are flow and temperature targets defined by the 2000 Flow and Temperature Recommendations. Please see table 2-1 in the EIS.

55g–55i
Throughout the 2000 Flow and Temperature Recommendations document, it is stated that the critical habitat for the endangered fish reside in Reaches 2 and 3. This is also stated in the EIS. Through modeling, Reclamation came to the determination that it was possible to reasonably predict future flows in Reach 2 with enough precision to efficiently augment these flows to achieve the target levels established in the 2000 Flow and Temperature Recommendations for Reach 2. The following statements are made in the 2000 Flow and Temperature Recommendations which support using Reach 2 as the priority reach:

- Section 5.2.1 "Recommended flows for Reach 1… are those measured at the USGS gauge near Greendale, Utah, and are, for the most part, release patterns from Flaming Gorge Dam needed to achieve the target peak and base flows identified for habitats of the endangered fishes in Reaches 2 and 3."
- Section 5.2.1 "Base flows in Reach 1 should be managed to ensure that within-year and within-day variability targets for Reach 2 are met."
- Table 5.4 General Recommendations: "Peak flows in Reach 1 should be of the magnitude, timing, and duration to achieve recommended peak flows in Reaches 2 and 3."

55j
Comment noted.

55k
Please see section 4.5.2 in the EIS which identifies the impacts.

55l
It is difficult to isolate a specific number of years to evaluate the percentage of targets and durations achieved because it is unknown what the natural hydrograph will be in the future. Over the long run when several different natural hydrological years have occurred, Reclamation would be able to determine whether the percentages are consistent with the 2000 Flow and Temperature Recommendations. The target flows and durations to be achieved each year are dependent on the natural hydrograph of that year and the hydrological classification of that year. If 6 consecutive drought years occur in a row, like now, then only low targets and durations would

be achieved. In very wet years, high targets with long durations would be achieved.

55m
Comment noted. Reclamation intends to maintain an administrative record for how decisions are made that will be available to the public. Reclamation is considering use of a web page and other means to keep the public informed on implementation of the proposed action. The administrative record is portrayed in section 2.5.3 in the EIS and will be maintained if the Action Alternative is implemented.

55n
It is recognized that much of the supporting data regarding the Flaming Gorge Model did not appear in the draft EIS. The Hydrologic Modeling Team produced an initial report entitled "Flaming Gorge Environmental Impact Statement Hydrologic Modeling Study Report" issued in October 1, 2001. This report contains much of the information regarding how the Flaming Gorge Model was constructed. This report was added to the Technical Appendices.

The Flaming Gorge Model extends to the stream gauge at Jensen, Utah. It was assumed that if Reach 2 flows were met, Reach 3 flows would also be met. This is described in the October report.

55o
Please refer to section 2.3.2 in the EIS.

55p
Reclamation chose to measure distribution via a focus on those mechanisms exerting the greatest influence on establishment of invasive species. Consequentially, this led Reclamation to focus as well on microhabitats or geomorphic features most associated with those mechanisms. The anticipated small difference between the No Action and Action Alternatives in total acreage of invasive species contributed to Reclamation's decision to focus research on those issues that can best be addressed through adaptive management efforts.

55q
Statements made in this section reflect research discussed (and cited) for vegetation in chapter 3. For clarification, additional citations have been added to section 3.7.2.6.

55r
Information describing flow conditions on the three reaches of the Green River is available in section 3.3.3 of the EIS.

55s
This section of the EIS was written to disclose environmental consequences of the No Action and Action Alternatives affecting terrestrial and avian animals existing on or near Flaming Gorge Reservoir. Text has been added to section 4.7.1.4 to clarify and support the conclusion. Please refer to 46k above.

55t
The EIS analyzed the difference between the Action and No Action Alternative and did not find any adverse impacts that required mitigation. Under the Action Alternative, if there are concerns, they would be addressed through the adaptive management process described in section 4.20 of the EIS. Please refer also to section 4.21 of the EIS which lists environmental commitments.

From: "Park, Edward" <edward.park@IngramMicro.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 10:34 AM
Subject: Ed Park: Comment on Operation of Flaming Gorge Dam for Draft Environmental Statement

This message is for Mr. Peter Crookston, Flaming Gorge Environmental Impact Statement Manager:

Sir,

I was referred to you by some friends that were advised of the option to participate in submission of comments regarding the impact of flows in the Flaming Gorge/Green River area.

As someone that was recently impacted by the flow management practices, I decided to take a few moments to relate to you an incident that happened a few months ago as well as how that has convinced me of the importance of making my voice heard.

Back in September, a group consisting of myself and a few friends were fishing the gorge on a sandbar in the area. We had reached the sandbar by power boat and were wading in waist deep water.

Unknown to us, the dam started releasing a higher flow and we found ourselves in a situation where the water level was rapidly increasing. . . . we had to beat a hasty retreat into shallow water and then back into the boat. Needless to say, we felt it was not only inconvenient, but
56a downright dangerous as some of our party had quite a way to go to get back to the boat. By the time we retrieved the last of our party, the sandbar was already completely underwater.

56b My comment with regard to this is that while there is an importance with maintaining power generating optimization and water levels above the dam, specific regard to recreation and preservation of human life below the dam is important and any future planning and considerations should, in my opinion, include this.

Not to mention, we spent a considerable amount of time, effort, and money to make this special excursion and not even halfway through the trip, the water quality degraded enough to cancel all additional fishing throughout the remainder of the weekend. I guess the worst aspect about all of this was not the time, money, or driving to get there, but simply how difficult it is to get the "weekend" pass from all of our wives at the same time.

Thanks for lending an ear. I hope my input has been helpful

best regards

Ed Park
AV, CA
949 395 1964

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56. ED PARK

56a

Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

56b

The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "Lex Patterson" <lex@dakcs.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 4:30 PM
Subject: Green River Flows

To Whom It May Concern:

57a As an avid fly fisherman and Utah resident who spends time fishing the Blue Ribbon resource we enjoy in Utah, I would like to add my name to the list of taxpayers who would like to see the flows on the river stabilized during the daylight/fishing hours. I'm sure a win/win situation can be worked out that will allow for the power needs, and still keep this valuable resource fishing up to it's full potential. Thanks for taking the time to read my comments.

Lex Patterson

V.P. of Technical Services

<http://www.dakcs.com/> DAKCS Software Systems, Inc.

mailto:lex@dakcs.com

3017 Taylor Ave.

Ogden, UT 84403

(801)394-5791 x242

57. LEX PATTERSON

57a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: Chet Preston <Chet.Preston@paccoast.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 2:19 PM
Subject: green river fishing

Mr. Peter Crookston,

I take 1 to 2 fishing trips a year to the green river and the last trip I took was the worst one yet the fishing was not very good at all it was ok in the morning but by the time the river come up to the peck the fishing stopped and got very slow . I stay at flaming George lodge and float with one of the guides so I spend the money to have a great time fishing that river but it's not wroth my time if I have to worry about the river going up and down and how it will affect the fish. In years past I have done

58a very well fishing the river with at least 30 to 40 fish a day when I float with the guide but this past year I had to work hard just to get about 15 fish so if there is any way that we could get around this it would be great if not it's not worth my time or my money

thanks for your time
green river fisherman

58. CHET PRESTON

58a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Tom Prettyman" <prettyfoto@adelphia.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 5:15 PM
Subject: Green River

Sirs,

I hope you will understand that my input is intended to be constructive for the Flaming Gorge area. There
59a have been flow fluctuations from the dam over the past several months that have resulted in a
degradation of fishing success and generally turned a lot of fishermen off from visiting the area. I do not
fully understand the reason for these fluctuations, but I do know that the end result must impact the local
59b economy somewhat when fishermen don't return due to a disappointing experience. I would think there
59c would be some way to compromise whatever electrical needs there are, with the recreational value to the
community.

Thanks for your attention to this issue.

Tom Prettyman
140 the Village #409
Redondo Beach, CA. 90277

59. TOM PRETTYMAN

59a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative.

59b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

59c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "Jairo Ramirez" <jairoram@comcast.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 11:24 PM
Subject: Green River Single Daily Peak Hump Restriction

Mr. Crookston,

I want to voice my concern regarding the timing of the daily flow changes to the Green River below
60a Flaming Gorge Reservoir. Increasing the flows during midday is both dangerous to wading fisherman and very disruptive to the fishing in general. Me and a group of guys routinely travel from Denver to the Green several times a year but have not been going recently because of this practice. I would encourage you to
60b change the peak increases in flow from midday to during the night. If we can be assured that this practice will change to during the night, we will return to the green much more frequently.

Thanks for listening.

Jairo Ramirez
jairoram@comcast.net
Denver, CO

60. JAIRO RAMIREZ

60a
The issue of daily fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

60b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

From: "Robert Rutkowski" <rutkowski@terraworld.net>
To: <fgeis@uc.usbr.gov>
Date: Mon, Oct 11, 2004 9:49 AM
Subject: Flaming Gorge Dam DEIS

Peter Crookston
Bureau of Reclamation
Provo Area Office
302 East, 1860 South
Provo, Utah 84606
Phone: (801) 379-1152
Fax: (801) 379-1159
Email: fgeis@uc.usbr.gov

Ref: Flaming Gorge Dam DEIS Comments

Dear Mr. Crookston:

61a I ask the Bureau of Reclamation to begin a comprehensive basin-wide approach to the recovery of the endangered fish of the Colorado River and its tributaries. The Bureau's piece-meal, one-dam-at-a-time approach to endangered fish recovery has yet to demonstrate any program success in the Colorado River basin. This approach must thoroughly evaluate how and if dams such as Flaming Gorge should continue to be operated.

