RECLAMATION
Managing Water in the West

Annual Report of Operations For Flaming Gorge Dam Water Year 2010

U.S. Department of the Interior
Bureau of Reclamation

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Table of Contents

Appendices

Annual Report of Operations for Flaming Gorge Dam

Water Year 2010

Introduction

This report details the operations of Flaming Gorge Dam during water year 2010[1], and is produced pursuant to the February 2006 Record of Decision for the Operation of Flaming Gorge Dam (ROD)[2], the Operation of Flaming Gorge Dam Final Environmental Impact Statement (FEIS)[3] and 2005 Final Biological Opinion on the Operation of Flaming Gorge Dam (2005 BO)[4]. This is the fifth year of operations of Flaming Gorge Dam under the ROD and this report is the fifth annual report produced as described in the ROD.

Flaming Gorge Dam, located on the upper main-stem of the Green River in northeastern Utah about 200 miles east of Salt Lake City, is an authorized storage unit of the Colorado River Storage Project. The Green River system is part of the upper Colorado River basin in Utah, Colorado, and Wyoming. Below Flaming Gorge, the Green River supports populations of four endangered native fishes. Operation of Flaming Gorge Dam influences downstream flow and temperature regimes and the ecology of the Green River, including native fishes. Downstream of Flaming Gorge Dam the Green River is joined by the Yampa, White and Duchesne Rivers, portions of which have all been designated as critical habitat under provisions of the Endangered Species Act of 1973, (Muth, et al 2000).

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) was initiated in 1988 by the signing of a cooperative agreement amongst the states of Colorado, Wyoming, and Utah, the Secretary of Interior and the Administrator of the Western Area Power Administration (Western). The goal of the Recovery Program is to recover the endangered fish species while allowing for the continued operation and development of water resources in the Upper Colorado River Basin. The Recovery Program is the forum for discussion of endangered fish response to Flaming Gorge Dam operations and for identification of endangered fish research needs.

In 2000, the Recovery Program issued Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam, (Muth et al, 2000), (Flow Recommendations). The Flow Recommendations provide the basis for the proposed action described and analyzed in the FEIS. The ROD implements the proposed

[1] A water year begins October 1 and ends September 30.
[2] Record of Decision Operation of Flaming Gorge Dam Final Environmental Impact Statement (February 2006
[3] Operation of Flaming Gorge Dam FINAL Environmental Impact Statement (September 2005)
[4] 2005 Final Biological Opinion on the Operation of Flaming Gorge Dam

action by modifying the operations of Flaming Gorge Dam, to the extent possible, to assist in the recovery of endangered fishes, and their critical habitat, downstream from the dam and, at the same time, maintains and continues all authorized purposes of the Colorado River Storage Project, (Reclamation 2006).

Operational Decision Process for Water Year 2010

The Flaming Gorge Technical Working Group (FGTWG) was established pursuant to the FEIS as recommended in the Flow Recommendations. The ROD clarified the purpose of the FGTWG as proposing specific flow and temperature targets for each year's operations based on current year hydrologic conditions and the conditions of the endangered fish. The FGTWG was also charged with integrating, to the extent possible, any flow requests received by Reclamation from the Recovery Program into the flow proposal so that Recovery Program research could also be facilitated. This process concurrently fulfills the informal consultation and coordination requirements of the ESA for the action agencies as committed to in the ROD.

Members of the FGTWG include biologists and hydrologists from Reclamation, the U.S. Fish and Wildlife Service (Service), and Western Area Power Administration (Western).

Each year, FGTWG's recommendation is presented to the Flaming Gorge Working Group, along with any flow requests or operational requests proposed by other federal or state agencies or stakeholders. The Flaming Gorge Working Group (Working Group) is open to the general public and was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operations of Flaming Gorge Dam. The Working Group meets biannually at a minimum and functions as a means of providing information to, and gathering inputs from, stakeholders and interested parties on dam operations, other resource concerns and research flows.

In 2010, the operational process developed in 2006 was used for making operational decisions at Flaming Gorge Dam. This process was developed based on descriptions provided in the FEIS (Section 1.5) and the ROD (Sections III, VI, and VII), (Reclamation, 2005, Reclamation 2006). A detailed description of this process can be found in Appendix A and a timeline of how this process was implemented in 2010 can be found in Appendix B. The implementation of the four steps of the process in 2010 is described below:

Step 1: Flow Requests for Research, and Other Federal, State and Stakeholder Input

Reclamation received, and provided to the FGTWG, a memorandum dated March 12, 2010 (Appendix C), from the Director of the Recovery Program providing the Recovery Program's research request for 2010 Green River spring flows. The spring flow request from the Recovery Program was for 15,000 cubic feet per second (cfs), or greater, for a minimum of five consecutive days in Reach 2 of the Green River. The Recovery Program also acknowledged ongoing coordination with the Service to develop base flow requests that

maintain the upper range of flows in Reach 1 that are thought to contribute to reduced reproductive success for nonnative smallmouth bass in Reach 1 and upper Reach 2.

The Recovery Program request indicated that they would be assessing the emigration rates of previously stocked razorback sucker from the Stirrup floodplain to the main stem of the Green River. Previous studies indicated a 30 centimeter (cm) water depth in passages between floodplains and the main river channel (e.g., levee breaches and outlet structures) is required for juvenile and adult Colorado pikeminnow and razorback sucker fish passage. The Recovery Program therefore requested a flow of 15,000 cfs to maintain a minimum depth of 30 cm at the connection channel of Stirrup Floodplain and the Green River for a minimum of 5 days. The Recovery Program estimated 15,000 cfs to be sufficient based on observations made in 2007. The request also indicated that the Recovery Program was still analyzing early findings on the flow effects on nonnative smallmouth bass reproduction and estimated 15,000 cfs to be sufficient based on observations made during monitoring from 2007-2009.

Reclamation received a base flow request from the Service on April 19, 2010 (Appendix D). The Service supported the Recovery Program research request dated March 12, 2010. The Service further requested that the calculated Reach 1 base flow targets be augmented as much as 40% higher than the average daily base flow for that reach of the Green River during the summer period through September 30. The intent of the request was to negatively impact nonnative fish species (particularly smallmouth bass) and provide benefits to endangered fish. The Service acknowledged that higher summer flows in Reach 1 might require balancing Flaming Gorge Dam flows during winter releases. The Service supported Reclamation reducing the duration of spring peak releases at Flaming Gorge Dam from two weeks to one week and, if necessary, reducing winter base flow releases.

Western had previously submitted a written request to Reclamation on October 16, 2009, (Appendix F), for the 2010 winter period (November 2009 through February 2010). Western requested that the winter period hourly release follow a daily double peak pattern, releasing greater amounts of water during the morning and mid-afternoon electrical peak demand and conserving water around noon and during the late evening when demand decreases. Western also requested specific research releases from Flaming Gorge during December, and at other times to be requested, for further study of impacts to river systems from double peak versus single peak patterns.

Reclamation received a base flow request from the Utah Division of Wildlife Resources (UDWR) on August 23, 2010 (Appendix G), which covered the remaining 2010 summer base flow season along with the upcoming 2011 winter base flow seasons. UDWR requested releases from Flaming Gorge Dam during the winter of 2010-2011 mimic a natural hydrograph with minimal fluctuations, including an absence of a daily double peak pattern typically conducted to benefit hydropower production. UDWR maintained that highly variable flow releases impact aquatic plant biomass and aquatic invertebrate abundance, which impacts trout growth/conditions. Additionally, UDWR alleged that the daily double peak pattern negatively impacts the local fishing economy of Dutch John because of perceived negative effects on fishing and a reduction in visitors to the Green River.

Step 2: Development of Spring Proposal

The FGTWG met on March 9, 2010, to begin the development of a flow proposal for the spring of 2010. The intent of the flow proposal was to integrate the flow request from the Recovery Program into a flow regime consistent with the ROD. The flow proposal for 2010 described three possible flow regimes that were consistent with the ROD and FEIS (see Appendix E for details). Depending upon the outcome of hydrologic conditions during spring runoff, the intent was to achieve one of these proposed flow regimes.

Step 3: Solicitation of Comments

On April 27, 2010, Reclamation presented the 2010 FGWTG flow proposal (Appendix E) and Service base flow request (Appendix D) to the Working Group. The Working Group meeting presentation clearly described the FGTWG proposed flow regime for the Green River, the intended operation of Flaming Gorge Dam for the spring and summer of 2010, and comments were received. Meeting minutes were recorded and written comments were solicited by Ed Vidmar, Chairperson of the Working Group.[5] Reclamation received comments from the public during the 2010 decision-making process and these comments are available for review in Appendix H.

Step 4: Final Decision

After reviewing the FGTWG proposal and all public input received during the 2010 decision-making process, Reclamation determined the Recovery Program flow request could be achieved within normal operating parameters. Reclamation made the decision to operate during the spring of 2010 to achieve a flow regime in Reach 2 of at least 15,000 cfs for a minimum duration of 5 days measured at the stream gage located at Green River near Jensen, Utah stream gage, (USGS 09261000) (Jensen). Releases were also managed in an attempt to achieve an instantaneous peak of 18,600 cfs in Reach 2.

In response to the base flow requests of Western and the Service, the FGTWG reconvened on May 7, 2010, to develop a flow proposal for the Green River during the base flow period (August through February of the following year). The FGTWG recommendation to Reclamation was to implement the Service's request to disadvantage smallmouth bass in Reach 1 and improve conditions for endangered fish in Reach 2 using the maximum base release of 40 percent higher flows than the average daily base flow through September 30, 2010.

Reclamation determined the Service's base flow request could be achieved within normal operating parameters and made a decision to utilize the base flow flexibility and maintain high base flow releases through September 30. Releases during the winter period would

[5] Working Group Meeting notes are also available at http://www.usbr.gov/uc/water/crsp/wg/fg/fg_20100427.html and http://www.usbr.gov/uc/water/crsp/wg/fg/fg_20100826.html.

follow a double-peak pattern request submitted by Western pursuant to ROD constraints, existing hydrologic conditions, and electrical demand.

Basin Hydrology and Operations

Progression of Inflow Forecasts

Snowpack conditions in the Upper Green River and Yampa River Basins varied significantly throughout the snow accumulation season (November 2009 through April 2010). The Upper Green River Basin snowpack condition was below average on January 1, 2010, at 57 percent of average.[6] On April 1, 2010, the snowpack condition in the Upper Green River Basin had increased to 61 percent of average. The Yampa River Basin snowpack condition was below average on January 1, 2010, at 79 percent of average. On April 1, 2010, the snowpack condition in the Yampa River Basin had decreased to 77 percent of average.

The Colorado Basin River Forecast Center (CBRFC), beginning in January every year and continuing through June, issues a monthly forecast of the total volume of anticipated unregulated inflow for the April through July period in thousands of acre-feet (kaf). The progression of Flaming Gorge Reservoir inflow and the Yampa River forecasts over the 2010 water supply season is shown in Table 1.

Table 1 – Progression of CBRFC Unregulated Inflow[7] Volume Forecasts for the April through July Water Supply Period

Forecast Issuance Month	Flaming Gorge Reservoir		Yampa River near Maybell, CO		Little Snake River near Lily, CO	
	Volume (1000 AF)	% of Average	Volume (1000 AF)	% of Average	Volume (1000 AF)	% of Average
January	770	65	790	80	315	86
February	675	57	710	72	290	79
March	515	43	695	70	265	72
April	450	38	575	58	260	71
May	515	43	700	71	330	90
June	575	48	835	84	405	110
July	685	58	---	---	---	---
Actual	**706**	**59**	**969**	**98**	**460**	**125**

Summary of Flaming Gorge Operations

Releases from Flaming Gorge averaged 1,750 cfs from October 1, 2009 through February 1, 2010, when releases were decreased to 1,550 cfs through February 28th. Hourly releases followed a single-peak pattern October and November, when the hourly release pattern was

[6] Percent of average is based on the 1971-2000 period of record.

[7] Unregulated inflow is defined as the actual inflow to the reservoir corrected for change in storage and evaporation in reservoirs upstream. In the case of Flaming Gorge Reservoir, unregulated inflow accounts for change in storage and evaporation at Fontenelle Reservoir only.

revised to a double-peak pattern from December through February. Releases were decreased from 1,550 cfs to steady releases of 800 cfs beginning in March 2010 and continuing through to the beginning of spring runoff in May.

Flaming Gorge Dam releases under the ROD are increased to coincide with the immediate peak and post-peak of the Yampa River spring peak flows to create a spring peak in the Green River at Jensen. Spring runoff in the Yampa River Basin generally produces two distinct peaks (flows above 10,000 cfs) as low elevation snow melts first followed by the mid-level and higher elevation snowmelt.

Yampa River flows measured at the U.S. Geological Survey (USGS) Yampa River at Deerlodge Park, Colorado, stream gage, (USGS 09260050) (Yampa River), increased above 11,000 cfs in mid- and late-May. Based on the estimation that there would only be one peak above 11,000 cfs given the decreasing snowpack, the Yampa River peak was projected to occur in late-May. Flaming Gorge releases were increased to power plant capacity (~4,550 cfs) for 10 days on May 24, 2010. Unfortunately, an unexpected cold front moved into the system and Yampa River flows decreased for a period of time.

Flaming Gorge was directed to decrease releases from power plant capacity at a down ramp rate of 350 cfs beginning June 5, 2010, and reaching the base flow release of 1,600 cfs on June 13, 2010. Yampa River flows peaked at 16,500 cfs on June 9th as Flaming Gorge Dam ramped down to base flows. The Green River at Jensen, Utah peak was 19,400 cfs on June 10, 2010. Flows at Jensen, Utah were above 18,600 cfs for two days.

Flows at Jensen, Utah remained above 15,000 cfs for 16 days from May 29 to June 15, 2010, with two days containing flows greater than 18,600 cfs. Flaming Gorge Dam releases were decreased from power plant capacity at a rate of 350 cubic feet per second per day (cfs) beginning June 5, 2010, to a daily average release rate of 1,550 cfs that began on June 13, 2010. Releases resumed within-day fluctuations for power generation with a single daily peak beginning June 13, 2010. Releases increased from 1,550 cfs to 1,575 cfs in July, and were further increased to 1,800 cfs beginning August 23 through September 30, 2010.

Flaming Gorge Reservoir elevation decreased a total of 6.23 feet (ft) from the annual maximum elevation of 6031.06 ft on October 1, 2009, to a minimum elevation of 6024.83 ft on September 30, 2010.

Flaming Gorge Dam releases (blue line), and flows for the Yampa River at the Deerlodge, Colorado gage (brown line) and Green River at the Jensen, Utah gage (green line) are illustrated in Figure 1.

