

RECLAMATION

Managing Water in the West

Annual Report of Operations for Flaming Gorge Dam Water Year 2008



Table of Contents

Introduction.....	1
Operational Decision Process for Water Year 2008.....	1
Step 1: Request for Research Flows.....	1
Step 2: Development of Spring Proposal.....	2
Step 3: Solicitation of Comments.....	2
Step 4: Final Decision.....	3
Hydrology.....	3
Flow Objectives Achieved in Water Year 2008.....	5
Operations and Maintenance Considerations.....	6
Temperature Objectives Achieved in Water Year 2008.....	7

Tables

Table 1 – 2008 Forecast Progression – April Through July Unregulated Volume in Thousand Acre-Feet (KAF).....	4
Table 2 – Historic Spring Hydrologic Classification for Flaming Gorge Reservoir from the May final forecast volume for April through July Unregulated Inflow.....	4
Table 3 – Reach 1 and 2 ROD Flow Objectives Achievement in 2008.....	6
Table 4 – Reach 1 and 2 ROD Temperature Objectives Achievement in 2008....	8

Figures

Figure 1 – 2008 Spring Release and Flow Hydrographs of the Green and Yampa Rivers.....	5
Figure 2 – Reach 1 Average Daily Temperatures on the Green River.....	7

Figure 3 – Reach 2 Average Daily Temperature Difference Between the
Green and Yampa Rivers9

Appendices

Appendix A – Flaming Gorge Decision Process – Intended Implementation Under
the 2006 Flaming Gorge Record of Decision

Appendix B – Flaming Gorge Decision Process for 2008 – Chronology of Events

Appendix C – Memorandum from the Recovery Program Director for Spring Flows
2008

Appendix D – Memorandum from the Recovery Program Director for Base Flows
2008

Appendix E – Flaming Gorge Technical Working Group – Proposed Flow and
Temperature Objectives for 2008

Annual Report of Operations for Flaming Gorge Dam Water Year 2008

Introduction

Pursuant to the February 2006 Record of Decision for the Operation of Flaming Gorge Dam (ROD) and as described in the September 2005 Operation of Flaming Gorge Dam Final Environmental Impact Statement (FEIS), this report details the operations of Flaming Gorge Dam during water year 2008. This is the third year of operations of Flaming Gorge Dam under the ROD and this report is the third annual report produced in response to the commitment in the ROD.

Operational Process for Water Year 2008

In 2008, the operational process developed in 2006 was used to operate Flaming Gorge Dam. This process was developed based on descriptions provided in the FEIS (Section 1.5) and the commitments in the ROD (Sections III, VI, and VII). A detailed description of this process is provided in Appendix A and a timeline of how this process was implemented in 2008 is provided in Appendix B. The four steps of the process are described below:

Step 1: Request for Research Flows

The Flaming Gorge Technical Working Group (FGTWG) received a letter dated February 28, 2008, from Robert Muth, Director of the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). The letter from the Recovery Program requested flows of 15,000 cubic feet per second (cfs), or greater, for a minimum of five consecutive days in Reach 2 of the Green River. A copy of this letter is provided in Appendix C.

The Recovery Program letter 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 identified that a 30-centimeter 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 minimum depth of 30 centimeters at the connection channel of Stirrup Floodplain and the Green River for a minimum of five days. The Recovery Program was uncertain of the flows needed to maintain a minimum depth of 30 centimeters, but estimated 15,000 cfs to be sufficient based on observations made in 2007.

The letter also put forward the that the Recovery Program might make requests for research flows in out years that would affect the base flows operations at Flaming Gorge Dam. The research flows would be aimed at attempting to disadvantage non-native smallmouth bass reproduction in Reaches 1 and 2 of the Green River.

The FGTWG received another letter dated July 3, 2008, from Robert Muth, on behalf of the Recovery Program, requesting research flows during the base flow period in water year 2008. The letter requested average daily flows of 1,500 cfs from the beginning of the base flow period through September 30, 2008, for the purpose of disadvantaging non-native smallmouth bass reproduction in Reaches 1 and 2 of the Green River. A copy of this letter is provided in Appendix D.

Step 2: Development of Spring Proposal

The FGTWG was established to provide proposals to Reclamation on what flow and temperature regimes in accordance with the FEIS would best achieve ROD objectives based on current year hydrologic conditions, operational limitations, past operations and the overall health of the endangered fish. The FGTWG also considers research flow requests from the Recovery Program in developing the flow proposal to facilitate Recovery Program research. The FGTWG consists of technical staff from the U.S. Fish and Wildlife Service, Western Area Power Administration (Western), and Reclamation. The proposal of the initial flow regime to the Flaming Gorge Working Group (Working Group) concurrently fulfills informal consultation and coordination requirements of ESA for the action agencies.

The FGTWG met on March 6, 2008, to begin development of a flow proposal for the spring of 2008. The intent of the flow proposal was to integrate the research flow request from the Recovery Program with a flow regime consistent with the ROD. The flow proposal for 2008 described five 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 operate Flaming Gorge to produce flows within one of these proposed flow regimes.

In June 2008, hydrologic conditions deteriorated from average to moderately dry. Reclamation convened the FGTWG on June 20, 2008, to develop a flow proposal for the Green River during the base flow period (August through February of the following year). The FGTWG proposed to Reclamation that flows in the Green River, during the base flow period, should fall within the average range, as described in the FEIS Action Alternative. The purpose of this proposal was to better match the flow conditions that occurred during the spring peak when average targets were achieved. Additionally, on July 3, 2008, the Recovery Program requested research flows of 1,500 cfs in the Green River below Flaming Gorge Dam during the base flow period through September 30, 2008.

Step 3: Solicitation of Comments

Meetings of the Flaming Gorge Working Group (Working Group) are conducted as a public process with regularly scheduled meetings usually held in Vernal, Utah, in mid-April and mid-August of each year. The Working Group provides a forum where Recovery Program, Western, and any other requests for specific flows, as well as FGTWG proposals, are presented for public comment. On April 17, 2008, Reclamation presented the 2008 flow proposal to the Working Group. The main purpose of this Working Group meeting was to clearly describe the proposed flow regime for the Green River and the intended operation of Flaming Gorge Dam for the spring and summer of 2008, and to receive comments from stakeholders and the public regarding concerns about this operation. Meeting minutes were

recorded and the public was invited to send written comments to Ed Vidmar (Chairperson of the Working Group).

During the August Working Group meeting, Western requested winter power fluctuations from November through March with a double peak rather than a single peak to assist Western in meeting contractual obligations during the winter months. Western indicated that it was working with the Utah Division of Wildlife Resources to study effects downstream of a double-peak fluctuating flow pattern.

Step 4: Final Operation

After reviewing the FGTWG proposal and all public input that was received, Reclamation determined that the Recovery Program research flow request could be accommodated within the operations for the proposed flow regime. Reclamation agreed to attempt operations during the spring of 2008 that would produce a research flow in Reach 2 of at least 15,000 cfs for a minimum duration of five days measured at the stream gage located on the Green River at Jensen, Utah (Jensen). Releases from Flaming Gorge averaged 1,500 cfs through September 30, 2008 with a single-peak fluctuating flow pattern.

In the ROD, Reclamation commits to patterning flows described in the Flow and Temperature Recommendations for Endangered Fishes in the Green River Downstream of Flaming Gorge Dam, September 2000 (2000 Flow Recommendations). The 2000 Flow Recommendations propose that for the average hydrologic classification, flows of at least 18,600 cfs in Reach 2 for a duration of at least two weeks occur 25 percent of the time. All analyses indicate this is a challenging objective to achieve. Reclamation recognized that opportunities to achieve this target should be acted upon when presented and agreed with the FGTWG Proposed Flow and Temperature Objectives for 2008 to operate above powerplant capacity to achieve this objective. If flows in Reach 2 measured at Jensen achieved 18,600 cfs for ten days and the forecasted Yampa River flows indicated that an additional four days of flows at or above 18,600 cfs could be reasonably achieved, Reclamation would consider using the bypass tubes at Flaming Gorge Dam to achieve the target flows of 18,600 cfs at Jensen for at least 14 days.

Hydrology

Snowpack conditions in the Upper Green River and Yampa River Basins differed significantly throughout the snow accumulation season (October 2007 through April 2008). The Upper Green River Basin snowpack condition was below average on January 1, 2008, at 64 percent of average. On April 1, 2008, the snowpack condition in the Upper Green River Basin had increased to 95 percent of average. The Yampa River Basin snowpack condition was above average on January 1, 2008, at 91 percent of average. On April 1, 2008, the snowpack condition in the Yampa River Basin had increased to 107 percent of average. Monthly unregulated inflow volume forecasts issued by the Colorado Basin River Forecast Center for Flaming Gorge Reservoir and the Yampa River are shown in Table 1. Early seasonal forecasts indicated that hydrologic conditions into Flaming Gorge Reservoir would likely fall into the moderately dry hydrologic condition during the spring of 2008; however,

forecasts indicated the hydrologic conditions for the Yampa River Basin would likely reach the moderately wet category for the same period. These forecasts indicated that Flaming Gorge Reservoir would have sufficient inflows to achieve a peak elevation of 6,021.8 feet above sea level by August 2008. The peak elevation that occurred in water year 2008 was 6,022.5 feet above sea level and occurred in mid-August. By the end of August, the elevation of Flaming Gorge Reservoir had declined to 6,022.1 feet above sea level. The end-of-water-year 2008 elevation for Flaming Gorge Reservoir was 6,021.25 feet above sea level.