Throughout the Colorado River basin, over 40 federal dams have reduced, or truncated, natural fish habitat to the meager miles set between large reservoirs. These altered habitats do not have the conditions necessary to fully recover the native fish from their endangered status. Such altered conditions include: reduced spawning beds, lower spawning temperatures, reduced water flows, reduced sediment and nutrient loads, and isolation from improving their genetic viability.

61b I ask for a basin-wide, programmatic EIS that will truly restore the Colorado River ecosystem. I also ask
61c that the congressional ban on studying the need to decommission Glen Canyon Dam be removed. Finally, I ask that alternatives for reservoir storage, such as recharging the depleted underground aquifers of the
61d basin, be fully considered for study.

Yes, it is possible to restore the original connectivity of the Green, Colorado and San Juan rivers for the benefit of endangered fish and, at the same time, provide water for people.

Thank you for the opportunity to bring these remarks to your attention.

Mindful of the enormous responsibilities which stand before you, I am,

Yours sincerely,
Robert E. Rutkowski

cc:
Nancy Pelosi

2527 Faxon Court
Topeka, Kansas 66605-2086
P/F: 1 785 379-9671
r_e_rutkowski@myrealbox.com

61. ROBERT E. RUTKOWSKI

61a –61d
Comments noted.

From: Peter Sagara <morsaga@cybermesa.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 8:18 AM
Subject: To put it bluntly...please change your tactics

Mr. Peter Crookston:

I fish the Green River below Flaming Gorge Dam and have been doing so *for years. During that time, I have been: with a friend who was* caught across the river when the water was raised, unable to wade back until a guide in his boat stopped and brought him across; I have been there when the fish stopped rising even with the recent hatch of insects still on top....as the water rose up my waders and I had to make a hasty retreat to shore.

Over the years I have been helping to support the economy of that area by staying at the Lodge, or at Red Canyon, and using guides and boats from Trout Creek Flies and of course, getting my Utah fishing license.

62a I support the single daily peak hump restriction but suggest that the timing could be managed so it has little or no impact on fishing activity.

Yours truly,

Peter Sagara
58A Loma Blanca
Santa Fe, NM 87506

62. PETER SAGARA

62a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Cris Shiffler" <cmshiffl@nuskin.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 9:19 AM
Subject: Draft EIS on the Operation of Flaming Gorge Dam

Mr. Crookston,

Good morning! I am writing to you this morning about a very important issue to both my wife Amanda and I that you are involved in. I have been made aware recently of a Draft Environmental Impact Statement on the Operation of Flaming Gorge Dam that you are in charge of. From my understanding of the Draft EIS, it would allow for daily
63a fluctuating flows (once a day) from Flaming Gorge Dam into the Green River.

I am actually intimately familiar with this practice, as both my wife and I fish the Green River below the dam many times each year. This summer in particular, we have experienced these daily fluctuations almost every day we visited this year (approx. 8 different times), and it was quite disturbing. It was disturbing to the fish, which seemed like they would "turn off" like a switch, to the dismay of many fishermen, some of which traveled a long way to experience this magnificent river. I have noticed that this problem happens with minor fluctuations in the river in years past, however this year seemed like quite large fluctuations occurred (from 800cfs-1500cfs or so) frequently throughout the week during the mid part of the day (around noon or so) which would ruin fishing for everyone one the river for the rest of the day. In addition to disturbing the fish, this practice disturbs not only myself, but many other fishermen (and women) as well. It is disturbing to notice that while you are wading in an already swift and large river, the water level begins to rise, sometimes rapidly in a short period of time. There were a few times this past summer where we noticed to our dismay that large sections of river were no longer accessible to us during the afternoon due to higher flows blocking wading access. Between lack of already limited access in some areas and disinterested fish, it can sure put a damper on a fishing trip.

We only travel from Provo to come up to Dutch John, but that still is a 3 hour one-way commitment. We spend a pretty decent amount of time in Dutch John, and a pretty decent amount of money each year supporting the few local businesses. I would suspect that 99% of all fishermen on the Green River below Flaming Gorge Dam are not from Dutch John. These same fishermen are also pretty particular about their fishing locales. Remember back to just a few years ago after the Mustang Ridge fire. Dripping Springs got blown out after those rainstorms and all of that debris got washed into the river. Sure, it affected fishing temporarily, but not that much. Word got out about the fire and the debris and people stopped coming to the river for quite some time because the "word" was that the river was ruined. That definitely was not the case, but many of the local businesses suffered. If these large daily flow fluctuations are allowed to continue, I believe that fishing pressure, and the tourism dollars, will begin to dissipate. Why would someone want to travel all that way to Dutch John only to be able to have a few hours of productive fishing in the morning hours. The flow increases and decreases will render the remainder of the day pointless for fishing.

I believe that power production and recreation can coincide harmoniously if some careful preplanning is done. My wife and I support

the single daily peak hump restriction, but its timing should be in a
63b manner that it has no impacts on river recreation activities, especially
fishing. The ideal situation for all recreationalists using the Green
River below Flaming Gorge Dam, not just fishermen, would be to time
these flow fluctuations to time periods that are not peak river use
hours. Late evening or even during the night would be a phenomenal
63c compromise. No one is on the river at that time (or very few people
anyhow). It would allow the fish and other river aquatic life time to
adjust to their changing habitat, while not receiving additional stress
and pressure from fishermen. In addition, from my understanding of the
authorized purposes of Flaming Gorge Dam, recreation and the inhabitants
63d of the river (fish, insects, etc.) have priority over power generation.
I believe that over the last few years, power generation has seemed to
take priority over everything. I believe that this tiny area of the
state brings in some serious tourism and recreation dollars not only for
the Dutch John area, but for the state of Utah in general.

We urge you to consider all of the options the Bureau of Reclamation has available during this Draft EIS period. We hope that a serious review of what is right for the river will be taken and that a compromise can be worked out that benefits everyone involved, not just for power generation. I would welcome the opportunity to discuss this issue and my views more with you if you would care to. Good luck and I appreciate you time for reading this!

Best regards,

Cris & Amanda Shiffler
Provo, UT
801-345-2709

CC: <dbreer@union-tel.com>

63. Cris and Amanda Shiffler

63a and 63b
The issues of fluctuations for power and the single daily peak hump restriction are outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

63c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day.

63d
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

From: <Snwrngr@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 11:00 AM
Subject: Green River below the Dam

Mr. Peter Crookston,

Just wanted you to know ...

64a I use to come to the river (below the dam) to fish. I do live in the Denver area and it is a little bit of a drive for me, but usually well worth it. I did experience a high flow increase in the middle of the day, each day, on my last 4 day visit. It really made the fishing bad ... especially in the evenings when the flow came back down.

I now take my vacation money and fish in Wyoming. It's not as pretty but the fishing is consistent. If you could manage your flows better I may come back.

Thank you for your time,

Jay Smith
Denver, CO 303-478-0345

64. JAY SMITH

64a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

FGEIS ZZ401 PRO - Green river fluctuation

From: "les smith" <l683971@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: 11/13/2004 10:02 AM
Subject: Green river fluctuation

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office

I have fished these waters for the last 20 years and have dealt with the fluctuation. It has been something I have excepted.

65a If the time could be moved to the night time Hrs. it would make my quality time a lot better. I live in Ft. Collins, Co. but I consider the Green home. I usually spend $100 a day any time I come to the river. Of course this is spread around to the different businesses. I feel I am the average person so this could be higher or lower.

Thank you for listening.

Les Smith

65. LES SMITH

65a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

From: "Kent Spittler" <kspittler@ksl.com>
To: <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 11:08 AM
Subject: Green River flow fluctuations

Dear Mr. Crookston,

I am writing to you because I believe there are mutually agreeable solutions to the power generation requirements you have to weigh, and the disruption of the quality fishing experience that the Green has become famous for due to the dramatic flow changes. First of all,
66a recreation takes priority over power generation according to the Flaming Gorge use authorization statements and second, power generation and great fishing can both happen if some common sense is applied. When the
66b flows dramatically change, up or down, it puts the fishing down for
66c hours at a time plus it poses a serious risk of life to those who wade fish the river when the inflow doubles in the middle of the day. I would suggest that the timing of the flow changes be altered to non
66d fishing periods (night time) so that the power can be generated and the fishing can recover by the time anglers get on the water. I visit the Green both for personal days on the river and I often times bring *clients of mine, (I am an account manager for* KSL Radio), and we spend money on lodging, food, licenses, flies, etc. The last thing I want to experience on those days is a four to six hour flat spot in the afternoon when some of the best fishing can be had. This doesn't have to happen. I'm sure there are issues on both sides to consider but I'm also sure that good solutions exist so that both needs can be realized. Please don't discount the effect that fishing has on the local economy and quality of life in general for those of us who love the Green.
Thanks!

