

Attachments to the Framework  
2022 Drought Response Operations Plan  
Index

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## Attachment A

### Summary of 2022 Drought Response Operations Plan

#### 1. Current (as of April 2022) and Projected Hydrological Information:

##### *1.1 Insert current and projected elevations at Lake Powell, including graphic representation from the Bureau of Reclamation's (Reclamation) multi-year projections;*

The April forecast for water year 2022 (October 2021-September 2022) ranges from a minimum probable of 5.27 million acre-feet (maf) (55 percent of average<sup>1</sup>) to a maximum probable of 8.99 maf (94 percent of average) with the most probable forecast for water year 2022 of 6.31 maf (66 percent of average) (Figure 1). There is a 10 percent chance that inflows could be higher than the current maximum probable forecast and a 10 percent chance that inflows could be lower than the minimum probable forecast.

Based on the April 2022 forecast of 6.31 maf unregulated inflow for water year 2022, the Colorado River Mid-term Modeling System 24-Month Study (24-Month Study) projects Lake Powell will end water year 2022 near elevation 3,522.72 feet with approximately 5.79 maf in storage (24 percent of capacity). Note that projections of elevation and storage for water year 2022 have considerable uncertainty at this point in the season. Projections of end of water year 2022 Powell elevations using the April 2022 24-Month Study Minimum Probable and Maximum Probable inflow forecast results model runs are 3511.71 feet (21 percent of capacity) and 3547.32 feet (30 percent of capacity), respectively (Figure 2). The annual release volume from Lake Powell during water year 2022 is 7.48 maf as determined under Section 6.C.1 of the 2007 Interim Guidelines. However, an April 8, 2022 letter from the Secretary of Interior requested the Basin States consider “potentially reducing Glen Canyon Dam releases to 7.0 maf this water year providing additional certainty regarding annual release volumes and tier determinations for the 2023 water year. Sections 6 and 7.D. of the 2007 Interim Guidelines authorized the potential reduction under current circumstances.”

Powell elevation as of April 10, 2022, is 3,522.94 feet (24 percent of capacity). The projected elevation based on the Probable April 2022 24-Month Study for December 2022 is 3,515.05 feet (22 percent of capacity) under the Most Probable scenario and 3,504.04 feet (19 percent of capacity) under the Minimum Probable projection.

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<sup>1</sup> Percent of average is based on the historical unregulated inflow for the period of record between October 1, 1990 through September 30, 2020 comprising the 1991 through 2020 water years.

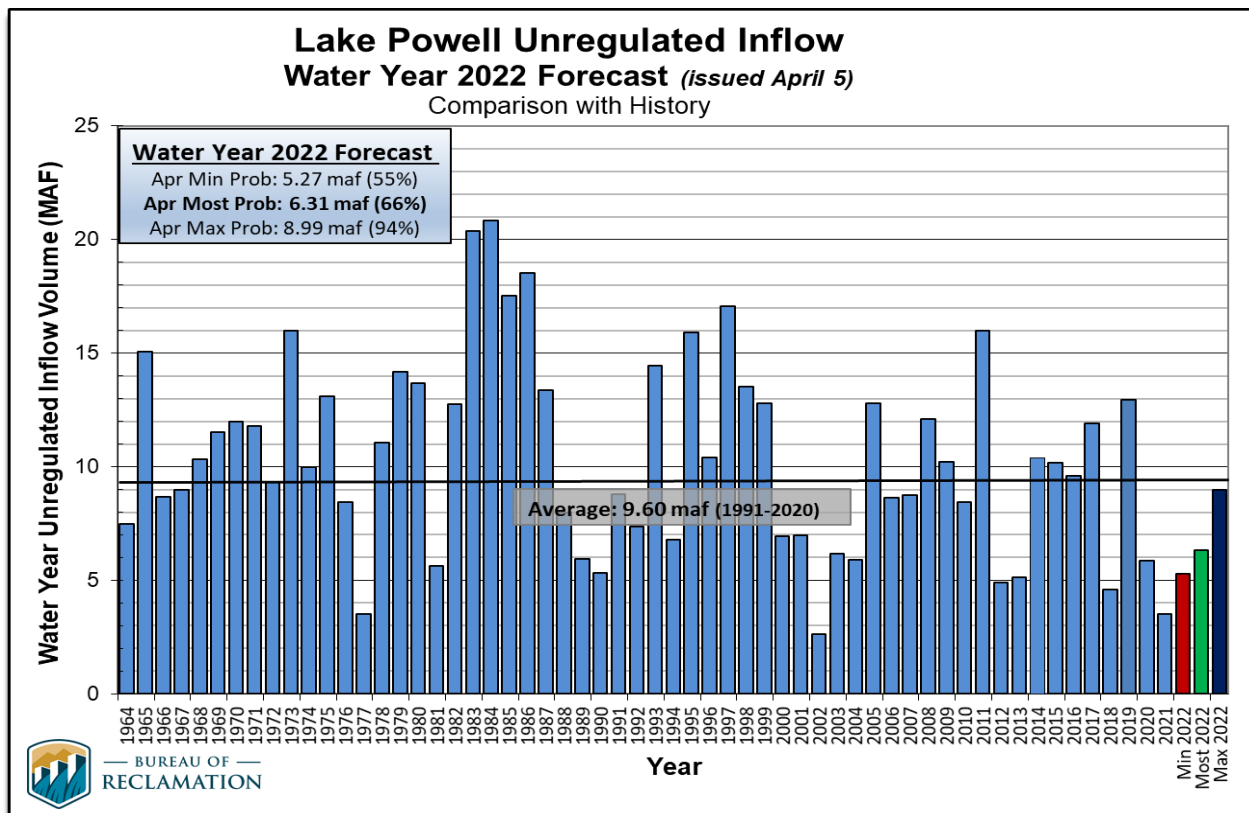


Figure 1. Lake Powell unregulated inflow for Water Year 2022 with the forecast issued April 5, 2022, for minimum, maximum and most probable forecasts as compared against chronological historical water year unregulated inflow forecasts.

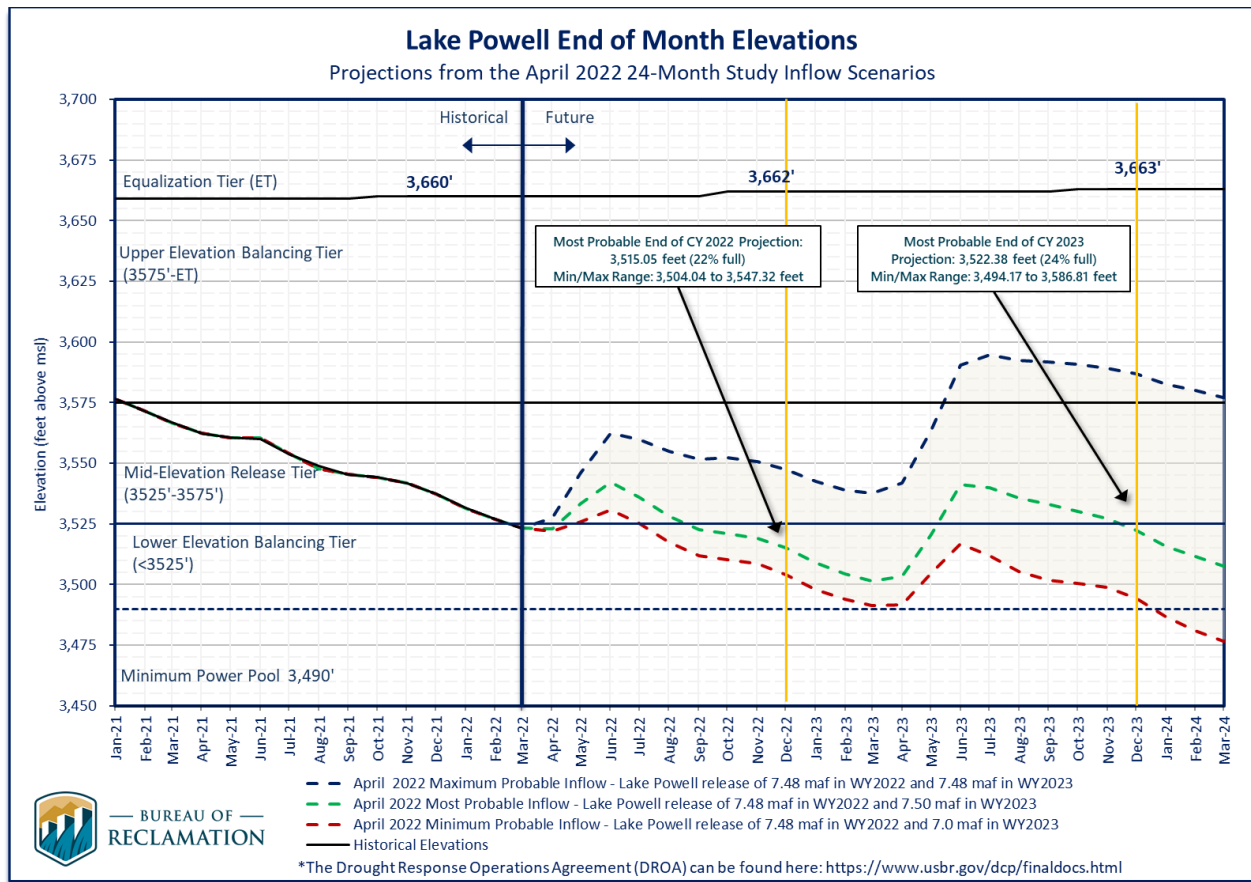


Figure 2. Lake Powell historical and projected end of month elevations using the Maximum, Minimum and Most Probable forecasts from the April 2022 24-Month Study.

*1.2 Insert Reclamation's most recent Colorado River Mid-term Modeling System 24-Month Study (24-Month Study);*

Reclamation's April 2022 24-Month Study Most Probable scenario can be found using this hyperlink: <https://www.usbr.gov/lc/region/g4000/24mo/2022/MAR22.pdf>.

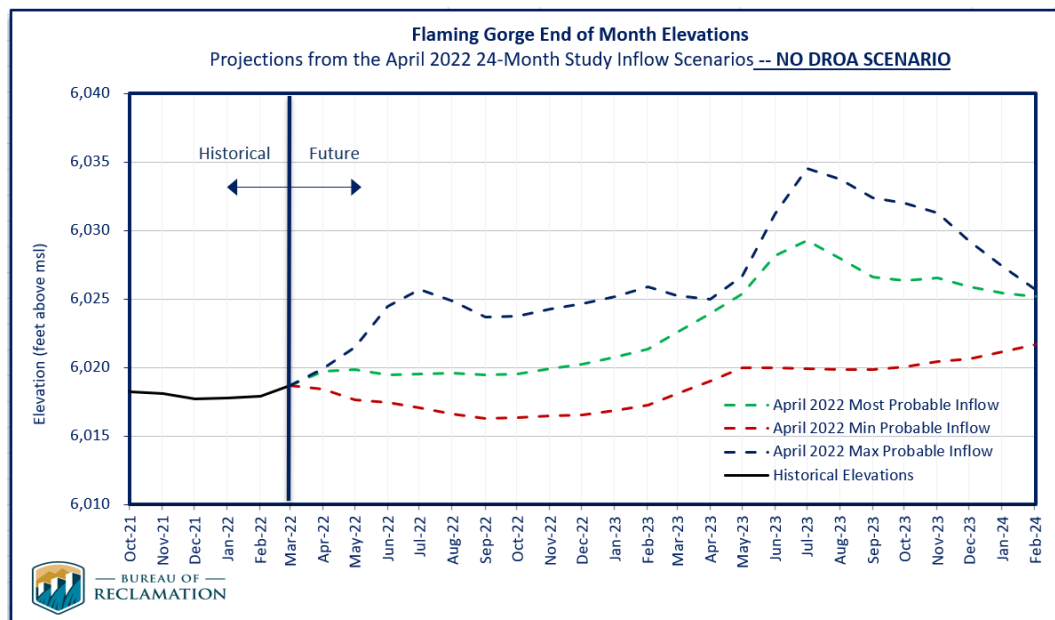
Reclamation's April 2022 24-Month Study Minimum Probable scenario can be found using this hyperlink: [https://www.usbr.gov/lc/region/g4000/24mo/2022/MAR22\\_MIN.pdf](https://www.usbr.gov/lc/region/g4000/24mo/2022/MAR22_MIN.pdf).

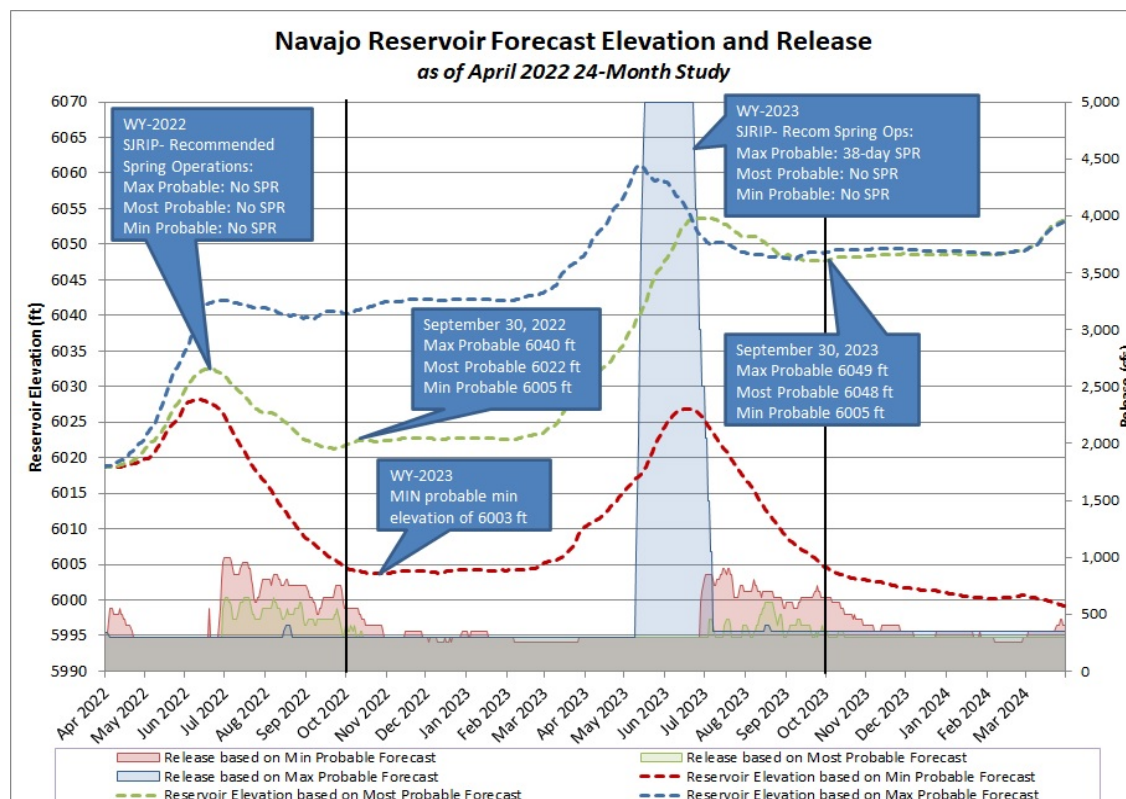
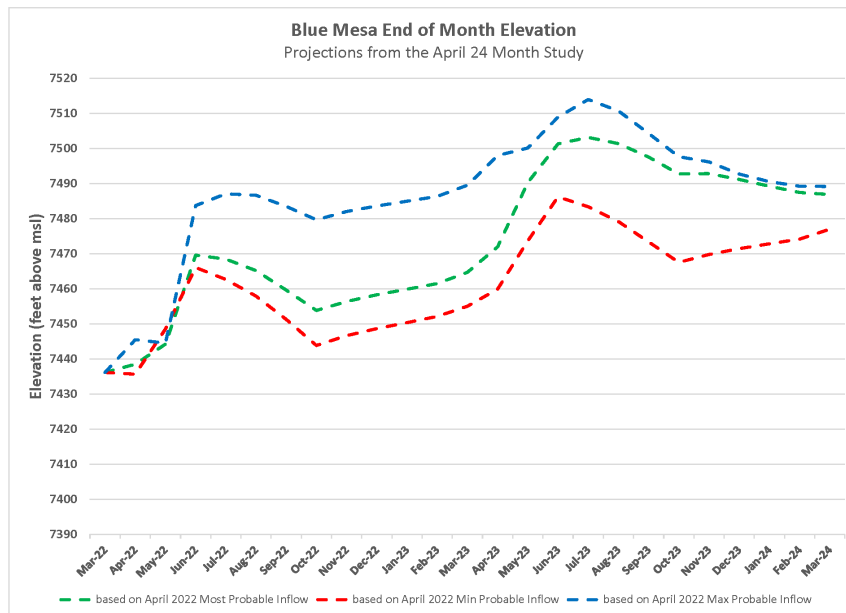
Reclamation's April 2022 24-Month Study Maximum Probable scenario can be found using this hyperlink: [https://www.usbr.gov/lc/region/g4000/24mo/2022/FEB22\\_MAX.pdf](https://www.usbr.gov/lc/region/g4000/24mo/2022/FEB22_MAX.pdf).