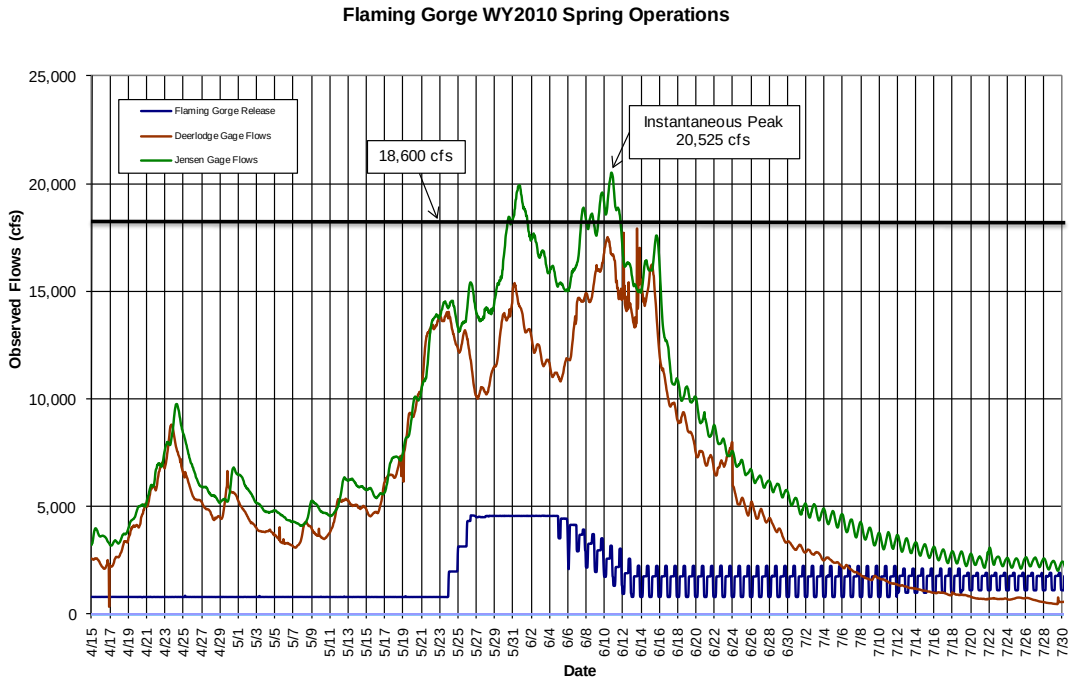


Figure 1 – 2010 Flaming Gorge Spring Releases and Flows Measured at Yampa River at Deerlodge and Green River at Jensen.

Spillway Inspection

The 2005 BO directs Reclamation to provide the results of its annual spillway inspections. During these inspections, inspectors operate gates 1 and 2 through a one-foot open and close cycle during which time it notes any unusual or excessive noise or vibration. The spillway inspection occurred on July 14, 2010, at reservoir elevation 6027.72 ft. Gate 1 and 2 are both opened one foot at different rates based on hydraulic pressure. The total volume released was approximately 2.5 acre-feet.

Flow Objectives Achieved in Water Year 2010

The ROD directs Reclamation to operate to achieve, to the extent possible, the Flow Recommendations as described in the FEIS, (Reclamation 2006). The Flow Recommendations divide the Green River below Flaming Gorge Dam into three river reaches. Reach 1 begins directly below the dam and extends to the confluence with the Yampa River. Reach 2 begins at the Yampa River confluence and continues to the White River confluence. Reach 3 is between the White River and Colorado River confluences, (Muth et. al 2000).

The Flow Recommendations use five different categories to classify both spring and base flow water year conditions and the Reach 1, 2, and 3 targets associated with that classification. Reach 1 targets are, for the most part, release patterns from Flaming Gorge Dam needed to achieve target peak and base flows identified in Reaches 2 and 3. Reach 2 targets are measured at Jensen, Utah and Reach 3 targets, measured at Green River, Utah, are largely dependent on flows targets for Reach 2 and runoff patterns of tributaries. The Flow Recommendations acknowledged that Reach 3 base flows will be subject to natural variation in tributary flows, and this variation should not be compensated for by Flaming Gorge Dam releases, (Muth et al 2000).

After the spring flow objectives in Reach 1 and Reach 2 have been achieved, flows should be gradually reduced to achieve base flow levels by no later than the date specified in the Flow Recommendation. Base flows in Reaches 1 and 2 should be managed to fall within the prescribed base flow ranges described in the Flow Recommendations based on the observed April through July unregulated inflow into Flaming Gorge Reservoir.

Pursuant to the Flow Recommendations, during the August through November base-flow period, the daily flows should be within ±40 percent of mean base flow. During the December through February base-flow period, the daily flows should be within ±25 percent of the mean base flow.

Additionally, the mean daily flows should not exceed 3 percent variation between consecutive days and daily fluctuations at Flaming Gorge Dam should produce no more than a 0.1-meter daily stage change at Jensen, Utah. On the basis of the stage-flow relationship near Jensen, the maximum stage change that could occur with this level of flow variability over the summer through autumn period would be about 0.4 meters. Flow variability during the winter (December through February) would produce a maximum stage change of about 0.2 meters. This recommendation is based on the fact that the average depth of backwaters occupied by Colorado pikeminnow larvae in Reach 2 is 0.3 m. By restricting within-day variation in flow, conditions critical for young of year fish in backwater habitats should be protected. (Muth et al 2000).

Table 2 – April–July Forecasts and Spring and Base Flow Hydrologic Classifications

Year	May 1st A-J Unreg Inflow Forecast (1000 AF)	Spring Hydrologic Classification	Observed A-J Unreg Inflow Forecast (1000 AF)	Base Flow Hydrologic Classification
2006	1,100	Average (Abv Median)	724	Moderately Dry
2007	500	Moderately Dry	370	Dry
2008	820	Average (Blw Median)	728	Moderately Dry
2009	890	Average (Blw Median)	1,197	Average (Abv Median)
2010	515	Moderately Dry	706	Moderately Dry

Spring Flow Objectives

The spring hydrologic classification is based on the CBRFC May final forecast of April-July unregulated inflow volume into Flaming Gorge Reservoir. The May final forecast for water year 2010 was 515,000 acre-feet (AF) and resulting spring hydrologic classification was moderately dry.[8] The peak-flow magnitude for Reaches 1, 2, and 3 were 4,600 cfs, 8,300 cfs, and 8,300 cfs, respectively.

The Reaches 1, 2 and 3, Flow Recommendation spring objectives and the desired frequency of achievement are described in Tables 3, 4, and 5. Water year 2010 is the fifth year of operations under the ROD and thus is the fifth year for establishing the long-term frequencies of these spring flow objectives.

Table 3 – Reach 1 ROD Flow Objectives Achieved in 2010

Spring Peak Flow Objective	Desired Frequency of Achievement %	Achieved in 2010	Achievement Rate to Date (Cumulative Frequency %)*
Peak >= 8,600 cfs for at least 1 day	10 %	No	0 %
Peak >= 4,600 cfs (power plant capacity) for at least 1 day	100 %	Yes	100 %

*Based on five years of operation under the ROD (2006-2010)

[8] Hydrologic classifications are based on Pearson III percentile exceedance volumes for the period of record beginning in 1963 through the previous year hydrology. This calculation results in annual variations in exceedance ranges.

Table 4 – Reach 2 ROD Flow Objectives Achieved in 2010

Spring Peak Flow Objective	Desired Frequency Percent of Achievement	Achieved in 2010	Achievement Rate to Date (Cumulative Frequency %)*
Peak >= 26,400 cfs for at least 1 day	10 %	No	0 %
Peak >= 22,700 cfs for at least 2 weeks	10 %	No	0 %
Peak >= 18,600 cfs for at least 4 weeks	10 %	No	0 %
Peak >= 20,300 cfs for at least 1 day	30 %	No	20 %
Peak >= 18,600 cfs for at least 2 weeks	40 %	No	20 %
Peak >= 18,600 cfs for at least 1 day	50 %	Yes	80 %
Peak >= 8,300 cfs for at least 1 day	100 %	Yes	100 %
Peak >= 8,300 cfs for at least 1week	90 %	Yes	100 %
Peak >= 8,300 cfs for at least 2 days except in extreme dry years	98 %	Yes	100 %

*Based on five years of operation under the ROD (2006-2010)

Table 5 – Reach 3 ROD Flow Objectives Achieved in 2010

Spring Peak Flow Objective	Desired Frequency Percent of Achievement	Achieved in 2010	Achievement Rate to Date (Cumulative Frequency %)*
Peak >= 39,000 cfs for at least 1 day	10 %	No	0 %
Peak >= 24,000 cfs for at least 2 weeks	10 %	No	0 %
Peak >= 22,000 cfs for at least 4 weeks	10 %	No	0 %
Peak >= 24,000 cfs for at least 1 day	20 %	No	20 %
Peak >= 22,000 cfs for at least 2 weeks	40 %	No	40 %
Peak >= 22,000 cfs for at least 1 day	50 %	Yes	80 %
Peak >= 8,300 cfs for at least 1 day	100 %	Yes	100 %
Peak >= 8,300 cfs for at least 1week	90 %	Yes	100 %
Peak >= 8,300 cfs for at least 2 days except in extreme dry years	98 %	Yes	100 %

Base Flow Objectives

Base flows are classified based upon the observed April-July unregulated inflow volume into Flaming Gorge and monthly base flow forecast from the CBRFC. The observed April-July unregulated inflow volume was 706,000 AF and resulting base flow hydrologic classification was moderately dry. Reach 1 flows were reduced to base flows by June 13, 2010. The observed April-July unregulated inflow volume into Flaming Gorge Reservoir, August final forecast and average daily releases needed to achieve the May 1, 2011 elevation target of 6027 feet were used to calculate the Reach 1 daily average base flow of 1,300 cfs, which is within the Reach 1 base flow range for moderately dry as shown in Figure 2.

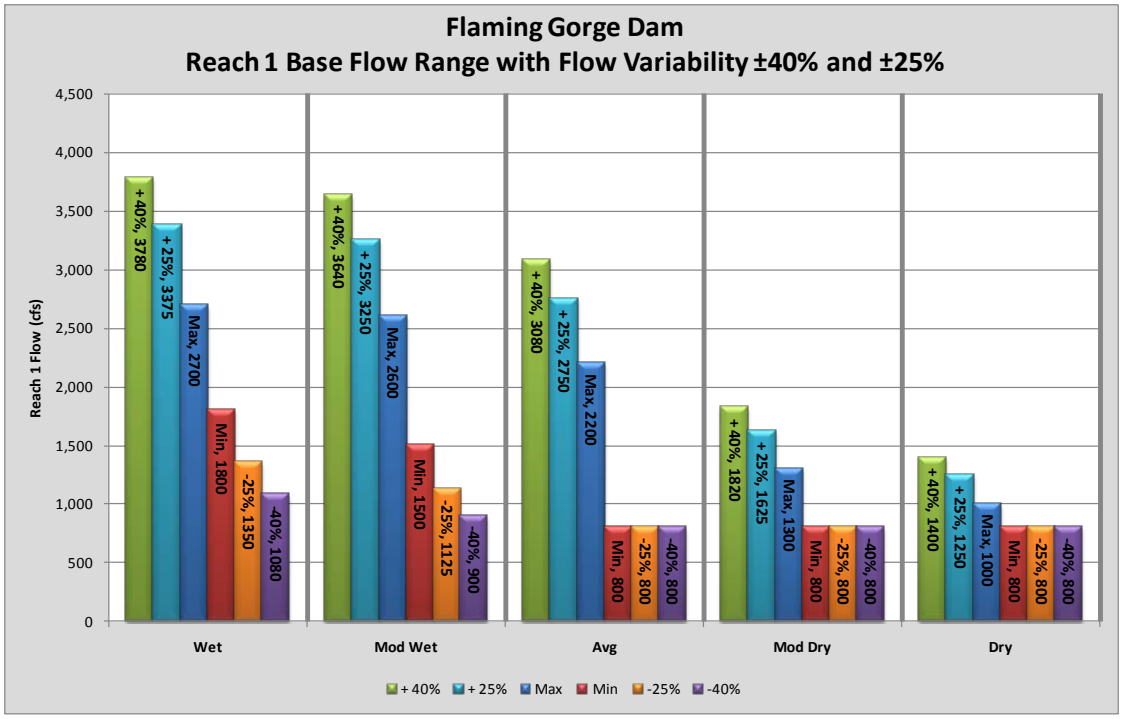


Figure 2 – Reach 1 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.

Flaming Gorge Reservoir inflows increased through the autumn and winter base flow period, and the base flow hydrologic classification moved into average (below median). Observed August through November base flows in Reach 2 were within 40 percent of the established base flow for the average hydrologic classification (*i.e.* between 900 cfs to 3,360 cfs as shown in Figure 3). Observed December through February base flows in Reach 2 were within 25 percent of the established base flow (*i.e.* between 1,125 cfs to 3,000 cfs). The daily fluctuations at Flaming Gorge Dam remained within the 0.1 meter daily stage change at Jensen, Utah parameters. The maximum daily stage change at Jensen was within the limits outlined in the Flow Recommendations.

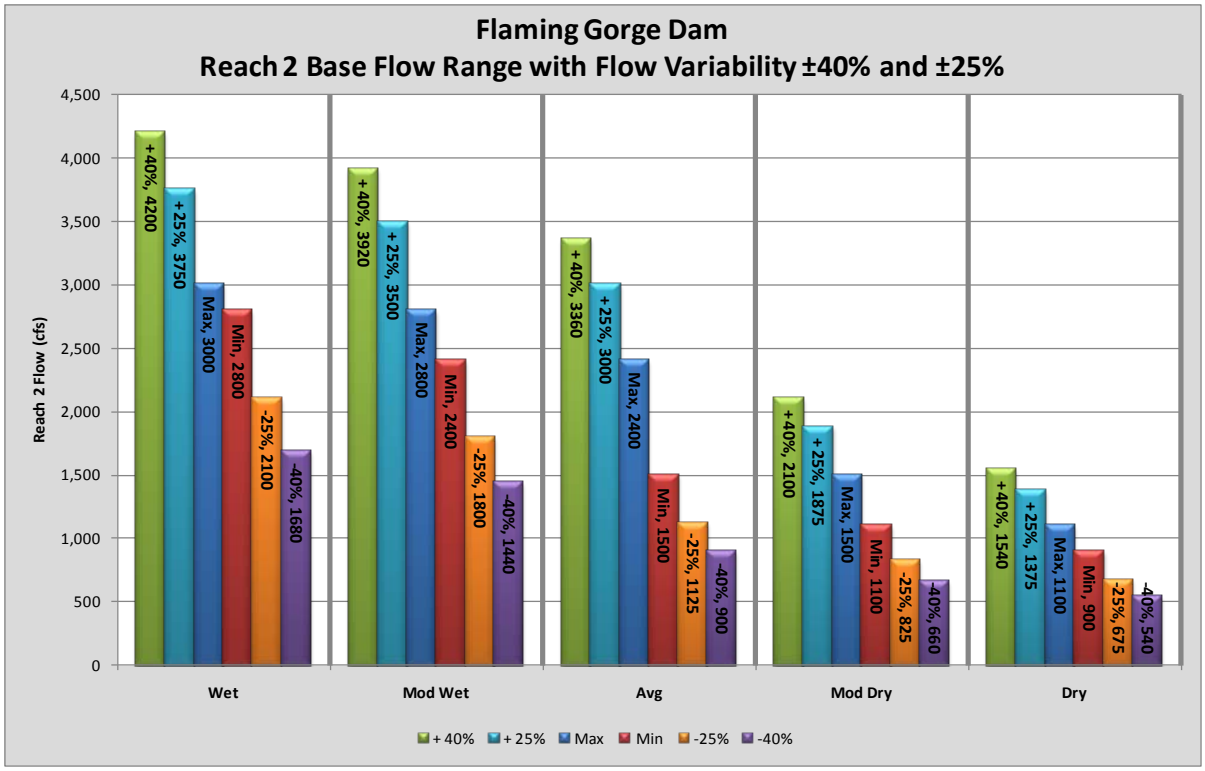


Figure 3 – Reach 2 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.