Kent

66. KENT SPITTLER

66a
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

66b
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

66c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

66d
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

From: "Wayne Stewart" <wstewart@csolutions.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 8:39 PM
Subject: Green River flow fluctuations

Mr. Crookston,

67a I am a Utah resident and fly fisherman. I've been fishing the river for about 13 years now and would like to request that you make a change in the fluctuations in the future. I wade and float the river when I fish. This last year I noticed that the consistency of my fishing experience has changed. I've noticed it in previous years as well but only became aware of the reason this last year. When water flow is changed the fishing is disrupted as the fish adjust to the new flow. This often happened in the middle of the day.

67b I would like to request that these flows be changed during non-fishing hours, after dark and enough before daylight that it won't effect the fishing experience. I've spoken with a couple of people who've done some research and understand that the change I'm requesting is not only possible, it is appropriate. I have friends and family members from Colorado, Ohio, Michigan, New York and California who come to Utah to fish a couple of times a year and one of our favorite spots is the Green River. They spend a lot of money when they visit and some mentioned their disappointment wit the river this year. One group, my college buddies, have scheduled a trip to Idaho next summer instead of the Green. Please adjust the flow schedule to accommodate the fisherman and other recreational users.

Sincerely,

Wayne Stewart

67. WAYNE STEWART

67a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

67b
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

From: Strong <strong@easilink.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 7:47 PM
Subject: Flaming Gorge EIS

68a Dear Sirs, as a Vernal city/Uintah County residentI wish to register my support for the action alternative to release surplus water during high runoff years from the Flaming Gorge dam. I believe the overall positive impacts from the increased flows are more than worth the various other negative impacts from the proposed releases.

Thank you

Steven Strong
Vernal, Utah

68. STEVEN STRONG

68a
Comment noted.

From: Jeff Talus <JTalus@skrco.com>
To: "'fgeis@uc.usbr.gov'" <fgeis@uc.usbr.gov>
Date: Mon, Nov 15, 2004 1:06 PM
Subject: Green River Flows

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774

69a I support the single daily peak hump restriction, but its timing should be in a manner so that it has no impacts on river recreation activities, especially fishing and floating. Not withstanding the negative impact to fishing and floating the daily flow changes had last summer, there is the
69b issue of safety, to which I will provide the following personal experience. During the weekend including 6/27/2004 I was part of a group camping on the B section below Flaming Gorge Dam. We left the campsite Sunday the 27th shortly after noon heading for Indian Crossing with the intension of returning home to Colorado Springs. I was rowing my drift boat and a friend was rowing his raft. Since a drift boat had more room than a raft, most of the gear was loaded into my drift boat for the trip down river. At Red Creek rapids, my passenger exited the boat to make the usually walk down the rapids while I rowed through. Unfortunately, as a result of the low flow, heavily loaded boat, and a rowing error on my part my boat ended up stuck on Dragons Thumb rock in Red Creek rapids. The boat was resting on its side on the upstream side of the rock with about 1/3 of the boat underwater. We tried to free it with the ropes we had but the current was too much so we left for Dutch John with the intension of returning later that day with more ropes and/or gear. When we returned later that day we found that the boat was now almost completely covered by the increased flow and pulling it off the rock was no longer an option during the increase flow. We were forced to stay overnight waiting for the flow to subside before we were able to free the boat the next day. Unfortunately, we were unprepared for another night of camping since some of our camping gear had floated down river after the earlier stranding. And it was a very cold and rainy night, probably in the low 40's. Luckily everyone survived the ordeal but it certainly could have ended differently.

69c Therefore, I believe the daily peak hump should be set in a manner so that it has no impact on river recreational activities, especially fishing and floating, and so that it does not endanger river users during recreation nor have a negative impact on the fish, which I understand are suppose to have a priority over power generation under the authorized purposes of the Flaming Gorge dam.

Sincerely

Jeffrey W. Talus, CPA

69. Jeffrey W. Talus

69a
The single daily peak hump restriction is outside the scope of the EIS; such operational details would continue under any alternative.

69b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

69c
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS. Please see response to individual letter 38 above.

From: "john & carson taylor" <owlck35@infionline.net>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 1:51 PM
Subject: comments of John I. Taylor on Flaming Gorge Draft

I thank you for the opportunity to comment on the DEIS for the reoperation of the Flaming Gorge Dam. This comment is submitted from the perspective of a private recreational user (whitewater boating and fishing) of the waters below the dam.

70a I strongly support the action alternative as this will create a more *natural river hydrograph, one that may make it possible for the recovery of* the listed endangered fish. I also support any modifications to the DEIS which would even more closely mimic the natural hydrograph of the Green River that existed prior to the building of the Flaming Gorge Dam. It seems to me that the recovery of the listed species is only possible if we restore to the extent possible the natural hydrograph.

Nor will such an operation of the dam adversely impact the opportunity for whitewater boating. I have had the good fortune to run the Yampa at high flood in May of 1983 (c. 20,000 CFS) and the Gates of Ladore during Fall base flows (c. 800 CFS). Both trips are wonderful, offering different but great recreational experiences. This would not change under the action alternative even if modified to more accurately mimic a pre-dam river.

The same is true for the tail waters fisheries below the dam. Roiling high water is never great for fishing whereas lower base flows are conducive to good fishing. Nothing would change under the action alternative, even if further modified.

In conclusion, this is about more than the survival of the listed species. Rather, the recovery of the listed species will indicate that the riparian and riverine ecosystems are functioning as they did before the dam. It is only under such conditions that the listed species can recover.

Thank you,

John

I. Taylor

CC: <csmith@amrivers.org>, <bmiller@westernresources.org>

70. JOHN I. TAYLOR

70a
Comment noted.

From: Jim & Linda Thompson <lthompson28@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Oct 31, 2004 12:19 PM
Subject: Comments on Operation of Flaming Gorge Dam DEIS

Dear Mr. Crookston,

My purpose in writing is to submit a few comments concerning the recently released DEIS of the "Operation of Flaming Gorge Dam". Please consider the following:

As always, I've been a strong supporter of doing whatever we can to assist wildlife, especially those that are endangered, threatened, or sensitive. I realize there are many demands from many different factions on the dam and reservoir. However, what really ought to come first, are the needs of the native fish and wildlife species that once thrived in the area before the dam's construction. True, it's great that there have been attempts to mitigate or ameleorate some of the negative impacts of the dam and its fluctuating river flows down stream, and that we still are trying. But it seems like a futile battle, in that the endangered populations are still declining--mainly due to the dam's impacts. So, yes, I guess I can
71a support the Proposed Action Alternative, but I'm not convinced anything will really do the job short of decommissioning the dam. So good luck!! I hope something will work--and maybe the proposed action will. Thank you for your attention. Sincerely, James W. Thompson, 3801 Viking Road, Salt Lake City, Utah, 84109, home ph: (801) 272-3683

71. JAMES W. THOMPSON

71a
Comment noted.

From: <PhilH2O@aol.com>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 4:55 PM
Subject: Flaming Gorge Environmental Impacat Statement

Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Dear Mr. Crookston,

72a I write to express my concern that flow management below the Flaming Gorge Dam may not be implemented to the best interests of recreationists, particularly fishermen. If, in fact, power generation can be managed while also coordinating flows that do not negatively impact fish, feeding patterns and the ability to safely navigate the river as well as wade its banks then please see that future policies express this desire.

72b The Green River below Flaming Gorge is an important and desired destination for sportsmen. Should the quality of the fishery be negatively impacted then our fear is that it most definately will negatively impact the economics of the surrounding area including the hamlet of Dutch John.

Sincerely,

Phil Waters
7322 Brook Trout Trail
Evergreen, CO 80439

72. PHIL WATERS

72a
The issue of fluctuations for power is outside the scope of this EIS; such operational details would continue under any alternative. Please see response to individual letter 38 above.

72b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

From: "bryanhwe" <bryanhwe@msn.com>
To: <fgeis@uc.usbr.gov>
Date: Sun, Nov 14, 2004 12:03 PM
Subject: Green River Flows

73a I have experienced the high and low flow rates several time this summer and must express my distaste for this practice. Not only do I feel it is an unsafe thing to do to wade fishermen, it has spoiled my entire day
73b fishing and puts me off on going to the green if this is going to continue. When I have limited time too spend fishing I want it to be worthwhile and therefore will go to waters (in Idaho) that do not do this up and down thing if this continues. I feel that my option and that of others that I know feel the same why should be seriously considered as not to adversely affect the generation of money spent in the Green River recreation area lost to other states. Lets even out the flows and have the best of both worlds, a win win
73c situation can be made here.

