

# UPPER COLORADO RIVER ENDANGERED FISH RECOVERY PROGRAM

FY 2023 ANNUAL REPORT

PROJECT: 19

## **Project Title**

General Hydrology Support

## **Bureau of Reclamation Agreement Number:**

R18PG40023

## **Project/Grant Period:**

Start date: 10/1/2022

End date: 9/30/2027

Reporting period end date: 12/31/2023

Is this the final report? Yes \_\_\_\_ No X

## **Principal Investigator:**

David Graf, Instream Flow Coordinator

Upper Colorado Endangered Fish Recovery Program Office

445 W. Gunnison Ave, Grand Junction CO 81501

Mobile Phone: (720) 441-7114

E-mail: David\_Graf@fws.gov

## **Abstract:**

The Recovery Program Director's Office (PDO) Instream Flow Coordinator provides basic hydrology support to Recovery Program researchers, partners, and PDO staff, and undertakes tasks that support the Recovery Program with basic data collection, monitoring, partner coordination, flow augmentation, data analysis, report reviews, data summaries and reporting. The work provided is supportive of other research projects or collaborative activities such as flow delivery, flow quantification, and habitat restoration, all of which have a direct impact on the recovery of the Colorado River threatened and endangered fishes.

A summary of accomplishments in 2023 is included below:

- Coordination of flow releases for 30,050 AF of stored water in the upper CO River Basin for 15 Mile Reach (15MR) flow augmentation, and 5,445 AF from Elkhead Reservoir for critical habitat protection in the Yampa River west of Craig. Weekly irrigation season coordination calls with water managers, Program and local partners, technical specialists, and other stakeholders occurred in both basins. Management and accounting for Program flow pools.
- \*Collection and posting of temperature data for sites on the Colorado, Green, Yampa, and Gunnison rivers. (\*The Program Data Coordinator performed this task in 2023. For lower Gunnison and some Colorado River sites, see Project 19b.)
- In response to the 15MR PBO review in 2022, the Program ISF Coordinator coordinated development of the 15MR Study Plan (Draft), which when finalized and adopted by Program committees, will guide studies and adaptive responses related to hydrology, biology, and habitat in the 15MR over the coming years. A report to Ecological Services is scheduled for 2028, with an additional PBO review in 2030.

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- The White River Management Plan was finalized in May 2023 and adopted by Program committees in summer 2023. The Recovery Program and the White River Planning Team continue to discuss whether to pursue development of a White River PBO at this time, or whether to continue to monitor depletion consultations in the basin and pause development of a PBO.
- Ongoing support and participation with Program committees for providing meeting and presentation materials; participation and outreach to external stakeholders and interested parties touring roller dam diversion facilities, water forums, festivals, and other targeted public outreach.

### **Study Schedule:**

1990-Ongoing

### **Relationship to RIPRAP:**

General Recovery Program Support Action Plan:

I.A.4.b. Conduct needed Geomorphology research and monitoring.

Green River Action Plan: Mainstream

I.A.3. Deliver identified flows.

Colorado River Action Plan: Mainstream

I.E. Evaluate and revise as needed flow regimes to benefit endangered fish populations.

Colorado River Action Plan: Gunnison River

I.D. Evaluate and revise as needed flow regimes to benefit endangered fish populations.

Yampa River Action Plan:

I.B.2 Provide augmentation of low flows.

Duchesne River Action Plan:

1.D Coordinate reservoir operation

### **Accomplishment of FY 2023 Tasks and Deliverables, Discussion of Initial Findings and Shortcomings:**

#### Stream Temperature Data Collection

The collection of water temperature data in various river reaches of the Upper Basin remains a task under the Hydrology Project 19 Scope of Work (also see 19b). Temperature monitoring duties are divided between the PDO staff, researchers at Colorado State University in Fort Collins, and the Fish and Wildlife Conservation Office field station in Grand Junction (FWCO-GJ)<sup>1</sup>. PDO and CSU staff deploy temperature loggers and collect data from seven locations on the Yampa and Green Rivers, as

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<sup>1</sup> Temperature data collection on the Colorado River by FWCO-GJ was consolidated in this Scope of Work beginning in FY99 and a separate budget table is included for this work. See 2023 annual report 19b General Hydrology Support (CRFP-Grand Junction contribution). Principal Investigators for 19b are Ben Schliecher and Dale Ryden.

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described below. FWCO-GJ currently collects water temperature data from four sites on the mainstem Colorado River, four sites on the Gunnison River and one site on the Uncompahgre River, as described in the separate Project 19b Annual Report. Changes in locations and distributions of the temperature sensors are described in that report. These data are downloaded semi-annually, quality-checked, and assembled into an Excel temperature database for use by Recovery Program researchers and others, following the format used by USGS in their Water Resources Data yearbooks. The PDO web enables and links them to the webpage: [Upper Colorado River Basin Data Repository - U.S. Fish and Wildlife Service \(fws.gov\)](https://www.fws.gov/upper-colorado-river-basin-data-repository). GPS locations for each thermograph are available by request; for security purposes exact locations are not provided on the web page.

FY2023 temperature data for all sites on the Green and Yampa rivers were downloaded by field crews during summer and in fall by the PDO Data Manager and retired FWS volunteer Jim Renne. For the CO, Gunnison, and Uncompahgre rivers, data were downloaded summer and fall 2023 by Benjamin Schleicher of FWCO-GJ. The one-hour interval readings from the previous year (FY22) as well as for FY23 were converted to daily means; raw data is available but not posted to the data repository. Data from all sites monitoring in FY 2023 will be processed and uploaded to the FWS link referenced above in spring of 2024.

The PDO maintains a summary table of site information for all known long-term stream temperature monitoring locations in the upper Colorado River basin, including those managed by cooperating entities such as USGS, Colorado State University, and the State of Utah. The purpose is to have a centralized inventory of this information to help address such questions as to where temperature data are collected, why those sites were selected, and how the data are used by the Program.