Table 1
2008 Forecast Progression – April Through July Unregulated¹ Volume
Thousand Acre-Feet (KAF)

Issuance Month	Flaming Gorge Reservoir		Yampa River near Maybell, CO		Little Snake River near Lily, CO	
	Volume (KAF)	% of Average*	Volume (KAF)	% of Average	Volume (KAF)	% of Average
January	875	74	940	105	360	105
February	840	71	1,020	114	430	126
March	840	71	1,100	123	460	135
April	890	75	1,150	128	470	137
May	820	69	1,160	129	475	139
June	785	66	1,230	137	465	136
July	705	59	---	---	---	---
Actual April-July	732	62	1,208	135	455	133

*Based on National Weather Service official 30-year historic record of April through July unregulated inflow from 1971-2000.

The 2000 Flow Recommendations classify the current hydrology of the Green River system into one of five hydrologic classifications. The hydrologic classification selected for the current year is established in May of each year based on percent exceedance ranges. The hydrologic classifications that have occurred since the signing of the ROD in 2006 are listed in Table 2.

Table 2
Historic Spring Hydrologic Classification for Flaming Gorge Reservoir
May Final Forecast Volume for April through July Unregulated Inflow

Year	Hydrologic Classification	Forecast Volume (KAF)	Percent Exceedance*
2006	Average	1,100	48
2007	Moderately Dry	500	86
2008	Average	820	68

*Based on April through July unregulated inflow from 1963 to operational year.

¹ Unregulated inflow is defined as the actual inflow to the reservoir corrected to remove the effects of 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.

Releases from Flaming Gorge Reservoir were increased to powerplant capacity of 4,300 cfs on May 17, 2008, in anticipation of peak flows on the Yampa River. On June 6, 2008, as a result of releases from Flaming Gorge Dam and flows on the Yampa River, the flows in the Green River at Jensen reached 23,875 cfs. Releases were maintained at powerplant capacity until June 15, 2008, when flows in the Green River at Jensen dropped below 14,000 cfs. Flows in the Green River at Jensen remained above 15,000 cfs from May 21, 2008, to June 14, 2008 (24 days), with 14 days of flows greater than 18,600 cfs. The use of the bypass tubes was not required to meet these flow objectives. Releases from Flaming Gorge Reservoir were reduced by 500 cfs per day beginning on June 15, 2008. Figure 1 shows the spring release hydrograph and corresponding Yampa River and Green River hydrographs that occurred below Flaming Gorge Dam.

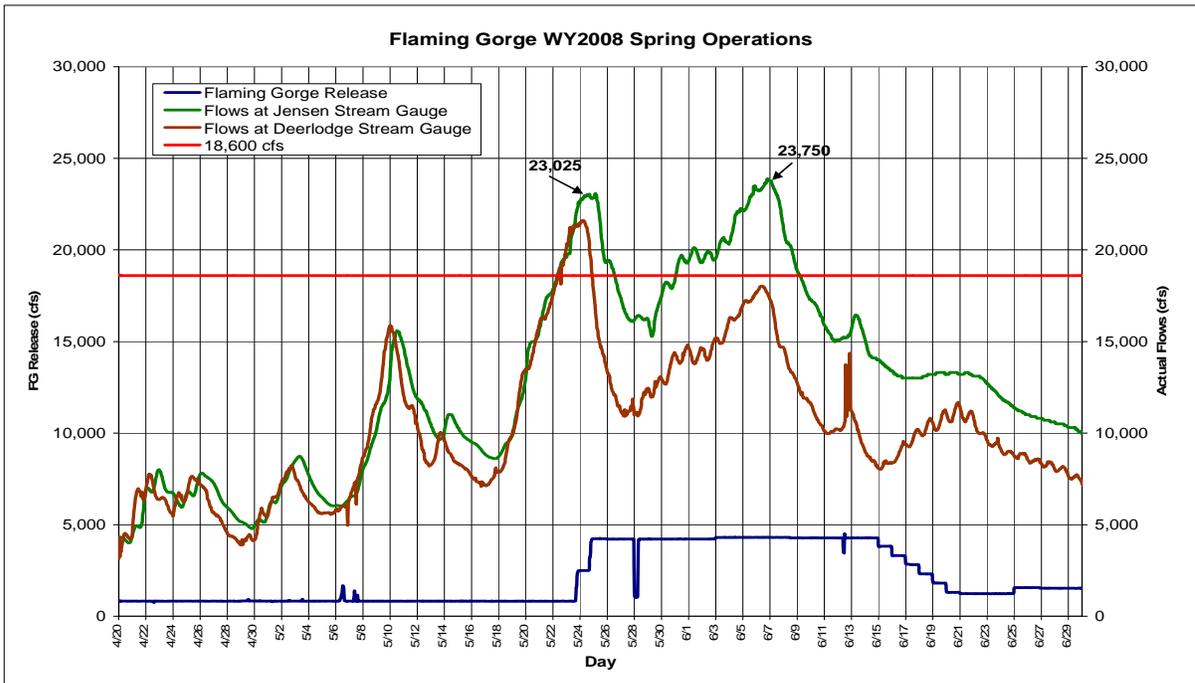


Figure 1 – 2008 Spring Release and Flow Hydrographs of the Green and Yampa Rivers

In June 2008, hydrologic conditions deteriorated from average to moderately dry. The FGTWG proposed that flows during the base flow period should fall within the average range and that releases should reach 1,500 cfs through September 30, 2008, pursuant to the Recovery Program base flow request. Releases reached 1,500 cfs on June 25, 2008, and were maintained at that level through September 30, 2008. On July 1, 2008, releases from Flaming Gorge Dam resumed within-day fluctuations for power generation with a single daily peak.

Base flow conditions in Reach 2 were maintained well within 40 percent of the established base flow target as allowed under the ROD during summer and fall months. With the Reach 2 base flow target established at 2,260 cfs, the 40 percent flexibility allowed Reach 2 flows to be between 900 cfs to 3,160 cfs. Reach 2 flows during August and September were maintained between 1,900 cfs and 2,720 cfs.

Operation and Maintenance Considerations

During water year 2008, the turbine runner for Unit 1 at Flaming Gorge Powerplant was replaced. This was the third and final turbine runner replaced at Flaming Gorge Powerplant since the powerplant became operational in 1963. The turbine runner for Unit 3 was replaced in 2006 and Unit 2 was replaced in 2007. As a result of these replacements, the release capacity of Flaming Gorge Powerplant was reduced by approximately 300 to 4,300 cfs. The turbine runner replacement increased the efficiency of the powerplant resulting in the same amount of electricity being produced with less water propelling the turbines.

Flow Objectives Achieved in Water Year 2008

In the ROD, Reclamation commits to operate to achieve, to the extent possible, flow objectives of the Action Alternative of the FEIS as described in the 2000 Flow Recommendations. These flow objectives and the desired minimum threshold frequencies are described in Table 2. This year (water year 2008) is the third year of operations under the ROD and thus is the third year for establishing the long-term frequencies of these spring flow objectives.

Table 3
Reach 1 and 2 ROD Flow Objectives Achievement in 2008

Hydrologic Condition	Spring Peak Flow Objective	Reach	Desired Frequency %	Desired Frequency Based on Actual Hydrologic Conditions %**	Achieved in 2008
Wet	Peak \geq 26,400 cfs for at least 1 day	2	10 %	0 %	No
Wet	Peak \geq 22,700 cfs for at least 2 weeks	2	10 %	0 %	No
Wet	Peak \geq 18,600 cfs for at least 4 weeks	2	10 %	0 %	No
Moderately Wet	Peak \geq 20,300 cfs for at least 1 day	2	30 %	0 %	Yes
Moderately Wet/Average	Peak \geq 18,600 cfs for at least 2 weeks	2	40 %	12.5 %	Yes
Average	Peak \geq 18,600 cfs for at least 1 day	2	50 %	50 %	Yes
Average	Peak \geq 8,300 cfs for at least 1 day	2	100 %	100 %	Yes
Average	Peak \geq 8,300 cfs for at least 1 week	2	90 %	100 %	Yes
Average	Peak \geq 8,300 cfs for at least 2 days except in extreme dry years	2	98 %	100 %	Yes
Wet	Peak \geq powerplant capacity and bypass for at least 1 day	1	10 %	0 %	No
All Other Hydrologic Conditions	Peak \geq powerplant capacity for at least 1 day	1	100 %	100 %	Yes

*Based on three years of operation under the ROD (2006-2008)

**Based on the hydrologic classification established in May for Flaming Gorge Reservoir (Table 2) for three years of operation under the ROD (2006-2008).

Temperature Objectives Achieved in Water Year 2008

An operational plan for the selective withdrawal structure (SWS) on Flaming Gorge Dam was completed by a subset of the FG TWG in June 2007. The operational plan provides guidelines for implementation of the 2006 ROD temperature objectives below Flaming Gorge Dam (see Table 4). Operational guidelines direct operators to achieve maximum gate elevation (40 feet below the reservoir surface) by June 15 of each year. In 2008, this target

was not achieved until July 8 due to maintenance schedules and rising reservoir elevations with onset of the base flow period. Mean elevation among all three SWS gates was maintained at 41 feet during July 9-18, but afterwards, excessive bearing temperatures on Unit 3 prompted dam operators to lower the gate elevation on that unit to 49 feet in an attempt to release cooler water. Gates on Units 1 and 2 remained near the 40-foot target for the duration of the base flow period, but the Unit 3 gate remained at 49 feet.