*1.3 Insert identification of months when the 24-Month Study Minimum Probable inflow and the Most Probable inflow each projected Lake Powell to be at an elevation below the Target Elevation;*

Powell elevations based on the Most Probable April 2022 24-Month Study decrease below the Target Elevation again in early September 2022 and remain below the Target Elevation through June 2023 before rebounding above the Target Elevation once again. Powell elevations based on the Minimum Probable April 2022 24-Month Study decrease below the Target Elevation in early August 2022 and remain below the Target Elevation through the end of the modeling run in March 2024. The elevation decreases below minimum power pool in January 2024 ending the Minimum Probable April 2022 24-Month Study model run at elevation 3,476.67 feet at the end of March 2024.

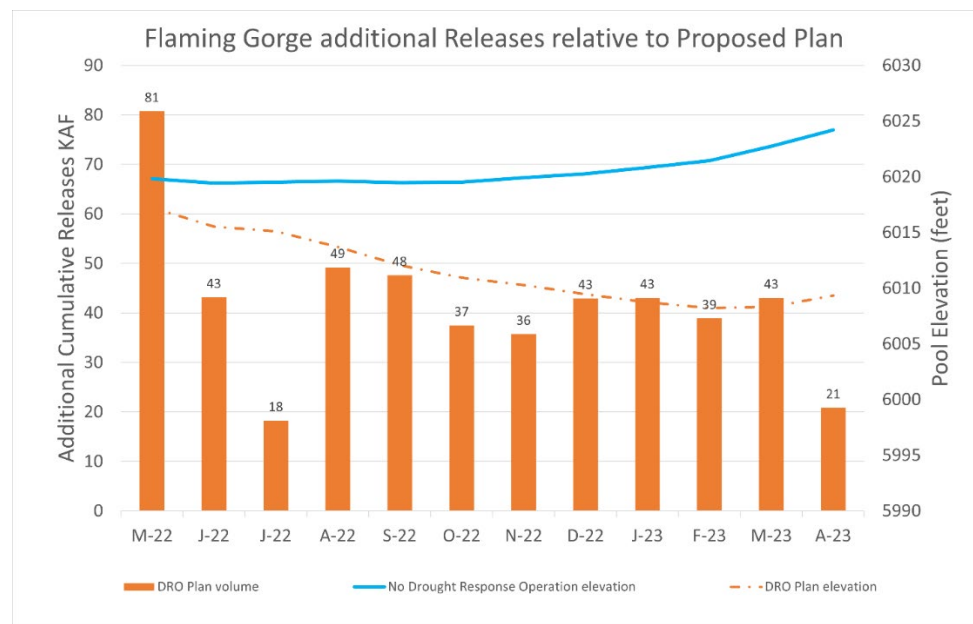
*1.4 Insert current and projected elevations at each of the Initial Units for the following 24 months;*





*1.5 Insert availability of water for Drought Response Operations at each of the Initial Units and the timing of such water availability;*

- i. Glen Canyon: Glen Canyon Dam operational adjustments during spring 2023 will be evaluated pursuant to 2022 Drought Response Operations Plan Section 5.2.2, Lake Powell Monthly Operations Adjustments.
- ii. Flaming Gorge: After consideration of potential Drought Response Operations release scenarios by the Flaming Gorge Technical Working Group and the Flaming Gorge Working Group, the volume of Drought Response Operations releases from Flaming Gorge under current conditions will be 500,000 acre-feet as follows:



- iii. Aspinall: Based on the current conditions, inflow forecast, existing contractual and release obligations, no Drought Response Operations Release will occur in water year 2022. In early water year 2023, the DROA Parties will consider Drought Release Operations if hydrology improves.
- iv. Navajo: Based on the current conditions, inflow forecast, existing contractual and release obligations, and the potential for the reservoir elevation to fall into the inactive pool without additional Drought Response Operations Releases, no Drought Response Operations Release will occur in water year 2022. In early water year 2023, the DROA Parties will consider Drought Release Operations if hydrology improves.

*1.6 Insert summary of previous Drought Response Operations at each Initial Unit (Glen Canyon, Flaming Gorge, Aspinall, Navajo), if any. The summary will include:*

*1.6.1 Previous Drought Response Operation Agreement Actions Prior to Current Plan*

*1.6.1.1 Previous Drought Response Operation Agreement Actions Prior to current plan at Glen Canyon Dam*

Reclamation began monthly adjustments at Glen Canyon Dam on January 1, 2022, taking initial steps to protect Lake Powell dropping below the Target Elevation. The monthly volume of water released from Glen Canyon Dam was adjusted to hold back 350 thousand acre-feet (kaf) of water in Lake Powell from January to April 2022 when inflow to the reservoir is low. The same amount of water (350 kaf) will then be released to Lake Mead between June and September 2022, after the spring runoff occurs. The annual volume of water released from Glen Canyon Dam is unchanged by these operational adjustments.

*1.6.1.2 Previous Drought Response Operation Agreement Actions prior to current plan at upstream Initial Units*

In 2021 during the months of July, August, September and October, additional releases were made based on a determination of imminent need by Reclamation as provided for in DROA II(A)(3)(j), which resulted in additional releases of 161,000 acre-feet from upstream Initial Units as follows:

**DROA Releases Completed in Water Year 2021**

	Jul	Aug	Sep	Oct	Nov	Dec	
	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	(kaf)	Sum
Flaming Gorge	12	45	44	24	0	0	125
Blue Mesa	0	17	16	3	0	0	36
Navajo	0	0	0	0	0	0	0
Sum:	12	62	60	27	0	0	161

*1.6.2 Estimated effect on Lake Powell from Drought Response Operation Releases based upon best available information*

The estimated effect on Lake Powell from 2022 Drought Response Operations Releases will be assessed prior to the 2023 Drought Response Operations Plan.

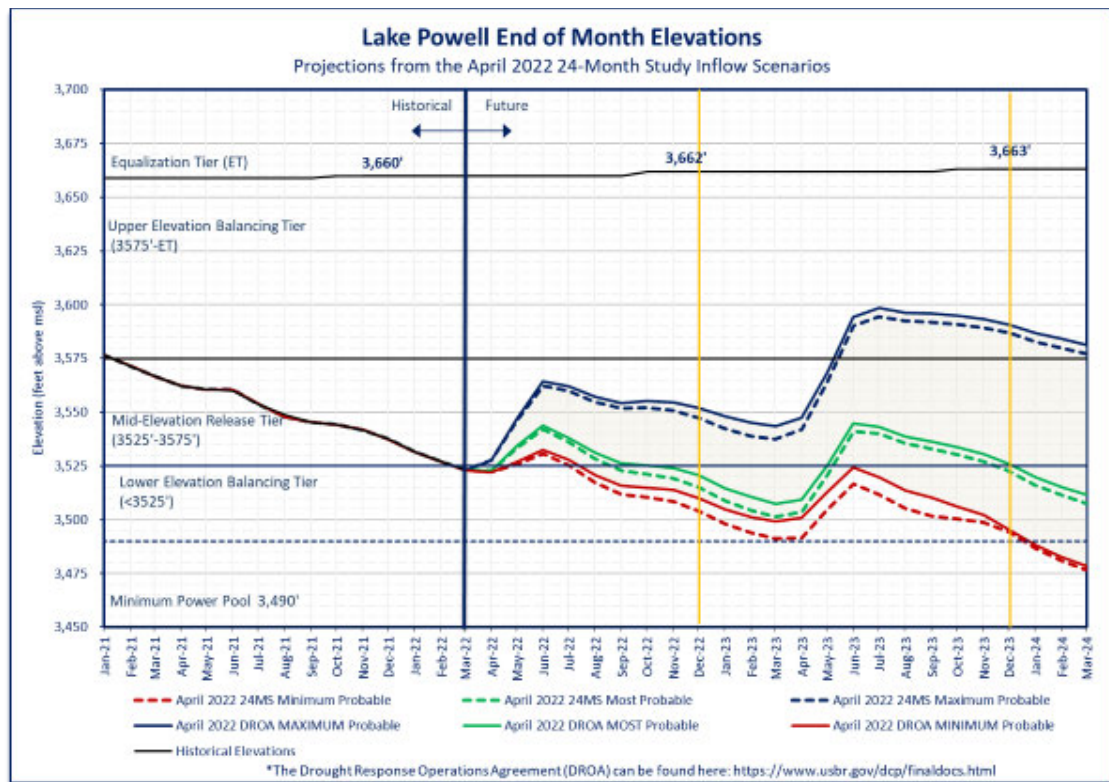


### *1.6.3 Status of Recovery from previous Drought Response Operation Releases, including any releases pursuant to Emergency Actions*

To date, the amounts listed above have not been recovered at Flaming Gorge or Blue Mesa.

## *2. Insert summary of 2022 Drought Response Operations. This summary will include the following:*

### *2.1 Projections for the Drought Response Operations incorporated for the Minimum, Maximum, and Most Probable inflow traces.*

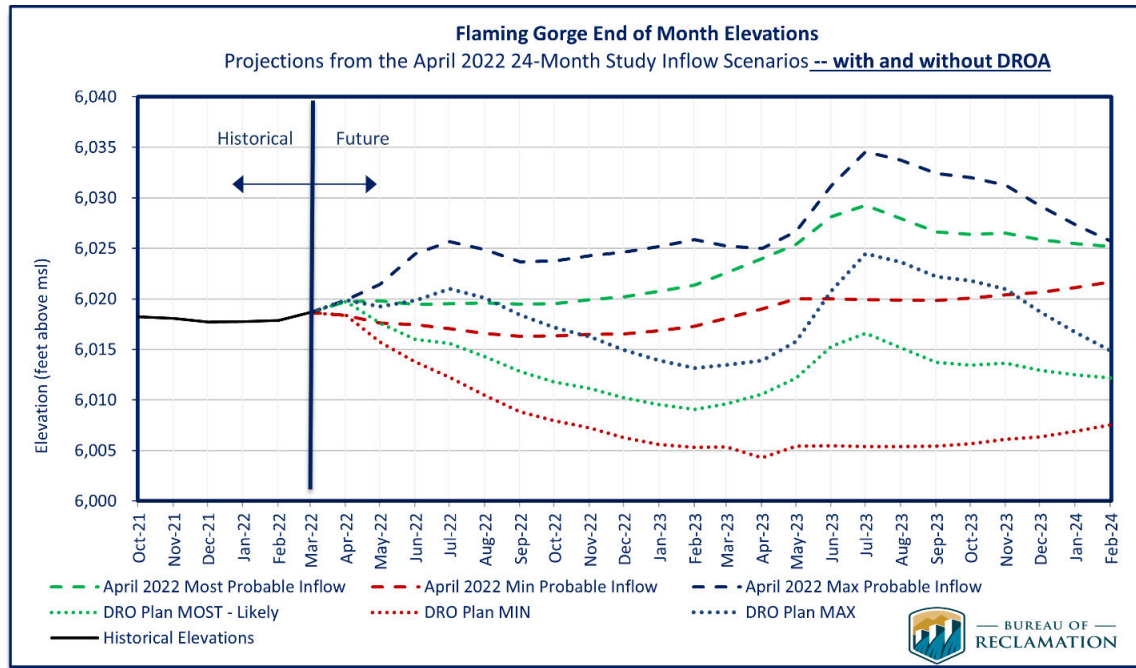


### *2.2 A description of operational adjustments at Glen Canyon Dam, if any, which will include a comparison of such operational adjustments to operations when no adjustments are made. This comparison may be provided through text, tables, figures, and graphs as needed.*

Glen Canyon Dam operational adjustments during spring 2023 will be evaluated pursuant to 2022 Drought Response Operations Plan Section 5.2.2, Lake Powell Monthly Operations Adjustments. These operational adjustments will be based on projections of the Target Elevation at Lake Powell during winter and spring 2023 and may be similar to the adjustments seen during 2022, if necessary.

### *2.3 A description of Drought Response Operations releases and recovery at affected Initial Units, as applicable, as set forth in Attachments C through E. This will include*

*the amount of water involved (rate, volume, and timing), a description of each reservoir's water level over the following 24 months.*



3. *Insert summary describing application of the effectiveness criteria described at Section 5.3. These criteria include, without limitation:*

For purposes of the 2022 Drought Response Operations Plan, the Parties analyzed the effectiveness of the 2022 Drought Response Operations Plan using the Colorado Basin River Forecast Center's (Forecast Center) April 1, 2022 forecast consistent with Reclamation's April 2022 24-Month Study projections. The evaluation of effectiveness considers the DROA Target Elevation of 3,525 ft. at Lake Powell and also the critical infrastructure elevation of 3,490 ft. at Lake Powell. The DROA identified the target elevation of 3,525 ft. as the level at which to begin to take proactive measures to protect Lake Powell from declining below elevation 3,490 ft. There are increasing risks to water management, infrastructure and hydropower resources as Lake Powell declines towards 3490 ft. The analysis considered the reduction in risk of Lake Powell declining below elevation 3,525 ft. or 3,490 ft. with contemplated release volumes of approximately 500,000 acre-feet from Flaming Gorge Reservoir. The DROA Parties will consider additional potential Drought Response Operations during the course of their monitoring activities.

Moreover, the overall effectiveness of the 2022 Drought Response Operations Plan may benefit from operational actions the Secretary of Interior may take at Lake Powell during water year 2022, in particular reducing Glen Canyon Dam releases from 7.48 MAF to 7.0 MAF, consistent with her authorities under the 2007 Interim Guidelines. Taken together, the 2022 Drought Response Operations Plan and the Secretary's

proposed 480,000 acre-foot reduction in release volumes from Lake Powell during water year 2022 will delay or avoid the operational uncertainties associated with Lake Powell elevations declining below 3,490 ft.

The DROA Parties have conducted analyses of the effectiveness of the 2022 Drought Response Operations Plan based on Reclamation's 2022 April 24- Month Study. The analyses are limited to the effectiveness of the proposed 2022 Drought Response Operations Plan based on the 2022 April 24-Month Study and do not create precedent for future DROA Plan effectiveness determinations.

The Parties analyzed the effectiveness of the 2022 Drought Response Operations Plan based on the following criteria, without limitation:

*3.1 The likelihood that the Drought Response Operation will increase the risk of a net decrease in the elevation at Lake Powell over any consecutive 12-month period based on the most recent 24-Month Study;*

Analyses of the April 2022 24-Month Study show that the inclusion of the 2022 Drought Response Operations Plan may increase the potential for Lake Powell annual releases to be increased under the Lower Elevation Balancing Tier operation condition (Lake Powell < 3,525') for some traces in water year 2023. In the April 24-Month Study Most Probable and Minimum scenarios, 2022 Drought Response Operations will result in Lake Powell continuing in the Lower Elevation Balancing Tier for water year 2023. In both scenarios, the analysis shows a net increase in the elevation at Lake Powell due to DROA 2022 operations (see Figure within Section 2.1 of this Attachment). However, the volume of releases from Lake Powell under the Lower Elevation Balancing Tier is based, in part, on the volume of water in Lake Mead. Therefore, releases from Lake Powell in Water Year 2023 could increase the annual release volume thereby reducing the effectiveness of the 2022 Drought Response Operations.

*3.2 The extent to which conducting a Drought Response Operation for certain durations and at certain times during the water year might affect the ability of the released water to reach Lake Powell;*

The operations under the 2022 Drought Response Operations Plan are coincident with the timing of the 2022 runoff period and extended baseflow releases for recovery implementation program experiments, thereby increasing the proportion of the 2022 Drought Response Operations Plan releases reaching Lake Powell. Downstream uses from the mainstem Green River are satisfied by baseflows, even under minimum baseflow conditions under the Flaming Gorge Record of Decision. Additional studies are necessary to provide estimates of incremental impacts of 2022 Drought Response Operations Plan to Lake Powell.