Observed August through November base flows in Reach 3 as measured at the USGS Green River at Green River, Utah stream gage were within 40 percent of the established base flows for the average hydrologic classification (*i.e.* between 1,080 cfs and 5,880 cfs as shown in Figure 4). Observed December through February base flows in Reach 3 were maintained within the 25 percent of the established base flow (*i.e.* between 1,350 cfs and 5,250 cfs).

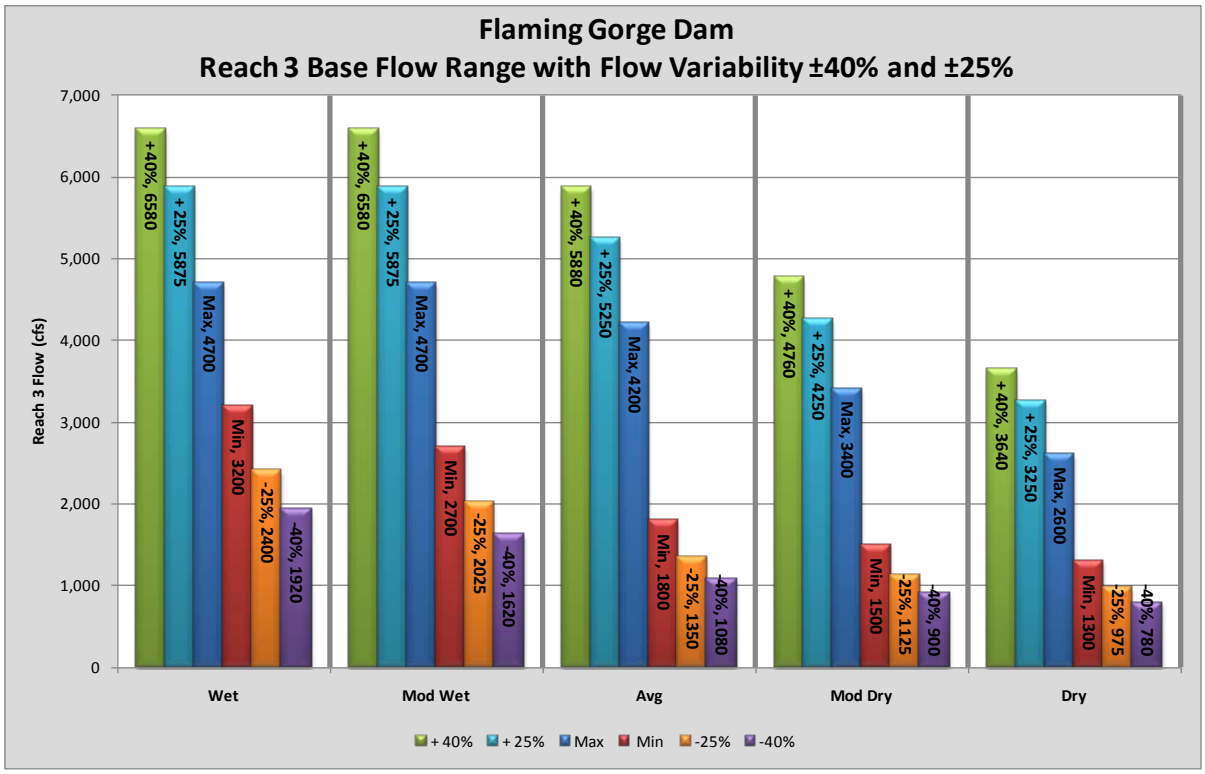


Figure 4 – Reach 2 Base Flow Ranges for each Hydrologic Classification as Outlined in the ROD.

Temperature Objectives Achieved in Water Year 2010

The Operational Plan for the Flaming Gorge Selective Withdrawal Structure (SWS) was completed by a subset of the FGTWG in June 2007, and is currently undergoing revisions. The SWS is a series of three gated intake structures that allow water to be drawn from different elevations in the reservoir. During summer months, water temperatures within the reservoir vary with depth and the adjustment of the SWS maintains some control over the water temperatures released into the Green River below Flaming Gorge Dam.

The Flow Recommendations indicate that warmer water would provide cues for adults migrating to spawning areas, aid reproductive success of fish in adulthood, enhance the likelihood of reproduction of certain fish in Lodore Canyon (Reach 1), and enhance growth of early life stages of fishes in nursery habitat including those in Echo, Island, and Rainbow Parks (all in Reach 2). Improving conditions in Lodore Canyon also could result in expansion of

endangered fish populations into lower Reach 1 and upper Reach 2. The timing of warm water releases is an important component of matching native fish life cycle reproduction and growth.

The operational plan provides guidelines in an attempt to meet the water temperature objectives below Flaming Gorge Dam that are contained within the 2006 ROD and described further in Table 6, below. Operational guidelines direct operators to achieve maximum gate elevation (40 ft below reservoir surface) by June 15 of each year in order to deliver outflow temperatures of 15-16 degrees Celsius (°C) (as measured at the Greendale Gage, USGS 09234500) during the summer months.

Temperature trends downstream from Flaming Gorge Dam in 2010 were very similar to those observed during 2009. Average daily temperatures at Gates of Lodore (USGS 404417108524900) in 2010 equaled or exceeded Reach 1 objectives (18 degrees C; Figure 5) for 49 days (7 weeks) beginning on June 28th and continuing intermittently through the end of September.

Reach 2 objectives (difference between Yampa and Green rivers does not exceed 5 degrees C; Figure 6) were achieved during June through September 2010. Maximum difference between the Yampa and Green rivers was 4.4 degrees C on July 19 and exceeded 4 degrees C for a total of 4 days between July 11 and July 20.

Table 6. Temperature Objectives for the Green River below Flaming Gorge Dam

Temperature Objectives	Reach*	Desired Frequency %	Achieved in 2010
Temperatures >= 64° F (18° C) for 3-5 weeks from June (average-dry years) or August (moderately wet-wet years) to March 1	1	100%	100%
Green River should be no more than 9° F (5° C) colder than the Yampa River during the base flow period	2	100%	100%

*Reach 1 is from the dam to the Yampa River confluence; Reach 2 is from the Yampa River to Sand Wash, UT.

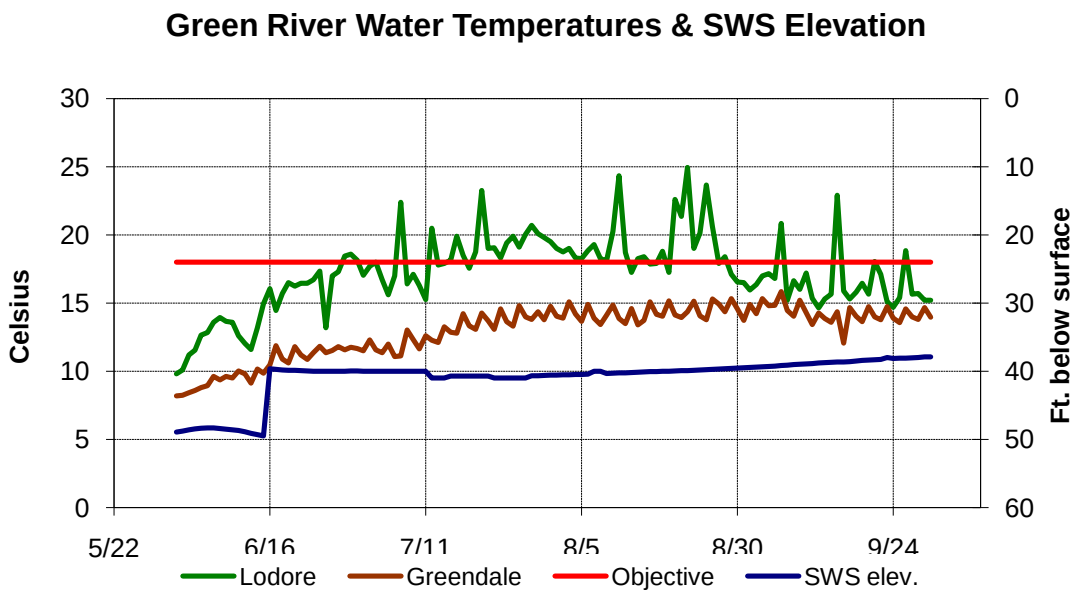


Figure 5. Reach 1 Green River Average Daily Temperatures & SWS Elevation

Recorded temperatures at the Gates of Lodore gage (USGS 404417108524900) (green series) and Greendale gage (USGS 09234500) (brown series), Reach 1 temperature objective (red line), and SWS gate depth below reservoir surface in blue, correlates to the right hand axis, June-Sept 2010. SWS gate depths depicted are the average of 3 gates.

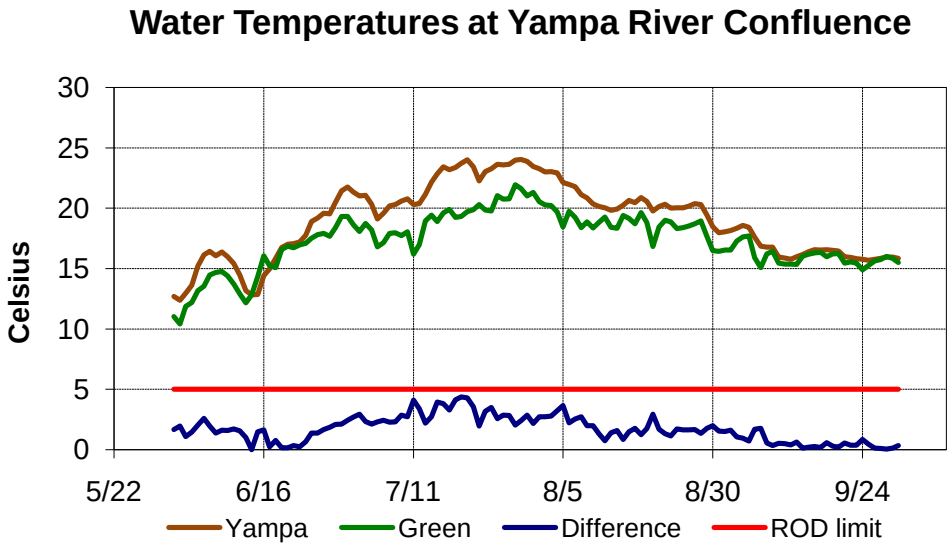


Figure 6. Green River Temperatures at the Yampa River Confluence

Temperatures are recorded at the Green River (USGS 404417108524900) (brown series) and the Yampa River (USGS 09260050) (green series), the difference between the two rivers (blue series), and the maximum temperature difference specified in the 2006 ROD (red line), June-Sept 2010.

Conclusion and Recommendation

In Water Year 2010, Reclamation operated Flaming Gorge Dam and Reservoir to comply with the commitments in the ROD and, to the extent possible, meet the goals and objectives of the Flow Recommendations. Reclamation met the spring peak, base flow and temperature objectives in 2010. Reclamation increased Flaming Gorge Dam releases in the spring to match the immediate peak and post-peak of the Yampa River. Reclamation worked closely with the CBRFC in determining the timing of the Yampa River spring peak. This coordination should continue in the future to assist Reclamation in determining the probability of the magnitude and timing of the Yampa River peak.

Literature Cited

Muth, R.T., L.W. Crist, K.E. LaGory, J.W. Hayse, K.R. Bestgen, T.P. Ryan, J.K. Lyons, and R.A. Valdez. 2000. Flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Final Report to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Muth, R.T. February 29, 2010. Memorandum to Larry Walkoviak and Heather Patno. Recovery Program Research Request for 2010 Green River Spring Flows. Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Muth, R.T. April 1, 2010. Memorandum to Larry Walkoviak and Heather Patno. 2010 Green River Base Flows. Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

U.S. Department of the Interior. 2005. Operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah.

U.S. Department of the Interior. 2006. Record of Decision on the operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah.

U.S. Department of the Interior. 2010. Flaming Gorge Technical Working Group Proposed Flow and Temperature Objective for 2010. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah.

Utah Division of Wildlife Resources, 2010. Letter to Heather Patno and Ed Vidmar. 2010 Green River base flows. Utah Division of Wildlife Resources, Vernal, Utah.

U.S. Fish and Wildlife Service. 2005. Final Biological Opinion on the operation of Flaming Gorge Dam. U.S. Fish and Wildlife Service, Denver, Colorado.

U.S. Fish and Wildlife Service. 2010. Memorandum to Larry Walkoviak and Heather Patno. 2010 Green River Spring and Base Flows to Assist in Recovery of the Endangered Fishes. U.S. Fish and Wildlife Service, West Valley City, Utah.

Western Area Power Administration. 2010. Western's proposed 2010 Green River Baser Flows. Email from Clayton Palmer to Malcolm Wilson and Heather Patno. Western Area Power Administration, Salt Lake City, Utah.

Appendix A

Flaming Gorge Decision Process
Intended Implementation under the 2006 Flaming Gorge Record of Decision

Overview – This document describes the four-step process the Bureau of Reclamation (Reclamation) will use to adaptively manage Flaming Gorge Dam operations and implement the 2006 Record of Decision for the Operation of Flaming Gorge Dam Final Environmental Impact Statement (ROD). These four steps are described in detail below:

1. Recovery Program
2. Flaming Gorge Technical Working Group (FGTWG)
3. Flaming Gorge Working Group (Working Group)
4. Reclamation Operational Plan

In 2000, the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) issued Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam (flow recommendations). The Flow Recommendations provide the basis for the proposed action outlined in the 2005 final environmental impact statement (FEIS). The ROD implements the proposed action by modifying the operations of Flaming Gorge Dam, to the extent possible, to assist in the recovery of endangered fishes, and their critical habitat, downstream from the dam and, at the same time, maintains and continues all authorized purposes of the Colorado River Storage Project.[9]

Reclamation believes that the Recovery Program remains the appropriate forum for discussion of endangered fish response to Flaming Gorge Dam operations, endangered fish research needs, and refinements to the flow recommendations. The purpose of the FGTWG would be limited to proposing annual flow and temperature recommendations as outlined in the FEIS, including research requests by the Recovery Program. The Working Group remains the forum for public information/input.

1. Recovery Program – The ROD Environmental Commitment #2 defines the science role of the Recovery Program in the adaptive management process to include design and execution of studies that monitor implementation of the flow recommendations, and testing the outcomes of such studies. This includes conducting research to answer specific questions raised by previous studies, to fill information gaps identified in the Recovery Implementation Program Recovery Action Plan and related documents, and/or to address uncertainties associated with the flow recommendations. For example, effects of specific spring flow elevations on entrainment rates of larval endangered fish and their floodplain habitats is an uncertainty which prompted the Recovery Program to request periods of steady flows during the spring 2005 runoff season. A request for such flows or release temperatures is not

[9] Reclamation, 2006, Record of Decision on the Operation of Flaming Gorge Dam Final Environmental Impact Statement.

necessarily explicit in the flow recommendations, but is necessary to fulfill adaptive management research functions that should be made no later than February of each calendar year.

Beginning each summer, the Recovery Program should begin a process to develop any desired flow request for the Green River for the following year. Maintenance schedules for the dam and powerplant are a critical part of the proposal in order to assure release capability. Reclamation will clearly communicate equipment and maintenance issues to the Recovery Program during development of any Recovery Program request. This communication should include analysis of contingency plans for maintenance issues, system emergencies, equipment failures, or changes in hydrology. The Recovery Program should issue a finalized flow request by the end of February to Reclamation, the U.S. Fish and Wildlife Service (Service), and Western Area Power Administration (Western).