Table 4
Reach 1 and 2 ROD Temperature Objectives Achievement in 2008

Spring Peak Flow Objective	Reach	Compliance frequency in 2008	Compliance frequency since 2006 ROD
Temperatures $\geq 18^{\circ}$ 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 5 $^{\circ}$ C colder than the Yampa River during the base flow period	2	100 %*	~100 %

*121 out of 122 days from June through September, or 99.99% of the time

Temperatures recorded at the Greendale gage seldom exceeded 15 $^{\circ}$ C during 2008. Average daily temperatures at Gates of Lodore equaled or exceeded the Reach 1 objective of 18 $^{\circ}$ C for 37 days during July 9 through August 26, 2008. This meets the recommendations for dry to average hydrologic categories, but the onset of target temperatures was somewhat delayed compared to previous years. Figure 2 shows the Reach 1 temperatures measured at the stream gages on the Green River at Greendale and Gates of Lodore.

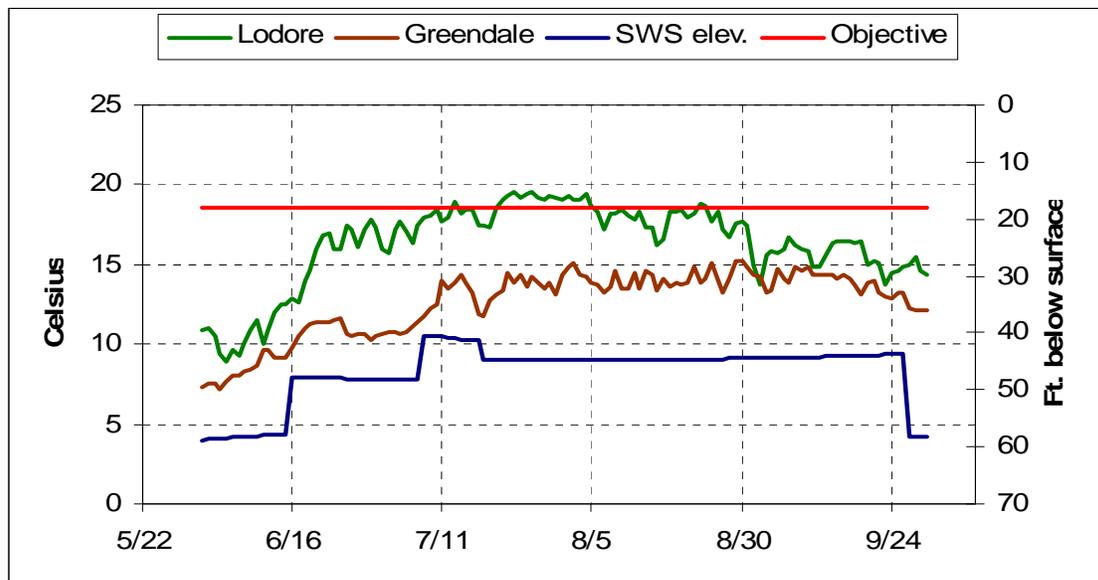


Figure 2 – Reach 1 Average Daily Temperatures on the Green River

Reach 2 objectives were achieved during June through September 2008 with the exception of July 26. The Green River was on average 2.4 °C cooler than the Yampa River during June through September, but temperature differences exceeded 4 °C during July 8-27. Figure 3 shows the Reach 2 average daily temperature difference between the Green and Yampa Rivers. Preliminary results of Colorado pikeminnow larval drift monitoring in the Yampa River suggest that larval drift began on or about July 21, which indicates a late spawn due to high flows and generally cool temperatures. Temperature differences between the Green and Yampa Rivers declined below 4 °C after July 28.

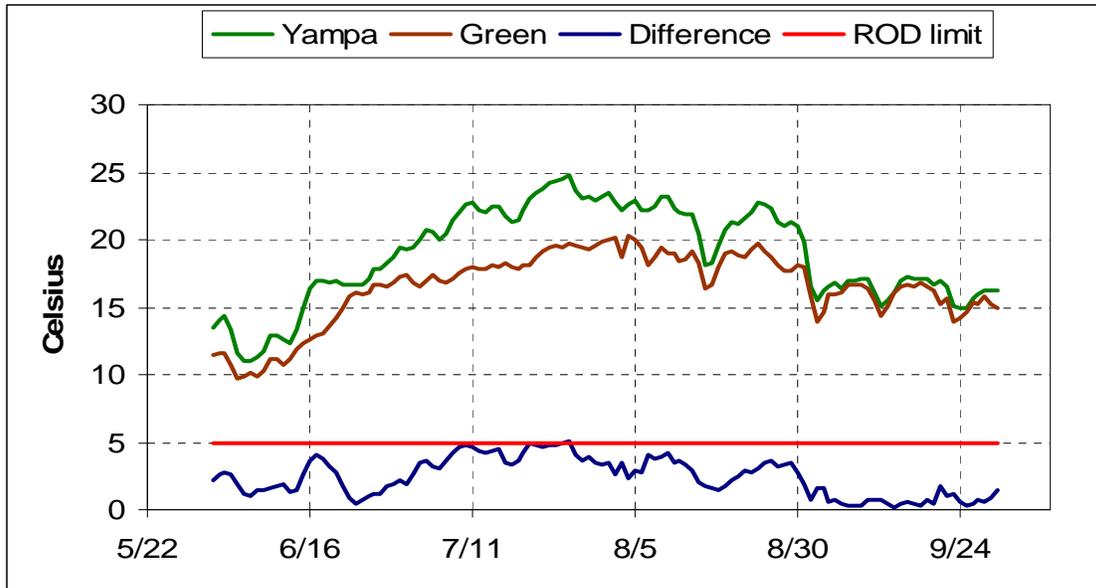


Figure 3 – Reach 2 Average Daily Temperature Difference Between the Green and Yampa Rivers

Onset of warm water (18 °C) in Reach 1 was delayed until July 8 in 2008, whereas the objective had been met in mid-June during 2006 and 2007. This is probably due to somewhat elevated base flows (1,500 cfs) during 2008 pursuant to the Recovery Program request; however, delays in reaching target SWS gate elevations may have also played a role. Similarly, the difference in temperatures between the Green and Yampa Rivers was greater in 2008 than in 2006 and 2007, which is also attributable to elevated base flows and perhaps slightly lower gate elevations at Flaming Gorge Dam.

In discussions leading up to their base flow request letter, Recovery Program biologists acknowledged that base flows in the range of 1,500-1,700 cfs, intended to disadvantage smallmouth bass, may delay the onset of 18 °C in upper Lodore Canyon and might compromise Reclamation’s ability to manage the Green River temperature within 5 °C of the Yampa River at their confluence during the drift period of larval Colorado pikeminnow. While results of both smallmouth bass and Colorado pikeminnow investigations are far from complete at this time, it is apparent from observations made in 2008 that biological tradeoffs between high base flows and resulting cool temperatures should continue to be evaluated.

Appendix A

Flaming Gorge Operation Process Intended Implementation Under the 2006 Flaming Gorge Record of Decision

Overview - To better clarify the adaptive management process by which operational decisions at Flaming Gorge Dam will be made under the 2006 Record of Decision on the Operation of Flaming Gorge Dam Final Environmental Impact Statement (2006 Flaming Gorge Record of Decision), as well as the role of the Flaming Gorge Technical Working Group (FGTWG), the following document describes the four-step process Reclamation will be implementing. This process incorporates the Upper Colorado River Endangered Fish Recovery Program (Recovery Program), the FGTWG, and the Flaming Gorge Working Group.

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 2000 Flow and Temperature Recommendations. The purpose of the FGTWG would be limited to proposing specific flow and temperature targets (and contingencies) to meet the goals of the 2006 Flaming Gorge Record of Decision or as modified by the Recovery Program. The Flaming Gorge Working Group remains our public information/input forum.

1. Recovery Program - As stated in Environmental Commitment #2 in the 2006 Flaming Gorge Record of Decision, the science role of the Recovery Program in the adaptive management process includes design and execution of studies to monitor the implementation of the 2000 Flow and Temperature Recommendations and test outcomes of modified flows and water temperatures from Flaming Gorge Dam. 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 2000 Flow and Temperature Recommendations (Section 5.5, Muth et al. 2000; Section 4.19 and 4.20, Flaming Gorge EIS; ROD environmental commitment #9). 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. Requests for such flows or release temperatures is not necessarily explicit in the 2000 Flow and Temperature Recommendations, but is necessary to fulfill adaptive management research functions that should be made no later than January 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 must be part of these initial discussions to assure release capability. Because of the critical need for dam and powerplant maintenance issues to be part of any proposal, Reclamation must 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. By the end of January each year, any desired flow request should be finalized and issued to Reclamation, the U.S. Fish and Wildlife Service, and the Western Area Power Administration.

2. Flaming Gorge Technical Working Group (FGTWG) - The primary purpose of the FGTWG is to formulate a proposal of what flows and temperatures should be achieved each year. The proposal should consider current and foreseeable hydrologic conditions in the Green River Basin (including the Yampa River Basin), the 2006 Flaming Gorge Record of Decision, and any Recovery Program flow request for the current year.