Bryan Weight

73. BRYAN WEIGHT

73a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

73b
Reclamation agrees that the safety of fishermen and others along the Green River is very important. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed, and so the fluctuations are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

73c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

From: "Hallie Serazin/Jim Wilson" <robinsnest@midohio.net>
To: <fgeis@uc.usbr.gov>
Date: Sat, Nov 13, 2004 7:37 PM
Subject: single peak flow management

TO:
Mr Peter Crookston
Flaming Gorge Environmental Impact Statement Manager
PRO-774
Bureau of Reclamation, Provo Area Office
302 East 1860 South
Provo, UT. 84606-7317

Greetings Mr. Crookston,
I write from Ohio. Other than the Lake Erie walleye fishery, which is under significant pressures, there is little to be proud of or get excited about in comparison to the magnificent Green River trout fishery. However, there is building momentum in our part of the country to take practical, doable steps to improve natural stream flow and habitat by doing such things as removing unnecessary low head dams on many of our river systems, and incentivizing conservation practices such as grassed filter strips along tributaries located on agricultural use land.

So why do I take the time to correspond from Ohio on the issue of flow management at Flaming Gorge ? I have been dreaming of the times soon to come when I will take my family and our young teen age son to get to know the special places in the American west. Fishing is sure to be a big part of that experience. Flaming Gorge and the Green River are sure to be a target destination. When we arrive will we find the best fishery possible?
74a Or, will management practices respond to some other set of priorities at the expense of the fishery ?

74b I encourage the Bureau to remain committed and responsive to the order of priority in the responsibilities with which it is charged. Please do all that is within your authority to operate Flaming Gorge in a manner that recognizes the specialness of the Green River fishery.

Warmest regards,

Jim Wilson
Delaware, Ohio

CC: "Denny Breer - Fish Green River" <dbreer@union-tel.com>

74. JIM WILSON

74a
The EIS states Reclamation's intent to balance the needs of all resources when making operational decisions under both the Action and No Action Alternatives. We appreciate your concern that power generation might have benefited at the expense of fishing and other uses. However, the analysis of the cumulative effects on hydropower generation shows that power has not been elevated above other authorized purposes and that, in fact, there have been losses to hydropower over the last 20 years. Please see section 1.4.2 for more information. The proposed action will not have a negative effect on the sport fishery, as shown in chapter 4 in the EIS.

74b
As stated in section 1.5 of the EIS, Reclamation's priorities are first, dam safety and then second, meeting project purposes in compliance with ESA.

Long-term negative effects to the tailwater trout fishery are not expected under the Action Alternative. Please see response to individual letter 38 above.

From: "Marshall Wilson" <mswilson33@earthlink.net>
To: <fgeis@uc.usbr.gov>
Date: Fri, Nov 12, 2004 7:13 PM
Subject: Flaming Gorge EIS

Dear Mr. Peter Crookston,

75a I am writing to express my concerns over the continued efforts to fluctuate flows from the Flaming Gorge Dam and hope that you will consider my comments in your decision on the Impact Statement. I have been making on average 3 trips a year to the Dutch John area and contributing to the economy of that area for over a decade now. Two fo these trips ususally fell in the late Spring and Summer. Seeing as I own my own drift boat, I usually bring 2 or more friends with me each time I visit.

I can honestly say that if you continue to advocate and fluctuate flows like you have this past year that I will no longer be making these trips to the Green. The fishing will be better elsewhere. And why would I want to to purchase an out of state fishing license, a Parking Pass! and fishing supplies if the fishing will be
75b nothing short of terrible? I'm sure the economy had to have suffered. I am a professional in the Travel and Leisure industry and I, like you, understand the importance of revenue streams in the economy. You can bet that the status quo will have an impact the you can quantify early.

75c I hope you will consider generating power at a higher, steady flow. Can you not produce the same amount of electricity either way? I would think this would be a great compromise.

All the Best,

Marshall Wilson
P.O. Box 3770
Copper Mountain, CO 80443-3770

CC: <dbreer@union-tel.com>

75. MARSHALL WILSON

75a
The issue of daily fluctuations is outside the scope of this EIS; such operational details would continue under any alternative.

75b
Implementing the Action Alternative is expected to have an overall positive effect to the three-county area near Flaming Gorge Dam. Please see response to Town of Manila, Utah, 3a.

75c
The changes in releases, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Increasing the releases at night or having a constant release during the day would not help meet the peak demands for electricity. However, in more recent years, the ramping rates have been scaled back to limit the changes in releases throughout the day. Please see response to individual letter 38 above.

FGEIS ZZ401 PRO

From: "Crista Worthy" <cristaworthy@hotmail.com>
To: <fgeis@uc.usbr.gov>
Date: 10/12/2004 10:41 PM

The health of the Colorado River is of great concern to me. I frequently fly to Utah or Arizona for backcountry hiking, and over the years have seen the area change for the worse.

76a The dams, as you know, have completely changed the character of the river. Mitigation below Glen Canyon Dam has not worked. Instead of looking at each section separately, we need a comprehensive, basin-wide approach to the recovery of the fish living in the Colorado and its tributaries.

The congressional ban on studying the decommissioning of the Glen Canyon Dam should certainly be removed! I have spent an enormous amount of time in this area. The side canyons are recovering now that the water is low. Plants, animals and birds are quickly returning.

76b We should study the replenishing of underground aquifers for water storage, instead of the reservoir, which loses so much water each year to evaporation. 30,000 dump truck's worth of silt flows into Lake Powell each day. It should be going into the Grand Canyon. Eventually the Glen Canyon Dam will be useless anyway.

I hope to hear what decisions you make.

Sincerely,
Crista Worthy
16664 Calle Brittany
Pacific Palisades, CA 90272
(310)560-7324

76. CRISTA WORTHY

76a and 76b
Both of the commenter's concerns are outside of the scope of the EIS.

PUBLIC HEARINGS

Moab, Utah – October 12, 2004

1. **John Weisheit, Living Rivers**

Salt Lake City, Utah – October 13, 2004

2. **Enos Bennion**
3. **Leslie James, CREDA**

Rock Springs, Wyoming – October 19, 2004

4. **Janet Hartford, Chamber of Commerce of Green River, Wyoming**

Dutch John, Utah – October 20, 2004

5. **Chad L. Reed, Daggett County Commissioner**
6. **Deloy Adams, Flaming Gorge Lodge**
7. **Dennis Breer**
8. **Jerry Taylor, Lucerne Valley Marina**

Vernal, Utah – October 21, 2004

9. **Steven Romney, Uintah Mosquito Abatement District**
10. **Edmond Wick**
11. **Melissa Trammell, National Park Service**

PUBLIC HEARING
HELD: OCTOBER 12, 2004, 6:00 P.M.
AT: RAMADA INN
182 SOUTH MAIN STREET
MOAB, UTAH

John Weisheit

My name is John Weisheit. I represent Living Rivers. I'm the conservation director. I also represent Colorado Riverkeeper. I'm the program director. The Riverkeepers Alliance—Waterkeeper Alliance, who sponsors my designation in Colorado Riverkeeper, and I also represent 50 groups. I believe those groups are listed in our scoping comments that supported our letter, scoping letter that we wrote back in July of 2000. And I also represent Colorado Plateau River Guides, because they were one of the sign-ons for the letter, and there are about 15 -- well, almost everybody here is a member of Colorado Plateau River Guides.

If I have more time, please let me know.

1a First of all, we do not think that the flows are high enough in Reach One to reduce the encroachment of vegetation which promotes channel narrowing and changes the natural morphology of the river, which is essential for spawning and nursery habitat.

1b We are also not fully convinced that the Bureau will successfully time the high water releases at the most advantageous time for the native fish. We think it is highly possible that the Bureau could inadvertently flush larval fish downstream into inappropriate nursery habitats downstream that would bring diminished recruitment and native fish mortalities.

1c We also think the Bureau should produce higher flows into Reach One to store sediment on the margins of Lodor Canyon and Dinosaur National Monument, with such subsequent improvements to the riparian habitat such as the recruitment of cottonwood trees, which are greatly diminished in this particular National Monument.

1d Most importantly, we believe that the Bureau should take a leadership role in providing a fish ladder at the Tusher Wash Diversion Dam near Green River, Utah. This would also include a device that would stop the incidental take of endangered fish that occurs as they migrate into man-made canals and waters that flow into powerhouse at this Green River.

The Colorado River system is under considerable stress at the present time due to the effects of climate change or extended drought. We feel that the proposed flow and temperature regime could be jeopardized by the circumstances of the changing global climate. We have concerns about a complete draw down at Flaming Gorge Reservoir should there be a compact call by the lower basin states. We are also concerned about lower water quality from the reservoir as it is returned to the river bed below the dam
1e during such an emergency situation. We therefore ask that the issue of climate change be addressed in the final EIS.

1f We are also disappointed that a survey—sediment survey was not done for the following reservoirs: Fontenelle, Flaming Gorge on the Green River and the Taylor Draw on the White River. To our knowledge, no sediment study has ever been formally completed on any of these reservoirs. We feel that it is not only essential, but it is also the responsibility to monitor the rate of reservoir sedimentation so that the Bureau can effectively manage the dam and reservoir for the purposes and needs for which it was built, and for the safety of the general public.

This is my big picture testimony.

We are not convinced that the Bureau of Reclamation is providing the necessary leadership that is truly required to improve the critical habitat of the Colorado River Basin for the benefit of the endangered fish species. Nor for that matter, the benefit of human beings.