2. <u>Flaming Gorge Technical Working Group (FGTWG)</u> - The ROD clarified the purpose of the FGTWG as limited to proposing specific flow and temperature targets for each year's operations based on current year hydrologic conditions and the conditions of the endangered fish. The FGTWG was also charged with integrating, to the extent possible, any flow requests from the Recovery Program into the flow proposal so that Recovery Program research could also be facilitated. Members of the FGTWG include biologists and hydrologists from Reclamation, the Service, and Western. This group also serves as the informal consultation body for Endangered Species Act compliance as has occurred historically and as directed by the ROD.

An annual meeting of the FGTWG should be held in early March to develop a proposed flow and temperature regime for the upcoming spring and base flow season (Proposal). This Proposal should achieve the flow recommendations and/or the Recovery Program flow request for the current year within the current hydrologic conditions and Reclamation's operating parameters.

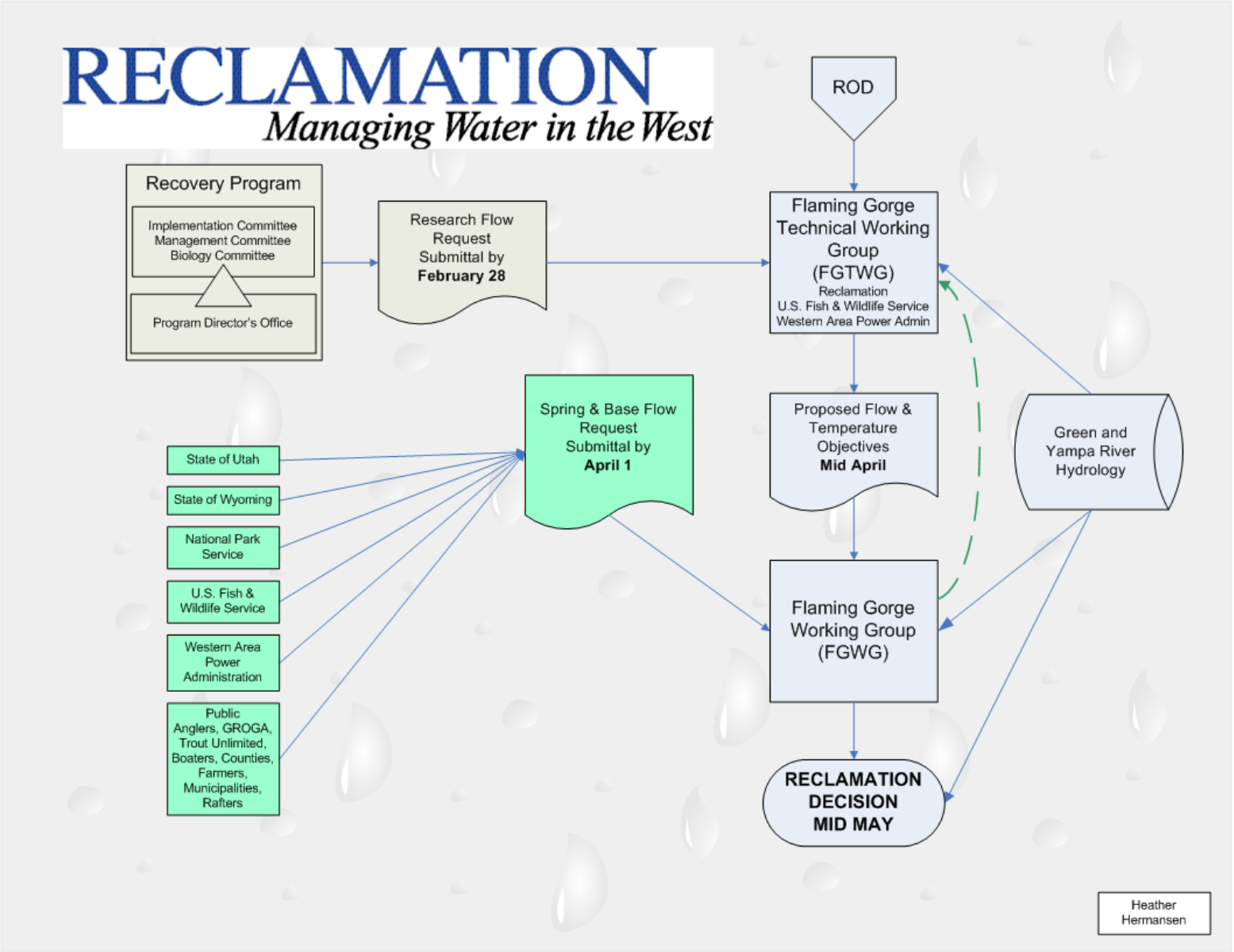
The FEIS specifically addresses and outlines the content of the Proposal. The Proposal describes the current hydrologic classification of the Green River and Yampa River Basins, including the most probable runoff patterns for the two basins. The Proposal also identifies the most likely Reach 2 flow magnitudes and durations that are to be targeted for the upcoming spring release. It further specifies that

> *Because hydrologic conditions often change during the April through July runoff period, the [Proposal] 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 (FEIS, Section 2.5.3.1).*

The FGTWG proposal should be finalized by early April in time to present to the Working Group.

3. <u>Flaming Gorge Working Group</u> – The Working Group was formed in 1993 to provide interested parties with an open forum to express their views and interests in the operations of Flaming Gorge Dam. The Working Group meets biannually (April and August) and functions as a means of providing information to and gathering input from stakeholders and interested parties on dam operations, other resource concerns and research flows. Reclamation presents the FGTWG Proposal to the Working Group during the April meeting and constitutes the public involvement and public outreach component of the adaptive management process as described in the FEIS (Sections 4.20, 4.21).

4. <u>Operational Plan</u> - Reclamation makes the final decision on how to operate Flaming Gorge Dam based on hydrologic conditions, the FGTWG flow proposal, and input from the public received via the Flaming Gorge Working Group.


RECLAMATION
Managing Water in the West
ROD
Recovery Program
Implementation Committee
Management Committee
Biology Committee
Program Director's Office
Research Flow Request Submittal by February 28
Flaming Gorge Technical Working Group (FGTWG)
Reclamation
U.S. Fish & Wildlife Service
Western Area Power Admin
Spring & Base Flow Request Submittal by April 1
Proposed Flow & Temperature Objectives Mid April
Green and Yampa River Hydrology
State of Utah
State of Wyoming
National Park Service
U.S. Fish & Wildlife Service
Western Area Power Administration
Public Anglers, GROGA, Trout Unlimited, Boaters, Counties, Farmers, Municipalities, Rafters
Flaming Gorge Working Group (FGWG)
RECLAMATION DECISION MID MAY
Heather Hermansen

Appendix A-3

Appendix B

Flaming Gorge Decision Process for 2010 Chronology of Events

Week of October 5th

Flaming Gorge releases for the month of October are a single-peak pattern released at a rate of 1,750 cfs/day.

Week of October 25th
Flaming Gorge decreased to 800 cfs for four hours on Sunday, October 25, 2009, for emergency response to retrieve boat lodged downriver of Flaming Gorge Dam.

Week of November 5th

Flaming Gorge releases for the month of November are a double-peak pattern released at a rate of 1,750 cfs/day.

Week of November 30th

Flaming Gorge releases are adjusted to one-week of a single-peak pattern release in order to research potential impacts of a double-peak pattern on trout.

Week of December 15th
Western Area Power Administration performed transmission maintenance on December 15, during which time all generators were down and releases were bypassed.

Week of January 25th

In response to a decreasing hydrologic forecast, Flaming Gorge releases are decreased from an average daily release rate of 1,750 cfs/day to 1,550 cfs/day beginning February 1, 2010.

Week of February 1st

Flaming Gorge releases are adjusted two hours in order for Argonne National Laboratories to conduct underwater videography to research the effects of various flow regimes on trout in the Green River.

Week of February 15th

Western Area Power Administration and Argonne National Laboratories conducted research on the Green River below Flaming Gorge Dam between February 15 through 18, 2010. Releases were advanced two hours for more daylight hours to conduct above-water and

underwater videography. Additionally, in order to smooth the transition to the previously directed releases, Flaming Gorge released 1,224 cfs on February 14, 2010 at 23:00 hours and February 19, 2010 at 0:00 hours. Flaming Gorge releases returned to the original daily average release pattern of 1,550 cfs beginning February 19, 2010 at 01:00 hours.

Week of February 22nd

Releases were decreased based on the February final forecast for the April through July unregulated inflow volume into Flaming Gorge Reservoir of 675 kaf or 57 percent of average. Snowpack in the Green River Basin was 58 percent of average. The daily average release decreased from 1,550 cfs to 900 cfs beginning March 1, 2010. The decrease occurred incrementally with decreases of 50 cfs/day over a thirteen-day period, and releases after March 13, 2010 continued at a daily average release rate of 900 cfs.

Week of March 8th

Releases continued to decrease beyond those set on March 13. The March final forecast for the April through July unregulated inflow volume into Flaming Gorge Reservoir decreased to 515 kaf or 43 percent of average. Snowpack in the Green River Basin was 57 percent of average. The daily average release continued to decrease from 900 cfs to a steady minimum release of 800 cfs.

The Flaming Gorge Technical Working Group met to begin development of a flow proposal for spring of 2010.

Week of March 15th

A letter was received by Reclamation from the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) requesting spring flow releases of 15,000 cfs for five consecutive days for research and requesting further discussion on base flows. (See Appendix C).

Week of March 22nd

The March mid-month forecast was issued by the River Forecast Center for Flaming Gorge Reservoir and indicated hydrology was in the moderately dry hydrologic classification and the Yampa River in the average classification.

Western and Argonne requested an additional day of releases to assist in the videography study conducted in February. Releases were altered to a single peak hourly pattern on March 24, 2010, and returned to 800 cfs steady releases on March 25, 2010.

Week of April 12th

Utah Division of Wildlife Resources (UDWR) requested specific releases on April 12th and 13th for the spring fishery assessment. Releases were modified to provide 1,600 cfs during the evening and nighttime hours for electrofishing.

The FGTWG met to discuss current hydrology, Recovery Program research request and potential base flows.

Week of April 19th

Reclamation received a letter from the U.S. Fish and Wildlife Service (Service) on April 19, 2012 supporting the Recovery Program spring research request and also requesting higher base flows by as much as 40% through September 30th to assist in recovery of the endangered fishes. The Service acknowledged the tradeoff between spring and base flows, and supported Reclamation reducing the duration of the spring peak flow and reducing the winter base flow conditions if necessary to meeting the higher summer base flow target. (See Appendix D).

Week of April 26th

Reclamation held the Flaming Gorge Working Group Meeting on April 27, 2010, in Vernal, Utah to discuss forecasted hydrology, research requests for spring and base flow releases, and any other stakeholder concerns.

Week of May 3rd

The FGTWG met to discuss the May final forecast in relation to the spring hydrologic classification. Further discussion occurred regarding the Recovery Program research request, the Service's base flow request and hydrologic tradeoffs.

Week of May 17th

Flaming Gorge Dam directed to increase releases beginning May 24th to achieve power plant capacity on May 27th. Yampa River flows at Deerlodge Park expected to achieve 10,000 cfs or higher for ten days.

Week of May 24th

Flaming Gorge was directed to decrease releases from power plant capacity at a downramp rate of 350 cfs beginning June 5, 2010, and reaching the base flow release of 1,600 cfs on June 13, 2010.

Week of June 7th

Yampa River flows peaked at 16,500 cfs on June 9th as Flaming Gorge Dam ramped down to base flows. The Green River at Jensen, Utah peak was 19,400 cfs on June 10, 2010. Flows at Jensen, Utah were above 18,600 cfs for two days.

Week of June 21st

Green River flows as measured at Jensen, Utah were above 15,000 cfs for a total of 18 days from May 29, 2010 to June 15, 2010.

Week of July 5th

Flows as measured at the Green River at Jensen, Utah USGS stream gage were fluctuating at greater than 0.1 meter stage change. In order to comply with the commitments related to maintaining 0.1 meter stage change as measured at Jensen, Utah, the hourly flow pattern at Flaming Gorge changed on Monday, July 12, 2010, maintaining an average daily release of 1,600 cfs.

Week of July 12th

The Yampa River declined to approximately 500 cfs. In order to comply with the commitments related to maintaining 0.1 meter stage change as measured at Jensen, Utah, the flow pattern at Flaming Gorge changed on Monday, July 19, 2010, maintaining an average daily release of 1,600 cfs.

Week of August 2nd

The FGTWG met to discuss Argonne National Laboratory backwater survey results.

Reclamation determined the Service's base flow request could be achieved within normal operating parameters and made a decision to utilize the base flow flexibility and maintain high base flows through September 30. Releases during the winter period would follow a double-peak pattern request submitted by Western pursuant to ROD constraints, existing hydrologic conditions and electrical demand.

Week of August 16th

In an attempt to keep flows in Reach 2 at an average of around 2,100 cfs, releases from Flaming Gorge Dam was increased at a rate of 50 cfs/day from 1,600 cfs to 1,800 cfs beginning on Sunday, August 22, 2010. Flaming Gorge releases reached 1,800 cfs on August 25th.

Reclamation received a letter from UDWR on August 23, 2010, supporting the Service's base flow request and promoting flow patterns with little overall change to Western's request for double peaking patterns during the winter base flow period. (See Appendix F).

Week of August 26th

Flaming Gorge Working Group meeting held in Vernal, Utah to discuss past spring releases, current hydrology and upcoming winter flows.

Week of September 13th

UDWR requested specific releases on September 13th and 14th for the fall fishery assessment. Releases were modified to provide 1,600 cfs during the evening and nighttime hours for electrofishing.

Week of September 20th

Reclamation, Western and UDWR meet to discuss double peak study plan and proposed winter releases.

Week of September 27th

Releases from Flaming Gorge Dam were decreased at a rate of 50 cfs/day beginning October 1, 2010, of the next water year, from the daily average release of 1,800 cfs/day to 1,050 cfs daily average winter flows.

Appendix C

March 12, 2010 Memorandum from the Recovery Program Director for Spring Flows 2010

Stephen D. Guertin, Chairman
Implementation Committee

Upper Colorado River Endangered Fish Recovery Program

Thomas E. Chart, Director
Recovery Program

U.S. Fish and Wildlife Service•P.O. Box 25486•Denver Federal Center•Denver, CO 80225•(303) 969-7322•Fax (303) 969-7327
FWS/CRRP
K3a1
Mail Stop 65115

Memorandum

To: Larry Walkoviak, Director, Upper Colorado Region, Bureau of Reclamation
Heather Patno, Chair, Flaming Gorge Technical Working Group, Bureau of Reclamation

From: Thomas Chart, Director, Upper Colorado River Endangered Fish Recovery Program

Subject: Recovery Program's Research Request for 2010 Green River Spring Flows

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) supports the Bureau of Reclamation's (Reclamation) operations at Flaming Gorge Dam in 2010 consistent with the 2005 biological opinion (U.S. Fish and Wildlife Service 2005) and 2006 record of decision (ROD; U.S. Department of Interior 2006). The Recovery Program has one ongoing study in the Green River sub-basin, which requires achieving a specific spring flow threshold to meet project objectives. The purpose of this letter is to describe our spring-runoff research flow request that corresponds with that study.