### Hydrology Support for Program Implementation and Monitoring

#### **Water Supply – Upper Co Basin 2023 Streamflow Summary**

A good monsoon summer and fall in 2022 provided antecedent soil moisture conditions in the upper Colorado basin much improved over fall in 2020 and 2021. The basin runoff forecast generally improved throughout the snowpack accumulation season with significant improvements in the upper Colorado basin in March, resulting in above- to well-above average snow water equivalent in every subbasin tributary to the upper Colorado River (Figure 1). In addition, significant May and June moisture in the Colorado front range limited front range storage capacity, leading to limitations on trans-basin diversion, reservoir spills well above what was predicted, and underestimates of total runoff in the upper Colorado and through the 15MR. Overall, runoff conditions in 2023 were significantly improved over 2022 (Table 1).

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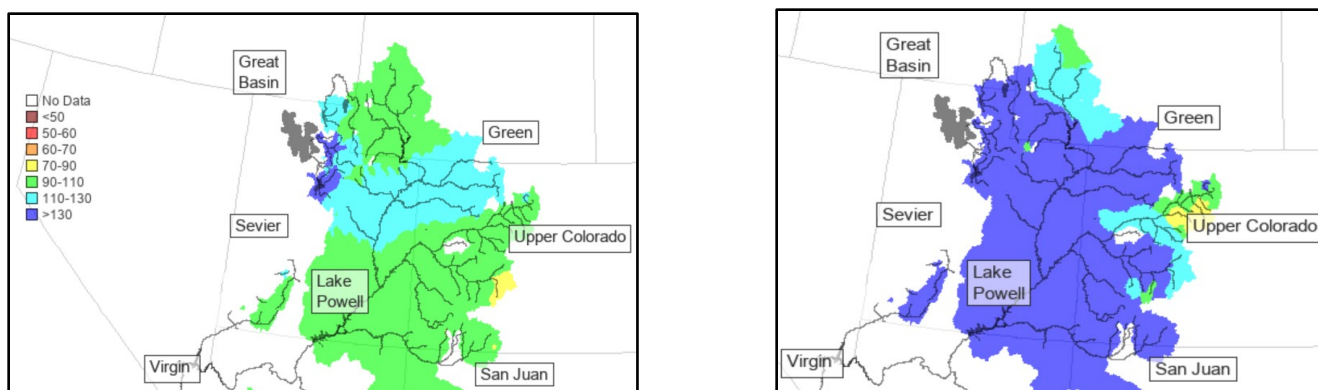


Figure 1. January 1 and May 1 water supply forecasts for the upper CO River basin (source: Colorado Basin River Forecast Center).

Table 1. ‘Native flow’ April – July Runoff in upper Colorado River subbasins, with reference to governing flow management processes.

<b>BASIN</b>	<b>2023 WATER SUPPLY (Hydrologic year-type)</b>	<b>GOVERNING FLOW CONTROLS</b>
Colorado River	123% Ave (WET)	Upper CO River PBO (2000)
Yampa River	152% Ave (WET)	Yampa River PBO (2005)
Green River (Flaming Gorge)	133% Ave (Moderately WET)	Flaming Gorge Record of Decision (ROD – 2006; Experimental Flows (LaGory et al, 2019)
Duchesne River	187 % Ave (WET)	Central Utah Project Completion Act (2009) – Duchesne Biological Opinion (2005)
Gunnison River	169% Ave (Average WET)	Gunnison PBO (2009); Aspinall Record of Decision (2012)
White River	156% Ave	White River Management Plan; NO ROD, PBO, or Active Flow Management

Lake Powell storage and elevations for the last three water years are shown below in Table 2 and Figure 2, reflecting total changes in Lake Powell storage between October 2020 and 2023, relative to full pool storage and water surface elevations. Protecting a critical elevation in Lake Powell of 3525 ft (35 ft of freeboard over minimum power pool intake elevations) is a focus of Reclamation’s management of the CO River Storage Project Act reservoirs in the Upper Colorado Basin.

Table 2. Lake Powell Storage Changes\*: 10/1/20 thru 10/1/2023

	<b>Storage (MAF)</b>	<b>% Total (26.2 MAF)</b>	<b>Pool Elevation (ft)</b>
<b>October 1, 2020</b>	11.34	43%	3595.83
<b>October 1, 2021</b>	7.18	27%	3545.29
<b>October 1, 2022</b>	5.83	22%	3529.92
<b>October 1, 2023</b>	8.79	34%	3573.55
<b>WY22-WY23 CHANGE</b>	<b>2.96</b>	<b>11%</b>	<b>WY22-23 Change = +43.6 ft</b>