*3.3 The extent to which a Drought Response Operation changes the risk of Reclamation being unable to meet obligations related to an upstream Initial Unit in future years at times after the 12-month period when a Drought Response Operation would occur;*

The DROA Parties, in the development of the 2022 Drought Response Operations Plan, considered the necessity of maintaining appropriate storage such that the upstream Initial Units can continue to meet operational requirements and commitments. The 2022 Drought Response Operations Plan does not increase the risk of the upstream Initial Units failing to meet their baseflow and operating requirements and commitments by maintaining sufficient storage at the end of the 2022 Drought Response Operations Plan through April 30, 2023.

*3.4 The degree to which a Drought Response Operation minimizes, to the extent practicable, impacts of the Drought Response Operation to natural resource conditions;*

The 2022 Drought Response Operations Plan provides natural resource benefits by facilitating enhanced experimental flows from Flaming Gorge in accordance with the 2005 Biological Opinion and 2006 Record of Decision for the reservoir. Without the 2022 Drought Response Operations Plan, experimental flows from Flaming Gorge would be limited to Larval Trigger Study Plan experiments and smallmouth bass spike releases, along with baseflow transition periods. However, with the 2022 Drought Response Operations Plan, additional experimental flows, including experimental Colorado pikeminnow base flows, are coincident with and facilitated by the 2022 Drought Response Operations Plan, thus providing an additional natural resource benefit. Additionally, impacts to river flows and Flaming Gorge reservoir water levels related to recreation were considered, along with potential downstream flooding risks.

*3.5 The degree to which a Drought Response Operation minimizes, to the extent practicable, impacts to the Upper Colorado River Basin Fund and impacts to the reliability of the Western Interconnected Bulk Electrical System;*

The 2022 Drought Response Operations Plan will provide releases from Flaming Gorge, and the potential for releases from Aspinall Unit (Blue Mesa), and thus an incremental increase in hydropower generation. However, this increase may be offset by a seven-day bypass release from Flaming Gorge as part of the 2022 Drought Response Operations Plan. Consequently, there is the potential for a negative impact to the Upper Colorado River Basin Fund due to reduced power revenues resulting from the bypass operation. Navajo Reservoir was not considered in this analysis because it does not generate CRSP hydropower.

The potential negative impacts to hydropower production at Flaming Gorge are offset by reduction of risk to interruption in hydropower production at Glen Canyon Dam. Analysis of the full range of hydrologic scenarios using the April 24 Month Study model ensemble demonstrates that the Plan reduces the risk of falling below elevation 3,490 ft. by approximately 10%, increasing the likelihood of Lake Powell maintaining hydropower generation capability throughout the period of the Plan to over 80%. Hydropower operations at Glen Canyon Dam are a significant resource in protecting the stability of the Western Interconnected Bulk Electrical System.

*3.6 The extent to which a Drought Response Operation minimizes adverse effects to resources and infrastructure in the Upper Basin and provides additional certainty on Colorado River water management, including but not limited to associated economic implications;*

The 2022 Drought Response Operations Plan minimizes potential adverse impacts to resources and ultimately protects infrastructure in the upstream Initial Units. The DROA Parties note that the 2022 Drought Response Operations Plan provides additional certainty to Colorado River water management by reducing the risks of Lake Powell declining below critical operating elevations, which would result in reservoir releases conducted solely through the Glen Canyon Dam river outlet works. There is a risk to Colorado River water management operations and critical infrastructure at Glen Canyon Dam resulting from the exclusive use of the river outlet works for releases.

*3.7 The extent to which a Drought Response Operation recovery at a particular Initial Unit will occur or has occurred by October 1, 2026.*

The 2022 Drought Response Operations Plan does not contemplate recovery of DROA release volumes through the 2022 Drought Response Operations Plan year. A summary of previous releases pursuant to DROA that require future recovery is shown in Section 1.6.1.2 above. The required recovery volumes from the 2022 Drought Response Operations Plan will be based on analysis of Operations Without Drought Response.

## Attachment B

### 2022 Drought Response Operations Plan

#### Operational Adjustments at Glen Canyon Dam

##### 1. Glen Canyon Dam Operations Without Drought Response

The 2007 Interim Guidelines control annual release volumes. Any monthly adjustments to Glen Canyon Dam releases cannot and do not change annual release volumes. Monthly releases from Glen Canyon Dam are determined by the 2016 Record of Decision for the Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP), which addresses hourly, daily, monthly, and experimental releases from Glen Canyon Dam and a variety of resources below Lake Powell in accordance with the Grand Canyon Protection Act of 1992. These operational parameters determine the flexibility for any Drought Response Operation.

##### 2. Current Hydrology

The April forecast for water year 2022 ranges from a minimum probable of 5.27 million acre-feet (maf) (55 percent of average<sup>2</sup>) to a maximum probable of 8.99 maf (94 percent of average) with the most probable forecast for water year 2022 of 6.31 maf (66 percent of average) (Figure 1). There is a 10 percent chance that inflows could be higher than the current maximum probable forecast and a 10 percent chance that inflows could be lower than the minimum probable forecast.

Based on the April 2022 forecast of 6.31 maf unregulated inflow for water year 2022, the Colorado River Mid-term Modeling System 24-Month Study (24-Month Study) projects Lake Powell elevation will end water year 2022 near 3,522.72 feet with approximately 5.79 maf in storage (24 percent of capacity). Note that projections of elevation and storage for water year 2022 have considerable uncertainty at this point in the season. Projections of end of water year 2022 Powell elevations using the April 2022 24-Month Study Minimum Probable and Maximum Probable inflow forecast results model runs are 3,513.35 feet (22 percent of capacity) and 3,567.29 feet (37 percent of capacity), respectively (Figure 2). Under these scenarios, there is a 10 percent chance that inflows will be higher, resulting in higher elevation, and 10 percent chance that inflows will be lower, resulting in lower elevation. Under Section 6.C.1 of the 2007 Interim Guidelines, the annual release volume from Lake Powell during water year 2022 will be 7.48 maf.

Powell elevation as of April 10, 2022, is 3,522.94 feet (24 percent of capacity). The projected elevation based on the Probable April 2022 24-Month Study for December 2022

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<sup>2</sup> Percent of average is based on the historical unregulated inflow for the period of record between October 1, 1990 through September 30, 2020 comprising the 1991 through 2020 water years.

is 3,515.05 feet (22 percent of capacity) under the Most Probable scenario and 3,504.04 feet (19 percent of capacity) under the Minimum Probable projection.

Based upon the April 2022 24-Month Study, Powell elevations under the Minimum and Most Probable scenarios are expected to decrease below the Target Elevation beginning March and April 2022 before rebounding above the Target Elevation in May 2022. Powell elevations based on the Most Probable April 2022 24-Month Study decrease below the Target Elevation again in early September 2022.

Powell elevations based on the Minimum Probable April 2022 24-Month Study decrease below the Target Elevation in early August 2022 and remain below the Target Elevation through the end of the modeling run in March 2024. The elevation decreases below minimum power pool in January 2024 ending the Minimum Probable April 2022 24-Month Study model run at elevation 3,476.67 feet.

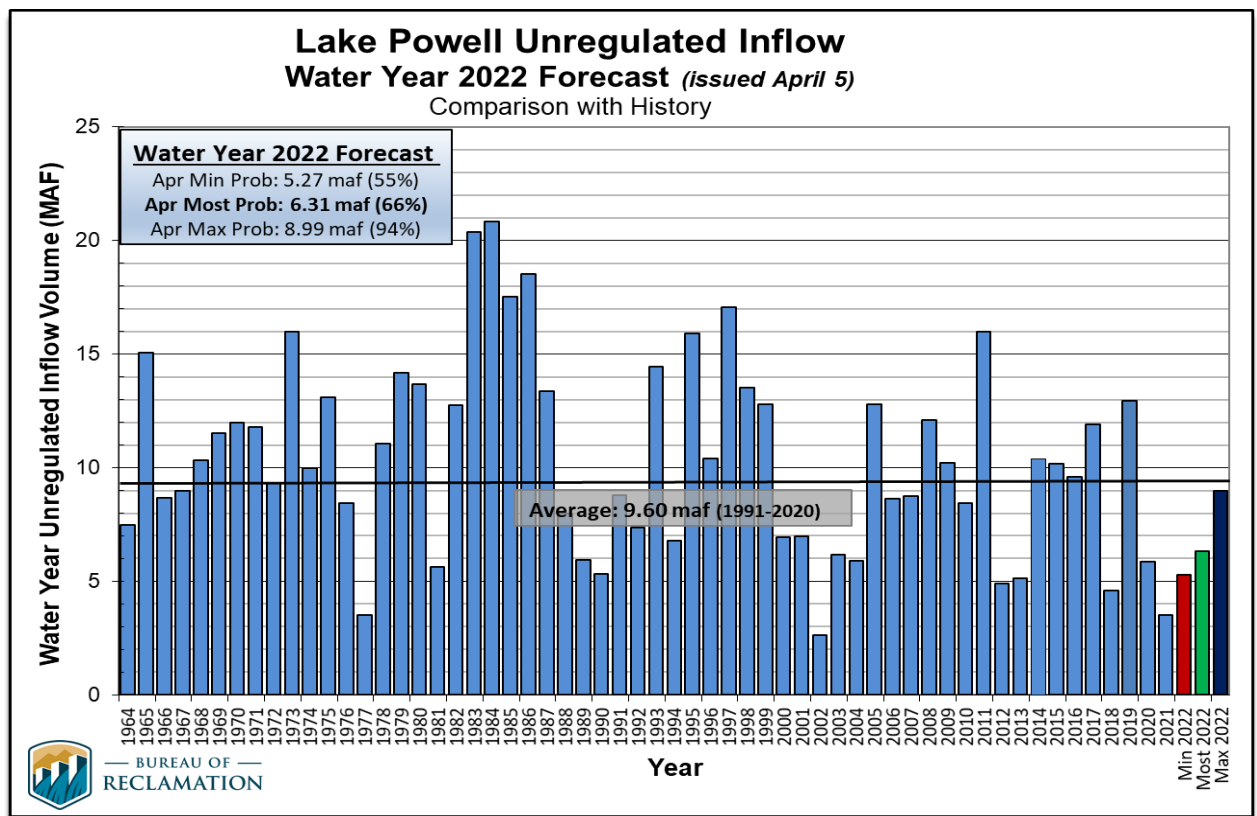


Figure 1. Lake Powell unregulated inflow for Water Year 2022 with the forecast issued April 5, 2022, for minimum, maximum and most probable forecasts as compared against chronological historical water year unregulated inflow forecasts.

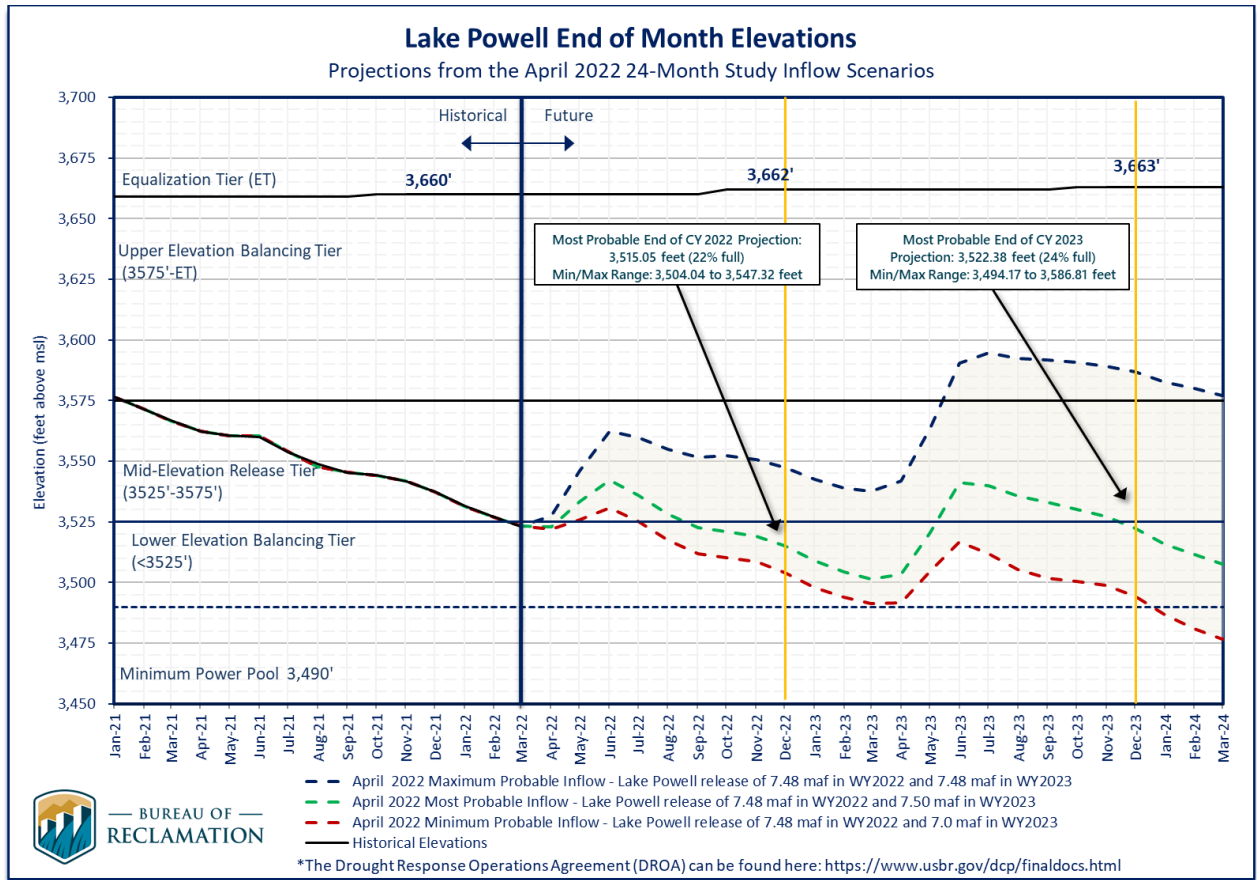


Figure 2. Lake Powell historical and projected end of month elevations using the Maximum, Minimum and Most Probable forecasts from the April 2022 24-Month Study.

### 3. Glen Canyon Dam without Drought Response during Plan year

The operation of Lake Powell in the April 2022 24-Month Study is pursuant to the Interim Guidelines and reflects the 2022 Annual Operating Plan (AOP). Pursuant to the Interim Guidelines, the August 2021 24-Month Study projections of the January 1, 2022, system storage and reservoir water surface elevations set the operational tier for the coordinated operation of Lake Powell during 2022.

The August 2021 24-Month study projected the January 1, 2022, Lake Powell elevation to be less than 3,575 feet and at or above 3,525 feet. Consistent with Section 6.C.1 of the Interim Guidelines the operational tier for Lake Powell in water year 2022 is the Mid-Elevation Release Tier and the water year release volume from Lake Powell is 7.48 maf. However, an April 8, 2022 letter from the Secretary of Interior requested the Basin States consider “potentially reducing Glen Canyon Dam releases to 7.0 maf this water year providing additional certainty regarding annual release volumes and tier determinations for the 2023 water year. Sections 6 and 7.D. of the 2007 Interim Guidelines authorized the potential reduction under current circumstances.”



As described in the 2019 Drought Response Operations Agreement and the 2022 Drought Response Operations Plan Section 5.2.2, Lake Powell Monthly Operations Adjustments, Lake Powell monthly release volumes are determined by the 2016 Record of Decision for the Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP), which addresses hourly, daily, monthly, and experimental releases from Glen Canyon Dam. The standard monthly release volume patterns for a range of annual flows, including for a 7.48 maf water year release volume, is contained in Attachment B of the LTEMP ROD. (Figure 3)

Monthly Release Volume (thousand ac-ft) <sup>a</sup>										
Total Annual	7,000	7,480	8,230	9,000	9,500	10,500	11,000	12,000	13,000	13,000
October	480	480	643	643	643	643	643	643	643	643
November	500	500	642	642	642	642	642	642	642	642
December	600	600	716	716	716	716	716	716	716	716
January	664	723	763	857	919	1,041	1,102	1,225	1,347	1,470
February	587	639	675	758	813	921	975	1,083	1,192	1,300
March	620	675	713	801	858	973	1,030	1,144	1,259	1,373
April	552	601	635	713	764	866	917	1,019	1,121	1,223
May	550	599	632	710	761	862	913	1,014	1,116	1,217
June	577	628	663	745	798	905	958	1,064	1,171	1,277
July	652	709	749	842	902	1,022	1,082	1,202	1,322	1,443
August	696	758	800	899	963	1,091	1,156	1,284	1,413	1,537
September	522	568	600	674	722	819	867	963	1,059	1,160

<sup>a</sup> Release volumes in October, November, and December typically do not vary in years with annual volumes  $\geq 8.23$  maf because the forecasted annual release volume is not known in the beginning of the water year. In other months, release volumes generally follow the proportions shown in the third column of Table 2, up to the maximum and minimum flow constraints presented in Table 1. Within a year, monthly operations may be increased or decreased based on factors referenced in Section 1.2 and 1.3.