Spring-Runoff Research Flow Request

The Recovery Program requests a spring-runoff flow of at least 15,000 cubic feet per second (cfs) for a minimum of 5 consecutive days in Reach 2 of the Green River for moderately dry and dry hydrologic categories. If hydrology precludes maintaining these flows for 5 days, the Recovery Program requests that Reclamation still maintain peak flows at 15,000 cfs in Reach 2 for as long as possible. The purpose of this research flow is to achieve the objectives of Recovery Program Study No.C6 RZ-RECR: *Razorback emigration from the Stirrup floodplain.* This study is designed to assess emigration rates to the river of razorback suckers stocked into the Stirrup floodplain wetland located in Reach 2 at River Mile 276.

Like 2009, the Utah Division of Wildlife Resources in 2010 intends to assess emigration rates of the stocked razorback suckers from the Stirrup floodplain wetland to the Green River provided the floodplain and river connect. In 1997, the Recovery Program breached the levee that surrounds the Stirrup so it would connect at approximately 13,000 cfs (Valdez and Nelson 2004).

Previous investigations into fish passage requirements for juvenile and adult Colorado pikeminnow and razorback sucker identified that a minimum depth of 30 cm (Burdick 1997) was necessary for unrestricted passage.

Based on subsequent field observations at the Stirrup, the Recovery Program has determined that at least 15,000 cfs is necessary to achieve the desired fish passage depth of 30 cm in the Stirrup connection channel. In 2009 the Recovery Program made a flow request very similar to that proposed for 2010. In conjunction with favorable flows from the Yampa River, Reclamation was able to fulfill the flow request, and the aforementioned emigration study was largely successful. Overall, 40 individual endangered fish comprised of three different species were observed using the breach during the 16 days of connection. Of these fish, most were razorback sucker (the target species), although Colorado pikeminnow and the extremely rare bonytail were also observed using the connection. The Recovery Program hopes to learn more about fish use of this habitat and others in Reach 2.

Recognition of Current Conditions

As this letter is drafted the Colorado Basin River Forecast Center is reporting dry conditions in the Upper Green River basin (55% average snow water equivalent (SWE) in the Upper Green River drainage in Wyoming; 78% average SWE in the Yampa and White River drainages in Colorado). We provide this spring flow request with hopes that wetter conditions return to the Green River sub-basin. However, if the current dry conditions persist the Recovery Program fully understands how difficult it would be for Reclamation to meet our spring flow request. Also, the Recovery Program requests that Reclamation work to balance our spring flow request with the U.S. Fish and Wildlife Service's (Service) forthcoming 2010 base flow request (see below) and is prepared to provide scientific guidance to strike that balance through the Service and the Flaming Gorge Technical Working Group (FGTWG) as new hydrologic forecasts become available during the spring and early summer periods.

Base Flow Requests

With regard to the base flow period, the Recovery Program has several studies in place, to assess impacts of flow and temperature recommendations on nonnative fish (Upper Colorado River Endangered Fish Recovery Program, 2007). In particular, for the last few years the Recovery Program has been investigating the relationship between base flow magnitude / main channel temperatures in the Yampa and Green rivers with the timing of nonnative smallmouth bass spawning and first year growth. Data are still being analyzed, but early findings suggest that base flows recommended by the Recovery Program in 2008 and 2009 (i.e., maintain average daily releases at Flaming Gorge Dam at the upper end of ranges specified in the ROD through at least September 30) may have contributed to reduced reproductive success for smallmouth bass in Reach 1 and upper Reach 2. These flows also allowed for ROD temperature objectives to be met in reaches 1 and 2 during the 2008 and 2009 summer base flow period.

The Recovery Program intends to have a specific study in place as soon as possible and when the budget permits to further study these relationships for nonnative as well as endangered fish (particularly Colorado pikeminnow). At that time, the Recovery Program will likely request

specific base flow targets or release patterns for consideration by Reclamation and the FGTWG. Until that time, and as was the case last year, the Recovery Program staff will coordinate with the Service' Utah Field Station as they develop their 2010 base flow request (to be covered in a separate letter) to assist in the recovery of the endangered fish.

In closing, the Recovery Program appreciates Reclamation's efforts in the past to achieve the flow and temperature recommendations and assist in recovery of the endangered fishes. Thank you for considering this Recovery Program request for spring research flows.

Literature Cited

Burdick, B.D. 1997. Minimum flow recommendation for passage of Colorado squawfish and razorback sucker in the 2.3-mile reach of the lower Gunnison River: Redlands Diversion Dam to the Colorado River confluence. Final Report to the Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

U.S. Department of the Interior. 2006. Record of Decision on the operation of Flaming Gorge Dam Final Environmental Impact Statement. U.S. Department of the Interior, Bureau of Reclamation, Salt Lake City, Utah.

U.S. Fish and Wildlife Service. 2005. Final Biological Opinion on the operation of Flaming Gorge Dam. U.S. Fish and Wildlife, Denver, Colorado.

Upper Colorado River Endangered Fish Recovery Program. 2007. Study plan for the implementation and evaluation of flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam.

Valdez, R.A., and P. Nelson. 2004. Green River Subbasin floodplain management plan. Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.

Appendix D

April 19, 2010 Memorandum from the U.S. Fish & Wildlife Service for Spring and Base Flows 2010

United States Department of the Interior
FISH AND WILDLIFE SERVICE
UTAH FIELD OFFICE
2369 WEST ORTON CIRCLE, SUITE 50
WEST VALLEY CITY, UTAH 84119

April 19, 2010

In Reply Refer To
FWS/R6
ES/UT
08-FA-0180

Memorandum

To: Director, Upper Colorado Region, Bureau of Reclamation (Reclamation)

Chair, Flaming Gorge Technical Working Group, Bureau of Reclamation

From: Field Supervisor, Utah Field Office, U.S. Fish and Wildlife Service

Subject: 2010 Green River Spring and Base Flows to Assist in Recovery of the Endangered Fishes

This letter describes our recommendations for 2010 spring and base flows in Reach 2 of the Green River for discussion by the Flaming Gorge Technical Working Group (FGTWG) in development of recommendations for Flaming Gorge Dam operations. Our intent is to work with other FGTWG members to ensure consistency with the 2005 biological opinion (BO) and 2006 record of decision (ROD), which call for flows to protect and assist in recovery of endangered fishes. The following suggestions are subject to forecasted and real-time April – July hydrologic conditions in the upper Green River drainage, with recognition that trade-offs of spring and base flows should be considered and used to adjust operations as deemed appropriate.

Spring-runoff research flow

We support the Upper Colorado River Endangered Fish Recovery Program's (Recovery Program) March 12, 2010 request for a spring-runoff research flow. Providing a flow regime that adequately connects the Stirrup floodplain wetland with the Green River is crucial to the assessment of emigration rates of stocked razorback suckers. Pursuant to the Green River Study Plan (Green River Study Plan ad hoc group 2007), knowledge gained from the Stirrup wetland assessment will further the understanding of the function of such floodplain wetlands in establishing self-sustaining razorback sucker populations.

However, we understand that water conditions may not allow this research flow to occur in 2010. As indicated below, we believe that maintaining adequate base flows in the forecasted moderately dry year should be the primary goal.

Base flow operations

We propose the following approach to base flow operations in 2010, which differs slightly from our suggested approach in 2009. Our 2010 proposal responds to significant hydrological and biological circumstances present this year and relies on the most up-to-date research available.

We understand that in accordance with the ROD and the BO, Reclamation will pick a Reach 1 base flow target commensurate with the April – July hydrologic condition. Reclamation selects a Reach 1 target that creates a flow condition in Reach 2 that falls within the appropriate base flow range when coupled with projected Yampa River base flows (Muth et al. 2000). For reasons mentioned below, we request that Reclamation release higher flows than the scheduled base flow target through September 30, 2010, with the understanding that Reclamation may need to release less than the base flow target through the remainder of the base flow period or adjust peak flow duration to balance annual operations.

Specifically, we request that Reclamation augment the Reach 1 calculated base flow target by as much as 40%. For example, if Reclamation determines that a release of 1,000 cfs is necessary to comply with the ROD and BO, then we request that up to 1,400 cfs be released through Sept 30, 2010. This augmentation is in accordance with the Reach 2 summer - autumn seasonal flow variability recognized in Muth et al. (2000). To meet this goal and remain within balanced operations, we support Reclamation reducing the duration of spring peak releases at Flaming Gorge Dam from two weeks to one week and reducing the winter base flow conditions, if necessary.

We believe that the 'Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam' (Muth et al. 2000) intended for the seasonal variability to be incorporated into dam operations to assist in the recovery of the species and accommodate natural variability, but not to allow for manipulation that targets a specific operational pattern. Our 2010 base flow proposal, which complies with the ROD and the BO, is consistent with the intent of the flow recommendations and is based on information gathered by the Recovery Program and responds to current biological conditions in the Green River system.

Our rationale for requesting elevated base flows through September 30 is similar to our request in 2008 and 2009 and is intended to accomplish two goals:

1) provide better habitat conditions for age-0 (young-of-year) Colorado pikeminnow in Reach 2; and
2) hinder nonnative smallmouth bass in Reaches 1 and 2 by delaying their spawning time and decreasing growth of the age-0 cohort.

Goal 1: Habitat conditions for age-0 Colorado pikeminnow

Since 2000, there have been a wide range of base flow conditions in Reach 2. Many of the lower base flow years coincided with low age-0 Colorado pikeminnow catch rates as determined each autumn via Recovery Program Project 138 – Interagency Standardized Monitoring Program (Table 1). For example, during the summers of 2001, 2002, 2003, 2006 and 2007 base flows in Reach 2 dropped below 1,000 cfs for varying periods of time and age-0 Colorado pikeminnow catch rates were in the single digits.

Contrastingly, in 2009, Reach 2 experienced average base flows that exceeded 2,000 cfs for the second consecutive year, and for only the second time in the most recent ten year period. That same year, Utah Division of Wildlife Resources biologists reported the highest catch of age-0 pikeminnow since 1991. We understand that there are many variables that could contribute to the increased catch of age-0 CPM, such as numbers of spawning adults, densities of nonnative fish throughout the larval drift zone, densities of nonnatives in backwaters, productivity of backwaters, and sampling efficiency. However, we believe that the higher base flows (approximately 2,400 to 2,600 cfs) in Reach 2 in 2008 and 2009 likely played some role in this increase.

Most above-average Colorado pikeminnow recruitment events in the middle and lower Green River occur when summer flows ranged from about 1,800 to 2,700 cfs (Bestgen 1997; in Muth et al. 2000). The relationship between base flow elevations and backwater rearing habitat availability is an information need identified in the Green River Study Plan (Green River Study Plan ad hoc group 2007) and is currently being investigated through a Recovery Program project entitled "Historical assessment of factors affecting young Colorado pikeminnow abundance and physical habitat availability in the Green River, Utah."

Year	# of age-0 Colorado pikeminnow collected	Average flow between July 15 and September 30	Years base flows dropped below 1000 cfs
2000	31	1423	
2001	8	1073	X
2002	0	876	X
2003	2	1101	X
2004	60	1367	
2005	8	1958	
2006	5	1213	X
2007	3	1122	X
2008	18	2376	
2009	325	2610	

Table 1. Age-0 Colorado pikeminnow (CPM) standardized catch and corresponding flow conditions in Reach 2 as measured by the USGS at their Jensen, Utah gage

Goal 2: Hinder smallmouth bass reproduction

Information continues to indicate that higher and cooler base flows delay smallmouth bass spawning and reduce growth of the age-0 smallmouth bass cohort. This information was gathered on the Yampa River and on the Green River in Reaches 1 and 2.

The effect of flow and temperature on the onset of smallmouth bass spawning is clearly demonstrated with data collected in Lodore Canyon (Reach 1), Green River (Figure 1). During a relatively wet and cool year (2005), smallmouth bass spawning occurred nearly 3 weeks later than during a drier, warmer year (2007). The same relationship was observed in related investigations on the Yampa River.

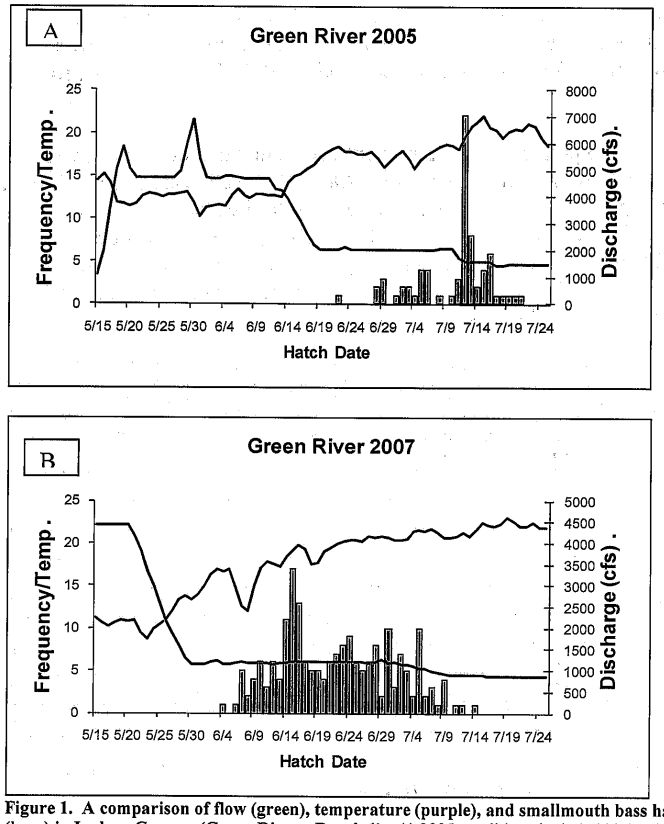


Figure 1. A comparison of flow (green), temperature (purple), and smallmouth bass hatching dates (bars) in Lodore Canyon (Green River - Reach 1). A) 2005 conditions included higher base flows and cooler temps; B) 2007 conditions included lower base flows and warmer temps. Figures excerpted from Recovery Program Project #115 2009 Annual Report (preliminary information)[1]

[1] Available online at: http://coloradoriverrecovery.org/documents-publications/work-plan-documents/arpts/2009/nna/115.pdf

Also, preliminary information from Yampa River studies (Recovery Program Project #140) indicate that age-0 smallmouth bass measured in September 2005 were on average 30 millimeter smaller than those collected in September 2007. Thus, high flows and associated cool temperatures appear to not only delay spawning but also slow the growth rates of age-0 smallmouth bass which in turn decreases their likelihood for overwinter survival (Shuter at al. 1980).

The 2007 smallmouth bass spawning event described above is a particular concern because this strong cohort will reach sexual maturity this year. Researchers predict that this cohort of smallmouth bass is on the brink of a significant spawning event this year. In response, the Recovery Program has adjusted their smallmouth bass removal schedules to maximize removal of adults prior to and during the spawning period.

Conclusion

In summary, we request that base flow operations through September 30, 2010 are augmented as much as possible. To meet these goals and remain in balanced annual operations, it is acceptable to decrease spring and winter flows. Predicted conditions for 2010 include extenuating hydrological and biological circumstances that require special responses. These include the strong Colorado pikeminnow age-0 year class from 2009, the large cohort of smallmouth bass from 2007 that is ready to spawn, and the dry flow conditions predicted for multiple Green River sub-basins.

We believe that data gathered by the Recovery Program make a strong case for our proposed base flow operation in 2010. Recovery Program representatives were present during the FGTWG conversation held on April 13, 2010 and clarified our interpretation of their preliminary information.