\*Full Pool = 26.2 Million AF

\*Full Pool Elevation = 3700 ft

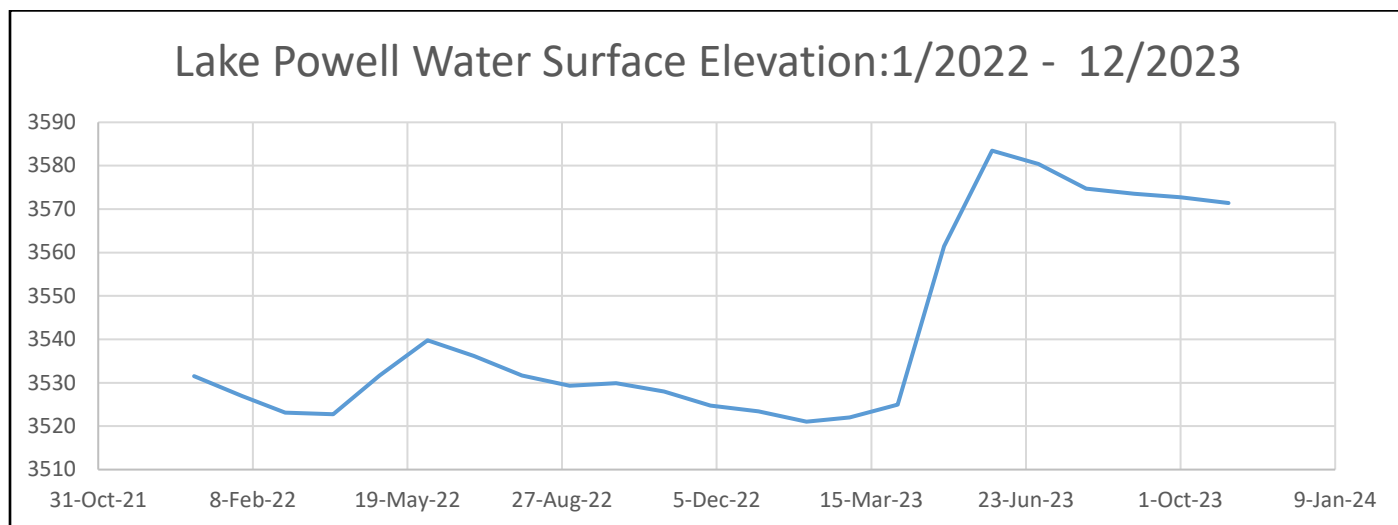


Figure 2. Water surface elevations at Lake Powell, January 1, 2022 thru December 5, 2023.

**Peak mean daily flows**

Peak daily flows (daily averages) observed at key gaging locations in the upper Colorado River basin are summarized in Table 3 below. All gages noted below recorded above average peak flows, ranging from near average at the Palisade gage (below the Grand Valley Irrigation Company diversion) to more than 200% of average peak flows at the ‘Nr Randlett’ gage on the Duchesne River and the ‘Gunnison at Whitewater’ gage. Peak flows at Jensen May 19 were barely higher than the 2023 peak on the Yampa at Deerlodge, and releases from Flaming Gorge reservoir were minimized during this period to avoid flooding downstream in Jensen and particularly near Green River, UT. Targeted high releases from Flaming Gorge the second week of June coincided with razorback sucker larval drift in order to maximize opportunity for entrainment in off-channel wetlands between Jensen and Ouray, resulting in a second peak at Jensen of >18,000 cfs approximately June 9-12.

Other notable qualifiers about the 2023 peak flows are included here:

- Colorado River at Palisade/ head of the 15MR: Despite average to above average snowpack in upper CO River subbasins, no Coordinated Reservoir Operations (CROS) operations occurred in 2023 (see also Annual Report C-12). This was due to uncertainty of fill in Ruedi, Granby, and other upper basin reservoirs (e.g., Dillon and Williams Fork), and a late, wet spring on the Front Range of Colorado. With limited capacity and an opportunity to fill Front Range reservoirs in priority with native eastern slope runoff, trans-mountain diversions were limited and resulted in unexpected spills from western slope reservoirs. For example, the April 1 prediction for Granby indicated a spill of ~1000 AF; the reservoir spilled ~66,000 AF. In addition, the yield in the Willow Ck subbasin was much greater than expected due to the East Troublesome fire, which limited infiltration in the drainage, increased runoff, and also resulted in excessive sedimentation in Willow Creek Reservoir. Flooding potential on Interstate 70 well downstream at the west end of the Grand Valley near Loma also required a cautious approach to enhancing seasonal peaks on the CO River.

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- Gunnison River at Whitewater: Reclamation operated Flaming Gorge releases in accordance with the ROD (2012) and moderately-wet peak flow targets described therein. Peak flow targets >14,000 cfs for 2 days, and 20 days at the ½ bankfull flows of 8,050 were exceeded in large part due to uncontrolled and largely ungaged runoff into the Uncompahgre and N. Fork Gunnison Rivers. Aspinall releases in spring were reduced such that the Black Canyon of the Gunnison National Park peak flow targets were not viable until runoff subsided, and were eventually met with high releases from Blue Mesa in late June after flooding concerns in Delta had passed.
- Duchesne River at Randlett: Starvation Reservoir spilled water for over 2 months, including flows over 4000 cfs for 6 days between May 25 and June 9, which contributes to the high flow metric used in the Duchesne Biological Opinion (2005) to assess channel maintenance flows in the lower Duchesne.
- San Juan River at Bluff: The San Juan also experienced an excellent runoff season with a peak flow ~147% of average and prolonged spring flows that enhanced sediment flux, improved riffle spawning habitat, and added to channel complexity by connecting the river to its floodplain and creation of new near-channel habitats.

Table 3. 2023 spring peak flow magnitudes compared to mean daily annual peak flow magnitudes at seven representative Upper Basin gage locations.

River / Location	Mean Daily Peak (cfs)	2023 Peak (cfs)	% of Avg Peak
<b>Yampa @ Deerlodge</b>	<b>12,500</b>	<b>19,900</b>	<b>159%</b>
<b>Green @ Jensen</b>	<b>16,500</b>	<b>20,100</b>	<b>122%</b>
<b>White @ Watson</b>	<b>2,400</b>	<b>3,420</b>	<b>143%</b>
<b>Duchesne @ Randlett</b>	<b>2,142</b>	<b>4,710</b>	<b>220%</b>
<b>Gunnison @ Whitewater</b>	<b>8,000</b>	<b>17,200</b>	<b>215%</b>
<b>Colorado @ Palisade</b>	<b>16,454</b>	<b>16,600</b>	<b>101%</b>
<b>San Juan @ Bluff</b>	<b>10,500</b>	<b>15,400</b>	<b>147%</b>