In 1979 the General Accounting Office reported that unless substantial management changes were completed by the year 2000, the Colorado River plumbing system would fail the needs of both the environment and for human consumption. Their caution has since become a promise fulfilled.

The Bureau must stop this piecemeal, one-dam-at-a-time approach to Colorado River management. We need solutions to our problems throughout the basin and not the
1g standard maintenance of the status quo. A basin-wide programmatic EIS must begin as soon as possible for the entire Colorado River Basin.

This programmatic EIS must be willing to accept all alternatives, especially those which are politically uncomfortable and unpalatable, such as dam decommissioning. We need to get rid of some of the infrastructure immediately to bring about better water efficiency for both human needs and for the endangered fish.

1h That alternative is the recharging of the depleted aquifers throughout the Colorado River Basin.

These aquifers can hold more water than the 62 million acre-feet of storage the Bureau has constructed since the 1902. These aquifers were already dangerously—are already dangerously depleted and need to be refilled before they close or subside more than they already have. By recharging our underground storage sites near cities and farms, we have no more reason to depend on wasteful reservoirs that evaporate precious water, reduce the water of—quality of the water, particularly the reduction of salt, nor do we have to worry about the consequences of dam failure.

I just wanted to say that we will be writing some more significant comments. I still have yet to read the entire document. I have comments in support to look at the biological opinion, which I haven't been able to find.

I also need to interview U.S. Fish and Wildlife and biologists and get more information, so I just wanted to let you know that thanks for having—letting us have another six days. I might need it. And so I look forward to learning more about what some of the other people are saying about this and promise to include them in future letters in the form of our final—our letter for the final EIS.

1. John Weisheit, Living Rivers

1a
Comment noted.

1b
Reclamation will develop an annual operational plan with substantial input from the Technical Working Group. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made using the criteria listed in table 2-5 of the EIS. Additional input from the Flaming Gorge Working Group would also be considered in planning operations. This allows opportunities to refine flow attributes based on an adaptive management process.

Also, the Recovery Program has monitored and likely will continue to closely monitor timing of endangered fish larval drift for the purposes of contributing to the flow planning process. Studies occurred in May-June 2005 to monitor dynamics of larval drift and entrainment over a range of flow elevations. The 2000 Flow and Temperature Recommendations recommend use of such real-time information gathered by the Recovery Program in determining the specific magnitude, duration, and timing of flows within any given year; and the EIS further recognizes the role(s) of continued research and monitoring in refinement of flow recommendations through an adaptive management process.

1c
The commenter speaks to establishing cottonwood in the national monument, part of which is in Reach 2. For example, the cottonwood forest in Island Park was studied in conjunction with hydraulic modeling of flows of the Green River completed by the National Park Service in 2001. Channel aggradation was noted for that portion of the Green River. It was also noted that growth of vegetation in the channel would increase the rate of sediment deposition locally in this area (*Two Dimensional Computer Modeling of the Green River at Dinosaur National Monument and Canyonlands National Park,* Gessler and Moser, July 2001).

1d
A decision as to the necessity and feasibility of a fish passage at Tusher Wash Diversion is a responsibility of the Recovery Program and is outside the scope of the Flaming Gorge EIS.

1e
Reclamation did not attempt to project specific climate changes into the future as these projections are considered speculative and difficult to quantify from a hydrologic standpoint. If climate change does occur, it will impact the inflow statistics and the hydrological year classification that will be used for making decisions about how to operate in a given year.

1f–1h
The commenter’s concerns are outside of the stated scope of the EIS.

PUBLIC HEARING
HELD: OCTOBER 13, 2004, 6:00 P.M.
AT: MARRIOTT HOTEL
75 SOUTH WEST TEMPLE
SALT LAKE CITY, UTAH

Enos Bennion

I came unprepared tonight. I was looking to have an opportunity to review this draft copy. And my only comment on this is I've had a hard time finding this document. I really think that you could do a better job advertising some way so that the public would have an opportunity to review this before this type of meeting. I don't know how we do that. I'm sure if I was not so ignorant, I would know what office I could go to, because you did mention you had sent a number of these things out. And they were available to the public.

I attended a meeting that was held in Vernal several years ago, and it was a discussion of the operations of Flaming Gorge itself, the water flow, fish management, recreational management and the whole schmear, and it was a public meeting, and maybe some of you people were in attendance at that meeting. But I got—I signed up for feedback on the information that was presented that night, and I did not receive it. So I know this is rather negative, but this has been my concern.

And I really can't comment on this tonight because I haven't had an opportunity to review it. But I would like to say that I have a concern over the total operation of the Flaming Gorge recreational area and the downstream area. From the standpoint that the objectives of the project itself, which started out early on as a flood control, a recreational area and power, economic power to pay for the project.

Later on, I guess, in the—after the completion of the dam, we got into the—the—you know, the law that cranked in protection of the fish and so forth, and since then I figure that—from what I can find out, that that's the primary reason for the dam at this point, number one priority, rather than the power or the recreational area that is often at the Flaming Gorge facility.

And I think it's a little out of balance. And that's probably because I haven't had an opportunity to see what kind of progress we've made here. I know that two or three years ago, of the four fish that were identified here, it was reported that one of them was basically extinct, and we hadn't had very much success in—in, you know, recovering the fish.

I can probably read this and find out how that progress is coming. Are we enhancing the environment for the fish by what we're doing? And I hope this will answer that. Or are we trying to do something else now to enhance it further?

2a In my simple way of thinking, it would seem to me like the best way to duplicate the environment that these fish should see when they were flourishing would be to fill the dam all the way up and let the high water take care of the overflow and just basically create an environment that was there before the dam was there to start with.

I can't see what is the matter with that plan or why it would be any different than the way it was before the dam was in place. We'd have high water in the springtime when the dam was overflowing and it would be a natural way of providing the environment that these fish once had.

And that's about all I have to say, but I—I do appreciate getting this information. And I plan on making some comment once I have an opportunity.

Leslie James

My name is Leslie James, representing the Colorado River Energy Distributors Association, CREDA. Our—my address is 4625 South Wendler Drive, Suite 111, Tempe, Arizona, 85282.

I'd just like to make a few remarks and we will submit some written comments within the time period.

CREDA is an organization, nonprofit, that represents the majority of the CRSP, our customers in the six western states. Our members serve about three million citizens in these six states.

I'd like to just point—make a couple of general statements. We fully appreciate the efforts that Reclamation has undertaken in developing this draft EIS. We recognize the difficulty is to balance all of the comments and all of the interested party information.

3a I'd like to point out two things, though. The Colorado River Basin Project Act expressly provides in it that nothing shall amend or modify the compacts, the treaty with Mexico or the Colorado River Storage Project.

And I make that comment with regard to the purpose and need section of the draft EIS.

3b A second general comment. Endangered fish recovery efforts are the express purview of the Endangered Fish Recovery Implementation Program, and to impose a standard other than to avoid jeopardy in our view is inconsistent with NEPA and the ESA.

We will submit, as I said, some detailed comments on some of the following areas of the draft EIS: the cumulative impact section, the hydropower section, environmental consequences with regard to the spillway use, financial analysis results. And we will also recommend that cash flow analysis also be incorporated into this draft EIS, particularly with regard to the current basin fund situation related to the drought conditions. And also flow recommendations and flooding section.

We are a participant in the Upper Basin Endangered Fish Recovery Program, and working through our biologist in that program, who was very involved in developing the
3c full recommendations, it's our opinion that the intent of those recommendations is to obtain an average of flows and not to meet specific flows.

3d These are recommendations, they are not mandates. And we also understand that there is significant new scientific information which has been discussed by the biology committee of that program as late as August that information should be incorporated into this draft EIS.

Thank you for the time.

2. ENOS BENNION

2a
The commenter's suggestion is a run of the river alternative. Please refer to section 2.2 of the EIS for related information.

3. LESLIE JAMES, CREDA

3a
The purpose and need is consistent with all applicable Federal laws, and Reclamation agrees that nothing in the CRBPA amends or modifies the compact or international treaty with Mexico.

3b
Development of water resources was highlighted in the EIS narrative to illustrate the close connection between this authorized project purpose, the proposed action, and the Recovery Program. Avoiding jeopardy to listed species and assisting in their recovery is consistent with both statute and the agreements of the Recovery Program.

3c
The intent of the proposed action (Action Alternative) is to achieve the 2000 Flow and Temperature Recommendations while maintaining and continuing all authorized purposes of the dam. Both the 2000 Flow and Temperature Recommendations and the EIS describe spring peak flows as "greater-than-or-equal-to" a given flow, indicating a minimum peak flow, not an average.

3d
The EIS was prepared using the best available information, and updates were included where appropriate in preparing the final EIS. The EIS acknowledges the flexibilities and uncertainties of implementing the 2000 Flow and Temperature Recommendations, and adaptive management will be used to address uncertainties as explained in the EIS.

PUBLIC HEARING
HELD: OCTOBER 19, 2004, 6:00 P.M.
AT: HOLIDAY INN
1675 SUNSET DRIVE
ROCK SPRINGS, WYOMING

Janet Hartford

I'm Janet Hartford. I'm the director for the Chamber of Commerce of Green River, Wyoming, located at 541 East Flaming Gorge Way in Green River, Wyoming, 82935.