The FGTWG should meet in early March of each year to develop a proposed flow and temperature regime for the upcoming year. This proposed flow and temperature regime should achieve the 2000 Flow and Temperature Recommendations as studied in the Action Alternative of the Flaming Gorge Environmental Impact Statement as directed in the 2006 Flaming Gorge Record of Decision and/or the Recovery Program flow request for the current year. The proposal should provide clear guidance for how to adjust flow and temperature objectives under alternate hydrologic scenarios in the event that conditions become wetter or dryer. The FGTWG proposal should be finalized by early April in time to present to the Flaming Gorge Working Group.

Because the FGTWG has representation from the U.S. Fish and Wildlife Service, Western Area Power Administration, and Reclamation, FGTWG meetings also serve the purpose of informal consultation for Endangered Species Act compliance.

3. Flaming Gorge Working Group - The FGTWG proposal is presented to the Flaming Gorge Working Group by Reclamation. Meetings of the Flaming Gorge Working Group are conducted as a public process with regularly scheduled meetings usually held in Vernal, Utah, in mid-April and mid-August of each year. This forum is where Recovery Program requests and FGTWG proposals are presented for public comment and constitutes the public involvement and public outreach component of the adaptive management component, as discussed in Sections 4.20 and 4.21 of the Operation of Flaming Gorge FEIS.

4. Operational Plan - 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.

Appendix B

Flaming Gorge Operation Process for 2008 Chronology of Events

Week of February 25th

A letter was received by Reclamation from the Upper Colorado River Endangered Fish Recovery Program requesting research flows during spring 2008 (see Appendix C).

Week of March 3th

The March final forecast for Flaming Gorge Reservoir and the Yampa River near Deerlodge, Colorado, was issued. Forecasts statistically put the Green River Basin into the average hydrologic classification.

The Flaming Gorge Technical Working Group met to begin development of a flow proposal for water year 2008.

Week of March 10th

The March mid-month forecast for Flaming Gorge Reservoir and the Yampa River was issued by the River Forecast Center.

Week of March 24th

The Flaming Gorge Technical Working Group held a conference call to discuss the working draft of the flow proposal.

Week of March 31th

The flow proposal was completed by the Flaming Gorge Technical Working Group. The flow proposal was provided to Reclamation for consideration.

Week of April 14th

A Flaming Gorge Working Group meeting was held in Vernal, Utah.

Week of April 21st

Comments from the Flaming Gorge Working Group accepted until April 26, 2007.

Week of April 28th

The Yampa River shows signs of early peak exceeding 7,000 cfs on May 2, 3, and 4, 2008. No actions were taken at Flaming Gorge Dam.

Week of May 5th

The Bureau of Reclamation agreed to adopt the Flaming Gorge Technical Working Group Proposal for guidance of operation of Flaming Gorge Dam during the spring of 2008.

Warm temperatures in the region increased runoff and the Yampa River reached a peak of 15,825 cfs on May 10, 2008. However, forecasts indicated a cold front descending over the region and continued snowpack throughout the Yampa River Basin. No actions were taken at Flaming Gorge Dam.

Week of May 12th

The forecasted cold front occurred and Yampa River flows decreased below 8,000 cfs.

Flaming Gorge Dam directed to increase releases beginning on May 13th to achieve powerplant capacity on May 15th.

Week of May 19th

Warm temperatures in the region increased runoff and the Yampa River reached a peak of 21,600 cfs on May 24, 2008. Forecasted colder temperatures indicated Yampa River flows would decrease on May 24, 2008. Flaming Gorge Dam directed to increase releases beginning on May 24, 2008 to achieve powerplant capacity on May 24, 2008.

Week of May 26th

Warm temperatures gradually increase Yampa River flows.

Week of June 2nd

Yampa River reaches second spring peak of 18,000 cfs on June 6, 2008. Reach 2 flows achieve five consecutive days above 15,000 cfs on May 25, 2008. Reach 2 flows achieve 14 days above 18,600 cfs on June 8, 2008. Reach 2 flows reach an annual peak of 23,875 cfs on June 6, 2008.

Week of June 9th

Flaming Gorge Dam directed to begin ramp down at a rate of 500 cfs/day on June 15, 2008, as Yampa River flows decrease below 8,000 cfs.

Week of June 16th

Flaming Gorge Dam ramps down to an average daily release of 1,200 cfs on June 21, 2008. Releases maintained at 1,200 cfs on average per day.

The FGTWG held a conference call to discuss the Reach 2 base flow target and proposes a target of 1,975 cfs.

Week of June 23rd

Flaming Gorge Dam directed to increase releases to an average daily release of 1,500 cfs on June 25, 2008 in anticipation of a Recovery Program official request.

Week of June 30th

Fluctuations for power generation begin on July 1, 2008.

A letter was received by Reclamation from the Upper Colorado River Endangered Fish Recovery Program requesting research flows during the 2008 base flow period (see Appendix D).

Week of July 21st

The FGTWG held a conference call to discuss the base flow request. The FGTWG proposed to change average daily releases from 1,975 to 2,260 cfs. It also proposed to adopt the Recovery Program base flow research request of 1,500 cfs average daily releases through September 30, 2008.

Week of July 28rd

The Bureau of Reclamation agreed to adopt the Recovery Program request and FGTWG proposal for average daily base flows of 1,500 cfs through September 30, 2008.

Appendix C

Memorandum from the Recovery Program Director for Spring Flows 2008



Upper Colorado River Endangered Fish Recovery Program

Robert T. Muth
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

FRES/CRRP
K3a1
Mail Stop 65115

FEB 28 2008

Memorandum

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

From: Director, Upper Colorado River Endangered Fish Recovery Program 

Subject: Recovery Program Recommendations for 2008 Spring-runoff Research Flows

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) supports the Bureau of Reclamation's operations at Flaming Gorge Dam, in 2008, to meet the flow and temperature needs of the endangered Colorado River Fish in the Green River (U.S. Department of Interior 2006; USFWS 2005). Within that range of operations, the Recovery Program requests that a spring-runoff research flow of 15,000 cubic feet per second (cfs), or greater, be maintained for a minimum of 5 consecutive days in Reach 2 of the Green River.

The purpose of this research flow would be to meet objectives of Recovery Program Study No. RZ-RECR: *Razorback emigration from the Stirrup floodplain*. More specifically, this study was designed to assess recruitment rates of Age 1+ and older razorback sucker. In 2007, razorback suckers (Age 1+ and 2+) were stocked in the Stirrup floodplain, located at Green River Mile 276. The Utah Division of Wildlife Resources (UDWR) (project lead) has strived to maintain healthful water quality conditions (pumping river water) and has monitored water quality and survival of the stocked fish since that time.

During spring runoff 2008 (and 2009), UDWR intends to assess emigration rates of the stocked razorback sucker from the Stirrup floodplain to the main stem Green River. Many of the razorback sucker will have achieved a total length of 30 cm or larger. Previous investigations into fish passage requirements for juvenile and adult Colorado pikeminnow and razorback sucker identified a minimum depth of 30 cm (Burdick 1997). Therefore, we would like to achieve a minimum depth of 30 cm throughout the connection channel for 5 consecutive days. We are uncertain what Green River flow equates to a stage necessary to achieve 30 cm in the Stirrup connection channel. For reference, in 1997, the Recovery Program breached the levee that surrounds the Stirrup so it would connect at approximately 13,000 cfs (Valdez and Nelson

Colorado River Energy Distributors Association • Colorado Water Congress • National Park Service • State of Colorado
State of Utah • State of Wyoming • The Nature Conservancy • U.S. Bureau of Reclamation • U.S. Fish and Wildlife Service
Utah Water Users Association • Western Area Power Administration • Western Resource Advocates • Wyoming Water Association

2004). Field observations at the Stirrup on May 17, 2007, when the Green River was very near its peak flow (estimated flow at site = 12,700 cfs) revealed a near connection. Based on additional observations at lower flows (11,100 cfs on May 15, 2007, and 11,900 cfs on May 16, 2007)¹ we estimate that 15,000 cfs would be required. As in years past, the Recovery Program would maintain close communications with the Bureau of Reclamation during these field investigations.

We would also like to take this opportunity to discuss the possibility of future research flow request(s) that would likely affect base flow operations at Flaming Gorge Dam. As you are aware, the Recovery Program is battling an increasing threat to the recovery of the endangered Colorado River fish due to expanding populations of predatory, nonnative fish. The Recovery Program is spending over \$1M per year to mechanically remove smallmouth bass and northern pike from the Yampa, Green, and Colorado Rivers. Smallmouth bass have expanded their range and increased in abundance throughout the Upper Colorado River basin including Reach 1 and 2 of the Green River. Our own research as well as smallmouth bass studies in other river drainages indicate that survival of smallmouth bass fry is negatively affected by fluctuations in flow and temperature. Researchers at Colorado State University are ageing a large number of young smallmouth bass collected in Recovery Program studies over the past several years to back calculate spawning times. The Recovery Program intends to use that, and all other pertinent information to design a study to investigate the utility of flow and temperature manipulations to disadvantage smallmouth bass. As mentioned, this will likely include requests for research flows during the base flow period in out years. Unfortunately, we cannot be more specific at this time, but wanted to broach the idea, as a research flow request may be forthcoming in 2009. The Bureau of Reclamation will be kept apprised of these developments through Biology and Management Committee discussions.

The Recovery Program appreciates the efforts of the Bureau of Reclamation, Western Area Power Administration, and the Flaming Gorge Technical Working Group to achieve the flow and temperature recommendations and assist in the recovery of the endangered fishes. Please contact me if there are questions.