In addition, and in accordance with the BO and ROD, we support Reclamation's release of water of an appropriate temperature to meet thermal targets in both upper Lodore Canyon and in Echo Park. Experience gained in 2009 and previous years indicates that our base flows proposal will not likely compromise Reclamation's ability to meet these temperature targets to an appreciable extent.

We thank Reclamation for the opportunity to provide this input and look forward to participating in the Flaming Gorge Technical Working Group process. If you have any questions or concerns, please contact Kevin McAbee or Paul Abate at 801-975-3330.

Literature Cited

Bestgen, K. R. 1997. Interacting effects of physical and biological factors on recruitment of age-0 Colorado squawfish. Doctoral Dissertation. Colorado State University, Fort Collins, CO.

Green River Study Plan ad hoc Group. 2007. Study plan for the implementation and evaluation of flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Upper Colorado Basin Endangered Fish Recovery Program, Lakewood, CO.

Muth, R.T., L.W. Crist, K.E. LaGory, J.W. Hayse, K.R. Bestgen, T.P. Ryan, J.K. Lyons, R.A. Valdez. 2000. Flow and temperature recommendations for endangered fishes in the Green River downstream of Flaming Gorge Dam. Upper Colorado River Endangered Fish Recovery Program, Denver, CO.

Shuter, B.J., J.A. MacLean, F.E.J. Fry, and H.A. Regier. 1980. Stochastic simulation of temperature effects of first-year survival of smallmouth bass. Transactions of the American Fisheries Society 109:1-34.

Appendix E

Flaming Gorge Technical Working Group – Proposed Flow and Temperature Objectives for 2010

Flaming Gorge Technical Working Group
Proposed Flow and Temperature Objectives for 2010

Current Hydrologic Classification

For the purposes of implementing the 2006 Flaming Gorge Record of Decision (ROD) in 2010 an evaluation has been made of the current hydrologic conditions in the Upper Green River (i.e. above Flaming Gorge Dam) as it relates to the historical unregulated inflow statistics for Flaming Gorge Dam during the period from 1963 through 2009. Based on these statistics and the May 1, 2010, final forecast of 515,000 acre-feet for Flaming Gorge, the spring 2010 hydrologic classification is moderately dry (70% to 90% exceedance). Appendix A illustrates the May 1, 2010, final forecast for Flaming Gorge Reservoir in relation to the hydrologic categories described in the Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam (Muth, et al, 2000) (Flow Recommendations).

Green River Basin Hydrology

The May 1, 2010, final forecast of April through July unregulated inflow (current forecast) for Flaming Gorge Reservoir is 515 thousand acre-feet (KAF) (43% of 30-year average). This forecast falls at approximately 86% exceedance based on the historic unregulated inflow record (1963-2009).

Flaming Gorge Reservoir currently has a water surface elevation of approximately 6026.75 feet above sea level. There is approximately 3.23 million acre-feet of live storage (86% storage capacity) in Flaming Gorge and approximately 0.527 million acre-feet of storage space.

Figure 1 shows the current forecast in relation to the historic unregulated inflow volumes.

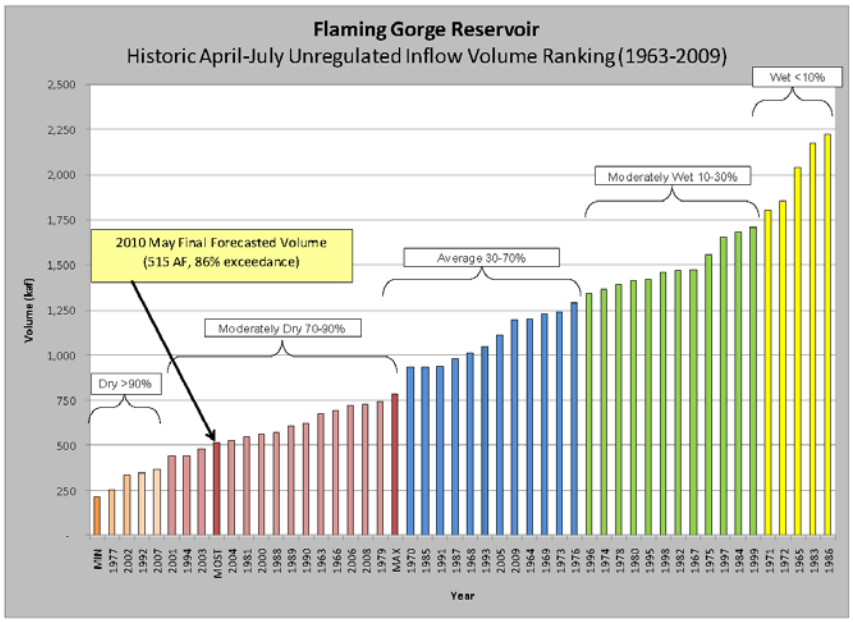


FIGURE 1—Flaming Gorge Reservoir May final forecast and ranked historic unregulated April through July inflow volume for years 1963-2009.

Yampa River Basin Hydrology

The current forecast for the Little Snake River and Yampa River combined (Little Snake at Lily plus Yampa at Maybell) is 1,030 KAF (76% of 30-year average). This forecast falls at approximately 68% exceedance based on a ranking of the historic record (1922-2009). Figure 2 below shows the current forecast in relation to historic flow volumes.

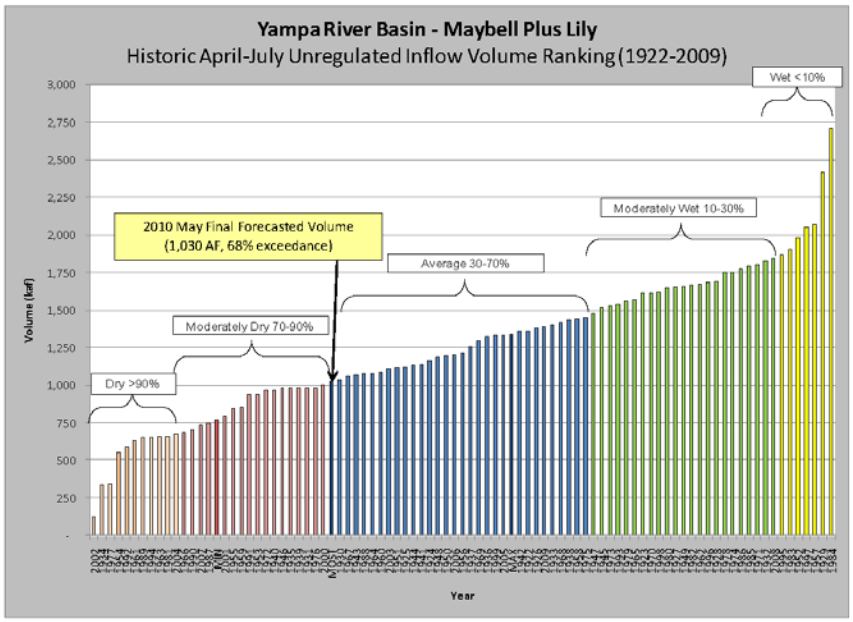


FIGURE 2—Yampa River Basin (Maybell plus Lily) current forecast and ranked historic unregulated April through July inflow volume for years 1922-2009.

Hydrologic conditions in the Yampa River basin do not look promising for high flows this year based on the current forecast.

Green and Yampa River Basin Hydrology (combined)

The current forecast for the combined Green River above Flaming Gorge Reservoir, Little Snake River near Lily, Colorado and the Yampa River near Maybell, Colorado (combined forecasts equal the Jensen, Utah unregulated flow) is 1,555 KAF. The combined April through July forecast for these points is the best indicator of the unregulated flow volume most likely to occur on the Green River at Jensen, Utah during 2010. This volume falls at 67% exceedance when compared to the historic record (1947-2009).

Figure 3 below indicates where within the wet to dry continuum the current April through July forecast falls in comparison to the historic record.

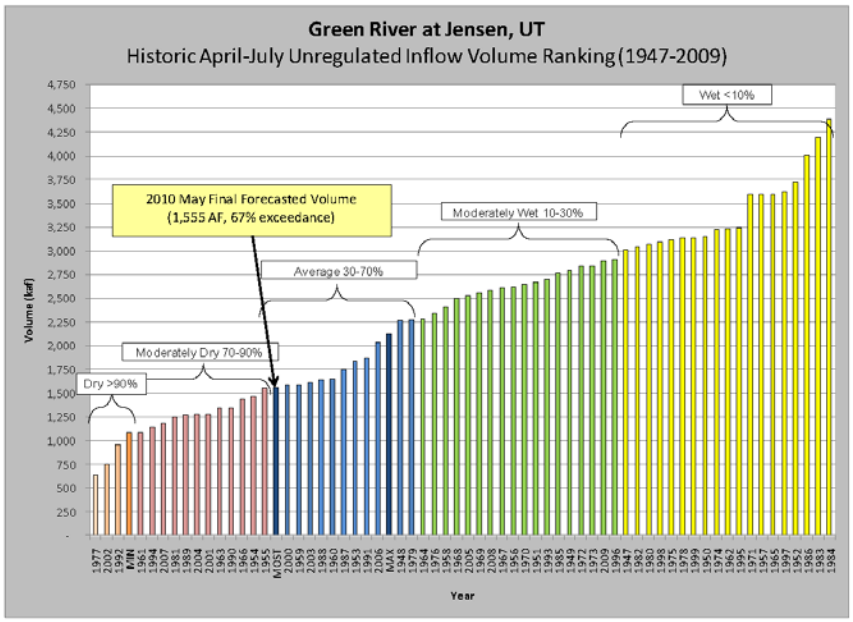


FIGURE 3—Green River at Jensen, Utah current forecast and ranked historic unregulated April through July inflow volume for years 1947-2009.

Probabilities of Flow Events for Spring 2010

This year hydrology is significantly drier than both 2008 and 2009, with both Flaming Gorge Reservoir in the moderately dry hydrologic classification and Yampa River Basin forecast barely in the average hydrologic classification as outlined in the Flow Recommendations. An analysis was completed to assist in the determination of appropriate flow objectives for spring and summer 2010. The ten most similar historic years for the Yampa River Basin (Maybell plus Lily) compared to the current forecast (Table 1) were analyzed assuming a normal distribution. Table 2 presents the percent exceedance of cumulative days greater than or equal to various flow levels at Yampa River (Maybell plus Lily).

TABLE 1—Yampa River (Maybell plus Lily) April through July unregulated inflow volume (KAF) of ten similar years to the current forecast of 1,030 KAF.

Year	April-July Unreg Inflow Volume (KAF)
MIN	770
1935	976
1939	976
1931	979
1976	981
2000	1,005
MOST	1,030
1930	1,031
1967	1,062
1943	1,071
1988	1,074
1964	1,075
MAX	1,340

TABLE 2—Spring 2010 probability of days above specific flow thresholds in Yampa River (Maybell plus Lily).

May Final Forecast	% Exceed	Days above 10,000 cfs	Days above 11,000 cfs	Days above 12,000 cfs	Days above 13,000 cfs	Days above 14,000 cfs	Days above 15,000 cfs	Days above 16,000 cfs
YAMPA	25%	11	6	2	2	1	0	0
	50%	5	3	1	0	0	0	0
	75%	2	0	0	0	0	0	0
	90%	1	0	0	0	0	0	0

Record of Decision Spring Flow Objectives

If the April through July unregulated inflow into Flaming Gorge Reservoir remains in the range from 427 KAF to 788 KAF the hydrological classification would be moderately dry. The ROD spring flow objectives for moderately dry years are:

Moderately Dry Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,300 cfs	that necessary to achieve duration target in Reach 2
Reach 2	≥ 8,300 cfs	1 week (i.e. 7 days)

In the event conditions become even drier and the Flaming Gorge Reservoir unregulated inflow forecast for April through July falls below 427 KAF, the hydrological classification would be dry. ROD spring flow objectives for dry years are:

Dry Spring Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,300 cfs	that necessary to achieve duration target in Reach 2
Reach 2	≥ 8,300 cfs	2 days except in extremely dry years (≥ 98% exceedance conditions)

In the event conditions become wetter and the Flaming Gorge Reservoir unregulated inflow forecast for April through July increases falls above 788 KAF, the hydrological classification would be average. ROD spring flow objectives for average years are:

Average Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,300 cfs	That necessary to achieve duration target in Reach 2
Reach 2	≥ 18,600 cfs in 50% of average years	Two weeks (i.e. 14 days) in 25% of all average years
	≥ 8,300 cfs in 50% of average years	One week (i.e. 7 days) in 50% of average years

In the unlikely event conditions become wetter than the current forecast at Flaming Gorge Reservoir and the April through July forecast increases above 1,337 KAF, the hydrological classification would be moderately wet. ROD spring flow objectives for moderately wet years are:

Moderately Wet Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,300 cfs	that necessary to achieve duration target in Reach 2
Reach 2	≥ 20,300 cfs	1 day in moderately wet years
	≥ 18,600 cfs	2 weeks (i.e. 14 days) in moderately wet years

Recovery Program Research Request

Reclamation and the Flaming Gorge Technical Working Group received a memorandum dated March 12, 2010, from Tom Chart, Director of the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). In 2010, the Recovery Program intends to

continue the assessment of emigration rates of razorback sucker stocked in the Stirrup floodplain to the main stem of the Green River. Studies have identified a 30 cm water depth in passages between floodplains and the main river channel (e.g., levee breaches and outlet structures) is required for juvenile and adult Colorado pikeminnow and razorback sucker fish passage. The request from the Recovery Program for a spring peak flow is 15,000 cfs, or greater, for a minimum of five consecutive days in Reach 2 of the Green River under current hydrologic conditions.

The Recovery Program will continue studies to assess the effects of the flow and temperature recommendations on the fish community in the Green River. Through those efforts the Recovery Program is gathering a better understanding how nonnative smallmouth bass reproduction (time of spawn and first year growth) is affected by base flow magnitude and main channel temperatures in the Yampa and Green rivers. In the future, in conjuction with a specific Scope of Work, the Recovery Program will likely request specific base flow targets or release patterns for Flaming Gorge Dam releases to: a)_ hinder smallmouth bass reproduction, and b) benefit Colorado pikeminnow reproduction. The Recovery Program will continue to coordinate with the U.S. Fish and Wildlife Service's Utah Field Station on all future research flow requests, and specifically as the Service develops their 2010 base flow request to assist in the recovery of the endangered fish.

Proposed Flow Objectives for Spring 2010

The 2005 Operations of Flaming Gorge Dam Final Environmental Impact Statement (EIS) specifically addresses the content of this operating plan in Section 2.5.3.1. The operating plan is to describe the current hydrologic classification of the Green River and Yampa River Basins, including the most probable runoff patterns for the two basins. This information has been provided above. The operating plan is also to identify the most likely Reach 2 flow magnitudes and durations that are to be targeted for the upcoming spring release. It further specifies that "[b]ecause 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."