Figure 3. LTEMP Attachment B, Table 3 setting forth the monthly volume releases for each water year release monthly release volume determined under the 2007 Interim Guidelines.

#### 4. Glen Canyon Dam Drought Response Operations

##### a. Previous Drought Response Operations Agreement Actions Prior to Current Plan – Spring 2022

Based upon the December 2021 24-Month Study, Powell elevations under the Minimum, Maximum and Most Probable scenarios are expected to decrease below the Target Elevation beginning March and April 2022 before rebounding above the Target Elevation in May 2022, which resultant elevation will be based on observed May through July runoff volumes. Current estimates of Lake Powell elevation below the Target Elevation based on the Most Probable April 2022 24-Month Study is projected to be 3,522.82 feet, which corresponds to 134 kaf below the Target Elevation at the end of the calendar year

Reclamation began monthly adjustments at Glen Canyon Dam on January 1, 2022, taking initial steps to protect Lake Powell dropping below the Target Elevation. The adjusted releases are designed to help protect the Target Elevation at Lake Powell until spring runoff materializes. The monthly volume of water released from Glen Canyon Dam is being adjusted to hold back 350 thousand acre-feet (kaf) of water in Lake Powell from January to April 2022, when inflow to the reservoir is low. The same amount of water (350 kaf) is currently scheduled to be released to Lake Mead between June and September 2022, after the spring runoff occurs as part of a 7.48 maf annual release volume. The annual volume of water released from Glen Canyon Dam is unchanged by these adjustments. (Figure 4). However, an April 8, 2022 letter from the Secretary of Interior requesting the Basin States consider “potentially reducing Glen Canyon Dam releases to 7.0 maf this water year providing additional certainty regarding annual release volumes and tier determinations for the 2023 water year. Sections 6 and 7.D. of the 2007 Interim Guidelines authorized the potential reduction under current circumstances.”

Lake Powell’s spring elevation will increase approximately 3.5 feet with the 350 kaf operational adjustment and the September 2022 end of month elevation remains the same after the total annual release volume of 7.48 maf for water year 2022. (Figure 5)

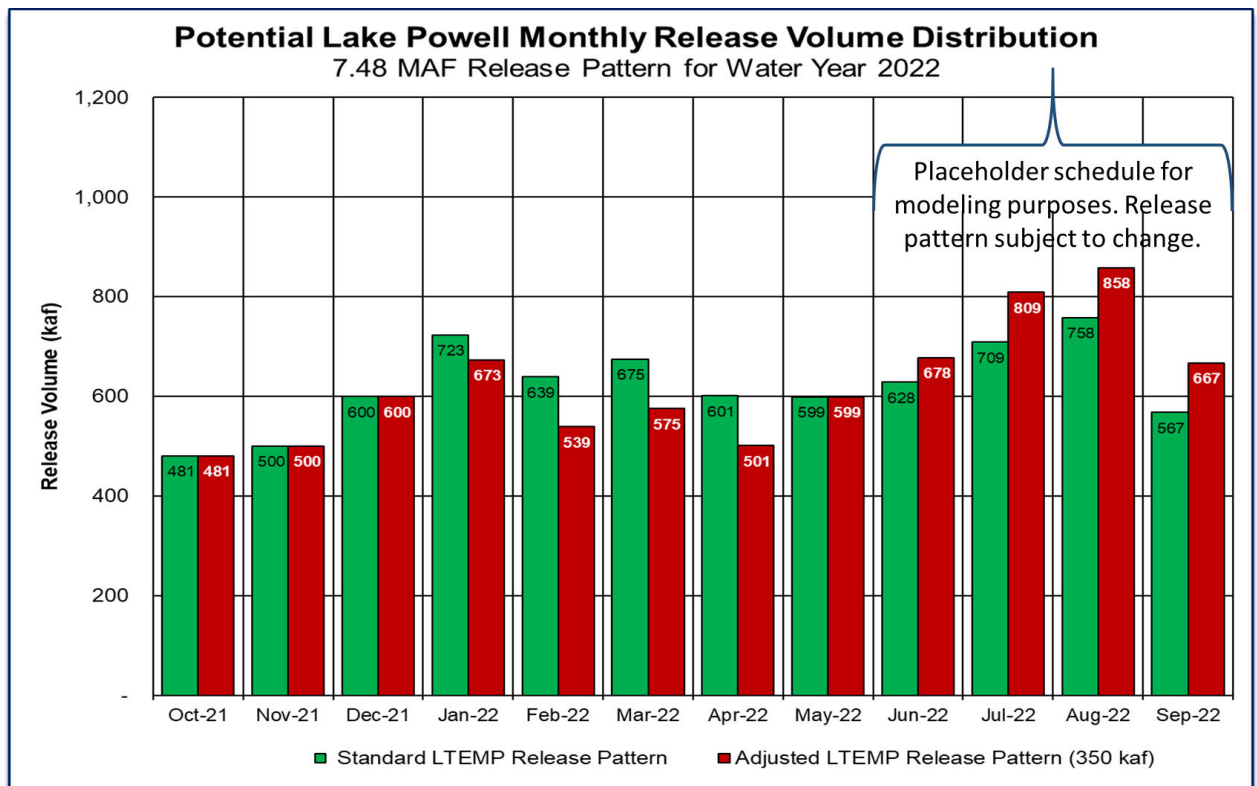


Figure 4. Lake Powell monthly release volume distribution for Water Year 2022 illustrating the standard LTEMP release pattern in green and the adjusted LTEMP release pattern holding back 350 thousand acre-feet (kaf) during January through April. The adjusted pattern during the months of June through September is for modeling purposes to

meet the operational requirements of releasing 7.48 million acre-feet (maf) under the Interim Guidelines Section 6.C.1. during Water Year 2022.

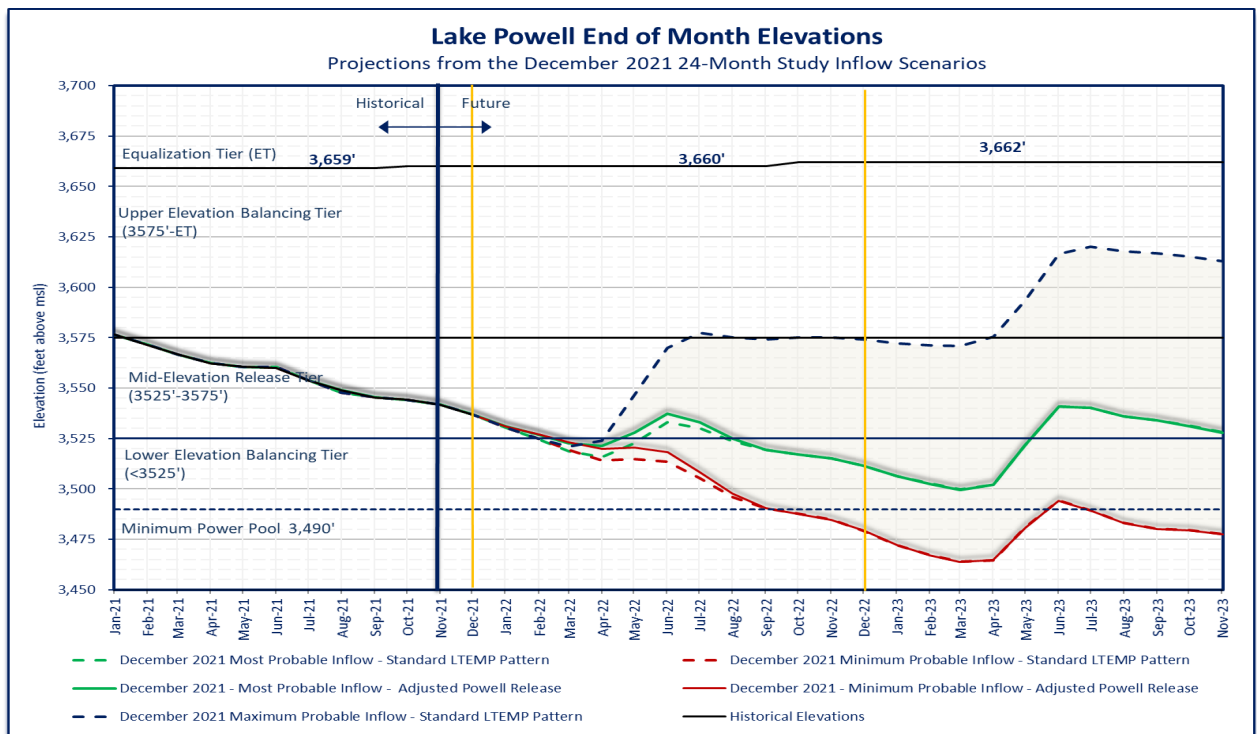


Figure 5. Lake Powell projected end of month elevations using the Minimum and Most Probable forecasts from the December 2021 24-Month Study to illustrate the increase in Powell Elevation from the adjusted LTEMP pattern holding back 350 thousand acre-feet (kaf) during January through April as compared against the standard LTEMP pattern. The Water Year 2022 release volume remains 7.48 million acre-feet (maf) for all scenarios and the September 2022 elevation converges.

The adjusted monthly release patterns during the January through April 2022 period for Glen Canyon Dam were discussed during the Glen Canyon Dam operational coordination meeting pursuant to LTEMP ROD, Attachment B, § 1.1, and the analysis performed above was provided during the discussion. Further, the operational adjustments of monthly release patterns during the January through April 2022 period, as contemplated in DROA, were discussed during the Glen Canyon Dam Adaptive Management Work Group hydrology and operations discussion held in January 2022.

#### b. Drought Response Operations (May 2022-April 2023)

Glen Canyon Dam operational adjustments during spring 2023 will be evaluated pursuant to 2022 Drought Response Operations Plan Section 5.2.2, Lake Powell Monthly Operations Adjustments. These operational adjustments will be based on projections of the Target Elevations at Lake Powell during winter and spring 2023 and may look similar to the adjustments seen during winter and spring 2022.

## 5. Contracts

Existing water supply contracts and agreements at Glen Canyon Dam are described below. Any future contracts which become executed will be described here. Water supply contracts and agreements are not impaired by monthly release volumes.

- i. City of Page: 2,740 af/yr.
- ii. Navajo Nation – LeChee Chapter (expires 12/23/2049): 950 af/yr.
- iii. Salt River Project (expires 12/22/2024): 1,500 af/yr.

## 6. Coordination regarding Glen Canyon operations

LTEMP Attachment B, Section 1.3 resource impacts were analyzed and specifically discussed for water delivery, sediment, hydropower production and WAPA's assessment of the Basin Fund, and Tribal concerns.

## Attachment C

### 2022 Drought Response Operations Plan

#### Operations at Flaming Gorge

##### 1. Flaming Gorge Operations Without Drought Response

Flaming Gorge is operated for authorized purposes, including water storage, contract releases, power production, recreation, and environmental conditions downstream of the reservoir for endangered fish recovery pursuant to the 2005 Biological Opinion and 2006 Flaming Gorge Record of Decision (FG ROD). Operating criteria have been developed to produce the necessary environmental parameters under a variety of hydrologic conditions<sup>3</sup>.

The allowable range of Flaming Gorge operations is a function of the period of the year, hydrologic conditions, and ongoing or planned studies related to adaptive management in support of the endangered fish recovery program. Current operations at Flaming Gorge reflect ongoing experimentation that has been coordinated by and through the Flaming Gorge Technical Working Group and with the Flaming Gorge Working Group stakeholders.

Flaming Gorge operations are established in the spring based on forecasted runoff for the upcoming 12 months. The year is broken into three periods: Spring, Base Flow, and Transition.

The Flaming Gorge Annual Operation Plan (FG AOP) describes specific annual operations and releases made within the flexibility of the 2006 FG ROD. Specific operations for the Spring Period are established in the FG AOP for each given year and its timing varies depending on yearly hydrology. The Base Flow Period follows the Spring Period and typically constitutes flows from mid-July through the end of February. The Transition Period runs from March 1st through the beginning of the Spring Period or peak release. The FG AOP may be amended. Details of potential flows during each of the periods can be found in the FG AOP.

The Spring Period marks the beginning of the Annual Operation Plan for Flaming Gorge. It is characterized by the timing of the Spring Runoff and typically includes the months of April – July. The timing of the spring runoff period varies depending on yearly hydrology of the basin and is established in the Annual Operation Plan. The Base Flow Period follows the Spring Period and typically constitutes flows from mid-July through the end of February. The Base Flow Period is further categorized by the Summer, Autumn, and

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<sup>3</sup> These criteria are found in several documents, including the Environmental Impact Statement, Record of Decision, Biological Opinion, and the FG AOP, among others.

Winter Base Flows which vary according to downstream targets (Muth et al, 2000) established in approved study plans and are dependent on Yampa River flows, and Flaming Gorge reservoir surface elevation. The Transition Period comprises releases from March 1<sup>st</sup> through mid-May.

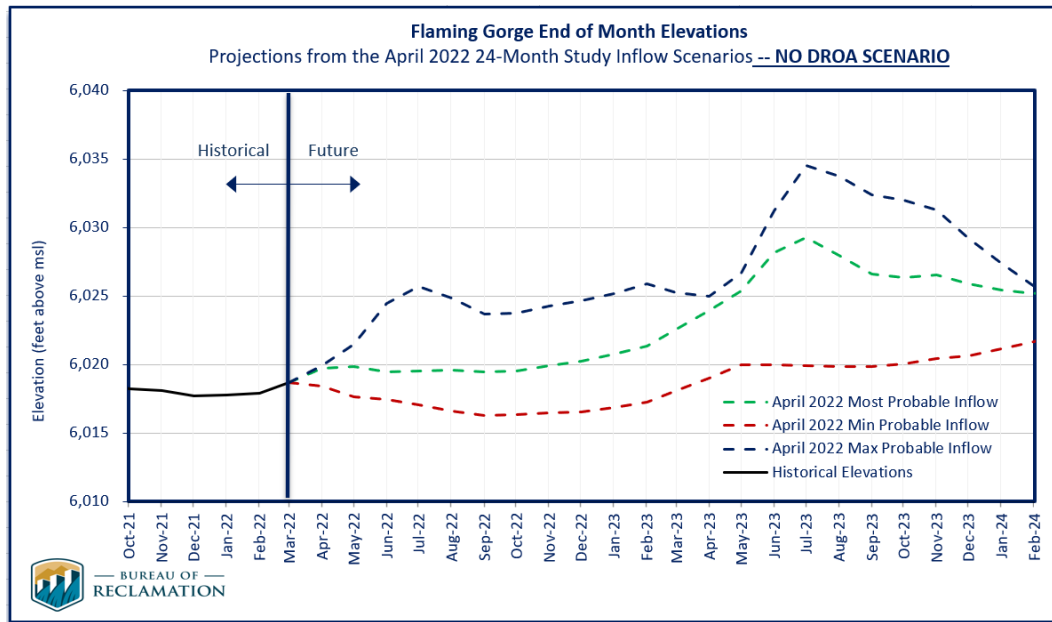
Paragraph II of the February 2006 Record of Decision for Operations of Flaming Gorge Dam Final EIS indicates Reclamation's "decision includes the potential for refinement of the flow and temperature recommendations if relevant new information gained through adaptive management supports that possibility." Current operations at Flaming Gorge reflect ongoing experimentation that has been coordinated with the Flaming Gorge Working Group stakeholders and vary from the flow recommendations included in the Final EIS (Table 2.1, Recommended Magnitudes and Duration of Maximum Spring Peak and Summer-to-Winter Base Flows and Temperatures for Endangered Fishes in the Green River Downstream from Flaming Gorge Dam as identified in the 2000 Flow and Temperature Recommendations).