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, Colorado River Recovery Program: 39+.
- 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, Consultation # 6-UT-05-F-006. U.S. Fish and Wildlife Service, Denver, Colorado.
- Valdez, R.A., and P. Nelson. 2004. Green River Subbasin floodplain management plan. Upper Colorado River Endangered Fish Recovery Program. Project Number C-6, Denver, Colorado.

cc: John Shields, Chairman, Recovery Program Management Committee
Krissy Wilson, Chairwoman, Recovery Program Biology Committee

bcc: Tom Chart, FWS/CRRP
CRRP file, rf

CRRP:TChart:men:02/28/08{I:\COLORIV\Flow request letters\Final Draft 2008 Program flow request.doc

FILE: Rivers\Green River\Flaming Gorge Dam\Flaming Gorge Operation Working Group

Appendix D

Memorandum from the Recovery Program Director for Base Flows 2008

Memorandum

July 3, 2008

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

From: Robert Muth, Director, Upper Colorado River Endangered Fish Recovery Program

Subject: Recovery Program Recommendation for 2008 Green River Base Flows

The Upper Colorado River Endangered Fish Recovery Program (Recovery Program) is aware that the Bureau of Reclamation (Reclamation), with input from the Flaming Gorge Technical Working Group (FGTWG), has set preliminary 2008 base-flow targets for Reaches 1 and 2 of the Green River. In an e-mail to the FGTWG dated June 13, 2008, Heather Patno indicated that based on projected April–July Flaming Gorge Reservoir inflow forecasts, Reclamation intended to ramp down off of spring operations to an average Flaming Gorge Dam release of 1,225 cfs to achieve an average base-flow target of 1,975 cfs in Reach 2 at Jensen, Utah.

The Recovery Program supports Reclamation's preliminary base-flow operations, which comply with the 2006 Flaming Gorge Record of Decision (ROD). We take this opportunity to offer our recommendation for a more specific base-flow release pattern, which is intended to:

- scale summer and early autumn base flows to peak flows in Reach 2, which, according to Muth et al. (2000), should yield greater backwater area (nursery habitat for young Colorado pikeminnow);
- provide a higher flow and cooler temperature base-flow regime throughout Reach 1 and the upper portion of Reach 2, which is expected to provide important and contrasting information to an ongoing Recovery Program fish-community monitoring project; and
- add to the existing database of how smallmouth bass (a nonnative predator) reproduction is affected by flow and temperature.

This Recovery Program base-flow recommendation is designed specifically to assist in the recovery of the endangered fishes and be consistent with Reclamation's selected base-flow operations. The Recovery Program understands that Reclamation will need to consider this recommendation through your decision-making process to ultimately determine operations to meet the ROD.

Recovery Program 2008 Base Flow Recommendation

1. Maintain average daily releases at Flaming Gorge Dam within a range of 1,500 to 1,700 cfs through at least September 30, 2008. Although, we would prefer a steady flow during this period, we fully understand that within Muth et al. (2000) and in accordance with the ROD, daily stage fluctuations in Reach 2 as measured at the Jensen gage are allowed.
 - a. Based on available information Reclamation has determined that base flows through February 2009 will need to average 1,225 cfs to meet the spring reservoir drawdown target. As stated, the Recovery Program recognizes and supports this decision. Therefore, our request for a higher dam release (rationale provided below) through at least September 30, 2008, would likely result in reduced flows through the remaining portion of the base-flow period (e.g., Reclamation has calculated that releasing an average daily flow of 1,500 cfs through September 30, 2008, would require that releases average 1,100 cfs through the remainder of the base-flow period).
2. In accordance with the ROD, we recommend that Reclamation release 15°C water, as soon as operations allow, to meet temperature targets in both upper Lodore Canyon and in Echo Park. Our request to increase releases from 1,225 cfs into a range of 1,500–1,700 cfs through September 30 is expected to result in a relatively cooler river throughout Reach 1 and the upper portions of Reach 2. Therefore, releases in the range of 1,500–1,700 cfs may delay the onset of 18°C water in upper Lodore Canyon and might compromise Reclamation's ability to manage the Green River temperatures within 5°C of the Yampa River at their confluence throughout the entire period of larval Colorado pikeminnow presence.

To put this potential tradeoff into perspective, we reviewed Reclamation's comparative analysis of Green River vs. Yampa River temperatures at their confluence during larval Colorado pikeminnow presence in 2005. First, as background, during 2005, Flaming Gorge average daily releases (July 15–September 30) ranged between 1,430 and 1,570 cfs. During the same period, the Yampa River ranged between 106 and 1,510 cfs. Reclamation's comparative analysis indicated that 93% of their hourly observations were within compliance, i.e., the Green River temperatures were within 5°C of the Yampa River temperatures. This discrepancy may have been due to lower than average flows in the Yampa River, which would have enhanced its warming rate. Also, the periods of non-compliance occurred on the scale of hours per day, not days or weeks.

Obviously, meeting the temperature criteria at the confluence in any year is contingent on the Yampa River thermal regime. In their Biological Opinion (USFWS 2005), the U.S. Fish and Wildlife Service understood that temperature recommendations would be more difficult to meet during wetter hydrology. The Recovery Program's Biology Committee (BC) discussed this potential tradeoff during a conference call on June 25, 2008. The majority of BC members thought the potential benefits of increasing base flows through September 30, 2008, would offset the potential negative effects to the thermal regime at the confluence.

Rationale

1. A tenet of Muth et al. (2000) was that base flows in Reach 2 be scaled to the magnitude of the spring peaks. The recommended base-flow ranges that correspond to various hydrologic categories in Muth et al.(2000) were developed largely from the work of Rakowski and Schmidt (1999) who described the formation and maintenance of Colorado pikeminnow nursery habitats from a physical perspective during a wet (1993) and dry (1994) hydrology. Their findings as related to the development of the flow recommendations were summarized by Muth et al. (2000) in Table 3.14, which states:

“Sand-bar topography, and therefore the availability of low-velocity habitats, changes annually in response to the passage of peak flows. As a result, no single base flow maximizes habitat availability under all conditions, and the range of measured optimal base flows varied from 35–140 m³/s [1,236–4,944 cfs] in the years studied. Large floods rebuild sand-bar topography and result in habitat availability being maximized at higher flows. Subsequent low-flood-peak years reduce the flow at which habitat availability is maximized. The duration of floods that are less than bankfull but greater than bar top should be minimized.”

Our recommendation to release 1,500–1,700 cfs, as opposed to 1,225 cfs, through September 30 would presumably increase base flows in Reach 2 from 1,975 cfs into a range of 2,250–2,450 cfs. A base flow of 2,250–2,450 cfs still falls largely within the recommended Average Hydrologic base-flow category (1,500–2,400 cfs). However, an instantaneous peak flow of 24,075 cfs was recorded at the Jensen gage on June 6, 2008, which exceeded the Moderately Wet Year minimum recommended peak of 20,300 cfs. Therefore, a base-flow target in Reach 2 on the wetter side of the average range this year is consistent with the recommendations of Muth et al. (2000) to scale the base flows to the spring peak.

Furthermore, since the year 2000, we have experienced consistently low base-flow conditions in Reach 2, which has been coincident with low catch rates of young-of-year Colorado pikeminnow. During this 8-year period, summer base flows have been less than 2,000 cfs in Reach 2. More specifically, during the summers of 2001, 2002, 2003, 2006, and 2007, base flows dropped below

1,000 cfs for varying periods of time. Our base-flow recommendation is in accordance with the ROD. Therefore, based on the year's hydrology, the Recovery Program believes that a higher base flow would benefit the native fish community. The Recovery Program is poised to gather fish-community response data as part of Projects # 144 and 138; Argonne National Laboratory personnel are also scheduled to continue their ongoing investigations of sand-bar topography as it relates to the availability of nursery habitat. There are still unanswered question regarding the relationship of river stage and the availability of backwater habitat.

2. In accordance with Recovery Program's Green River Study Plan (UCREFRP 2007), monitoring the effect of the flow and temperature recommendations on the nonnative fish community in Reaches 1 and 2 was considered a high priority. An aspect of the flow and temperature recommendations called for warming the river through Reach 1 and the upper portions of Reach 2, with the intention of benefitting the native fish community. In fact, coincident with the low and warm flows in Lodore Canyon in 2006, Colorado pikeminnow spawning was documented for the first time in Reach 1. However, the Muth et al. (2000) also recognized that nonnative fish could also benefit.

Bestgen et al. (2007) compared physical and biological data collected in this portion of the river throughout two time frames: 1994–1996 and 2002–2006. They reported the expansion and increased abundance of several nonnative fish species during that latter low-flow period. Perhaps most notably was the establishment of a reproducing population of smallmouth bass in Lodore and Whirlpool canyons. Bestgen et al (2007) recommended (1 of 7 total recommendations) that the Recovery Program “*Compare fish community response to different flow and temperature regimes from Flaming Gorge Dam to better understand factors that may limit invasive species, particularly predators*”.

Since 2002, base flows in Reach 1 have ranged between 800 and 900 cfs, with the exception being 2004 (1,150–1,175 cfs) and 2005 (~1,500 cfs). The 2008 hydrology provides the Recovery Program with an opportunity to study a higher flow and cooler temperature regime than we have experienced since the year 2000. Reclamation's proposal to release 1,225 cfs would be beneficial because that level has only been exceeded once since the year 2000. However, our recommendation to release in the range of 1,500–1,700 cfs potentially would result in a larger effect and hopefully a more biologically significant fish-community response. Specific investigations into the effects of flow and temperature on smallmouth bass spawning time (via otolith analysis; a recently added objective to Project #115) were initiated in 2006. Our understanding of those effects would be increased if similar information was collected when base flows are higher and cooler to determine if smallmouth bass spawning is delayed, which would presumably negatively affect their overwinter survival. Again, Project #115 is in place to monitor the effects of the 2008 flow and temperature regime.