### Additional Support Provided by the Program Hydrologist in FY2023:

#### *Mainstem Colorado River*

- The ISF Coordinator participated in the weekly 15MR Historic Users Pool (HUP) coordination calls throughout the irrigation season, including pre-irrigation start-up (March-April), and weekly calls beginning in early July. No water delivery from HUP surplus carryover from Green Mountain Reservoir was required in April 2023, and the HUP pool ‘re-set’ in early May after Reclamation declared ‘start of fill’ for Green Mountain Reservoir.
- The ISF Coordinator managed delivery of the augmentation pools available to the Recovery Program (26,825 AF) and additional leased water made available by CWCB (3,225 AF) to support 15MR flows during late summer. Recovery Program releases from Granby Reservoir were initiated August 1, and were enhanced by additional releases

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from Wolford Mountain and Ruedi Reservoirs beginning August 5. Releases from all Program sources were between 345 and 395 cfs between August 11 and August 31, when an HUP Surplus was declared, and flow releases began in earnest September 1. Benefits to flows in the 15MR are illustrated in Figure 3, and details of augmentation by Program and HUP sources are shown in Figure 4. 46,700 AF of HUP surplus water was delivered to the 15MR in September and October, greatly improving the flows through the 15MR. Releases from Ruedi, Granby, Wolford and Green Mountain Reservoirs (Figures 5a and 5b) were made in consultation and consideration of local streamflow conditions in the upper Colorado and Fryingpan Rivers. In the upper Colorado River, the ISF Coordinator worked cooperatively with the 'Learning By Doing' operations group in Grand County to supplement flows when flows decreased and water temperatures increased.

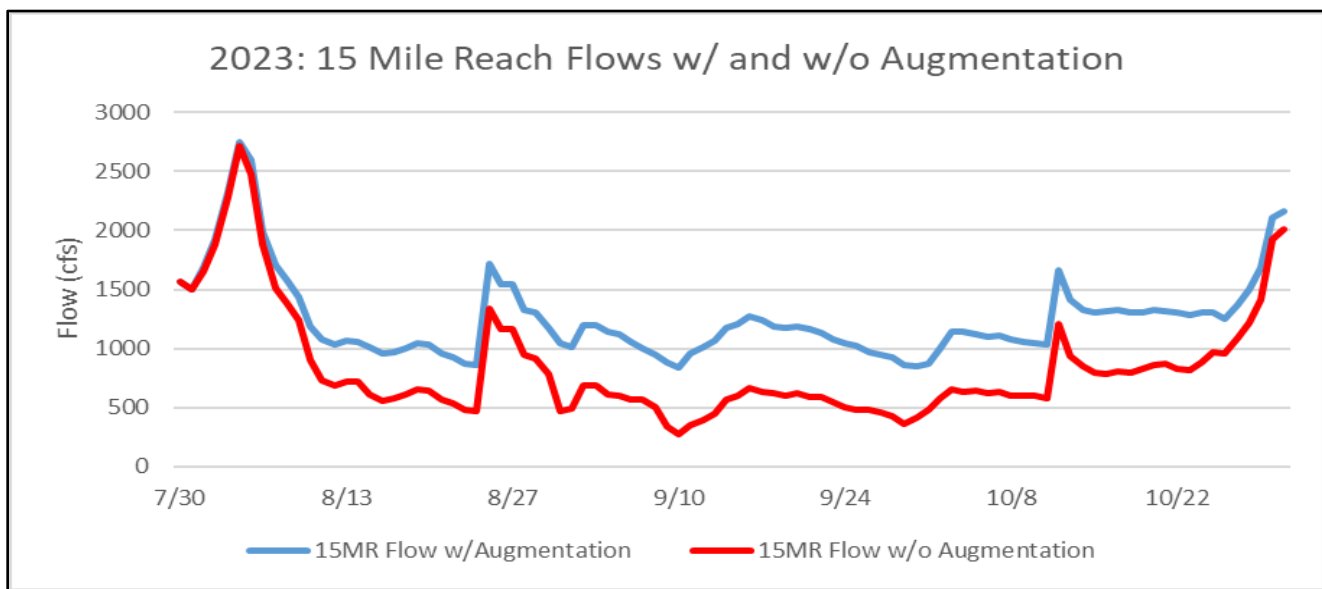


Figure 3. Late July through October 2023 flows in the Colorado River at the Palisade gage location below the GVIC diversion (USGS #09106150), with and without augmentation flow releases from Recovery Program pools, lease pools, and the HUP Surplus.

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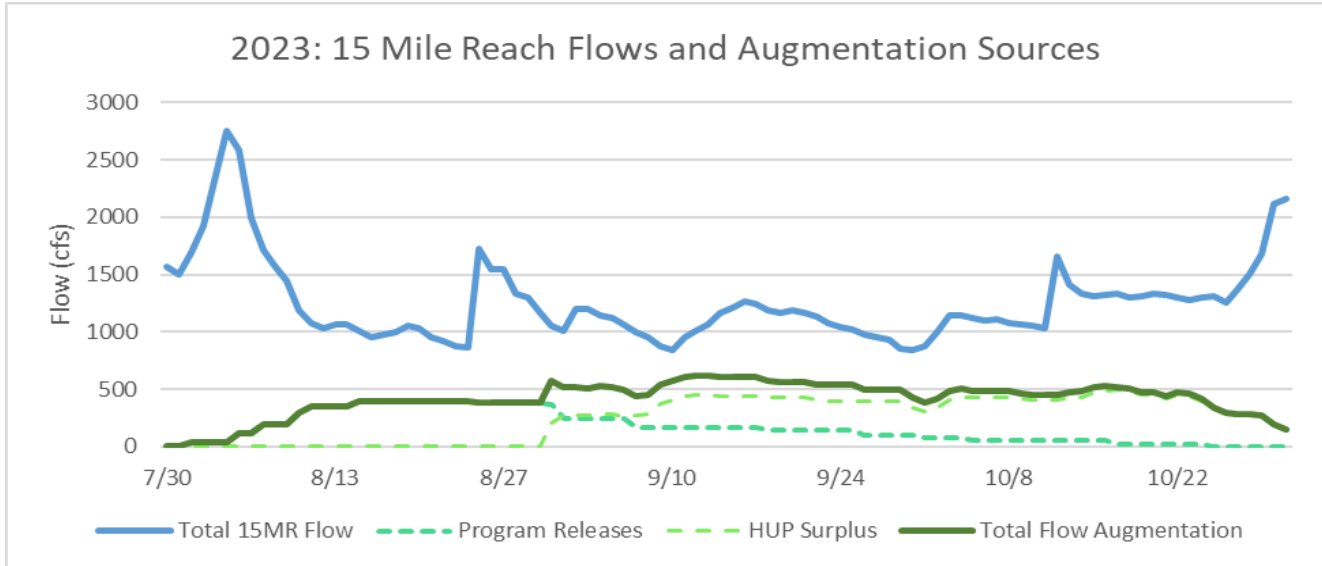