## 2. Current Hydrology

Reclamation's April 2022 24-Month Study forecast for the April through July inflow into Flaming Gorge Reservoir is 0.520 million acre-feet, or 54 percent of average. The hydrologic classification for the Upper Green is moderately dry per the 2006 Flaming Gorge Record of Decision. Forecasted exceedance flow volumes from the Yampa River Basin were similar to projected exceedance flow volumes from the Upper Green River Basin and also fell into the moderately dry hydrologic condition. Depending upon Yampa River conditions, the flexibility in the Record of Decision allows for a change in hydrology classification; two higher and one lower than that designated by the forecasted unregulated inflow volume on May 1. Based upon the May 1 forecasted unregulated inflow and Yampa River conditions (based on the April 2022 24-Month Study forecast) the hydrologic classification is moderately dry.

Monthly 24-Month Study Reports present hydrological descriptions and projected operations for the Colorado River system reservoirs for the next two years. The 24-Month Study computer model projects future reservoir conditions and potential dam operations for the system reservoirs given existing reservoir conditions; inflow forecasts and projections; and a variety of operational policies and guidelines. Monthly reservoir inflow forecasts and projections are produced by the National Weather Service, Colorado Basin River Forecast Center. The following 24-month study reservoir elevations plot show projections for the April 2022 24-Month Study inflow scenarios without Drought Response Operations.

More information on 24-month studies can be found on the Upper Colorado Basin Operations website here: <https://www.usbr.gov/uc/water/crsp/studies/index.html>.



### 3. Flaming Gorge Operations without Drought Response during the 2022 Drought Response Operations Plan Year

Flaming Gorge operations without Drought Response Operations was developed through the established process for the Flaming Gorge Annual Operation Plan for the 2022 DROA Plan May 2022 through April 2023 timeframe.

The Flaming Gorge Annual Operation Plan outlines the Upper Colorado River Endangered Fish Recovery Program (Recovery Program) flow request, which includes three scenarios, one equal to or less than 30 percent exceedance, one between 30 and 50 percent exceedance, and one above 50 percent exceedance. The most likely scenario, a moderately dry scenario, includes Spring releases consistent with Larval Trigger Study Plan (LTSP), a smallmouth bass (SMB) flow spike, and Colorado pikeminnow (CPM) proposed flows within the confines of the 2000 Flow and Temperature Recommendations (Summer Base Flow Period). The Flaming Gorge Annual Operation Plan includes dry, moderately dry, average (below and above median), and moderately wet scenarios for the spring peak flows, summer-autumn base flows, and winter base flow periods. The summer-autumn and winter base flow periods follow the 2000 Flow and Temperature Recommendations.

Before Spring Peak Releases (May) – Prior to the spring peak releases, releases will be maintained at 850 cfs.

Spring Peak Releases -- During the spring peak flow period, a LTSP release will be optimized to achieve a flow greater than 8,300 cfs in Reach 2 for 7 or more days after the larval razorback sucker have been detected. The mean calendar date of the first capture of razorback sucker larvae (i.e., the "larval trigger") is May 28 and ranges from May 7 to

June 24. Historically, 50% of first captures occurred between May 21 and June 2; 75% occurred between May 16 and June 4. Following the LTSP releases will be ramped-down to 850 cfs until the SMB flow spike.

Smallmouth Bass Flow Spike --Following the post-LTSP period, the SMB flow spike will occur. This flow spike will consist of a ramp-up to full power plant capacity (about 4,600 cfs) in one day, an experimental flow of 72-hours' duration maintained at full power plant capacity, and a down-ramp at 2,000 cfs per day, to a release rate of 850 cfs. The SMB flow spike is predicted to occur between mid-June and early July 2022.

Base Flow Period -- During the base flow period (early-mid July 2022 – Feb 28, 2023), releases from the dam will be 850 cfs with Reach 2 targets in the lower Muth et al. moderately dry range of 1,100-1,500 cfs. This may include being within the +/-40% and +25% respective Reach 2 ranges.

Transition Period (March 2023 through middle to late May 2023) -- The end of the operational period will occur between March 1 to April 30, 2023. During this transition period, average releases are increased or decreased to achieve the Upper Limit Drawdown (EIS Table 2-3, see below). Under normal operations during the transition period, releases would be limited to a range from 800 cfs to powerplant capacity (4,600 cfs). Under current projections, the anticipated release is 850 cfs.

#### 4. Flaming Gorge Operations with Drought Response during the 2022 Drought Response Operations Plan Year

Potential Drought Response Operations were also developed through the established process for the Flaming Gorge Annual Operation Plan, but for the 2022 DROA Plan May 2022 through April 2023 timeframe. Potential Drought Response Operations were considered by the Flaming Gorge Technical Working Group and were included in the group's flow proposal. Drought Response Operations were also considered and reviewed by the Flaming Gorge Working Group. Generally, the magnitude and duration of Drought Response Operations will depend in part on the Yampa River contributions for Reach 2 targets.

The acceptable range of flows meeting required environmental conditions downstream of the dam for each hydrologic condition are included in Appendix 1 to this Attachment.

After consideration of potential Drought Response Operations release scenarios by the Flaming Gorge Technical Working Group and the Flaming Gorge Working Group, the DROA Parties propose that the volume of Drought Response Operations release under current conditions be 500,000 acft.

Drought Response Operations will be performed within the operating range for the year's hydrologic condition classification. Monthly operations during Spring releases may be modified by changing the hydrologic classification up two levels, or down one level, or



during base flow operations the hydrologic classification may be changed up one level, or down one level. Drought Response Operations must remain within the range prescribed in the tables for the corresponding hydrologic conditions within the authorized flexibilities.

Before Spring Peak Releases (May) -- During the transition period and before the LTSP spring flow peak, releases will closely match unregulated inflow.

Spring Peak Releases -- The spring peak flow period includes a LTSP scenario for dry, moderately dry, and average below/above median hydrologic condition, which will be sustained for multiple days until targets are no longer obtainable. Bypass tubes will be used for 7 days with a ramp-down rate of 2000 cfs/day. Following the LTSP period, releases will be ramped-down to 850 cfs until the SMB flow spike.

Smallmouth Bass Flow Spike -- Following the post-LTSP period, the SMB flow spike will occur. This flow spike will consist of a ramp-up to full power plant capacity (about 4,600 cfs) in one day, an experimental flow of 72-hours' duration maintained at full power plant capacity, and a down-ramp at 2,000 cfs per day, to a release rate of 850 cfs. The SMB flow spike is predicted to occur between mid-June and early July 2022.

Base Flow Period (early-mid July 2022 – Feb 28, 2023) -- The requested CPM base flow is an approved experimental study plan and will be fully implemented. The CPM base flow is an approved experimental study plan and can be fully implemented. CPM base flows occur in early through late summer. CPM base flow rates and autumn – winter base flow rates will be derived from the spring LTSP spring release target as described in Table 1. below. The CPM early summer Reach 2 targets will be in the lower range and the later summer spring Reach 2 target will be in CPM higher range. Finally, the autumn and winter releases can also achieve the higher range of the associated CPM range.

Table 1. Corresponding Drought Response Operations, LTSP, and CPM Releases

LTSP Reach 2 targets	CPM early summer Reach 2	CPM late summer Reach 2	Autumn – Winter Base Flow Reach 2
8,300 cfs <sup>1</sup>	~1,700 cfs	~1,800 cfs	~1,800 cfs
14,000 cfs <4 days	~2,100 cfs	~2,400 cfs	~2,400 cfs
14,000 cfs > 4 days	~2,200 cfs	~2,500 cfs	~2,500 cfs
18,600 cfs <7 days	~2,300 cfs	~2,600 cfs	~2,600 cfs
18,600 cfs >7 days	~2,300 cfs	~2,600 cfs	~2,600 cfs
18,600 cfs >10 days	<2,500 cfs	<2,600 cfs	<2,600 cfs
20,300 < 7 days	<2,200 cfs	<2,400 cfs	<2,800 cfs
20,300 >7 days	<2,200 cfs	<2,800 cfs	<2,800 cfs
20,300 > 10 days	<2,200 cfs	<2,800 cfs	<2,800 cfs

Transition Period (March 2023 through middle to late May 2023) – The transition period releases will average 1,410 cfs.

Table 2. Difference between Flaming Gorge Operations without Drought Response Operations and with Drought Response Operations.

Operation Period	Flaming Gorge Operation Without DRO	Flaming Gorge Operation With DRO*
Spring Peak LTSP Release– Release Volume (thousands of acre-feet or kaf) / Peak Release Rate (cfs) and Duration (days)	89 kaf / 4600 cfs 7 days	170 kaf / 8600 cfs 7 days
June inc. SMB Release Volume (kaf) / Peak Release Rate (cfs) / Duration (days)	102 kaf / 4600 cfs 3 days	145 kaf / 4600 cfs 3 days
Base Flow Release Volume (kaf) / Average Release Rate (cfs) / Duration (July through February) (days)	410 kaf / 850 cfs	723 kaf / 1500 cfs
Transition Period Release Volume (kaf) / Average Release Rate (cfs) / Duration (March through April) (days)	103 kaf / 850 cfs	166 kaf / 1410 cfs
<b>TOTAL Release Volume</b>	<b>704 kaf</b>	<b>1204 kaf</b>

*\*Release volumes dependent on Yampa River flows to achieve Reach 2 targets.*

Table 3. End of Month Elevation, Flaming Gorge Operations without Drought Response Operations and with Drought Response Operations.

	Flaming Gorge Elevation Without DRO	Flaming Gorge Elevation With DRO
May-22	6019.69	6017.23
Jun-22	6020.03	6015.53
Jul-22	6020.12	6015.10
Aug-22	6020.22	6013.69
Sep-22	6020.06	6012.07
Oct-22	6020.11	6010.94
Nov-22	6020.53	6010.28
Dec-22	6020.85	6009.44
Jan-23	6021.40	6008.73

Feb-23	6022.05	6008.22
Mar-23	6023.33	6008.32
Apr-23	6024.77	6009.33

## 5. Upper Limit Drawdown Level

In addition to the operating ranges identified in the tables in Appendix 1 to this Attachment, Flaming Gorge has a range of operating elevations that correspond to hydrologic conditions. The Upper Limit Drawdown Level is defined in the 2005 EIS, Table 2-3, provided here in Table 4, and was established to provide safe operation of the reservoir. Generally, to provide adequate flood storage space, Flaming Gorge must be drawn down to at least the elevations in Table 4 by May 1 of each year.

Table 4 –Upper Limit Drawdown Levels for Flaming Gorge Reservoir (2005 EIS Table 2.3)

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

## 6. Lower Drought Response Operations Limit

The lower Drought Response Operations limit is a function of hydrologic conditions and storage water demands necessary on May 1st. At Flaming Gorge, these demands are primarily releases made for the Recovery Program. Using the same unregulated inflow forecast percentage exceedance range used in Table 4, the DROA Parties will determine the minimum acceptable drawdown elevation levels to fulfill the 2006 Flaming Gorge Record of Decision requirements and water supply agreements.

## 7. Drought Response Recovery at Flaming Gorge

There is no Drought Response Recovery planned for Flaming Gorge during the 2022 DROA Plan year.

Future Drought Response Recovery at Flaming Gorge will be complete only when the first of either of the following occurs:

- a. The Flaming Gorge Account Balance as defined in Section 6 of the Framework has no balance; or
- b. Flaming Gorge elevation reaches the May 1 Upper Limit Drawdown Level. However, this Upper Limit Drawdown Level represents the maximum allowable elevation for dam safety purposes and operators have typically held a buffer from the maximum elevation as a prudent reservoir management measure. An evaluation of operations from 2006 to 2021 demonstrates the regular operating threshold is typically one-half foot below the May 1 Upper Limit Drawdown Level as shown in Table 5. When the targets in Table 5 are achieved, recovery will be complete.

Table 5 – Regular Operation Target Elevation (2005 EIS Table 2.3)

Unregulated Inflow Forecast Percentage Exceedance Range	Recovery May 1 Elevation Level
1 to 10	6023 (+/-0.5)
10.1 to 30	6024 (+/-0.5)
30.1 to 40	6025 (+/-0.5)
40.1 to 59.9	6027 (+/-0.5)
60.0 to 70	6027 (+/-0.5)
70.1 to 90	6026.75 (+/-0.75)
90.1 to 100	6026.5 (+/-1.0)

## 8. Contracts

Existing water supply contracts and agreements at Flaming Gorge are described below. Any future contracts which become executed will be described here. Water supply contracts and agreements are not impaired by any Drought Response Operations because the water under contract or agreement is considered unavailable under DROA.

- i. Daggett County (expires 3/6/2026): 1,000 af/yr

## 9. Coordination

The Recovery Program provided its flow request to Reclamation on February 23, 2022, regarding 2022 FG Operations and generally identified considerations with regard to potential Drought Response Operations at Flaming Gorge.

The Flaming Gorge Technical Work Group discussed Drought Response Operations during its March 2022 meetings. The discussions centered around the allowed flexibility of the proposed operation plan without Drought Response Operations. The Flaming Gorge Technical Work Group Proposal, which included experiments that supported Drought Response Operation release scenarios, was shared with the Flaming Gorge Working Group on March 15.

The Flaming Gorge Work Group met on March 17<sup>th</sup> and again on April 19<sup>th</sup>. Multiple Drought Response Operations scenarios were presented to and considered by the Work Group.

#### 10. Accounting

In 2021 during the months of July, August, September and October, additional releases were made based on a determination of imminent need by Reclamation as provided for in DROA II(A)(3)(j), which resulted in Flaming Gorge releasing a total of an additional 125,000 acre-feet.

A table accounting for these 2021 additional Flaming Gorge releases is included in Section 1.6.1.2 of Attachment A.

As Drought Release Operations will be occurring from Flaming Gorge under the 2022 DROA Plan, there is no Drought Response Recovery planned for Flaming Gorge during the year DROA Plan year.

## Attachment D

### 2022 Drought Response Operations Plan

#### Operations at the Aspinall Unit (Aspinall)

##### 1. Aspinall Operations Without Drought Response

Aspinall operates in accordance with multiple state-decreed water rights and agreements and pursuant to the 2012 Aspinall Record of Decision (Aspinall ROD).

At all times, Aspinall must meet Colorado water administration requirements as determined by the Division 4 Engineer, including the required amount of flow-through necessary to meet downstream water rights senior to Aspinall. Releases above the aforementioned flow-through requirements may be made for various purposes according to the water right decrees for the Aspinall Unit reservoirs and their power plants.

Releases above flow-through amounts necessary to meet downstream senior water rights may be made for other decreed purposes such as power generation at the Aspinall Unit reservoirs. Releases above that required for the aforementioned decreed purposes will not be considered as made pursuant to "Operations without Drought Response" as defined in 5.2.1, but would be calculated as "Drought Release Operations".

As the primary storage facility for the Aspinall Unit, Blue Mesa Reservoir is operated to store water during the spring runoff period. Reservoir elevations typically peak late in the spring runoff and then decline as releases are made to satisfy water administration requirements, to meet authorized purposes including power generation, for flood control, for downstream target flows pursuant to the 2012 Aspinall ROD and to meet the December 31 target elevation of 7,490 feet.

Downstream target flows pursuant to the Aspinall ROD are divided into spring peak and baseflow periods. These targets vary by hydrologic year type and are determined by May 1 forecasts of April through July inflow into Blue Mesa Reservoir as detailed in Figure 1.

Operations for spring peak flows are typically timed to match the spring peak from the North Fork of the Gunnison River. Releases during the baseflow period meet multiple purposes including power generation and baseflow targets and to draw the reservoir down to 7,490 feet by December 31 to prevent icing issues upstream of the reservoir. Flexibility exists during the baseflow period to increase releases pursuant to DROA.