In closing, we appreciate Reclamation's efforts to work closely with the Recovery Program to provide flows to assist in recovery of the endangered fishes. As you know, there have been few opportunities to study the effect of matching peak and base flows during a wet or even an average hydrologic year. We hope to take advantage of this year's hydrology and monitor responses in the fish community and habitats. Thank you for your consideration of this most recent Recovery Program recommendation.

Literature Cited

- Bestgen, K.R., K.A. Zelasko, and C.T. Wilcox: 2007. Nonnative fish removal in the Green River, Lodore and Whirlpool canyons, 2002–2006, and fish community response to altered flow and temperature regimes, and nonnative fish expansion. Larval Fish Laboratory Contribution 149. Final Report: Project 115.
- 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.
- Rakowski, C.L., and J.C. Schmidt. 1999. The geomorphic basis of Colorado pikeminnow nursery habitat in the Green River near Ouray, Utah. Report A *in* Flaming Gorge Studies: Assessment of Colorado pikeminnow nursery habitat in the Green River. Final Report of Utah Division of Wildlife Resources to Upper Colorado River Endangered Fish Recovery Program, Denver, Colorado.
- USFWS. 2005. Final biological opinion on the operation of Flaming Gorge Dam.
- 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.

Appendix E

Flaming Gorge Technical Working Group Proposed Flow and Temperature Objectives for 2008

Flaming Gorge Technical Working Group Proposed Flow and Temperature Objectives for 2008

Current Hydrologic Classification

For the purposes of implementing the 2006 Flaming Gorge Record of Decision (ROD) in 2008 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 2007. Based on these statistics and the March 1, 2008, forecast of 840,000 acre-feet for Flaming Gorge, the most likely hydrologic classification will be average (30% to 70% exceedance) for spring 2008. Appendix A illustrates the March 1, 2008, 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 March 1, 2008, forecast of April through July unregulated inflow (current forecast) for Flaming Gorge Reservoir is 840 thousand acre-feet (KAF) (71% of normal). This forecast falls at approximately 66% exceedance based on the historic unregulated inflow record (1963-2007). Figure 1 shows the current forecast in relation to the historic unregulated inflow volumes. For reference, the 30% and 70% exceedance volumes are shown in black.

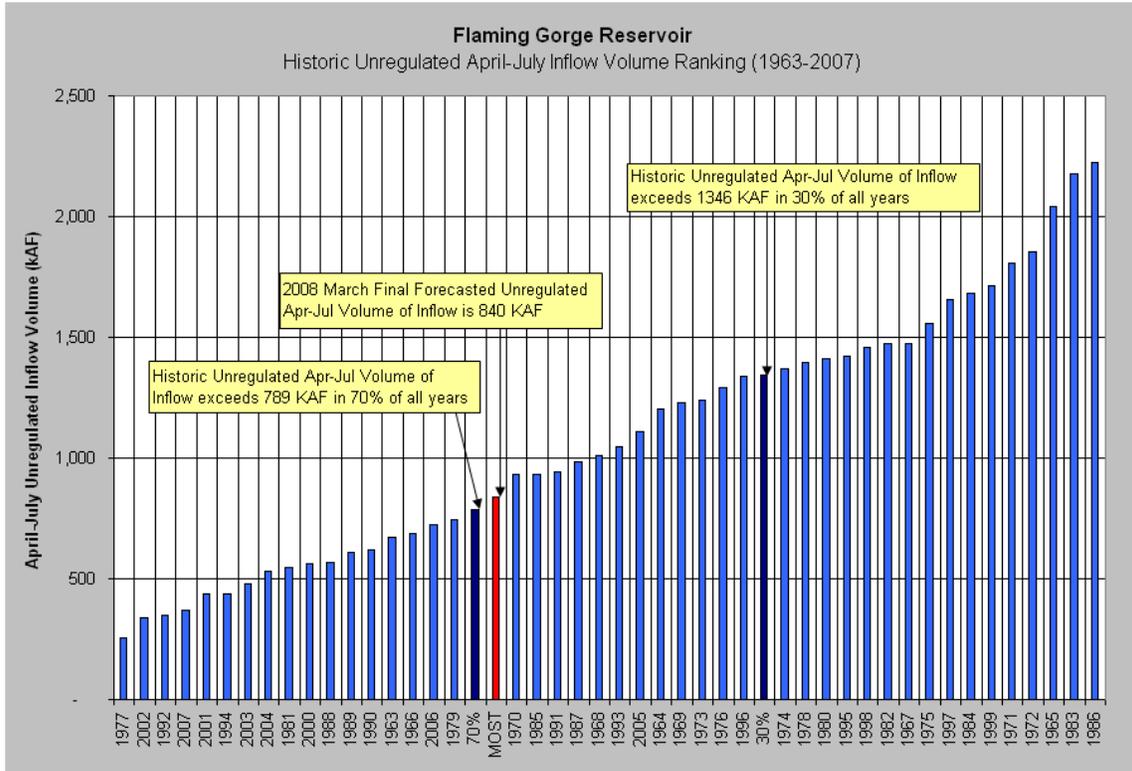


FIGURE 1—Flaming Gorge Reservoir current forecast and ranked historic unregulated April through July inflow volume for years 1963-2007.

Flaming Gorge Reservoir currently has a water surface elevation of approximately 6021 feet above sea level. There is approximately 3.02 million acre-feet of live storage (81% storage capacity) in Flaming Gorge and approximately 0.76 million acre-feet of space.

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 1,560 KAF (119% of normal). This forecast falls at approximately 26% exceedance based on a ranking of the historic record (1922-2006). Figure 2 below shows the current forecast in relation to historic flow volumes. For reference, the 10% and 30% exceedance volumes are shown in black.

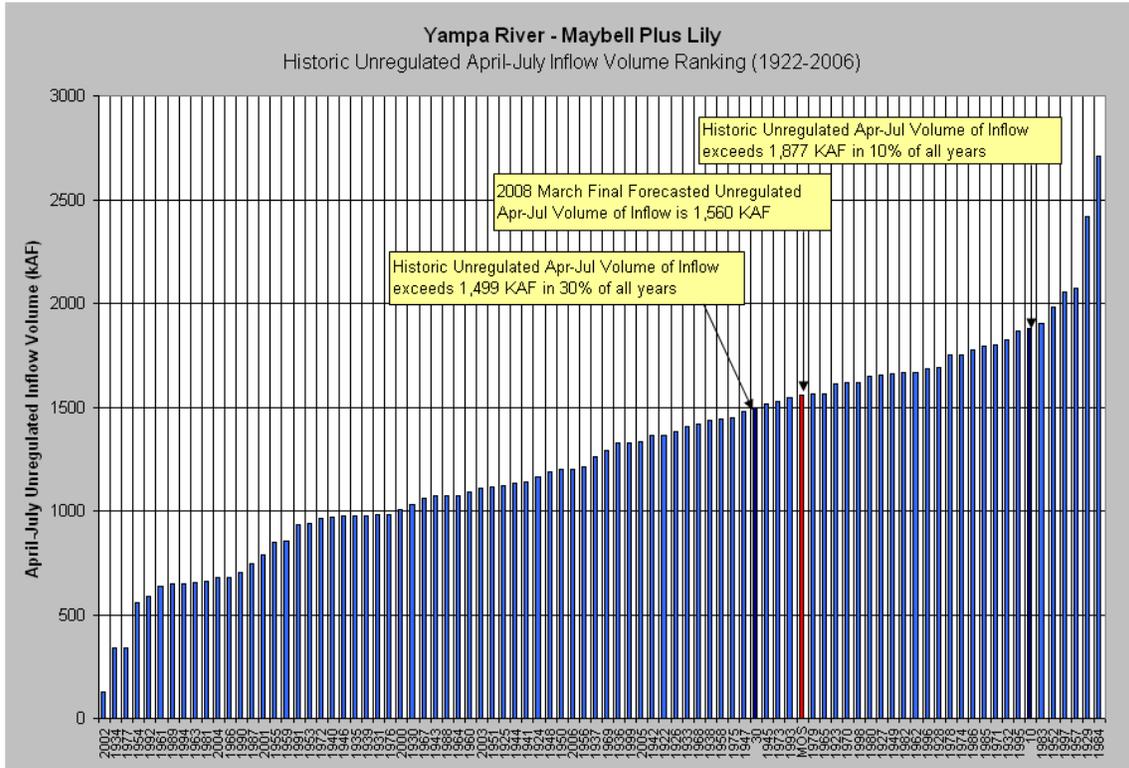


FIGURE 2—Yampa River Basin (Maybell plus Lily) current forecast and ranked historic unregulated April through July inflow volume for years 1922-2006.

Hydrologic conditions in the Yampa River basin 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 2,400 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 2008. This volume falls at 50% exceedance when compared to the historic record (1947-2006).

Figure 3 below indicates where within the wet to dry continuum the current April through July forecast falls in comparison to the historic record. For reference, the 30% and 70% exceedance volumes are identified in black.