At the September Board of Directors meeting I brought up and passed out a copy of a basic statement about the EIS and your folks asking for comments. The Board of Directors unanimously voted for me to write a letter to you—and so I will read that letter to you—in regards to your EIS, and their unanimous action or support is to take no action. So I will read that letter and then I will give it to you.

"Dear Mr. Crookston,

"I am writing you in regard to the EIS that will affect the Flaming Gorge Dam and the proposed flow regulations. The Green River Chamber of Commerce would like to strongly express its recommendation and support to the NO ACTION plan. The Chamber feels that any change in flow would dramatically affect several aspects of the Flaming Gorge area.

4a "Sweetwater County looks upon Flaming Gorge Lake as a great tourist attraction that funnels over 90,000 tourists (sic) to the area a year. That translates into dollars that are spent not only at marinas but also at the service industries, in other words, the gas stations, sporting goods stores, grocery stores, restaurants, hotels. We also rely on the lake as a recreation for our local residents. Our youth, as well as the rest of the Sweetwater County community, spend many days of the summer at the lake.

4b "The lower level would be detrimental to the economy as well as our way of life. Sometimes change is good, but in this case, we do not feel this kind of change is beneficial. There is no guarantee that by changing the flows, the endangered fish in question will prosper, but it is a guarantee that game fish, recreation, quality of life and the economy will become endangered.

"Thank you for the opportunity to express our opinion."

And it's signed by myself and it is in support from the Board of Directors.

Thank you.

4. JANET HARTFORD, CHAMBER OF COMMERCE OF GREEN RIVER, WYOMING

4a
Comment noted.

4b
There are no requirements of the 2000 Flow and Temperature Recommendations or the 1992 Biological Opinion which specify particular reservoir elevations. Reservoir elevations are a product of dam safety and water storage. The EIS shows that the reservoir elevation would be more stable under the Action Alternative. See figure 4-1 in the EIS for a comparison between alternatives of the mean monthly reservoir elevation.

PUBLIC HEARING
HELD: OCTOBER 20, 2004, 6:00 P.M.
AT: DUTCH JOHN CONFERENCE CENTER
SOUTH BOULEVARD
DUTCH JOHN, UTAH

Chad L. Reed

I am Chad L. Reed, representing Daggett County as a county commissioner. We will be submitting written comment, but we wanted the opportunity to make verbal comment at this time.

In reviewing the EIS and in participating in past meetings dealing with the flows of Flaming Gorge Dam, we are somewhat pleased with some of the outcome of what is at least in the proposed EIS, but we would like to refer to at the inception of the Flaming Gorge Dam, there was assurances that were given to the county commissioners at that time that the process was of a national recreation area being developed, and those areas of recreation, management and utilization of the natural resources and the promotion of the area would not negatively affect the overall economic development of Daggett County.

And to refer to page S-4 of the Executive Summary, it gives some statements referring to the National Recreation Area Act of 1968 that gives some three specific reasons or purposes that a creation of Flaming Gorge Recreation Area and the Flaming Gorge Dam.

I'm going to comment on more than three but they state that the purposes for the area was to—and the development was for the public—public outdoor recreation benefits, conservation of scenic, scientific, historic and other values contributing to enjoyment and such management, utilization and disposal of natural resources that would promote or are capable—compatible with and do not significantly impair the purposes for which the recreation area was established.

Furthermore, there has been other information provided through—information has been given to the public and through the creation of the legislation of Flaming Gorge Dam that one of its sole purposes was for the creation of hydroelectric power.

5a With these statements that we've made, it's of grave concern to the county officials of Daggett County that all economic impacts of this state would be protected in the future dealing with the study that has been done for the stability of those businesses that are already in the area and those in which we are trying to also bring to the area through the development of Dutch John, Utah, and the privatization of Dutch John and the resources that was transferred to Daggett County with the purpose of further development, which was—transferred to approximately 25 hundred acres for further development of the public area to enjoy.

The main three reasons that the—you know, dealing with three reasons that I mentioned earlier, mainly they're recreation benefits. We appreciate the opportunity to comment and we'll make written comments also.

Deloy Adams

My name is Deloy Adams. I'm one of the owners of Flaming Gorge Lodge. We are—we actually own two of the outfitter permits on the Green River from the dam to the Colorado border. And basically I do have some concerns about the action plan, but I will consolidate those in writing.

6a One of—in a conversation I had earlier today with Roger Schneidervin from Utah Division of Wildlife Resources, one of the items he touched on was ramping the flows. And I think as an outfitter that's an area of deep concern not only for the benefit and 6b welfare of the trout fishery, but one of safety for the public, especially the wade fishermen that are wading at flows of 800 cfs to—there's really nothing that I could see in writing and no specific written agreements to control the amount of flow that could be taken up for generation of power or for an emergency of any kind. Of course, probably in an emergency, it would probably be going the other way from some flow down.

But just this past summer we had several fishermen that were wade fishing down around Little Hole that got stranded with just the flows of going from 800 cfs to 1600 cfs. It would be nice if we could give some kind of notice, even though we have been 6c announcing to everyone that the flows did come up in the afternoon, but if—at 800 cfs, I don't think there's much—as much problem with somebody getting into trouble as if maybe we jumped from 800 to 24 cfs -- 2400 cfs.

That could certainly put some people in some real jeopardy if they were out in the middle of the river at Little Hole. They would not only would not able—be able to get back to the shore, they would basically be stranded with money—with water coming up at a level that they wouldn't be able to move, and at some point in time being washed down and possibly having a serious accident. So I did want to touch on that.

Other than that, probably the biggest concern that I see with the action plan is the 6d temperature requirements and what is of most benefit for the trout fishery on Reach One.

And having said that, I will be putting in a written comment and I appreciate the opportunity of letting me speak, even though I wasn't planning on it.

Dennis Breer

I'm Dennis Breer, B-r-e-e-r. Okay. I planned to sit down today and put my thoughts together on some paper but didn't—didn't get everything done because I got involved in this thing and got carried away and realized it was deeper than what I wanted to get involved in, but.

The first thing I want to do is thank the—for the opportunity to comment on the operation of the Flaming Gorge Dam and the draft EIS and its appendages.

I'm here as a couple of different positions, one as a resident of Dutch John and also secondly as a business owner who lives three miles from the dam and whose livelihood depends on the Green River and consequently is—you know, how the dam is operated affects how my business would be affected as well, so we—you know, thanks for including Dutch John in this process, because I know originally it was not a part of your programming and—which kind of surprised me, because you had Moab on there and yet the place where the most severe impact is right here in Dutch John and it wasn't included, and so I thank you for putting us on the map for your meeting tonight.

I've been a part of the Flaming Gorge Work Group since its beginnings in '93. So I've got a little more perspective than many folks in that. I've sat through the process of all the efforts that the Bureau of Reclamation has made in order to bring all the interested groups together and really try to form a consensus of, you know, all the—all the various interests that have—that have developed around the Flaming Gorge asset, and—and now the dam has been operated and all the values that that has created.

And so I think I have a good understanding of a lot of the issues, and certainly I think the Flaming Gorge Work Group and I have to say I have to commend the Bureau for making that Flaming Gorge Work Group such an effective organization. So thanks to the Bureau for providing that—that window where everybody can get together and express and exchange values and ideas and try to develop some kind of consensus.

I have two approaches that I want to talk about tonight. In fact, I'm going to have to extend the other one and probably come to the Vernal meeting tomorrow night to make another comment on the economic part of the DEIS, but.

In the biological aspect, I think I've come to support most of the aspects of the biological opinion, and in particular what I'm looking at is that, you know, the flow and temperature recommendations for the threatened and endangered species, as long as they're consisted with the maintaining of and whenever possible the enhancement of the Flaming Gorge Tail water Sport Fishery are certain things that I have interest in. And I think that we have seen a lot of common ground in those work groups where the interest of trout and the interest of T and E fish have had a commonality.

In particular, the recommendations that were made in the DIS—EIS is—that I support are the recommendation of flow limitations, fluctuation limitations, which includes a single daily hump fluctuation. In other words, the absence of multiple fluctuations during the day, and that they be done in a reasonable manner, which the recommendation is 800 cfs on the ascending and descending ramp rates, which I think are extremely important as well so we're not jumping the flows up and down and displacing fish in that effort.

And that's in—basically in line with a lot of the historic operations that have occurred over the last ten years during this interim.

The recommendation also for the 55 degree water—Fahrenheit water temperature releases, you know, really help us maintain water trout temperatures down to the Colorado/Utah state line, and—which, you know, keeps the range of trout from the tail water—in the tail water section extremely valuable to us. So, you know, the further the trout can survive down the river, and that 55 degree Fahrenheit water temperature certainly does that.

Those—those things we can agree on because it's—it's things that I think we share with the T and E fish downriver and—and—in their attempt to effect change and help the T and E fish in their effort for recovery. So, you know, anything—and while my basis is on trout fishing, and the reason that is because I'm tied to the trout fishery here, as a guide and outfitter and also as a sport fisher, having been to this river for many years.