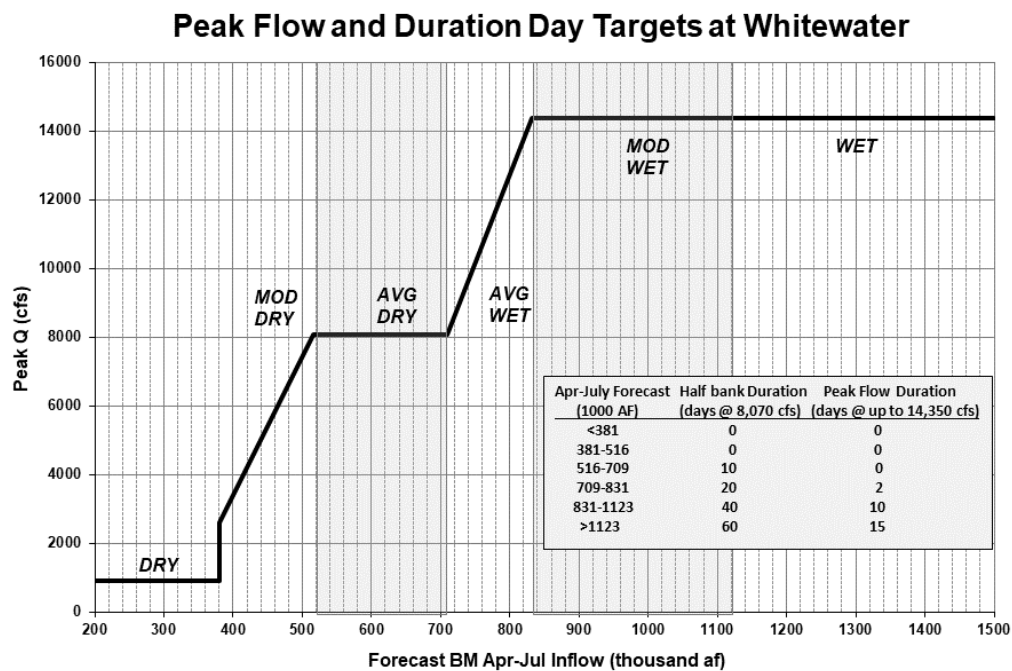
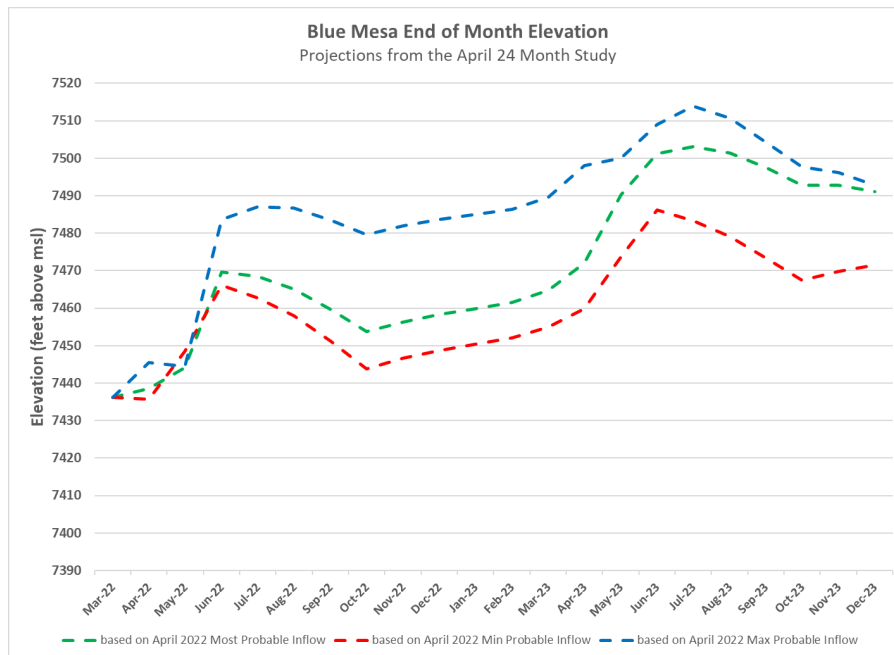


Figure 1.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<b>Wet</b>	1050	1050	1050	1050	1050	1500	1500	1500	1050	1050	1050	1050
<b>Mod Wet</b>	1050	1050	1050	1050	1050	1500	1500	1500	1050	1050	1050	1050
<b>Avg Wet</b>	1050	1050	1050	1050	1050	1500	1500	1050	1050	1050	1050	1050
<b>Avg Dry</b>	1050	1050	1050	1050	1050	1500	1500	1050	1050	1050	1050	1050
<b>Mod Dry*</b>	750	750	750/790	750/890	750/890	1050	1050	1050	750/890	750/790	750/790	750
<b>Dry*</b>	750	750	750/790	750/890	750/890	1050	1050	750/890	750/890	750/790	750/790	750

\*During March through November in Moderately Dry and Dry type years, additional releases will be made as necessary to provide flows above the 750 cfs anticipated to be diverted by the Redlands Water and Power Company, for the fish ladder and fish screen as shown.

## 2. Current Hydrology

The total live capacity at Blue Mesa Reservoir is 828,000 acre-feet. The active capacity at Blue Mesa Reservoir is above elevation 7393 ft, and totals 748,000 acre-feet. Below the elevation of 7393 ft, no releases through the power plant can be made.

As of April 11, 2022, Blue Mesa Reservoir is at 7436.9 ft of elevation, with 243,000 acre-feet of live storage (29% of live capacity) and 163,000 acre-feet of active storage (22% of active capacity). The active content, less various commitments described further below, determines water available for a potential Drought Response Operations Release. The current reservoir elevation and storage on this date is the second lowest on record since the reservoir first filled in 1970.

The April unregulated inflow forecast for Blue Mesa Reservoir in water year 2022 ranges from a minimum probable of 654,000 acre-feet (74 percent of average) to a maximum probable of 994,000 acre-feet (108 percent of average) with the most probable forecast for water year 2022 of 755,000 acre-feet (84 percent of average). There is a 10 percent chance that inflows could be higher than the current maximum probable forecast and a 10 percent chance that inflows could be lower than the minimum probable forecast.

Under the most probable unregulated inflow scenario, Blue Mesa Reservoir content is projected to peak at 429,000 acre-feet (elevation 7469 feet) and drop to a content of 365,000 acre-feet at the end of 2022 (elevation 7460 and 44 percent of live capacity). This corresponds to an active content of 285,000 acre-feet (38 percent of active capacity).

## 3. Aspinall Operations without Drought Response during Plan year

Under the most probable unregulated April-July inflow scenario, releases from Crystal Dam will be made to deliver water to the Gunnison Tunnel for diversion to the Uncompahgre Valley Water Users Association starting in late March and continuing through October 2022.



Releases to the extent necessary to maintain flows in the Black Canyon to meet the targets described in the Black Canyon Reserved Water Right Decree may occur from time to time. Based on the current forecast under the Black Canyon Reserved Water Right Decree, flows in the Black Canyon will be maintained above 300 cfs until a spring peak release is made in May or early June which will meet or exceed 2,660 cfs in the Gunnison River through the Black Canyon.

Releases from Crystal Dam will be made to help meet the Aspinall ROD (2012) spring peak and base flow targets in the Whitewater reach of the Gunnison River. Under the current forecast, the Aspinall ROD (2012) target for baseflows prior to the spring peak are 1,050 cfs in the Whitewater reach. The spring peak target is currently 8,070 cfs for a duration of 10 days in the Whitewater reach. Following the spring peak, baseflows in the Whitewater reach will be maintained above 1,500 cfs through July and then drop to 1,050 cfs for the remainder of 2022. These releases made to satisfy the Aspinall ROD (2012) result in Gunnison River flows that meet or exceed the flows described in the Black Canyon water rights decree.

#### 4. Aspinall Drought Response Operations

The available water for a potential Drought Response Operations Release is determined to be the active content of Blue Mesa Reservoir excluding the volume of Taylor Park water stored within Blue Mesa Reservoir (see below for explanation of the Taylor Park Exchange Agreement) and excluding 1,300 acre-feet designated to contracts.

The calculation of available water for a Drought Response Operations Release can vary daily and will be directly affected by several factors including changes to inflow forecasts throughout spring 2022 and the determination of Black Canyon and Whitewater flow targets from the May 2022 forecasts. Therefore, the official volume available for any future potential Drought Response Operations Release will be calculated after May 2022 and regularly updated.

Based on the current conditions and inflow forecast and existing contractual and release obligations, no Drought Response Operations Release will occur in water year 2022. In early water year 2023, the DROA Parties will consider Drought Release Operations if hydrology improves.

##### a. Releases

No Drought Response Operations Release is contemplated for water year 2022. The volume of available DROA water will be re-evaluated at the beginning of water year 2023.

b. Recovery

Recovery options are hydrology/year type dependent. For years with longer duration targets (such as moderately wet), opportunities to reduce durations to recover water will be pursued. This would require consultation with and concurrence from the Upper Colorado River Endangered Fish Recovery Program (Recovery Program).

If Drought Response Operations Releases result in Blue Mesa Reservoir elevation being below the spillway elevation when it otherwise would have been at or above the spillway elevation, the reductions in spring releases based upon elevation limitations can be accounted as recovered water.

When operations without Drought Response would cause releases to drop Blue Mesa Reservoir elevation to the Dec 31 icing target, accounting would include that volumetric difference as recovered.

There are two elevation targets, which, if reached, will “recover” all prior Drought Response Operation releases:

- 7517.4 - 7519.4 feet (full reservoir)
- Dec. 31: 7490.0 feet (icing target)

5. Contracts

Existing water supply contracts and agreements at Aspinall are described below. Any future contracts which become executed will be described here. Water supply contracts and agreements are not impaired by any Drought Response Operations because the water under contract or agreement is considered unavailable under DROA.

**a. Contract Deliveries**

Aspinall currently has 1,300 acre-feet of water under contract for delivery downstream, or for augmentation of depletions upstream in any given year. Water under contract is not available for Drought Response Operations pursuant to DROA.

**b. Taylor Park Exchange Agreement**

The Taylor Park Reservoir Operation and Storage Exchange Agreement (1975) allows for the exchange of water stored in Taylor Park Reservoir and Aspinall (Blue Mesa Reservoir) to improve utilization and management of available water supplies under the water rights of the Uncompahgre Project and Blue Mesa Reservoir. The maximum amount of Taylor Park Reservoir exchange water that can be stored within Blue Mesa Reservoir at any time throughout the year is 106,230 acre-feet. The amount of Taylor Park Reservoir exchange water stored in Blue Mesa Reservoir is for diversion by the Uncompahgre Project at the Gunnison Tunnel and is determined

through accounting managed by the Colorado Division of Water Resources. This water is not available for release pursuant to DROA.

### **c. Subordination Agreement**

The Subordination Agreement, dated June 1, 2000, formalizes the commitment made by the United States during the planning of the Aspinall Unit to allow subordination of Aspinall Rights up to 60,000 acre-feet per year to in-basin water users so that Aspinall would not interfere with future water development in the Upper Gunnison River Basin. A decree entered in Case No. 03CW263 (October 10, 2006), Water Court, Water Division No. 4, for a plan for augmentation permitted the subordination of Aspinall Rights to augment existing and future water rights exercised for all decreed beneficial purposes within the Gunnison River Basin through any decreed structure or facility upstream of the Crystal Reservoir Dam. Accounting for the plan for augmentation is the responsibility of the State of Colorado Division Engineer's Office, Water Division No. 4. This water is not available for release pursuant to DROA.

## **6. Coordination**

Aspinall Unit stakeholder coordination meetings are held three times annually in January, April, and August. DROA plans will be presented for comment and feedback at these meetings to all interested parties. Additionally, Reclamation reaches out to stakeholders as needed for input and coordination on operations outside of regularly scheduled meetings.

## **7. Accounting**

In 2021 during the months of August, September and October, additional releases were made based on a determination of imminent need by Reclamation, as provided for in DROA II(A)(3)(j), which resulted in Aspinall releasing a total of an additional 36,000 acre-feet. A table accounting for these 2021 additional Aspinall releases is included in Section 1.6.1.2 of Attachment A. These additional releases were accounted for through elevated flows in the Whitewater Reach of the Gunnison River above the minimum flow rate required under the Aspinall ROD (2012). In August, the release volume from Crystal Reservoir was 100,000 acre-feet which was 17,000 acre-feet more than necessary to meet the Whitewater Reach base flow target. In September, the release volume for Crystal Reservoir was 96,000 acre-feet which was 16,000 acre-feet more than necessary to meet the Whitewater Reach base flow target. In October, the release volume from Crystal was 66,000 acre-feet which was 3,000 acre-feet more than necessary to meet the Whitewater Reach base flow target. Consequently, the total additional release volume in 2021 is computed to be 36,000 acre-feet.

The additional releases made in water year 2021 from the Aspinall Unit were computed to be 36,000 acre-feet. As of April 2022, no recovery for these releases has occurred and no recovery is anticipated in water year 2022.

## Attachment E

### 2022 Drought Response Operations Plan

#### Operations at Navajo Reservoir

##### 1. Navajo Reservoir Operations Without Drought Response

Navajo Reservoir Operations are guided by the Record of Decision (ROD) for Navajo Reservoir, Navajo Unit which implements the operating criteria contained in the Preferred Alternative of the 2006 Navajo Reservoir Operations Final Environmental Impact Statement (FSEIS).

The U.S. Fish and Wildlife Service transmitted to the U.S. Bureau of Reclamation (Reclamation) the Final Biological Opinion for Navajo Reservoir Operations on January 5, 2006, which outlined the intent for Reclamation through the proposed operations in the preferred alternative to mimic the San Juan River's natural hydrograph downstream from its confluence with the Animas River.

The ROD provides for potential refinement of the flow recommendations based on relevant new information that may be gained over time through an adaptive management process. The range of downstream releases specified in the Navajo Reservoir Operations ROD can vary from 250 to 5,000 cfs.

The Navajo Dam Operating Procedures for implementing the operating criteria are evaluated and revised as needed. The most recent operating procedures were adopted by the SJRIP and Reclamation in 2018. The Revised Operating Procedures document prescribe a year-round target baseflow in the San Juan of 500 to 1000 cfs in the critical habitat reach (from Farmington, NM to Lake Powell).

The flow recommendations recommend mimicry of a natural hydrograph in terms of flow magnitude, duration, and frequency during the spring runoff period. Duration and frequency minimums are specified in the Flow Recommendations document and are based on modeling of hydrology from 1928 to 1993. A spring peak release is considered every year to meet recommended flow targets in the critical habitat reach, based on water availability forecasts, projected contract water use, and releases to meet the target baseflow. A spring peak release calls for 5,000 cfs of water to be released continuously, over a period varying from 21 to 60 days.

The End of Water Year Storage Target (EWYST) is one of two target reservoir elevations on September 30th of each year. The lower EWYST, 6,050 ft, is used for the calculation of forecast available water for a spring peak release to benefit endangered fish and critical habitat. If there is not enough available water for a spring peak release or after the spring peak release occurs, then the EWYST changes to 6,063 ft for the calculation of Excess Water (Excess Water). If there is water in the reservoir above 6,063 ft, that water is considered Excess Water. If Excess Water is available in a given year, it could be released

based on a request from the SJRIP to meet a variety of goals of the SJRIP.

Spring Peak Releases and Excess Water are both examples of water which release is timed to benefit the goals of the SJRIP.

In case of severe drought with anticipated shortages to the Navajo Reservoir water users, the ROD allows for consideration of a temporary revision to the spring peak release criteria or lowering of baseflow targets in the critical habitat reach.

## 2. Current Hydrology

As of April 10, 2022, Navajo Reservoir is at 6,019.53 ft of elevation, or 862 kaf of live storage (52% of live capacity) and 236 kaf of active storage (23% of active capacity). The current reservoir elevation and storage on this date is the third lowest since water year 1991.

The April modified unregulated inflow forecast for Navajo Reservoir in water year 2022 ranges from a minimum probable of 455 thousand acre-feet (kaf) (50 percent of average to a maximum probable of 786 kaf (86 percent of average) with the most probable forecast for water year 2022 of 555 kaf (61 percent of average). There is a 10 percent chance that inflows could be higher than the current maximum probable forecast and a 10 percent chance that inflows could be lower than the minimum probable forecast.

## 3. Navajo Reservoir Operations without Drought Response during Plan year

Based on the April 2022 most probable forecast of 555 kaf modified unregulated inflow for water year 2022, the Colorado River Mid-term Modeling System 24-Month Study (24-Month Study) projects Navajo Reservoir elevation will end water year 2022 near 6021.6 feet with approximately 881 kaf in live storage (53 percent of live capacity), or 255 kaf in active storage (25 percent of active capacity). The total live capacity at Navajo Reservoir is 1,647,940 acre-feet. The active capacity at Navajo Reservoir is above elevation 5990 ft, and totals 1,021,910 acre-feet. Below the elevation of 5990 ft, contract deliveries can no longer be made.

Note that projections of elevation and storage for water year 2022 have considerable uncertainty at this point in the season. Projections of end of water year 2022 Navajo elevations using the April 2022 24-Month Study Minimum Probable (drier hydrology) and Maximum Probable (wetter hydrology) inflow forecasts are 6,004.8 feet (45 percent of live capacity, 11 percent of active capacity) and 6,040.3 feet (65 percent of live capacity, 43 percent of active capacity), respectively (Figure 1). Under these scenarios, there is a 10 percent chance that inflows will be higher, resulting in higher elevation, and 10 percent chance that inflows will be lower, resulting in lower elevation.