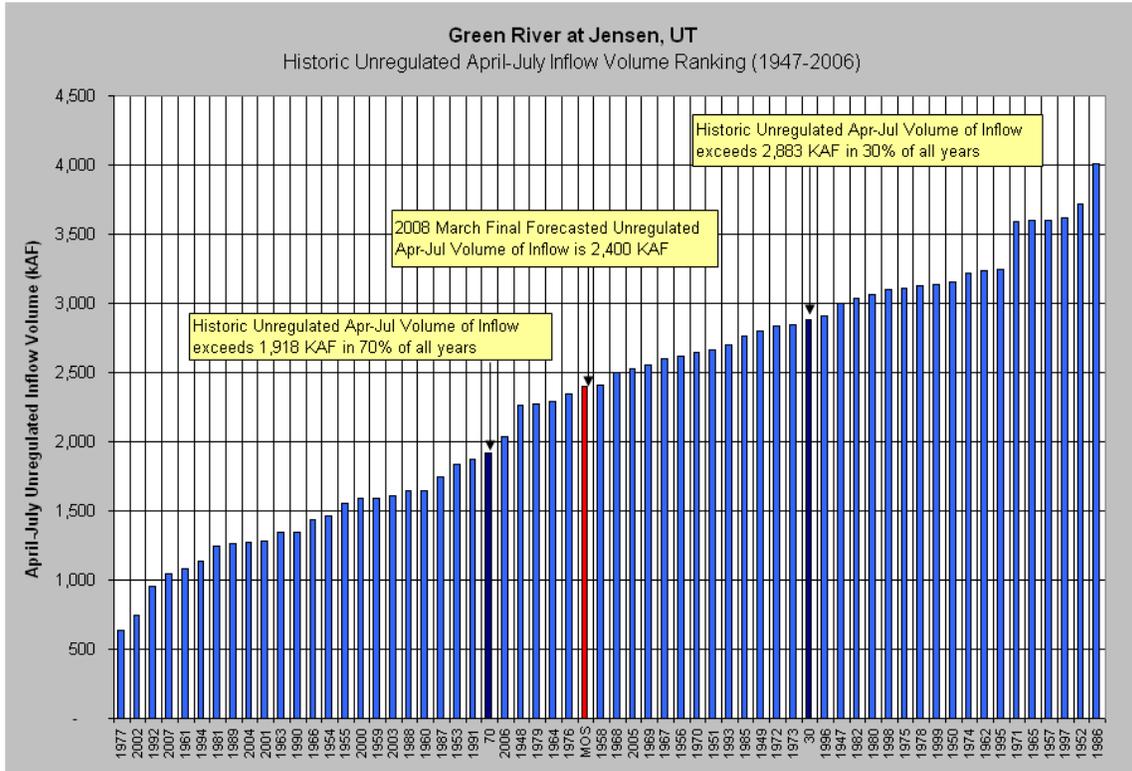


FIGURE 3—Green River at Jensen, Utah current forecast and ranked historic unregulated April through July inflow volume for years 1947-2006.

Probabilities of Flow Events for Spring 2008

The 2008 Flaming Gorge Reservoir forecast is significantly different from the 2008 forecast for the Yampa River Basin. An analysis was completed to assist in the determination of appropriate flow objectives for spring and summer 2008. 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 1,560 KAF.

Year	April-July Unreg Inflow Volume (KAF)
MIN	1,095
1975	1,450
1947	1,479
1945	1,514
1973	1,527
1993	1,543
MOST	1,560
1979	1,562
1965	1,564
1923	1,614
1970	1,618
1998	1,621
MAX	2,110

TABLE 2—Spring 2008 probability of days above specific flow thresholds in Yampa River (Maybell plus Lily).

	% 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%	32	25	19	13	10	9	6
	50%	26	19	14	10	7	5	2
	75%	22	17	13	9	5	2	0
	90%	21	15	11	5	4	2	0

Record of Decision Spring Flow Objectives

The 2005 Operations of Flaming Gorge Dam Final Environmental Impact Statement (EIS) specifically addresses operating options during spring runoff years similar to the current one where Flaming Gorge Reservoir inflow is significantly different from that of the Yampa River Basin. The EIS states the expectation for spring operations is to follow the flow magnitudes and durations outlined in the Flow Recommendations. However, because other factors are also considered, “particularly runoff conditions in the Yampa River, there would be some years where the peak flows that occur in Reach 2 achieve the targets for either one or two classifications higher (wetter) or one classification lower (drier) than the actual classification established for the Green River.” (2005). Based on current hydrology and unless the Yampa River Basin forecast falls significantly, the proposed 2008 spring objectives will follow the average flow objectives outlined in the Flow Recommendations.

If the April through July unregulated inflow into Flaming Gorge Reservoir remains in the range from 789 KAF to 1,346 KAF the hydrological classification would be average. The ROD spring flow objectives for average years are:

Average Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,600 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

It is possible that hydrologic conditions into Flaming Gorge Reservoir could change before implementation of the proposed 2008 flow objectives. In the event conditions become drier and the Flaming Gorge Reservoir unregulated inflow forecast for April through July falls below 789 KAF, the hydrological classification would be moderately dry. ROD spring flow objectives for moderately dry years are:

Moderately Dry Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 4,600 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 670 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	≥ 4,600 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)

If conditions become wetter than the current forecast at Flaming Gorge Reservoir and the April through July forecast increases above 1,346 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	≥ 4,600 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

If conditions become even wetter and the Flaming Gorge Reservoir unregulated inflow forecast for April through July increases above 1,786 KAF, the hydrological classification would be wet. ROD spring flow objectives for wet years are:

Wet Flow Objectives

Reach	Spring Peak Magnitude (cfs)	Spring Peak Duration
Reach 1	≥ 8,600 cfs	That necessary to achieve duration target in Reach 2
Reach 2	≥ 26,400 cfs	One day in wet years
	≥ 22,700 cfs	Two weeks (i.e., 14 days) in wet years
	≥ 18,600 cfs	Four weeks (i.e., 28 days) in wet years

Recovery Program Research Request

The Flaming Gorge Technical Working Group received a letter dated February 29, 2008, from Robert Muth, Director of the Upper Colorado River Endangered Fish Recovery Program (Recovery Program). The Recovery Program will be assessing the emigration rates of previously stocked razorback sucker from 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 Recovery Program has requested a minimum depth of 30 cm at the connection channel of Stirrup Floodplain and the Green River for a minimum of five days. The Recovery Program is uncertain of the flows needed to maintain a minimum depth of 30 cm depth, but estimate 15,000 cfs to be sufficient based on observations made in 2007. The flow request from the Recovery Program is 15,000 cfs, or greater, for a minimum of five consecutive days in Reach 2 of the Green River.

Proposed Flow Objectives for Spring 2008

Average Classification

The current forecast of 840 KAF into Flaming Gorge reservoir is average and the 1,560 KAF for the Yampa River Basin would fall into the moderately wet category of the Flow Recommendations. The following proposed flow objectives apply to an average hydrologic classification. Proposed Reach 1 flows should be managed to achieve a peak of 4,600 cfs or greater in order 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. Reach 1 flows should be gradually reduced at a rate of 500 cfs/day to base flow levels once it is no longer reasonable to achieve flows of 14,000 cfs in Reach 2, for the purposes described below.

The ROD requires that, based on a long-term average and for the average hydrologic classification, flows of at least 18,600 cfs in Reach 2 for a duration of at least two weeks

occur 25% of the time. All analyses indicate this is a challenging objective to achieve. Opportunities to achieve this target should be acted upon when they present themselves. There is a possibility that as a result of managing for the flow objectives described above flows in Reach 2 may achieve 18,600 cfs for ten days. If this scenario occurs and forecasted Yampa River flows indicate that an additional four days of flows at or above 18,600 cfs in Reach 2 can be reasonably achieved, flows in Reach 1 should be managed to achieve this objective. Flows in Reach 1 may be managed above 4,600 cfs with the objective of achieving flows of 18,600 cfs or greater for at least two weeks in Reach 2. In the event this scenario occurs, Reach 1 flows should subsequently be gradually reduced at a rate of 500 cfs/day to base flow levels.

Inundated floodplain depressions provide important nursery habitat for larval razorback suckers. The Recovery Program has estimated that critical floodplains for nursery habitat connect to the river at approximately 14,000 cfs. Therefore, if flows in Reach 2 achieve and/or exceed 14,000 cfs as a result of the implementation described above, Reach 2 flows should additionally be managed to sustain this level as long as reasonably possible during the spring of 2008. This level should be sustained only if larval fish are present at the time of the high flows. The U.S. Fish and Wildlife Service will monitor for the presence of larval fish and communicate this information to the Bureau of Reclamation on a real-time basis. This level is not considered a target, but rather a level to be sustained for as long as reasonably possible if achieved as a result of timing the Reach 1 peak flows with the peak flows of the Yampa River.

Moderately Dry Classification

In accordance with the operational flexibility outlined in the ROD to achieve objectives one or two classification higher than the actual classification established, if the Flaming Gorge Reservoir forecast falls below 789 KAF and the Yampa River Basin forecast remains at or above 1,248 KAF, it is proposed that flows would be managed under the ROD spring flows objectives for average hydrologic conditions outlined above.

If Flaming Gorge Reservoir forecast falls below 789 KAF and the Yampa River Basin forecast falls below 1,248 KAF, it is proposed that flows in Reach 1 would be managed up to 4,600 cfs to achieve 8,300 cfs in Reach 2 for at least one week. In the event this occurs, it is unlikely that the Recovery Program research flow request could be met.

Dry Classification

If Flaming Gorge Reservoir forecast falls below 670 KAF, it is proposed that Reach 1 flows be managed up to 4,600 cfs to achieve flows greater than 8,300 cfs in Reach 2 for two days or more.