Moderately Dry Classification

The current forecast of 515 KAF into Flaming Gorge reservoir is solidly in the moderately dry category of the Flow Recommendations. The Yampa River Basin forecast of 835 KAF if compared against the percent exceedance in the ROD is also in the moderately dry category. The following proposed flow objectives apply to a moderately dry hydrologic classification as determined by the May 1, 2010 final forecasted unregulated inflows for the April through July period into Flaming Gorge Reservoir. Proposed Reach 1 flows should be managed to achieve a peak of 4,300 cfs or greater in an attempt to meet the Recovery Program research request, timed coincident with the spring peak flows of the Yampa River. To meet the Recovery Program research request, the flows in Reach 1 should be managed to achieve at least 15,000 cfs in Reach 2 for a minimum duration of five days or for as long as possible. Reach 1 flows should be gradually reduced at a rate of 350 cfs/day to base flow levels once flows have achieved at least 15,000 cfs in Reach 2 for a minimum duration of five days or as long as possible. If it is not feasible to achieve the Recovery Program research request,

Reach 1 flows should be managed to achieve 4,300 cfs for one week and then gradually reduced at a rate of 350 cfs/day to base flow levels. The current operation schedule is for Reach 1 flows to be maintained for ten days at 4,300 cfs, which is predicted to result in an average daily base flow of 1,160 cfs. If Reach 1 flows are reduced to one week at 4,300 cfs, then the average daily base flow forecast increases to 1,200 cfs.

Dry Classification

If the Flaming Gorge Reservoir forecast falls below 427 KAF the spring flow proposal would fall into the dry classification. Proposed Reach 1 flows should be managed to achieve two days at 8,300 cfs in Reach 2 and then gradually reduced at a rate of 350 cfs/day to base flow levels.

Average Classification

If Flaming Gorge Reservoir forecast increases above 788 KAF, it is proposed that Reach 1 flows be managed to achieve average hydrologic classification release of at least one week at 8,300 cfs in Reach 2. In addition, it is proposed that Reach 1 flows be managed to achieve the Recovery Program research objectives outlined above in the moderately dry hydrologic classification of at least 15,000 cfs for five days. Following achievement of these objectives, Reach 1 flows would gradually be reduced at a rate of 500 cfs/day to base flow levels.

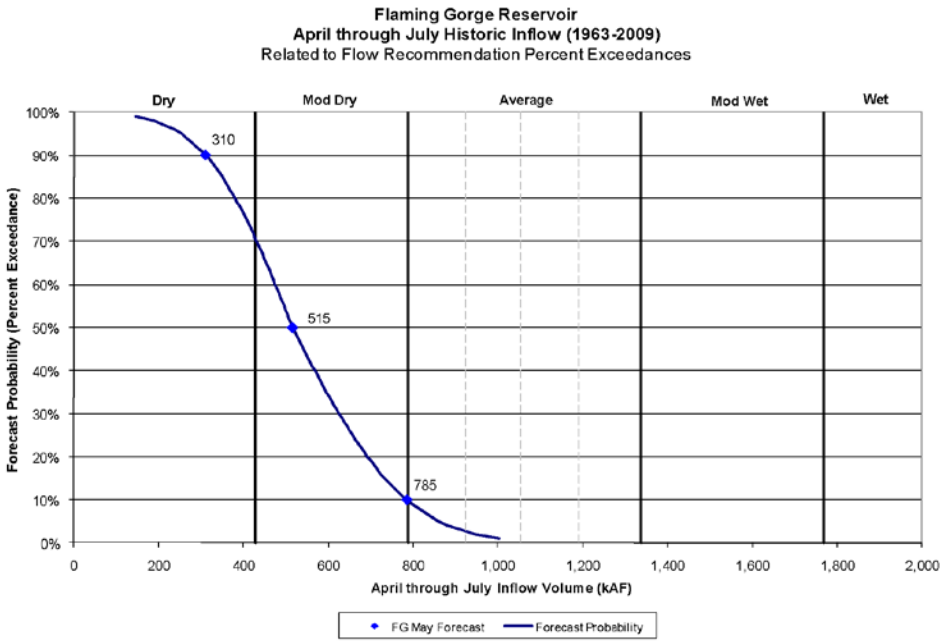
Proposed Base Flow and Temperature Objectives for Summer 2010

After the spring flow objectives in Reach 1 and Reach 2 have been achieved, flows should be gradually reduced to achieve base flow levels by no later than July 1, 2010. Base flows in Reaches 1 and 2 should be managed to fall within the prescribed base flow ranges described in the Flow Recommendations based on the observed April through July unregulated inflow into Flaming Gorge Reservoir. During the August through November base-flow period, the daily flows should be within ±40% of mean base flow. During the December through February base-flow period, the daily flows should be within ±25% of the mean base flow. Additionally, the mean daily flows should not exceed 3% variation between consecutive days and daily fluctuations at Flaming Gorge Dam should produce no more than a 0.1 meter daily stage change at Jensen, Utah.

Additionally, the temperature of flows should be managed to be at least 18° C for 2 to 5 weeks in Upper Lodore Canyon during the beginning of the base flow period. Water temperatures in the Green River should also be managed to be no more than 5° C colder than those of the Yampa River at the confluence of the Green and Yampa Rivers for the summer period of 2009 (June through August).

APPENDIX A

May 2010 Final Forecast for April-July Unregulated Inflow
Flaming Gorge Reservoir, Yampa River and Green River



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May 2010 Final Forecast for April-July Unregulated Inflow
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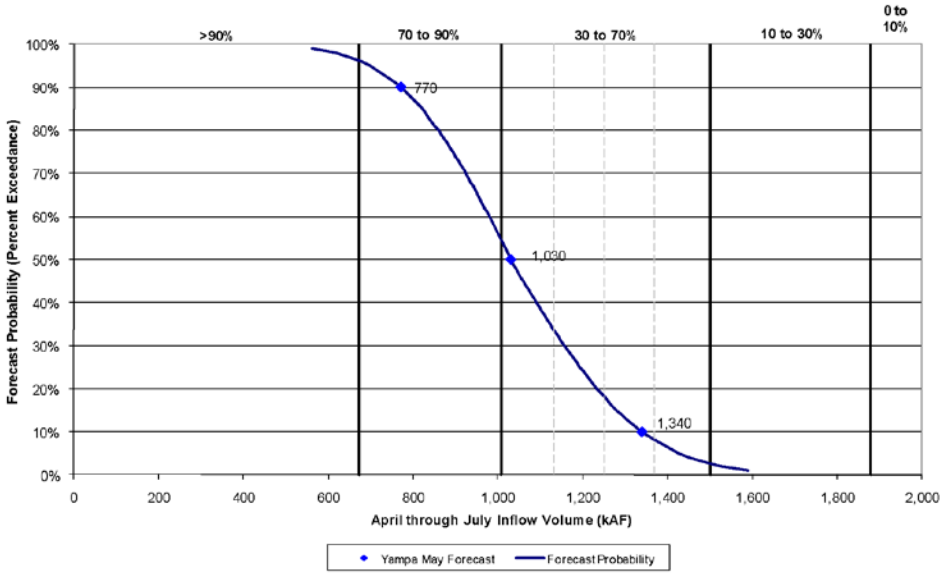
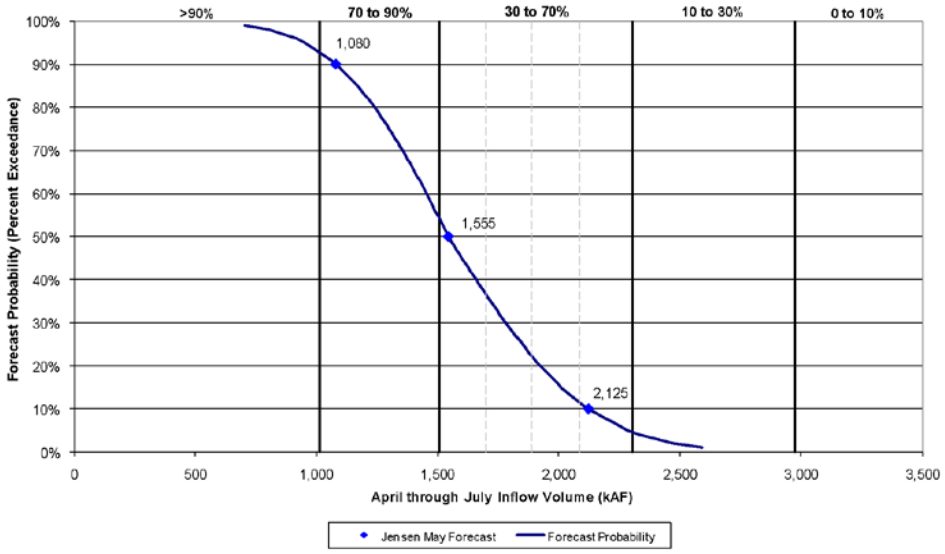


APPENDIX A

May 2010 Final Forecast for April-July Unregulated Inflow
Flaming Gorge Reservoir, Yampa River and Green River

Green River at Jensen, Utah
April through July Historic Inflow (1947-2009)
Related to Flow Recommendation Percent Exceedances



Appendix F

October 16, 2009 Email from Western Area Power Administration, Subject: Meeting with Green River Fishing Guides, Regarding winter 2009-2010 Flows

From: Clayton Palmer [cspalmer@wapa.gov]
Sent: Friday, October 16, 2009 5:25 PM
To: Patno, Heather E; Wilson, Malcolm M
Cc: lagory@anl.gov; Burt Hawkes; Laverne Kyriss; Sam Loftin
Subject: Meeting with Green River Fishing Guides

Hello:
We met yesterday with fishing guides at Dutch John.

It was a very productive meeting and we agreed to propose a course of action for Flaming Gorge flows to Reclamation for the Winter Season.

* Winter Season flow will be load following (double peaking) from November 1st to February 28.

* The daily pattern will have a minimum value of 833 cfs and a maximum of 2,559 cfs. Ramp up will begin at 06:00 and ramp down at HE 23:00. (the 24-hour pattern will be sent to you in a separate e-mail).

* Argonne will gather additional information on the location of Brown Trout redds. This information will used as input to the IBM Green River Trout model and the proposed load following pattern will be tested. The IBM model analysis will be brought to another Guides meeting about November 1st. Possibly, the model will show an impact on Brown trout recruitment. If this is the case the above pattern may be modified. If so, the modification will be carried on through the peak of the Brown trout spawning and incubation period.

* After this, the flow pattern described above will continue throughout the Winter Season.

* One week in December during the planned drift study will be a single peak in order for the people doing the drift study to be able to contrast drift with a single peak against drift with a double peak.

Please call or e-mail with any questions you may have.

Thank you. Clayton Palmer

Appendix G

August 23, 2010 Letter from the Utah Division of Wildlife Resources

GARY R. HERBERT
Governor
GREG BELL
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCES
MICHAEL R. STYLER
Executive Director
Division of Wildlife Resources
JAMES F. KARPOWITZ
Division Director

Heather Patno
Co-chair, Flaming Gorge Working Group
Upper Colorado Region, Bureau of Reclamation
125 South State Street
Salt Lake City, UT 84138

Ed Vidmar
Co-chair, Flaming Gorge Working Group
Provo Area Office, Bureau of Reclamation
302 East 1860 South
Provo, UT 84606

Re: 2010 Green River base flows

Dear Ms. Patno and Mr. Vidmar,

The Utah Division of Wildlife Resources (Division) has assembled this 2010 base flow request in an effort to more actively participate in the development of annual flow releases from Flaming Gorge Dam.

Base flow request to benefit the endangered fishery
As you are aware, the Division is a partner and participant on the Upper Colorado River Endangered Fishes Recovery Program. As such, our biologists are annually implementing projects to benefit the endangered fish and/or disadvantage nonnative fish. Based on recent field observations, the Division supports the elevated base flow request sent to you from the U.S. Fish and Wildlife Service's Utah Field Office Field Supervisor on 19 April 2010. Observations were detailed in that letter, but are included herein as a reminder:

1. During the fall young-of-year sampling in 2009, Division biologists sampled more Colorado pikeminnow than at any time since the early 1990's. In this same year, base flows averaged 2,610 cfs, more than any previous base flow period since the 1990's. While this is not a conclusive cause-effect relationship, Division biologists would like to once again test this developing theory that elevated base flows provide more habitats for young-of-year Colorado pikeminnow.

1594 West North Temple, Suite 2110, PO Box 146301, Salt Lake City, UT 84114-6301
telephone (801) 538-4700 • facsimile (801) 538-4709 • TTY (801) 538-7458 • *www.wildlife.utah.gov*

UTAH DNR WILDLIFE RESOURCES

2. In 2007, Division biologists observed and recorded significant young-of-year smallmouth bass in Reach 2. This age class has persisted in all locations where active mechanical removal has not been done (i.e., below the confluence with the Duchesne River). During that same year, base flows averaged substantially less than any other year in which mechanical removal has occurred (removal began in 2004 in Reach 2). It has also proven to be the *only* year since removal began that we have observed substantial numbers of young-of-year smallmouth bass in Reach 2. Given the amount of time and effort required to remove these fish after they have successfully overwintered, we would rather limit the number of smallmouth bass that have the opportunity to overwinter than remove them once they have become established in the river. We feel that elevated base flows are a good way to limit overwintering success.

This elevated base flow was requested through 30 September 2010. We are also in support of this ending date as we believe the critical time for young-of-year fish occurs before this date.

Finally, the native species biologists defer to the 2005 biological opinion, 2006 record of decision, and the needs of the Flaming Gorge tailrace fishery for base flows for the remainder of the water year.

Base flow request to benefit tailwater fishery

Due to impacts to the tailwater fishery, the Division requests that flow releases from Flaming Gorge Dam during the winter of 2010-11 mimic a natural hydrograph. Typically, overwinter hydrographs in natural riverine systems in the intermountain west are characterized by low, stable flows with minimal fluctuations. Research has shown that highly fluctuating flows, like those seen below dams, can severely impact invertebrate production and trout growth/condition (Cushman 1985). Double peak flow releases were implemented from Flaming Gorge Dam during the winters of 2006-07, 2008-09, and 2009-10. Sampling completed on the Green River by Utah State University researcher Mark Vinson indicated aquatic plant biomass and aquatic invertebrate abundance was lower than the 16-year average, immediately following these flow events. Subsequently, trout, already in poorer condition over-winter than any other season (due to low water temperatures, spawning, and lower invertebrate densities; Filbert and Hawkins 1995), could be subjected to even further declines in condition due to unnatural and highly dynamic flow releases which can further increase their overall energetic requirements.

Flow patterns with little overall change are also more conducive to angling on the Green River. Anglers/guides utilizing the Green River during the winter months have an overwhelming perception that fluctuating flows negatively impact fishability. This group has observed and been extremely vocal about a decrease in trout catchability on the descending limb of flows, especially those that occur during the peak fishing period from about 7AM-7PM. In addition, prescribed daily fluctuations and higher magnitude flow changes, as seen in the past, can reduce angler-use, as some anglers choose not to visit the Green River based on the perceived negative effects of these fluctuating flows. Thus, even perceptions have the very real capability of negatively impacting the local economy at Dutch John, which is heavily reliant upon angler use and recreation at Flaming Gorge Reservoir and the Green River. Angler use characteristically drops during the winter months, and local businesses struggle to attract

visitors to the Green River, regardless of the increased negative perception of fluctuating flows, thus it is important to maintain positive perceptions when and where feasible in this important fishery.

We acknowledge this request is predominantly biologically and angling based, as these are our areas of expertise. There are certainly other interests in this system. Thus, if you determine that a deviation from a stable flow regime is warranted to balance the needs of all system users, we would like an opportunity to comment on the proposed fluctuations and fluctuation rates when that is released.

Thank you for your consideration of this flow request. If you have any questions, you may contact Ryan Mosley at 435-885-3164 or Trina Hedrick at 435-781-5314 for further information.