Figure 4. 15MR flow and augmentation source releases, including Program releases and HUP surplus releases.

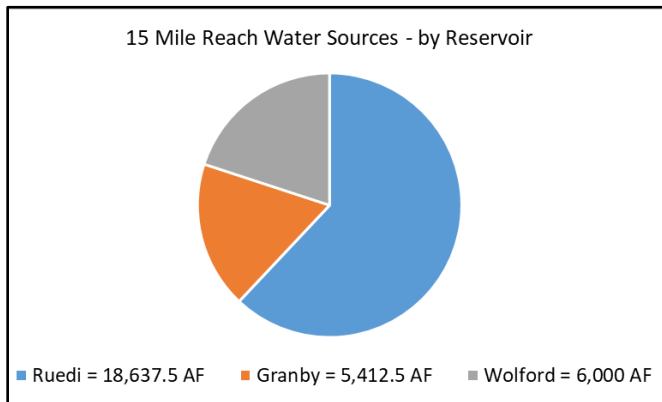


Figure 5a.

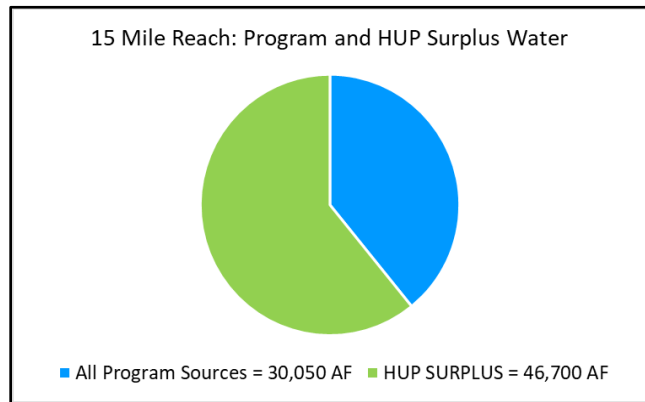


Figure 5b.

Figure 5. Allocations of Program pool releases by reservoir (5a), and total 15MR releases available in 2023, including HUP Surplus water (5b). Note that Ruedi releases include 3,225 AF of leased water made available by CWCB by leases with the Ute Water Conservancy District and Garfield County.

- Total Cameo April-July runoff was in the top 20 percent of historic runoff volumes; thus the hydrologic year-type was considered ‘WET’. Monthly flow targets for a WET hydrologic year type were met in March and May, and though the WET year flow target in June (15,560 cfs) was not met, average monthly flows in May and June were 13,890 cfs and 13,320 cfs, respectively, which was a significant improvement over spring flows in 2020, 2021, and 2022.
- Late irrigation season flow targets for ‘WET’ and ‘Average WET’ year-types were not met, but Program and HUP Surplus releases were successful in maintaining average monthly flows over 1000 cfs. Figure 6 shows the details of August through October



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flows relative to flow targets, and Figure 7 depicts how monthly average flows in 2023 (January – October) compared to flow targets set in the CO River 15MR PBO.