Moderately Wet Classification

If Flaming Gorge Reservoir forecast increases above 1,346 KAF, it is proposed that Reach 1 flows be managed to achieve the objectives outlined in the average hydrologic classification. In addition, flows in Reach 1 would be managed in order to achieve a one-day peak flow of 20,300 cfs in Reach 2 and 18,600 cfs in Reach 2 for at last two weeks.

Wet Classification

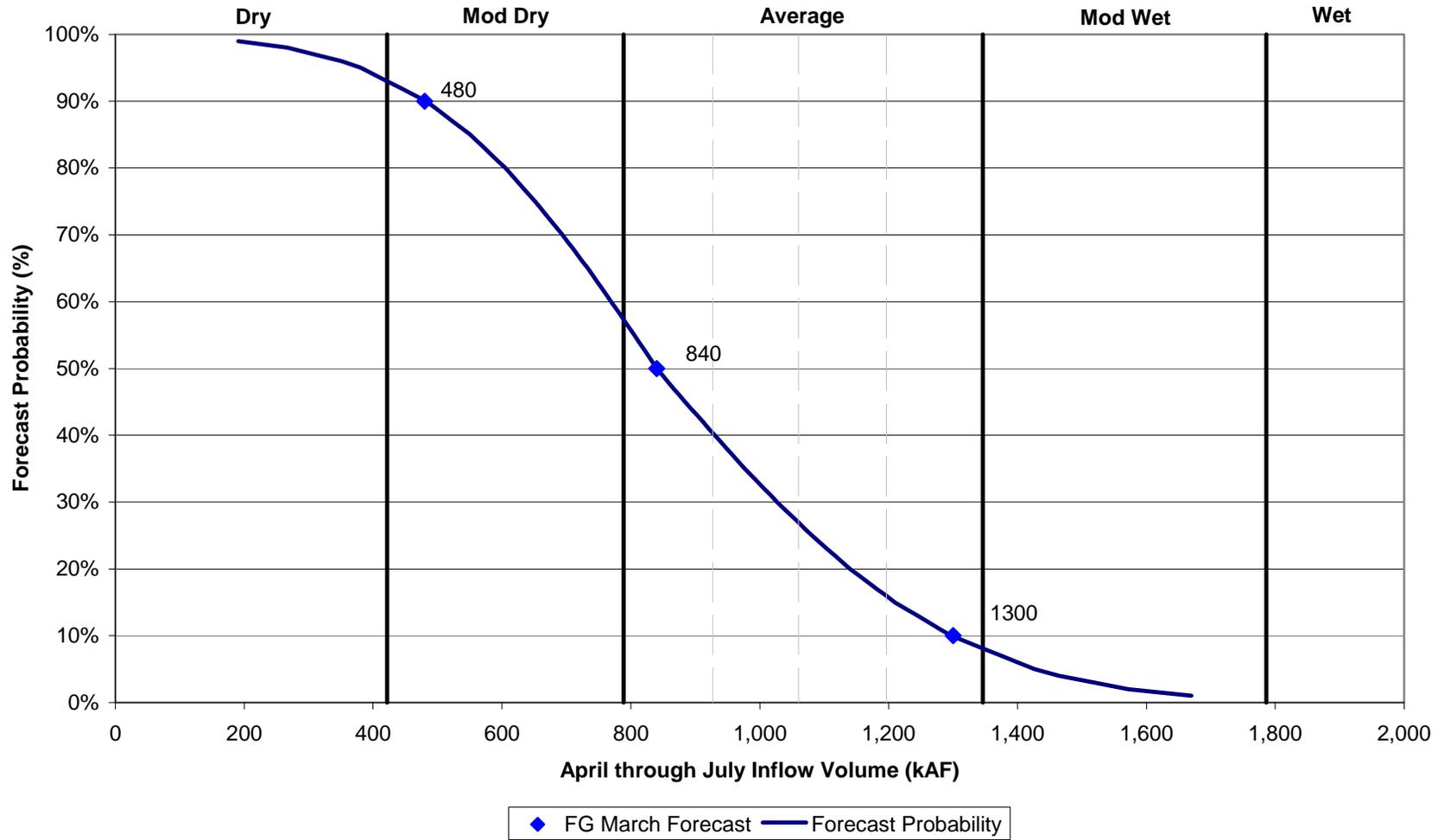
If Flaming Gorge Reservoir forecast increases above 1,786 KAF, it is proposed that Reach 1 flows be managed to achieve the objectives outlined in the average hydrologic classification. In addition, flows in Reach 1 would be managed to achieve a one-day peak flow of 26,400 cfs in Reach 2, two-week duration of 22,700 cfs and at least four-week duration of 18,600 cfs in Reach 2.

Proposed Base Flow and Temperature Objectives for Summer 2008

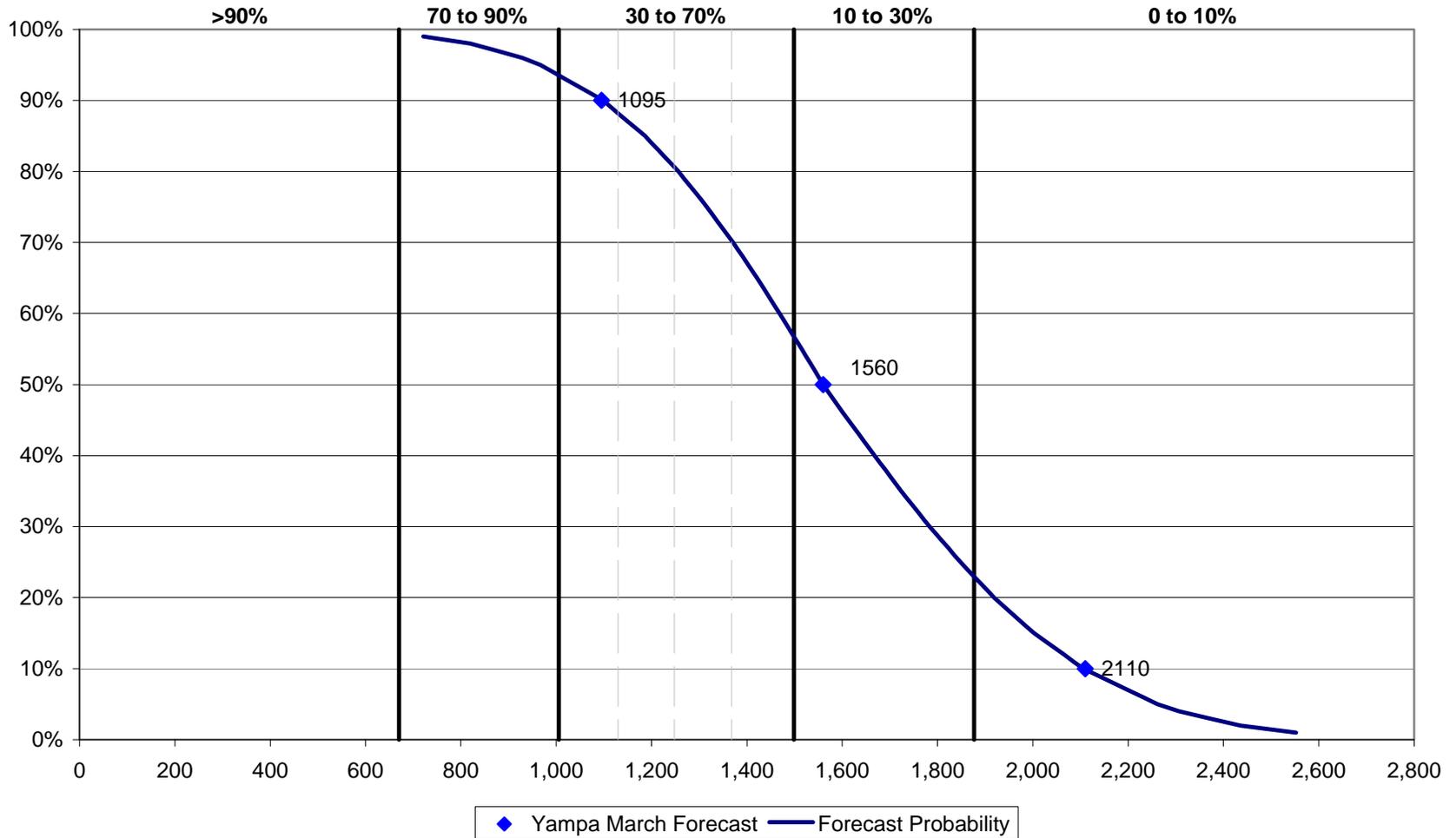
After the spring flow objectives in Reach 1 and Reach 2 have been achieved, flows should be gradually reduced to achieve base flow levels by no later than July 15, 2008. Base flows in Reaches 1 and 2 should be managed to fall within the prescribed base flow ranges described in the Flow Recommendations 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 $\pm 40\%$ of mean base flow. During the December through February base-flow period, the daily flows should be within $\pm 25\%$ 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 2008 (June through August).

Flaming Gorge Reservoir
April through July Historic Inflow (1963-2007)
 Related to Flow Recommendation Percent Exceedances



Yampa River - Maybell Plus Lily
April through July Historic Inflow (1922-2006)
 Related to Flow Recommendation Percent Exceedances



Green River at Jensen, Utah
April through July Historic Inflow (1947-2006)
 Related to Flow Recommendation Percent Exceedances