And it's been about—since about 1975, so I have a great deal of interest in the river.

I'm going to probably make some comments tomorrow night. I'm going to show up to the Vernal meeting and make some comments, but the first things that I'd like to say about the economic part of this, and when looking at recreation, recreation in Daggett County and in Dutch John is—is probably keen in terms of economics.

7a And in some of the things that were put into the economic aspects and looking at the consequences of the action or no action alternatives, it really stuck out to me in terms of talking about losses of jobs and declines under certain scenarios, which would be the average dry and wet years, and having seen the last four or five years be extremely dry, you know, and I have to wonder what average is anymore. You know, it just—it is—there's no average anymore that really fits that criteria, and so it's kind of hard to really look at it.

7b But anything that affects jobs in Daggett County is generally affecting—being affected by changes in recreation. And so I'm kind of concerned about some of the aspects that are in the biological opinion, in particular when it comes to the recreation industry, because where I'm seeing the most changes are when it comes not to the Flaming Gorge Reservoir, but to the Green River. And so the impacts on that seem to be the most affected area.

7c Well, then that puts Dutch John itself in the most jeopardy and the Green River activities being in the most jeopardy of having economic consequences, and so that's why I'm very, very concerned if the recreation or the guides and outfitters here are taking the brunt of the change—I read a fact or a statement in here that in the tri-county area that recreational services and also car rentals were a small sector of—very small, only like 2 or 3 percent affecting the numbers of jobs. Well, 2 or 3 percent spread over three counties isn't that much, but 2 or 3 percent really equates into 30 or 40 percent in Dutch John, because we are recreation.

So those aspects I think really need to be evaluated and looked at. And some of the bases for some of the information in here, there's parts of it that just does not make sense to me and I think it's too easy to get into voodoo economics. You can prove or disprove anything by, you know, the facts. And one of the things that I did notice in the—in addressing recreation in here was that a lot of the language is skewed towards the positive side of it.

So I'm going to make written and possibly show up for the meeting tomorrow night about the economics, and I think that our county commissioners should be extremely concerned about the loss of jobs and recreation opportunities on the river under these different scenarios and be very concerned and at least have some idea of what's going to happen as these things move forward.

Biologically I'm very much in favor of the steps that the Bureau has taken in terms of T and E fish and with the trout fishery, but it comes as an economic cost to the local community, and I'm concerned about that.

Thank you.

Jerry Taylor

My name is Jerry Taylor. I am owner and operator of Lucerne Valley Marina and Flaming Gorge Corporation. We're concessionaires with the Forest Service. We've been on the lake in operation since 1965. We put Buckboard Marina in originally and sold it to Les Tanner, who still operates it.

And basically we're here to make sure that the infrastructures that are operating on the lake, the marina operations and stuff are represented with their concerns about the economic viability of those operations.

All of the marine operations around Flaming Gorge essentially are marginal marine operations in inland-water waters. They're seasonal in nature, they are—if you look at the economy of scales and if you check with a Ph.D. at Western Illinois University who does inland water marina studies, he will tell you that the economy of scale for marine operations is 300 slips.

None of the operations on Flaming Gorge meet that criteria. So if you look at the economies of scale, you're talking about a system that has operating expenses right on the back end of their income on a—on a regular basis, a seasonal basis, and a yearly
8a basis. Because we can't—we haven't achieved the economies of scale that would allow us to have a larger margin to work with.

Because we're working on such short margins, our operations are very sensitive
8b to fluctuation of water levels and those kinds of things. Currently all three marinas are going through some transition with the current water levels.

We probably spent an additional $23,000 in expenses for the '04 operations of Lucerne Valley Marina this year, relative to moving fuel lines, power systems, water systems, communications systems to operate our fuel dock on the other side of the ramp at Lucerne.

Those are things that have a major impact on our—our overall income for this operating season. Coupled with some of the other things that's going on, so what I'm saying is that the operations and the marina operations that are on Flaming Gorge are very sensitive to economic impact. And fluctuating waters is a major thing to deal with.

Our situations are somewhat unique and we do operate on very steep inclines on the lake, except for Buckboard, which has some shallow water warnings. And of course, when they lose the shallow water warnings, then they have to move the facilities even farther to facilitate enough floatation to facilitate the slips in the location on the water, so. They can actually have more impact up there in the shallow operations.

The Forest Service has considered additional marina operations on the lake, which would be Firehole. That's not even feasible under current water conditions for that operation to either be established or to operate under current water levels.

So those are some of our concerns. I have attended the flow meetings for this process historically from the time that it first started and will be there each time they talk about the annual flows, and those should reflect the amount of water that's available for
8c Mother Nature for each year's releases.

Thank you.

5. CHAD L. REED, DAGGETT COUNTY COMMISSIONER

5a
Comment noted.

6. DELOY ADAMS, FLAMING GORGE LODGE

6a
Ramping the flows is outside the scope of the EIS. However, it is noted that the changes in flows, as part of the operation of the powerplant, are designed to help meet the demand for electricity as usage of electricity increases during the day and decreases at night. Meeting peak demands is currently tempered by environmental and other concerns. This operational detail would be the same under either the Action or No Action Alternative. Please see section 4.4.1 in the EIS which accurately describes the limitations of ramp rates.

6b and 6c
Reclamation agrees that the safety of fishermen and others along the Green River is very important. Currently, through efforts of the Flaming Gorge Working Group, the agreed upon ramping rate is established at 800 cfs per hour. This ramping rate has been the agreed upon standard since the Flaming Gorge Working Group meeting of April 11, 1994. There is prominent signage along the river warning fishermen of the potential for sudden fluctuations. A warning horn at the dam is also sounded before increased dam releases begin. Daytime fluctuations have been a part of operations since the dam was completed 40 years ago, and so are common knowledge among those who have visited the river in the past. Nevertheless, Reclamation continues as part of its management of Flaming Gorge Dam to pursue all reasonable means of providing notification to the public of river fluctuations and other public safety concerns.

6d
See section 4.7.2.4.1.2 in the EIS. In dry and moderate years, 55 °F (13 °C) water would continue to be released from the dam as it is currently, resulting in no more impacts to trout during summer months than are currently sustained. Long-term negative effects to the trout fishery are not expected under the Action Alternative.

7. DENNIS BREER

7a
Average, wet, and dry flows and reservoir water levels by alternative were estimated by the hydrologic model by superimposing Action and No Action Alternative operations on conditions experienced across a hydrologic period of record.

7b
The EIS shows that Green River recreation visitation could be negatively affected, particularly during wet and dry conditions.

7c
While lack of county specific recreation expenditure data precluded a county by county socioeconomic analysis, the loss of Green River recreation visitation and expenditures during wet and dry conditions (each estimated to occur 10 percent of all years) may suggest adverse impacts to Dutch John. Gains on the reservoir may outweigh losses on the river for certain businesses, while others (e.g., commercial guide operations) may be disproportionately affected. The point that a relatively small loss within the

three-county area, if concentrated within a single county or community, could occur is well taken. Clarifying text was added to section 4.12 in the EIS.

8. JERRY TAYLOR, LUCERNE VALLEY MARINA

8a–8c
Comments noted.

PUBLIC HEARING
HELD: OCTOBER 21, 2004, 6:00 P.M.
AT: WESTERN PARK CONVENTION CENTER
300 EAST 200 SOUTH
VERNAL, UTAH

Steven Romney

I've already left a copy of my oral record with your recorder. This will be surely less than five minutes, but I'll just read it off quickly.

I am Steve Romney, director of the Uintah Mosquito Abatement District that's located now coming up on 30 years in Vernal, Utah. And I'll present my commentary.

This is specifically as per the Green River Bottomlands Reach 2 of Project Area That's fundamentally our major operating area as far as the river drainage goes.

All right. I'll just quickly read this and go from there.

"When seasonally flooded with river sub-up or overflow water, the Green River bottomlands region in question presents enormous acreages of some of the most productive aquatic mosquito habitat in western North America. Literally millions of mosquitoes per acre can be produced. Many thousands of acres of such habitat are involved. The most important mosquito species are of the genera Aedes, Ochlerotatus, Culex and Anopheles. Some floodwater species can and often do migrate in staggering numbers as far as 20 or more miles from their bottomlands points of origin and present a substantial threat to the public health, veterinary health, ranching and agriculture, outdoor recreation, outdoor commerce and the economically vital tourist industry in Uintah County.

"Of new and greatest concern is the ongoing potential for the large scale river bottomlands production of the mosquito species Culex tarsalis, an extremely abundant and highly competent local vector of West Nile Virus. Ecologically, the additional and superbly productive mosquito habitat to be activated with the artificially enhanced and prolonged flooding of the Green River periphery presents a reproductive bonanza for this now critically important species. Due to the flattened, almost level contour of much of the Green River bottomlands topography, even minor increases in river elevation at high water can translate into huge additional acreages of sub-up and overflow mosquito habitat.