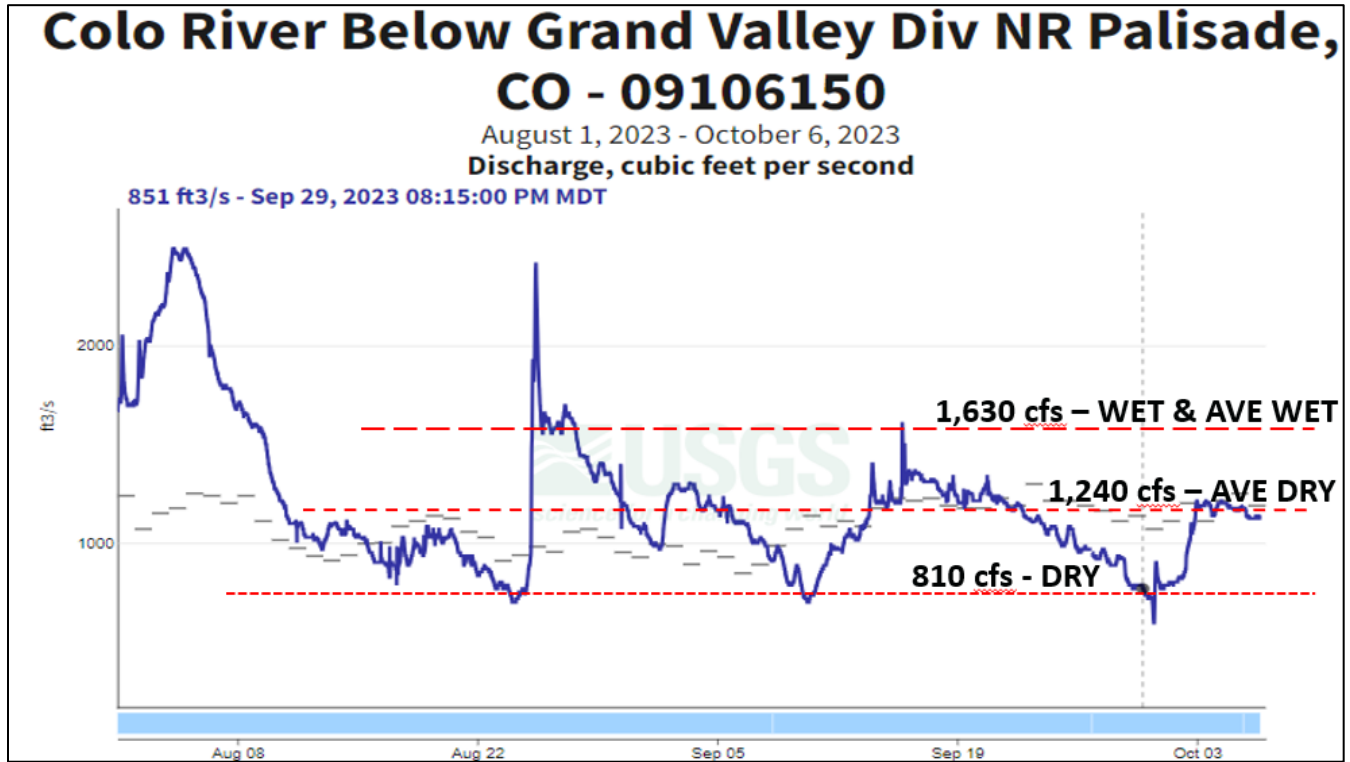


Figure 6. August through October 15MR flows with hydrologic year-type targets shown.

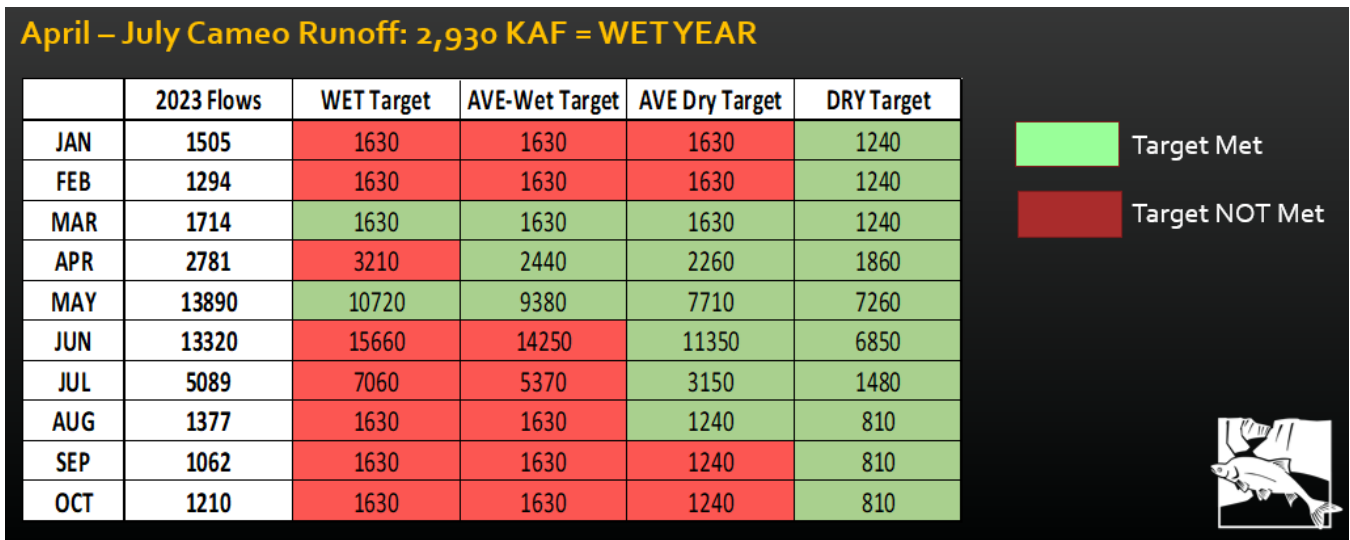


Figure 7. Overall January – October monthly flows in 2023 compared to year-type flow targets for the 15MR.

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- As requested by Ecological Services in their spring 2022 response to the 15MR PBO Review, the PDO and ISF Coordinator contracted to develop a comprehensive 15 Mile Reach Study Plan that includes hydrology, geomorphology, and biological study components. Included in these assessments are an effort to better understand current and future water supply challenges (despite flow pools and CROS operations), habitat changes that have occurred since the original habitat studies were conducted in the 1990s, and habitat utilization by listed fishes in the 15MR. An interdisciplinary workgroup was established, which developed and prioritized important questions related to hydrologic and biological uncertainties in the 15MR. The final Study Plan is scheduled for completion in January 2024, and implementation is considered concurrent with completion of the 15MR Study Plan.

### *Yampa River*

- In 2023 the Yampa River basin received ample snowpack that manifested in April – July runoff that was the 8<sup>th</sup> largest in the 108-year Maybell gage record. As noted earlier, peak flows at Maybell were over 15,000 cfs, and over 20,000 cfs at the Deerlodge gage below the Little Snake River confluence. These conditions led to extensive floodplain inundation and connection with the active channel. In addition, the Little Snake River (tributary to the Yampa between Maybell and Yampa Canyon) substantially augmented high flows, shoulder flows, and base flows, and also provided a large input of sand from a significant storm event in April. This sand wave was detected by suspended sediment monitoring equipment installed near the mouth of the Little Snake River (see Project 85f for a comprehensive description of the sediment flux monitoring).
- The Yampa PBO suggests that a flow target of 200 cfs is reasonable on a wet year; however by early August flows were decreasing rapidly and were below 200 cfs. After an initial lower Yampa River flow coordination call July 26, the ISF coordinator convened weekly meetings beginning August 11, which continued through October 4. The Program had 833 AF of lease carryover water in Elkhead Reservoir from 2022, in addition to the firm pool of 5000 AF. Flow releases were initiated August 18 and varied from 25 to 70 cfs (Figure 8), and a total of 5,445 AF was released in 2023. Although the wet year flow target is tentatively set at 200 cfs in the Yampa PBO and Yampa Management Plan, there was not enough storage to keep Maybell flows above 200 cfs, so a minimum target of 134 was set for the late irrigation season. Flow during the August – October period was near 150 cfs throughout this period, with some instantaneous data showing flows as low as 126 cfs. Daily average flows remained above the 134 cfs ‘average year’ target throughout the season, and there were 47 days below 200 cfs (Figure 9). In addition to the lower Yampa River coordination calls, the ISF Coordinator participated in weekly upper Yampa River flow coordination calls, in which releases from Stagecoach or other upstream reservoirs are considered in conjunction with contemplated Elkhead releases.