Based on the current storage and the April 2022 inflow forecast, and pursuant to the ROD for the Navajo Unit, the available water calculated for water year 2022 is insufficient for a spring peak release as recommended by the SJRIP under all three forecasts. The release throughout water year 2022 will be the minimum required to maintain the minimum downstream target baseflow as specified in the ROD and is likely to range between 250 cfs and 1,000 cfs.

Based on the April 2022 most probable forecast of 899 kaf modified unregulated inflow for water year 2023, the Colorado River Mid-term Modeling System 24-Month Study (24-Month Study) projects Navajo Reservoir elevation will end water year 2023 near 6,047.5 feet with approximately 1,143 kaf in live storage (69 percent of live capacity), or 517 kaf in active storage (51 percent of active capacity). Note that projections of elevation and storage for water year 2023 have considerable uncertainty. Projections of end of water year 2023 Navajo elevations using the April 2022 24-Month Study Minimum Probable and February 2022 24-Month Study Maximum Probable inflow forecast results model runs are 6,004.8 feet (45 percent of live capacity, 11 percent of active capacity) and 6,048.7 feet (70 percent of live capacity, 52 percent of active capacity), respectively (Figure 1). Under these scenarios, there is a 25 percent chance that inflows will be higher, resulting in the higher elevation and/or releases, and 25 percent chance that inflows will be lower, resulting in lower elevation and/or releases.

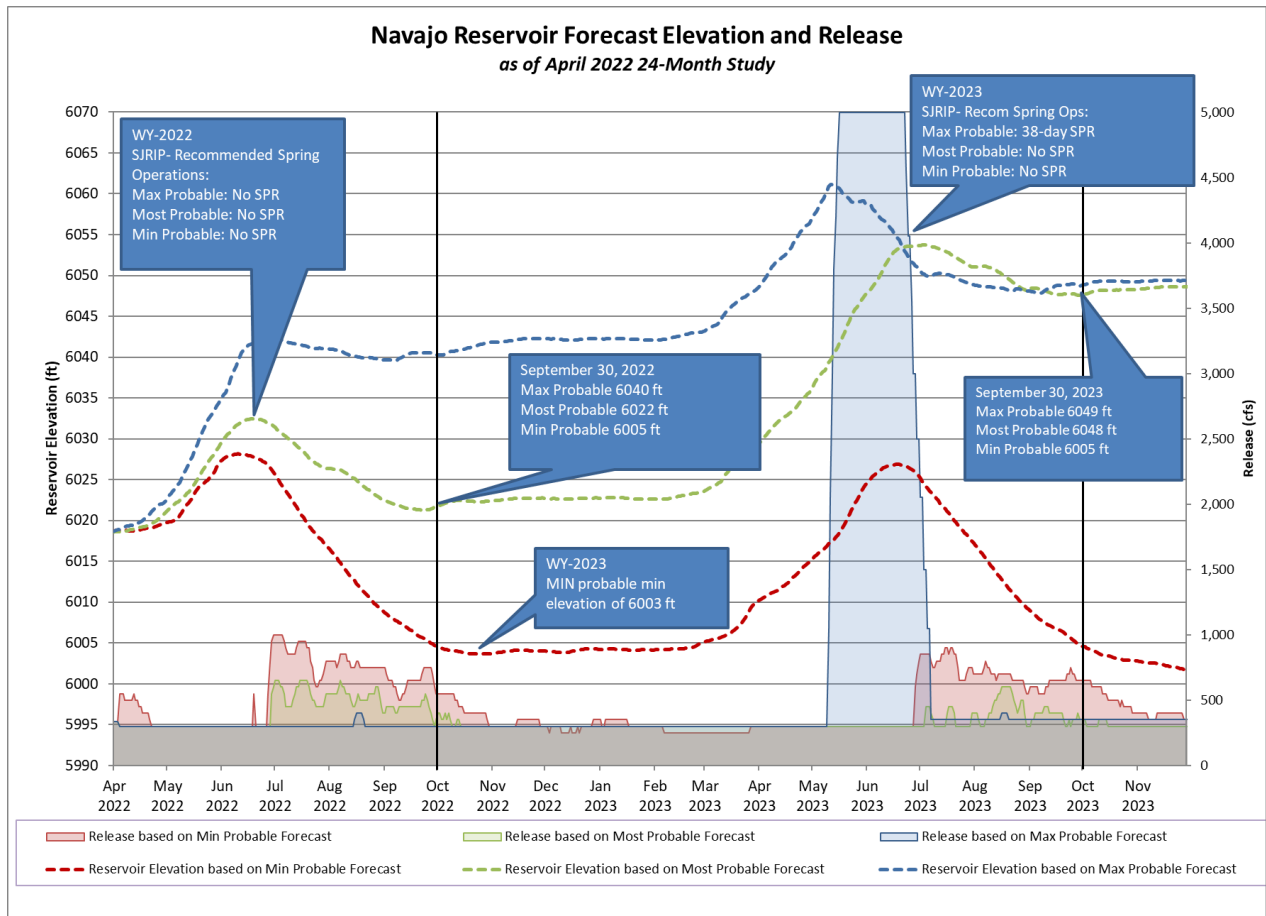


Figure 1.

#### 4. Navajo Reservoir Drought Response Operations

Based on probabilistic modeling using the operational model used for the San Juan portion of the 24-Month Study with the Ensemble Streamflow Prediction (ESP) traces, there is a 10% risk of shortage in water year 2023, based on 3 of 30 traces that fall into inactive storage under normal operations without DROA. Based on the current conditions and inflow forecast, existing contractual and release obligations, and the potential for the reservoir elevation to fall into the inactive pool without additional Drought Response Operations Releases, no Drought Response Operations Release is contemplated in water year 2022. In early water year 2023, the DROA Parties will consider Drought Response Operation Releases if hydrology improves.

##### a. Releases

No Drought Response Operations Release is contemplated for water year 2022. The volume of available DROA water will be re-evaluated at the beginning of water year 2023. If a release is to be made before May 1, 2023, it may be released as an augmentation of fall or winter baseflows, staying within the confines of the ROD. In the event of such a consideration, Reclamation will seek input from



tribes, contractors, SJRIP, and other stakeholders in formulating the schedule.

b. Recovery

No releases have been made from Navajo Reservoir to date pursuant to DROA. Therefore, no recovery is necessary as of April 1, 2022.

Operational Flexibilities for Drought Response Recovery

a. Recovery Tools Under the Navajo Reservoir Operations:

i. Recovery of the Cumulative Volume of the Drought Response Operation Release

Recovery of the total Drought Response Operations volume can occur in one operation, or over several operations with partial recovery. The following are examples of potential operations that result in recovery. All recovery scenarios are dependent upon hydrological conditions. Recovery would not occur under any of the described scenarios if below-average hydrology persists in future years. Any reduction in Operations without Drought Response may count towards recovery. It should be noted that some of these scenarios for recovery may have an impact on the volume, frequency and duration of releases as specified in the Revised Operating Procedures document.

The variables used in the equations for these scenarios are as follows:

$D_{tot}$  = Total Drought Response Operations volume released in prior release(s)

$D_o$  = Drought Response Operations volume recovered under any of these recovery scenarios. If  $D_o$  is less than or equal to zero, no Drought Response Operations volume is recovered.

$D_{rem}$  = Remaining Drought Response Operations Volume to be Recovered =  $D_{tot} - \sum D_{oi}$  ( $i=1..n$ , representing total number of events that have resulted in the recovery of Drought Response Operations releases). Once  $D_{rem}$  is reduced to zero, full recovery has occurred.

$S_{6063}$  = Storage volume at 6063 ft

$S_{6085}$  = Storage volume at 6085 ft (maximum active storage)

$S_{fcm}$  = Maximum flood control storage as defined by the USACE water control manual, based on forecast inflows and date.

$S$  = Observed storage

AW = Available Water = Projected available water volume for a spring peak release

SPR = minimum volume required to make a spring peak release

SPRING OPERATIONS: A spring peak release (Spring Peak) from Navajo Reservoir, as recommended and described by the SJRIP, will occur when, after accounting for forecast inflows, regular releases and contract uses, and evaporation, it is projected that there will be enough Available Water over the lower EWYST of 6050 ft to make a spring peak release for the recommended duration. There is opportunity for partial or full Drought Response Operations recovery under this scenario. The equation below illustrates how such recovery would be calculated.

$$Do = AW + Drem - SPR$$

FALL OPERATIONS: If the Excess Water is available, withholding some, or all of that Excess Water could result in partial or full Drought Response Operations recovery. If Excess Water is not available, there could still be a potential for partial recovery depending on the storage in the reservoir. The equation below illustrates how such recovery would be calculated.

$$Do = S + Drem - S6063$$

FLOOD CONTROL OPERATIONS: The US Army Corps of Engineers (USACE) defines variable flood control space to allow for forecast inflows without spilling during runoff season. This flood control space is based on the inflow forecast and day of the year. Partial or full Drought Response Operations recovery could occur if the difference between the maximum flood control storage volume and the actual storage is less than or equal to Drem. The equation below illustrates how such recovery would be calculated.

$$Do = S + Drem - S_{fcm}$$

Similarly, partial or full Drought Response Operations recovery could occur if the difference between the top of active storage and the actual storage is less than or equal to Drem.

$$Do = S + Drem - S6085$$

There are four elevation targets, which, if reached, will “recover” all prior Drought Response Operation releases. These elevation targets are also used in the previous section for incremental recovery by tracking volumes.

- September 30th: 6063 ft or higher

- September 30th: 6050 ft or higher – Recovery complete (only if a spring peak release was made that calendar year).
- January 1st – July 15th: If the reservoir elevation intersects the maximum flood control elevation allowed by the U.S. Army Corps of Engineers at any point in this timeframe.
- Jan 1st – Dec 31st: 6085 ft

## 5. Contracts

Existing water supply contracts and agreements at Navajo Reservoir are described below. Any future contracts which become executed will be described here. Water supply contracts and agreements are not impaired by any Drought Response Operations because the water under contract is considered unavailable under DROA.

Navajo Reservoir contracted water volumes listed below represent the full allocation of water contract:

- i. Williams Gas Processing (expires 3/31/28): 50 af/yr.
- ii. Navajo Nation Settlement Contract (no expiration): 508,000 af/yr for NIIP which includes 22,650 af/yr of diversion (20,780 af/yr of depletion) for the Navajo-Gallup Water Supply Project.
- iii. Jicarilla Apache Nation Settlement Contract (no expiration): not to exceed 33,500 af/yr diversion (25,500 af/yr of depletion) from the Navajo Reservoir Supply for use by the Nation or for subcontracting outside the reservation, in accordance with the Jicarilla Apache Tribe Water Rights Settlement Act of 1992.
- iv. Hammond Conservancy District Contract (no expiration): 23,000 af/yr of depletion.

Shortages to contracts at Navajo Reservoir will be handled according to the provisions of Public Law No. 87-483, as amended by Public Law No. 111-11.

## 6. Coordination

Navajo Unit stakeholder coordination meetings are held three times annually in January, April, and August. Operational plans are presented for comment and feedback at these meetings to all interested parties. Additionally, Reclamation reaches out to stakeholders as needed for input and coordination on operations outside of regularly scheduled meetings.

There is a formal process for coordination between Reclamation and the SJRIP on spring peak releases from Navajo Reservoir. Reclamation provides an available water calculation by April 1<sup>st</sup> to the SJRIP, and a recommendation for the size and shape of a spring peak release is made by mid-April. This process can also be used for any Drought Response Operation that may occur as a spring peak. Outside of the spring, direct coordination between Reclamation and the SJRIP is conducted through updates at Biology Committee and Coordination Committee meetings, which are scheduled regularly throughout the year. Additional meetings with the SJRIP will be conducted as needed with each Drought Response Operation from Navajo Reservoir.

#### 7. Accounting

No releases have been made from Navajo Reservoir to date pursuant to DROA. Therefore, no accounting or recovery has been necessary as of April 1, 2022.

Attachment F  
2022 Drought Response Operations Plan  
Natural Resources Consideration

*Overview of consideration of Natural Resource Conditions, as applicable:*

Lake Powell:

- Minimizing reservoir elevation drop to address considerations of non-native predators potentially passing through Glen Canyon Dam and the potential effects on listed species: The 2022 Plan is designed to raise the elevation of Lake Powell. Research regarding the effect of low reservoir elevations in Lake Powell is ongoing concerning the elevations where passthrough increases because the temperature zones suitable for non-natives are overlapping with the penstocks. Though this research is ongoing, higher elevations, particularly those at or above 3,525 ft., could potentially reduce the risk of warm-water predators passing through Glen Canyon Dam and provide cooler water temperatures below Glen Canyon Dam that are less suitable for spawning by such predators. These conditions could reduce the risk to the ESA-listed and other native fish below Glen Canyon Dam.
- Releasing most of the withheld winter volume as a spring peak flow in May or June: The determination of how any withheld volumes will be released from Glen Canyon Dam is ongoing. The Department of the Interior will work with the Adaptive Management Program to identify potential release options and assess their potential effects, including but not limited to experimental releases that could address predation by non-natives and sediment retention.
- Consideration of effects on sediment erosion and river temperature concerns related to warm water nonnative fish breeding: Effects of Drought Response Operations regarding Lake Powell releases on sediment erosion and river temperature will be considered by the Department of the Interior working with the Adaptive Management Program to identify potential release options and assess their potential effects.

Flaming Gorge:

- Razorback Sucker: Floodplain wetland habitats provide important ecological functions to benefit endangered fishes of the Green River if those habitats are hydrologically connected to the main channel at a frequency and duration to meet life history needs. Drought Response Releases to extend the duration or augment the magnitude of spring peak flows can benefit razorback sucker recruitment if the Drought Response Releases are scheduled according to the Larval Trigger Study Plan experiment. Drought Response Releases from Flaming Gorge Dam should occur after razorback sucker larvae first presence is documented in the Green River, based on real-time capture information. Augmenting the magnitude or duration of spring peak flows increases the likelihood of inundating floodplain wetland habitats and entraining larval razorback sucker into those nursery habitats. Floodplain wetlands are important nursery habitats for early life stages of the razorback sucker, and it is assumed that peak flows of sufficient magnitude, duration, and frequency that occur when larval suckers are drifting and can be entrained in wetlands also benefit other endangered fishes. Drought Response Releases

would augment spring peak flows to support endangered species by filling wetlands that otherwise may not have connected. Longer connections also provided by Drought Response Releases add more water to wetland systems, increasing their likelihood of maintaining water through the subsequent summer.

- **Colorado Pikeminnow:** Drought Response Releases to augment base flows in summer through autumn could benefit Colorado pikeminnow larvae and juveniles by assisting in larval transport from the spawning bar to nursery habitats, and by maintaining those habitats through summer. Years of moderate summer baseflows consistent with the ranges described in the Flaming Gorge Record of Decision tend to be years with higher abundance of Colorado pikeminnow. The Drought Response Releases, timed to create suitable habitat conditions prior to Colorado pikeminnow arrival from the Yampa River downstream into Green River nursery habitat, could enhance the survival of Colorado pikeminnow larvae. Suitable timing involves implementing baseflows up to one week prior to arrival of Colorado pikeminnow larvae. These types of releases could also increase and maintain backwater nursery habitats. Releases extended through the winter at the summer release volumes or less could extend the presence of the backwater nursery habitat through the fall and winter when the species may be vulnerable. Releases higher than summer through winter base flow ranges described in the Flaming Gorge Record of Decision may substantially reduce nursery habitats and displace small Colorado pikeminnow during a vulnerable time of year, which is why the U.S. Fish and Wildlife Service recommends Drought Response Releases remain in the suggested pikeminnow baseflow release targets after summer.
- **Smallmouth Bass:** Although a smallmouth bass flow spike is considered part of this year's baseline flow releases and is not part of the Drought Response Releases in 2022, Drought Response Releases can be used to implement the smallmouth bass flow spike experiment. This experiment is intended to reduce the reproductive success of this invasive, nonnative predator, which will benefit endangered fishes by reducing predation.
- **Channel complexity and vegetation:** Drought Response Releases to extend the duration or augment the magnitude of spring peak flows can help to maintain channel complexity and reduce vegetation encroachment; however, releases that augment base flows could have the opposite effect. The Drought Response Releases that include bypass flows in spring could support those channel maintenance functions, which may be especially valuable now due to multiple years of low-flow conditions. Multiple years of low-flow conditions may increase vegetation encroachment, a condition that may be stopped or reversed by higher spring peak flows as augmented by Drought Response Operations.
- **Consideration of experimental recommendations of the Upper Colorado River Endangered Fish Recovery Program:** Drought Response Releases in the form of a spring peak flow, a Smallmouth Bass flow spike, and summer base flows to benefit Colorado Pikeminnow will address all three experimental priorities from the Recovery Program's 2022 flow request letter, assuming dry to average hydrology. The currently proposed Drought Response Releases from Flaming Gorge attempt to meet these experimental requests and are within the range of flows recommended by the Recovery Program to benefit ESA-listed fish species. Applying Drought Response Release volumes to these experiments will increase the

likelihood of achieving individual experimental requests, as well as increasing the chances of implementing more experiments than otherwise might occur in a moderately dry flow scenario.