"The presence of mosquito-borne West Nile Virus in Utah was first documented in the late summer of 2003. That year the first human and equine West Nile Virus infections ever recorded in Utah were acquired in Uintah County"—not too many feet from this building. "Our neighbor state of Colorado suffered an incredible 2,947 human West Nile Virus infections in 2003. 63 were fatal. At season's end, 2004, ten human West Nile infections had been recorded in Utah. Two cases were acquired in Duchesne County. The newly arrived virus is now permanently established in the Uintah Basin and many other regions of Utah. The 2005 and future seasons will thus undeniably present every real possibility of severe outbreaks of mosquito-borne West Nile Virus in local human, equine and reservoir bird populations.

"The above is a far too brief but absolutely valid account of the circumstance at hand. I struggle with what would seem to be a lack of meaningful onsite field
9a observations having been conducted for the EIS assessment of the potential impact of various Flaming Gorge operational scenarios on bottomlands mosquito production. Over some thirty years of very personal interactions with Green River mosquitoes I have repeatedly found that far more can be learned by wading in their habitat rather than flying over it in the course of aerial surveys of the same.

"Some Fair Questions:

"Are the hoped for research benefits which might be gained by way of the
9b controlled release of Green River flows so as to both substantially increase and artificially prolong the flooding of the river periphery worth the for certain harmful public health and economic impact which would be forced upon the citizens of Uintah County? Simply put, more water in this case means far more mosquitoes, some of which the next time around may be able to kill you.

"Large scale Green River bottomlands mosquito control is extremely expensive and, for numerous logistical and biological reasons, is immensely challenging. It demands perfectly timed and repeated low-level aerial applications of degradable biological control mosquito larvicides to aquatic mosquito sources dispersed throughout some 50 linear miles of remote, often densely vegetated, nearly impenetrable river periphery. The Uintah Mosquito Abatement District is funded by local property taxes.
9c Should Uintah County citizens be the only ones to pay for the best possible and utterly essential control of what will be much larger and medically important mosquito populations when their otherwise simple prevention is wholly dependent on the whim of the Recovery Program for Endangered Fish Species?

"When the Operation Of Flaming Gorge Dam EIS 'Action Alternative' is inevitably implemented, I will be requesting that the Uintah Mosquito Abatement District
9d (and thus the taxpayers of Uintah County) at least be awarded full and fair federal compensation for those additional, much higher public health mosquito control expenses which will ultimately result from that policy decision.

"Such supplemental federal funding for Uintah County public health mosquito/disease vector control, though in no way fair compensation for the true extent of the adverse consequences of the 'Action Alternative,' would at least to some limited extent serve to elevate our citizens above the status of hapless victims in this matter. From a mosquito's perspective, federal funds in exchange for Uintah County's blood may seem like a good deal.

"Thank you for your valuable time and attention.

"Steven V. Romney, Ph.D., Director, Uintah Mosquito Abatement District."

Thank you, gentlemen.

Edmond Wick

Yeah, I think—I will not be submitting written comments, but I was over here working on a field project and heard about the meeting, decided I'd come in and comment a little bit.

I'm just a consultant at the present time and I've worked for the National Park Service, the U.S. Fish and Wildlife Service, and Colorado Division of Wildlife on endangered fishes for about 25 years, and would like to just point out a few areas of the report that I thought were a little bit inconsistent and might need some rewriting.

And my main concerns center around the timing of flows. In other words, I agree quite a bit with the magnitude levels of the flows that you're proposing, but the work that we've been doing on sediment issues in particular have brought up a lot of issues concerning the timing of flows.

And on page S-30 of your summary report here, on Table S-7, a lot of the flow *timing* of the releases from Flaming Gorge are based on the Yampa River peak flows. And what we've found over the years is the Green River and the Yampa River often do not coincide with the peaks.

And I understand that the reason we try to time the releases of Flaming Gorge to coincide with the Yampa is obviously to—you know, to get the maximum peak flow.
10a But in reality, these peaks have not coincided often and the Green River many times peaks a lot later.

10b And the work we've been doing with razorback suckers in particular show it's problematic in terms of sedimentation on the spawning bar when the flows from Flaming Gorge are released early coinciding with the Yampa, because we initiate sediment transport in the river, which tends to deposit sediment over the spawning bar.

So I see here that on page, I guess it's S-25 -- or 24 -- 24 and 25, you have a table called S-4. And I understand that during average years that we have a set of criteria on which we'll initiate the onset of peak flows. And some of those criteria are, for instance, the initial appearance of larval razorback suckers in the river and the condition of habitat for razorback sucker adults on the spawning bar and young.

And you'd find that in many cases what you need to do perhaps is reference back to your different tables and so forth and clarify that on the years you're indicating that one out of three years, particularly on average years, that you would have flows that would be relatively high that would help the razorback sucker. That's what that's for. So that in many cases you have to override your one statement of coinciding with the Yampa
10c should be overridden by the factors concerning the life history of the razorback sucker to make sure that the spawning habitat is protected.

So I think what I see here is kind of a conflict of one table versus a general statement of matching Yampa River flows. It kind of conflicts because very seldom do
10d the appearance of larval razorback suckers coincide with the flows of the Yampa River.

So that's my main concern, and I guess from our work that we've seen over the years, we've seen a lot of problems with flow timing, for instance, in wet years the tendency is to release flows early in May and wet years prior to even the Yampa peaking. So what's happening is the Flaming Gorge initiates large releases prior to the Yampa even peaking. And that combining with the Yampa flows initiates tremendous sediment transport and problems.

So what's happening is a lot of times during wet years when we could maximize production of razorbacks because the flood plains are available, we see poor production. So in order to improve the situation long term, we need to go ahead and probably do
10e more management in average years for razorback, because that's when we get the best production. So we need to clarify those tables that I mentioned and clarify those statements.

Melissa Trammell

I'm Melissa Trammell and I'm representing the National Park Service, and I'd like to say that basically and in general we think that the flow and temperature recommendations and the way that the EIS has been laid out represents an improvement in the situation on the Green River and probably additionally protect resources in Dinosaur National Monument.

11a Having said that, I will go on to say that we don't necessarily think that the EIS has gone far enough in the right direction, particularly in terms of peak magnitude of spring flows. And we hope to work within the adapted management system after the EIS is implemented to encourage more variability, annual variability with flows in the upper end of the range.

And that's all I have.

9. STEVEN ROMNEY, UINTAH MOSQUITO ABATEMENT DISTRICT

9a
The EIS uses the best available information as called for by the CEQ regulations implementing NEPA. Reclamation relied heavily on Dr. Romney's input to ensure valid data. In site visits along the Green River near Jensen during June and July 2005, Reclamation staff discovered the greatest concentrations of mosquitoes in and adjacent to irrigated crops rather than in or near standing water in the flood plain.

9b
We do not anticipate adverse consequences to humans if the 2000 Flow and Temperature Recommendations are implemented. The river flood plain is likely to be inundated in wet years under either alternative.

9c and 9d
The EIS acknowledges (section 4.13.3.) that the proposed action will increase mosquito habitat to the greatest extent in Reach 1, and to a lesser extent in Reach 2, which includes the town of Jensen as well as Uintah County. Based on our analysis, Reclamation believes that the increased risk of diseases such as West Nile virus, compared to other potential vectors for the disease, including irrigation and standing water on private property closer to population centers, is so small that it is insignificant. We do not anticipate a linkage between Reclamation's proposed action and an increased threat from West Nile virus or other mosquito-borne diseases.

Reclamation notes that the issue of mosquito control along the Green River has been discussed annually at the Flaming Gorge Working Group meetings, and we expect such dialogue to continue in the future, whether or not the proposed action is implemented. As noted in section 4.21 of the EIS, Reclamation is committed to continuing dialogue with county officials to explore the potential to assist with mosquito control.

10. EDMOND WICK

10a
It is true that the Green River peak flows naturally occur later than those for the Yampa River. In order to minimize impacts to the authorized purposes of Flaming Gorge, however, the most optimal timing of peak releases is when the Yampa River peak flows occur. If releases from Flaming Gorge Dam are timed to be later than the peak flows of the Yampa River, the releases from Flaming Gorge Dam would have to be greater in magnitude and duration to achieve the flow objectives.

10b–10e
The 2000 Flow and Temperature Recommendations are intended to aid in recovery of four endangered fish species by restoring a more natural flow regime to the Green River. The authors of the 2000 Flow and Temperature Recommendations recognized that certain aspects of the flows may affect certain species differently than others. Razorback sucker historically have spawned on increasing and peak runoff flows. One objective of spring peak flows is to entrain razorback sucker larvae in flood plain depressions, so it is possible that dam-release augmentation of the Yampa River peak flow would occur after spawning activity. Decisions regarding the timing, duration, and magnitude of peak flows within a given year under the Action Alternative would be made with input from the Technical Working Group which will evaluate criteria listed in table 2-5 when

making recommendations. Additionally, the Recovery Program has and likely will continue to monitor both timing of endangered fish reproductive activity and geomorphic processes for the purposes of contributing to the flow planning process. The 2000 Flow and Temperature Recommendations recommend use of such information gathered by the Recovery Program in determining the specific magnitude, duration, and timing of flows within any given year; and the EIS further recognizes the role(s) of continued research and monitoring in refinement of flow recommendations through an adaptive management process.

11. MELISSA TRAMMELL, NATIONAL PARK SERVICE

11a
Comment noted.