Sincerely,

Kevin Christopherson
Northeastern Regional Supervisor

cc: Walt Donaldson, Utah Division of Wildlife Resources
Krissy Wilson, Utah Division of Wildlife Resources

Cushman, R.M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5:330-339.

Filbert, R.B. and C.P. Hawkins. 1995. Variation in condition of rainbow trout in relation to food, temperature, and individual length in the Green River, Utah. Transactions of the American Fisheries Society 124:824-835.

Appendix H

Comment Letters Received from the Public during the 2010 Decision-Making Process

From: Kevin Clegg [mailto:kevin.fgres ort@yahoo.com]
Sent: Wednesday, March 24, 2010 5:34 PM
To: Patno, Heather E
Cc: Vidmar, Edward; Bomar Tipton; Boomer Stout; Chad Jacques; Craig Collett; Dave Jones; Doug Burton; Dudley Campbell; Scott Barris; Steve Schmidt; Terry Collier; Trout Creek
Subject: GROGA Flow Recommendation

Heather,

The Green River Outfitters and Guide Association met last week and I was elected to share with you our recommendation of flows for the upcoming season.

Our first recommendation is to have a steady release with no peaks. This would apply to any hydrology conditions (dry, avg, wet).

Our second choice would be for a single peak. We would like to see the single peak happen as late in the afternoon as possible. With the single peak recommendation we would like to see as high of a base flow as possible. We request that the single peak should **not** double the base flow.

Also we would again propose that a couple/few day flushing flow of 10,000 or greater cfs is needed to move silt and sediment to rejuvenate the river and aquatic bugs. We believe the decreasing average size of trout is linked to several years of low water and increase of sediment. This flush could happen most any time of the year and makes most sense to do it when the Yampa is running low so we don't flood the Jensen folks.

Regarding the spring release we support what needs to happen and appreciate as much notice possible. It is important to us that the ramp up and ramp down rates are gentle. We also appreciate the increased involvement of GROGA duing the process.

"Fishability" is our reasoning for the above recommendations. The later in the day the ramp up occurs the less impact it will have on the recreational angler.

If you need any clarification on the above recommendations let me know. This is new to me so I don't fully understand the process. Is email ok or is it more official in a physical letter? This proposal is not biology based but more economic and "fishability". Thank you for reading this and we appreciate the oppourtunity to comment.

Thanks,

Heather Patno
Hydraulic Engineer
Bureau of Reclamation
125 South State Street, UC-436
SLC, UT 84115

Heather,

I organize a group that fishes the Green below the Flaming Gorge Dam during the last week of April each year. There were 12 in the group this year and we had one day of snow, wind, and cold. Half of the group had air reservations and the other half drove. The half with air reservations stayed and fished and froze their tails off. Consequently, I'm getting pressure to move the trip into May or a little later.

As we move the trip later we encounter conflicts with Mothers' Day, crowds, etc.; however the biggest concern is the Spring water release from the Flaming Gorge Dam which wipes out fishing for a few days.

Can you give me any advice on how to plan around the water release? Next year we are looking at the dates 9 through 12 May. Is the water release date known far enough in advance to be able to plan with some certainty?

Thank you and your colleagues at the Bureau of Reclamation for the superb work you do in preserving and enhancing the unique fishery on the Green River below the Flaming Gorge Dam.

Cheers,

Ray O'Mara
Major General, USAF, Retired

-----Original Message-----
From: Ryan Mosley [mailto:ryanmosley@utah.gov]
Sent: Tuesday, February 16, 2010 10:16 PM
To: hayse@anl.gov; lagory@anl.gov; Speas, David W; scott.miller@usu.edu; Clay Perschon; Roger Schneidervin; cspalmer@wapa.gov
Cc: dryflylovejoy@gmail.com; Patno, Heather E; kevin.fgresort@yahoo.com
Subject: Green River Trout Stranding

I wanted to notify members of this group pertaining to another angler account of a trout stranding event, resulting from receding Green River flows.

I received a concerned call from fishing guides, Darren Bowcutt and Brad Lovejoy, the evening of Sunday, February 14th. Brad and a fellow angler were fishing at Little Hole early Sunday afternoon as the morning flows receded. Sometime between 1:15-1:30 PM, they witnessed several hundred juvenile brown trout stranded in the shoreline vegetation. Brad stated that both he and his partner quickly saved 50+ fish each, before snapping some photos of the occurrence. I've attached two of these pics. Brad indicated most of the stranding was near the inflow of Goslin Creek (between Ramps #2 and #3) but some was observed just above Ramp #1. He also observed 6 Great Blue Herons feeding on stranded fish.

In response, I spent a couple of hours on Monday at Little Hole surveying these areas as the morning flow receded. Kirk and John are currently working on the river, and were also on-site Monday to help look for stranded fish. Unfortunately (or fortunately), after several passes we did not observe any stranding on Monday.

Brad is cc'ed on this message, if anyone wants to contact him for his personal account. Once again, I merely want to inform everyone in the research group of this occurence. In the future, we may want to reconsider these events and how they can be addressed to determine the potential impacts of fluctuating flows on the Green River fishery.

Thanks, Ryan

The person who coined the phrase "Money can't buy you happiness!", never bought a Utah fishing license!

Ryan Mosley
Wildlife Biologist II
Flaming Gorge Project
Utah Division of Wildlife Resources
P.O. Box 145
Dutch John, Utah 84023
CP(435)790-4097
WP(435)885-3164
ryanmosley@utah.gov

Green River Outfitters Guide Association (GROGA) Client Survey Results Presented at FGWG

2.	We have fished the Green for over 10 years and seen the management of flows change. I use to fly fish from the banks but with the high flows in the last few years there are no banks to fish from safely. The managers of the dam are ruining one of the best fly fishing waters in the western United States,	
4.	Only complaint after traveling to the Green numerous times is the water flow. Sometimes it is un-fishable and folks like myself spend a lot of money to make the trip, often having to cancel a day or days of guided fishing. Can fully appreciate spring runoff, etc., just hate losing a day on the water!	
12.	double peak flows are negativly impacting fishing. i will not return as long as current flow schedule is in effect.	
16.	We need to have more constant flows on the green. The river is struggling every summer and winter with now double peaks. The fish need a constant flow in order to have a constant feeding pattern	
19.	Double peak flows are unnecessary. they only disrupt the ability of fish to "settle" into their comfortable lies . a one-time high peak flow{10,000cfs or more} should be adequate for moving sediment and producing spawning conditions for downstream endangered species. thank you.	
27.	I love the Green River but unfortunately many others do as well. I can understand the need for some of the flow adjustments but wish they were a little less radical.	Tue, May 25, 2010 6:59 PM
42.	The Green is a beautiful river. The fishery would be greatly improved if all involved could agree on a consistent and stable management of flows.	
44.	stable flows please	Fri, May 7, 2010 3:18 PM
47.	Have fished river same week in April for about 18 years. Needs big flow to flush out silt and moss. Noticeably fewer feeding fish, lower catch rates. May no longer be worth time and expense of trip.	Wed, May 5, 2010 7:30 PM
46.	The fluctuating water patterns of recent years have affected the size and number or fish caught per trip. Smaller fish, smaller flies required, less active feeding fish.	Thu, May 6, 2010 1:58 PM
65.	It's frustrating as a fisherman when they fluctuate the flows during the day because it always effects the fishing in a negative way.	Fri, Apr 30, 2010 9:17 AM
67.	The flows should mimic the natural hydrograph with the high peak in the spring. Two peaks daily are not acceptable. The peaks can put the fish off for a period of time. Thanks for allowing us to comment.	Thu, Apr 29, 2010 8:10 PM
79.	keep the flow as even as possible	Tue, Apr 27, 2010 6:04 PM
82.	Peaking flows move the fish around and disturb the hatches which messes up the fishing!	Tue, Apr 27, 2010 3:57 PM

86.	Thank you for providing the opportunity to comment. The flow issue is huge for me. Not that fishing should be easy, but it the variable flows knock the fish to the middle of the river, even if there are large hatches taking place. It makes it more difficult to swallow knowing the power generated is going to California. Thank you.	Tue, Apr 27, 2010 2:26 PM
88.	This fishery is too important economically to be sacraficed just to sell public power at peaking power rates.	Tue, Apr 27, 2010 1:36 PM
95.	the fluctuating flows are destroying a great resource...how sad...	Fri, Apr 23, 2010 10:16 PM
98.	The double peak regimen cannot be what is best for the fishery. A constant flow would be more beneficial for the fish and the people who come the river	Thu, Apr 22, 2010 1:36 PM
101.	Last year we found it very difficult to find out what the projected flows and or operations of the dam were going to be. As fishermen who live several hundred miles from the river we like to have an idea as to what kind of flows we can expect on a given day. This lack of transparency on the operation of the dam was very frustrating. If this lack of information continues I will be forced to write my congressmen and demand that the administration of the dam be investigated. In addition it was also difficult to get a straight answer from the dam administration regarding why the up and down flows were being selected. Was it for power generation, or what ? The up and down flows made bank fishing next to impossible. We have fished the Green river for many, many, years and have never seen such a blatant disregard for the fishing public on the Green. We spent a lot of money each and every time we fish the Green. Our estimate is close to $250.00 per day with boat rentals, gas to and from, the river food and supplies purchased in the surrounding towns. We generally fish for three to four days, six to eight times a year. If you guys don't get your act together and seriously consider the fisheries of the best rivers in Utah and for that much in the West, I will personally become and activist in seeing that the mangers of the Dam be investigated. Consider this a warning. I am a retired federal employee and know how to get to the bottom of misguided management policies.	Tue, Apr 20, 2010 11:51 AM
102.	I cannot imagine the theory behind the management of this pristine resource... I personally spend thousands of dollars a year on fishing, yet the managers of Green seem to put the sportsman way behind other interests. I know that Daggett county has little to no other revinue than tourism, and the green is a primary source. Many lively hoods will be adversely effected if the area develops a negative reputation. I have read alot on blogs, websites, and chat forums that the Green is a fishery in decline. (general consensus that the decline is caused by a detrimental double peaking flow) I know this may be dismissed, but explain why so many seem to point at the double peak! I demand that the Bureau and Power co. realize that this is a multi million dollar tourism resource to the area and the state of Utah, that cannot be mis-managed, for all interests! The economic impact is TOO important for these small communities and businesses.	Tue, Apr 20, 2010 10:35 AM
104.	Please find some way to preserve this excellent fishery. The up and down on the flows has to be bad for the aquatic insects, and that will be bad for the fish.	Sun, Apr 18, 2010 8:15 PM
110.	Have fished the Green every year for the past 6 years. The hatches and fishing has been great until 2009 when the DOW started mucking with the flows. The fish are no longer as active nor are in their feeding lanes (hatches have also been impacted as well). Will not return until they go back to the spring flush (2-3 weeks) and then stable flows for the rest of the year. Too much good water elsewhere that is managed correctly.	Tue, Apr 13, 2010 3:28 PM
115.	I really don't like when they change the flows during the day, it really screws up the fishing for us....	Fri, Apr 9,

	maybe we aren't very good at what we do. I would prefer (if it has to be done) a single peak in the night, so the fishing is stable all day long.	2010 9:25 PM
116.	i think constantly adjusting flows has a negative effect on the fishing quality.	Fri, Apr 9, 2010 7:41 PM
123.	We need to explore other flow options besides twice daily. Since twice daily I have seen quality and quantity of fish decline.	Tue, Apr 6, 2010 7:15 PM
127.	Last year was the worst year of fishing I have had on the Green, in the 10 years I have been fishing it. I fished it several times throughout the year, and the fishing really suffered due to the double peak flows and the inconsistent water temps. I hope this year will be different, and that the flows and temps will be more consistent.	Tue, Apr 6, 2010 2:26 PM
129.	We would really like to see the flows stay stable. Whatever that is. Just stay around the same amount throughout the day. We have been fishing Idaho a lot more because of the consistency of the rivers there. We would much rather fish the green and keep the money in Utah, but it is hard to deal with the fluctuating flows.	Tue, Apr 6, 2010 11:15 AM
135.	I have been fishing the Green since 1990 and have had great times fishing there. I do feel that fishing becomes very poor when the level of water fluctuates. Even when the water levels were high but stable the fishing would be great. I feel that fluctuations in the flows are the biggest reason the fishing becomes poor. I used to drive and fish the Green and return to Salt lake because of the experience but remember those times the fishing was disappointing when the water levels changed mid morning. I do feel that fish seem to adjust well when their environment is consistent even if it is high water.	Mon, Apr 5, 2010 7:27 PM
136.	please relay my distain for the total disreguard for fisherman in the release regiment that the electric company has come up with.	Mon, Apr 5, 2010 6:21 PM
138.	I typically fish the Green River in February or March. Crowds are usually down a little that time of year, and the great midge/bwo hatches give me an opportunity to catch fish on dry flies in the winter time. The last time I fished the Green they were doing the double peak flows. It seemed to really screw up the the hatch that I typically encounter that time of year. I can't imagine that less bugs is good for the fish or the fisherman. If the wacky flows continue next year, I may look elswhere for me late winter/early spring dry fly fix.	Mon, Apr 5, 2010 2:33 PM
141.	I wish they would quit playing mother nature. The amount of money generated by fishing on the green greatly surpasses the revenue saved from the studies I have seen. I seems like the quality of fish has gone down steadily over the last few years and is why I have started focusing on different rivers.	Sun, Apr 4, 2010 5:39 PM
145.	Love the green, hate double peak flows.	Sun, Apr 4, 2010 9:49 AM
151.	i would prefer a more steady flow whith as few changes each day as possible. double peaks should be discouraged.	Sat, Apr 3, 2010 4:05 PM
161.	Based on my 20 plus years fishing the Green, I think flow fluctuation is the worst thing for the fishing. I also think that there should be a limit on the number of recreational rafter that can use the	Fri, Apr 2, 2010 3:49

	corridor on a daily basis.	PM
166.	it kills the fishing if they fluctuate flows on a daily basis!!	Fri, Apr 2, 2010 12:07 PM
167.	The flows ave been hard for us to fish. we are not local so it is lots of time and money to get there. we love that river, and call it home. just hope that the fishing will continue to pick up, and they will stop playing with the flows, so the fish can get some consistency.	Fri, Apr 2, 2010 11:41 AM
169.	Water fluctuation is very troublesome for the fisherman. Temperature is already well managed. All other factors such as fish activity and bug hatch follow from river flow fluctuation.	Fri, Apr 2, 2010 10:32 AM
183.	Please stop the double peak days and have a high spring release to clean out sediment in river! Then return to stable flows.	Thu, Apr 1, 2010 6:56 PM
184.	Releases need to mimic a natural hydrograph as much as possible, no matter the consequences. Federal dollars paid for the dam at Flaming Gorge, the least the operators can do is repay the public with flows that benefit native fish, wildlife, and riparian areas.	Thu, Apr 1, 2010 6:30 PM
200.	Fish catching on the green has steadly declined in my opinion because of the fluctuating flows.I	Thu, Apr 1, 2010 2:06 PM
209.	The fluctuation in water flow killed the fishing on our last trip to the Green.	Thu, Apr 1, 2010 1:18 AM
224.	This river as a fishery is too valuable to not protect against the damage of double peak flows. The fishery contributes greatly to the local and state economies. It also offers a strong positive experience for out of state visitors, which leads to further and future economic value as a tourist attraction.	Tue, Mar 30, 2010 11:07 PM