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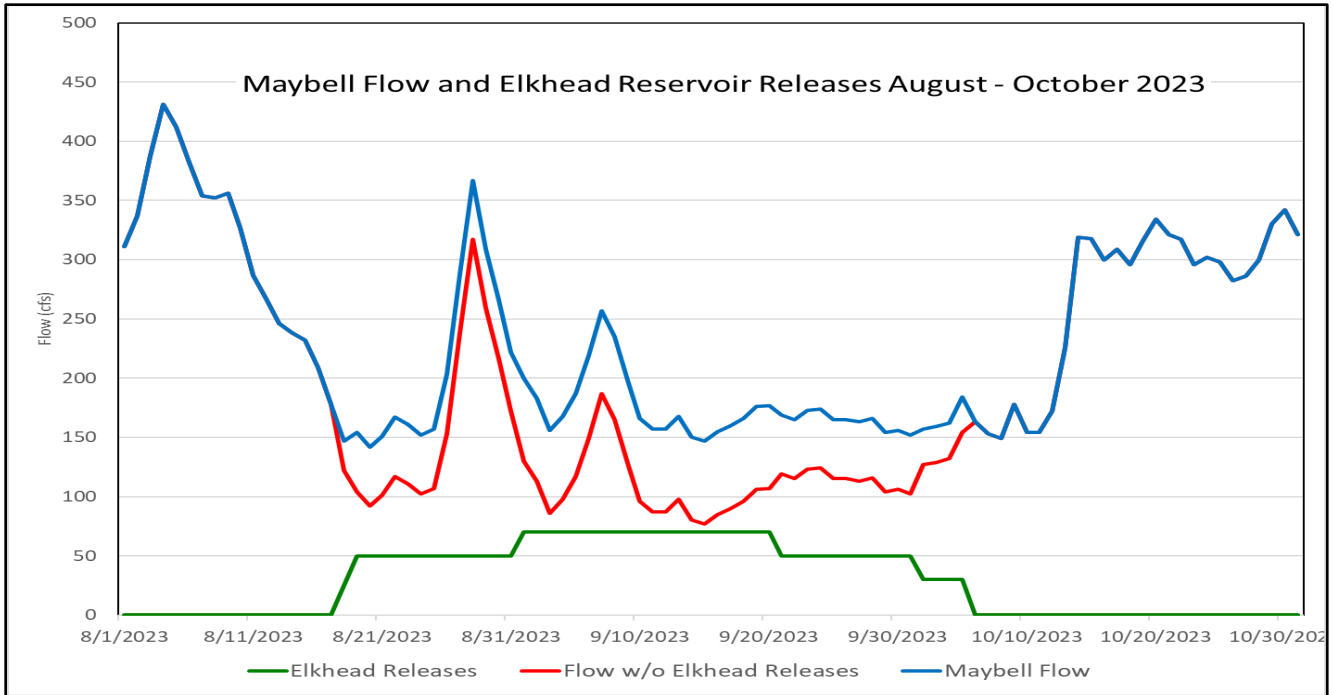


Figure 8. Recovery Program releases from Elkhead Reservoir, and August through October 2023 flows in the Yampa River at the Maybell gage with and without Elkhead Reservoir flow releases.

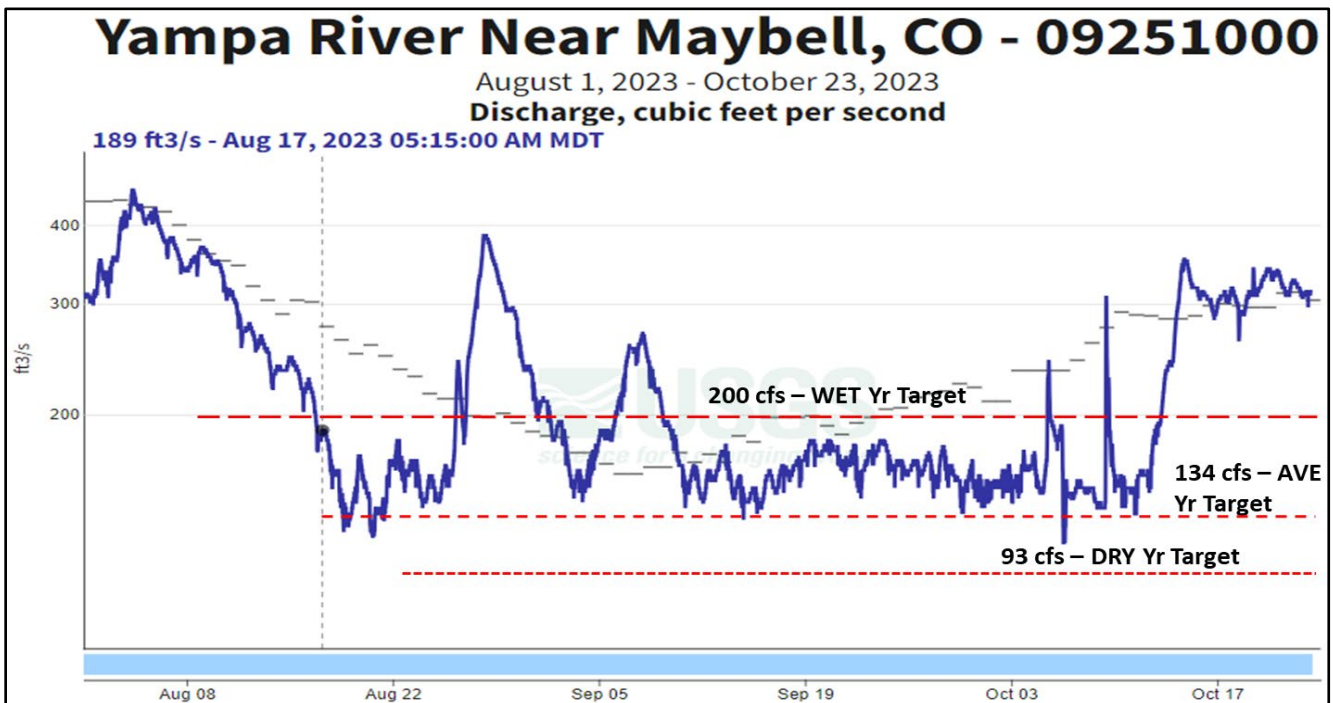


Figure 9. Instantaneous 2023 flows at the Maybell gage (August through October) relative to PBO flow targets.

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- The ISF Coordinator also participated in the Yampa River Fund’s Advisory Technical Review Committee to help review and make recommendations on their fourth round of grant proposals.
- The ISF Coordinator continued to remain engaged with implementation of the Yampa River Integrated Water Management Plan (IWMP), which recognizes the needs of listed species and describes an explicit goal to meet flow targets for listed fish as frequently as possible.

### *Green River*

- The ISF Coordinator participated in the Flaming Gorge Working Group discussions and kept abreast of the implementation of flow experiments for the Larval Transport Study Plan (entrainment of razorback sucker larvae into off-channel wetlands between Jensen and Ouray) and baseflows for the Colorado pikeminnow. No smallmouth bass flow spikes occurred in 2023, since the delay of spawning for smallmouth bass due to higher, cooler flows began to overlap with the emergence and presence of pikeminnow larvae.

### *White River*

- The PDO/ Instream Flow Coordinator finalized the White River Management Plan (WRMP) in coordination with CWCB and Recovery Program Partners. The WRMP was adopted by the White River Planning Team (WRPT) in early May, reviewed and approved by Program technical committees in July (Water Acquisition and Biology Committees), and adopted by the Management Committee in early August. The WRMP may provide the basis for a PBO, which would provide streamlined ESA compliance for an increment of future depletions in CO, UT, and Ute Tribal Lands within the White River basin. The WRPT continues to deliberate whether to actively pursue PBO development, though current discussions have not led to consensus on this issue. Nonetheless, the WRMP contains potential management activities that could be incorporated into the Program’s RIPRAP in subsequent years as part of the annual work planning process.

### *Duchesne River*

- The Duchesne River spilled water from Starvation Reservoir from April through July, and added 2070 ‘cfs-days’ that specifically count toward achieving a high-flow (channel maintenance) metric for downstream habitat. Flows remained above the Priority 1 goal of 50 cfs throughout the 2023 water year; given that runoff was 187 percent of average, all other Priority II-V flow targets were also achieved (see Duchesne Biological Opinion, 2005).

### *Other/General*

- Seminars and Webinars relevant to Upper Co River Basin water management as appropriate (Colorado Water Congres; Utah Water Users Assoc; Ruth Hutchins Powell CMU Water Center; CRWUA; Basin Roundtables in Colorado...)
- Presentations on the Recovery Program purpose and flow management specifics were ongoing throughout FY2023. Field tours of the 15MR infrastructure and descriptions of the flow program continued to provide incidental outreach opportunities for the Recovery Program to numerous water user and community groups.

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### **Additional noteworthy observations:**

The Recovery Program's ISF Coordinator is invested in working with the Water Acquisition Committee (WAC) to gain a greater knowledge of the nuances between providing sufficient water to meet habitat needs while at the same time recognizing the increasing pressures and demands on the water resources in the upper Colorado River basin. Water Year 2023 brought a welcome but likely short-term reprieve from the drought conditions that have plagued the entire basin beginning in summer of 2020. While the Program recognizes the broader landscape reflecting short term negotiations between States, Tribes, and the Federal Government related to the post-2026 operating guidelines for the basin, the ISF Coordinator is hopeful that Program Partners will work with these entities so they understand the critical importance of integrating the needs of listed fish into long-term basin planning.

### **Recommendations:**

- Continuation of the current data collection and flow management activities administered under this Project, and specifically to continue participation and coordination of the managed flow programs in the Yampa and Colorado basins that result in improved flow conditions for listed fish.
- The collection, storage, and use of temperature data by Program Partners and participating researchers should be re-assessed as there is a tremendous volume of data and little understanding of how these data are being used.
- The ISF Coordinator should continue outreach with water user groups and active basin water forums, coordinate and implement the production of useful information germane to Recovery Program management activities, and promote the PBO compliance efforts undertaken by the Recovery Program.
- During FY2024 - 2028, implementation of the 15MR Study Plan will be critical; funding for specific contracted components of this plan, and for field offices that are essential to its implementation should be prioritized.
- The ISF Coordinator should further develop and refine the functions and engagement of the WAC to assist all partners in helping recovery of the listed fishes.

### **Project Status:**

Ongoing and on-track.

### **FY 2023 Budget Status**

Funds Budgeted/Provided: \$189,473

Funds Expended: \$189,473

Difference: -0-

Status of Data Submission

N/A

### **Signed:**

David Graf

Principal Investigator

December 28, 2023