- Consideration of Drought Response Operations relative to recommended baseflows between December and March: Under currently projected hydrology, Drought Response Releases in winter (December through March) could be higher than base flow recommendations listed in Muth et al. (2000). Winter base flow releases proposed as part of Drought Response Releases are consistent with experimental base flow recommendations that are proposed to benefit Colorado Pikeminnow nursery habitat, and could maintain those habitats during the winter. Winter base flows higher than the experimental recommendations (scaled to hydrology) should be avoided, since higher flows in winter could “overtop” nursery backwaters with the main channel, create flow-through conditions and displace juvenile Colorado pikeminnow during a vulnerable life stage and critical time of year.

#### Aspinall:

- Effects of Drought Response Operations involving Blue Mesa will be described in potential modifications to the 2022 Drought Response Operations Plan, if applicable.

#### Navajo Reservoir:

- Effects of Drought Response Operations involving Navajo Reservoir will be described in potential modifications to the 2022 Drought Response Operations Plan, if applicable.

#### All Upstream Initial Units:

- Effects of future Drought Response Recovery: Though no Drought Response Recovery is proposed for the 2022 Plan, future Plans should consider recommendations concerning the effects of Drought Response Recovery on natural resource conditions.

Attachment G  
2022 Drought Response Operations Plan  
Impacts to the Basin Fund and Bulk Electrical System

*1. Overview of effects to the Basin Fund*

- a. Describe the estimated financial impacts to the Upper Colorado River Basin Fund (Basin Fund) if Drought Response Operations do not occur. This description will include the underlying operational assumptions and other factors upon which the estimate is based, for each Initial Unit.*

Assumptions:

- The CRSP powerplants are electrically integrated, so impacts described below are for the system of and for individual CRSP units.
- The firm rate assumed to be in place during this period is WAPA-199<sup>4</sup>, which largely shifts firming and replacement energy costs directly to power customers
- The scope of possible hydrological scenarios throughout this period consists of all the CRMMS traces modeled for January 2022.
- The Basin Fund balance is \$70 million and is anticipated to total \$83 million by the end of this fiscal year.
- Reclamation implements the proposed 2022 Drought Response Operations Plan from May 2022 to April 2023 and may consider further adjustments to the Plan if hydrological conditions worsen.
- In the analysis of the Basin Fund that follows, if Glen Canyon generation were to cease, CRSP transmission and merchant function revenues and operations expenditures would continue. Furthermore, revenue from capacity sales would continue, but revenue from energy sales will be substantially reduced.

Impacts to the Basin Fund without Drought Response Operations:

- The Basin Fund will maintain approximately current levels in all but the driest hydrological scenario, mostly due to the WAPA-199 rate construct.
- Power revenues to meet operations expenses come from CRSP capacity and energy sales. Revenue from capacity sales is independent of the CRSP energy

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<sup>4</sup> WAPA-199 was implemented in December 2021. WAPA-199 is a firm electric service rate for SLCA/IP federal electric power. Since the CRSP project makes up the major set of powerplants in the SLCA/IP, in this document, we will refer to the CRSP rate. Under the CRSP marketing plan and the under preceding CRSP firm rates, WAPA commits to firm electric service, contractually, and purchases firming energy from market sources in order to meet its contractual obligations. Because of the current drought affecting the Colorado River and projected high prices for firming electrical power in 2021 and 2022, WAPA, in consultation with its customers, developed and implemented WAPA-199. Under this new rate, sales are limited to the deliverable sales amount (DSA) that can be generated. WAPA will make firming purchases to meet the projected DSA amount. Customers must provide the difference between generation and contractual allocations. WAPA has added Western Replacement Firming (WRF) to the products it provides. WRF is a pass-through product where WAPA purchases the additional power where the Customer pay for the additional purchases in the current year in order to tie repayment to cost occurrence. This avoids negative impact on the Basin Fund. Under WAPA-199, customers have the option of reducing their delivery of CRSP power and avoid this expense. So far, under WAPA-199, customer have largely chosen to avoid the firming expense by taking only the amount of CRSP power projected to be available from the CRSP Initial Units.



generated and sold. Capacity revenue is approximately one half of total sales revenue.

- Under WAPA-199, Western Area Power Administration (WAPA) will have little to no firming expenses.
- The potential for experimental releases or other bypass flows exists at the Initial Units with or without Drought Response Operations. The Basin Fund may be required to fund experimental flows within the Plan year. This may reduce the Basin Fund balance by \$1 to \$3 million depending on the number and design of experiments.
- In a majority of hydrological scenarios, when Lake Powell elevations are above 3490 ft. and the Glen Canyon Powerplant is generating electrical power, WAPA expects that firming expenses through April 2023 will be small relative to recent years.
- If the driest hydrological scenario occurs, Lake Powell elevations could fall below 3490 ft. as early as October 2022.
  - If Glen Canyon generation is lost, while revenue from capacity sales would continue, sales revenue from energy will be substantially reduced.
  - WAPA estimates that revenue from the CRSP project will total \$155 million in FY 2023; \$92 million from capacity sales, \$30 million from transmission service and merchant sales and \$33 million from CRSP energy sales. If Lake Powell elevations fall below 3490 ft., then Glen Canyon generation, which is about 80% of total CRSP energy, would be lost. Therefore energy sales revenue without Glen Canyon generation is expected to fall to \$6.6 million (20% of \$33 million). Revenue from capacity, energy, and other sales is expected to fall to \$128.6 million (\$92 million in capacity sales + \$6.6 million in energy sales + \$30 million for other).
  - Assuming expenses would remain at \$170 million in FY 2023 or about \$14.2 million/month, revenue would total \$128.6 million or about \$10.7 million per month. The difference between revenue and expenses (\$3.5 million per month) would have to be withdrawn from the balance in the Basin Fund.
  - The Basin Fund is projected to be \$83 million at the beginning of FY 2023. If, to meet operations expenses, WAPA drew exclusively on the Basin Fund at the rate of \$3.5 million per month, the Basin fund would have an FY 2023 ending balance of \$41 million.
  - Absent additional actions, the Basin Fund would be depleted before the end of FY 2024.
  - At present, WAPA and Reclamation are developing a plan to reduce expenses, but most expenses are fixed and required for operation and maintenance.
  - It would be difficult, if not impossible, for WAPA and Reclamation to reduce expenses by \$42 million in FY 2023 in order to maintain a sustainable balance in the Basin Fund.

- b. Describe the estimated financial impacts to the Basin Fund if the proposed Drought Response Operations occur. This description will include the underlying operational assumptions and other factors upon which the estimate is based, for each Initial Unit.*

Impacts to the Basin Fund with Drought Response Operations:

- As described above, for this analysis, it is assumed Reclamation will implement the proposed 2022 Drought Response Operations Plan. If hydrological conditions worsen, Reclamation will increase Drought Response Operations Releases from upstream Initial Units, or take other necessary actions, over this time period to maintain elevation 3490 ft. at Lake Powell.
- Under WAPA-199, WAPA will have little to no firming expenses.
- A Drought Response Operation reduces the risk of negative impacts to the Basin Fund because it increases the possibility of maintaining the Lake Powell elevation at or above 3490 ft. This will result in the power customers continuing to receive hydropower energy. The projected revenues would be collected in the Basin Fund for WAPA and Reclamation expenses.
- The potential for experimental releases or other bypass flows exists at the Initial Units with or without Drought Response Operations. The Basin Fund may be required to fund experimental flows within the Plan year. This may reduce the Basin Fund balance by \$1 to \$3 million depending on the number and design of experiments.

2. Overview of effects to the Bulk Electrical System

- a. Describe the potential effects if Drought Response Operations do not occur. This description will include the underlying operational assumptions and other factors upon which the estimate is based, for each Initial Unit.*

Assumptions:

- WAPA's CRSP Management Center (CRSP MC) will remain with its current marketing structure throughout this time period.
- WAPA operates the WACM Balancing Authority (BA) with its Rocky Mountain Region and the CRSP MC participating. CRSP makes 40 MW available to this BA from the CRSP powerplants for regulation purposes. Regulation means keeping the electrical grid within tolerances (i.e. maintaining 60 Hz) in the BA geographic scope by modifying electrical output in response to changing in electrical supply and use.
- Glen Canyon Powerplant has a "black start and emergency shut down" contract with Arizona Public Service for the Palo Verde nuclear generating station, and Glen Canyon has "black start" responsibilities within the Western Electric Coordinating Council (WECC), (a Western US reliability council).
- The CRSP MC participates in emergency reserve sharing which requires that CRSP powerplants respond to electrical emergencies when they occur.

Impacts to the bulk electrical system without Drought Response Operations:

- Over the majority of hydrological conditions, WAPA is able to meet its BA, reliability, reserve pool and black-start conditions.
- However, some hydrological conditions result in the Lake Powell elevations that eliminate electrical production at the Glen Canyon powerplant. While there is no electrical production at Glen Canyon:
  - Glen Canyon black start obligations cannot be accomplished.
  - The loss of Glen Canyon generation would require power customers to utilize replacement resources, which would be limited during peak demand months.
  - BA regulation is accomplished by using the powerplants at Flaming Gorge and Aspinall, if these Initial Units are available.
  - Flaming Gorge and Aspinall may respond to reserve sharing emergencies where additional generation may be needed to stabilize the electric grid. However, responding to emergencies with these Initial Units would change these dams' water releases and could have environmental impacts.

*b. Describe the potential effects if Drought Response Operations occur. This description will include the underlying operational assumptions and other factors, including timing, upon which the estimate is based, for each Initial Unit.*

Assumptions:

- Over the time frame described, Reclamation implements the 2022 Drought Response Operations Plan.
- If hydrological conditions worsen, Reclamation will make adjustments to Drought Response Operations Releases from upstream Initial Units, or take other necessary actions, over this time period to maintain elevation 3490' at Lake Powell.

Impacts to Bulk Electrical System with Drought Response Operations:

- With Glen Canyon's powerplant in operation – even at low Lake Powell elevations, WAPA will be able to maintain its commitments to its BA and to the reliability of the bulk electrical system.
  - Glen Canyon black start obligations are maintained.
  - BA regulation is accomplished using +/- 20 MW at Glen Canyon Dam.
  - Electrical emergencies are responded to using Glen Canyon Dam.

3. *Overview of effects to the CRSP contracted power deliveries*

- a. *Describe the estimated effects to the Electrical Power Customers if Drought Response Operations do not occur. This description will include the underlying operational assumptions and other factors upon which the estimate is based, for each Initial Unit*

Assumptions:

- During the time frame described, firm electric service customers will receive WAPA's contractual delivery of available CRSP power and energy as forecasted by WAPA under Rate Order WAPA-199.

Impacts without Drought Response Operations:

- Under WAPA-199, firm electric service contract customers are voluntarily taking reductions of their contracted CRSP power and energy. Reductions have been up to one third of CRSP energy – compared to historic power deliveries by WAPA (pre WAPA-199). The reductions are greater in the winter months than in the summer months.
- These reductions in energy deliveries to customers will continue through the scheduled time frame of WAPA-199, which expires December 2023.
- Without Drought Response Operations, in cases where Lake Powell elevation falls below 3490', the loss of Glen Canyon power generation, which represents 75-80% of the CRSP resource, would result in a proportional decrease in electrical power deliveries of approximately 75-80%. Customers would have to replace lost generation with more expensive replacement power, especially in the peak months of July, August, December and January.

- b. *Describe the estimated effects to the Electrical Power Customers if the proposed Drought Response Operations occur. This description will include the underlying operational assumptions and other factors upon which the estimate is based, for each Initial Unit.*

Impacts with Drought Response Operations:

- Ensuring sufficient water elevation at Glen Canyon would allow customers to continue receiving energy deliveries and provide continued revenue to the Basin Fund. It allows customers to optimize the use of their capacity allocation to reduce their power costs.
- Power customers are working with WAPA to create a long-term solution for rate making purposes. Having some certainty in deliveries from Glen Canyon allows customers time to craft both replacement options and rate structures with WAPA.
- Power customers would continue to receive hydropower energy and resulting revenues would be collected in the Basin Fund for WAPA and Reclamation expenses.

Attachment H  
2022 Drought Response Operations Plan  
Consultation, Coordination, and Outreach

*1. Describe how Consultation, Coordination, and Outreach occurred for the Plan.*

- a. The Drought Response Operations draft Framework and Attachments were developed by the DROA Parties in accordance with DROA. Together, the Framework and Attachments form the 2022 Drought Response Operations Plan.

During the Fall of 2021, the DROA Parties began drafting the Framework document. During this time, they consulted, coordinated, and conducted outreach with Lower Division States, applicable Federal agencies, Tribes, and NGOs.

On January 28, 2022, a public webinar was held to outline the contents of the initial draft of the Drought Response Operations Framework and Attachments. Invitations were sent to a large number of individuals representing a variety of entities including Tribes, Federal agencies, States, stakeholders and other interested parties. A press release announcing the webinar was also published.

During this webinar, participants were provided a link to the draft documents and information on how to submit comments. Comments on the draft Framework and Attachments were to be received by February 17, 2022. A summary of the comments received after the webinar can be found at [DROA Plan Framework \(usbr.gov\)](https://www.usbr.gov/droa/plan/framework/). Approximately 770 comments were received in connection with the draft Framework. All comments received were taken into account.

Comments received generally addressed (1) the concern that DROA is not sufficient in the long-term to address the on-going drought and climate change, (2) the recommendation that the target elevation to protect at Lake Powell be higher than 3,525 for recreational purposes, and (3) concern over specifics about the consultation process.

Where appropriate, the 2022 Drought Response Operations Plan has been edited to address comments received. Many comments, however, address matters outside the scope of DROA. DROA does not have the ability to modify the authorities that control Initial Unit operations. As such, DROA cannot address the effects of the on-going drought and climate change on reservoir operations beyond what is already specifically included in the authorities that control Initial Unit operations. DROA utilizes the flexibilities in these authorities to maintain the Target Elevation or reduce the risk of falling below elevation 3,490 ft. at Lake Powell If dry conditions persist or worsen because of on-going drought, climate change, or other factors, available storage volumes at the Initial Units may be insufficient to maintain the Target Elevation at Lake Powell or eliminate the risk of Lake Powell falling below elevation 3,490 ft.

- b. The following describes the consultation, coordination, and outreach that occurred, as referenced in Section 7 of the Framework, for the development of the 2022 Drought Response Operations Plan, in addition to the January 28, 2022 public webinar described above.

i. Consultation with the Lower Division States

The DROA Parties consulted with Arizona, California and Nevada regarding the contents of the draft Framework and Attachments, and received comments from those States.

ii. Outreach to and Consultation with Native American Tribes

Since Fall 2021, Reclamation and the Tribes have participated in regular weekly meetings on the status of DROA efforts.

In addition, representatives from the Upper Division States conducted targeted outreach to the Tribes to keep them informed and receive input about the DROA process.

iii. Coordination within the Department of the Interior

Since Fall 2021, DOI agencies have held regular meetings on the status of DROA efforts.

iv. Coordination with WAPA

Since Fall 2021, Reclamation and WAPA have held regular meetings on the status of DROA efforts.

v. Coordination with Initial Unit Workgroups

Workgroups with special expertise regarding each Initial Unit met at various times throughout the development of the Framework and the Attachments to discuss issues specific to each Initial Unit. Description of specific coordination with each initial unit workgroup is contained in Attachments B through E, which provide information for each Initial Unit.

vi. Outreach to other stakeholders and interested entities

Other stakeholders and interested entities were invited to participate in the public webinar held on January 28, 2022. Approximately 200 individuals attended the webinar. Comments received following the webinar are described above.

1 Attachment C – Appendix 1

2 Estimated Normal<sup>5</sup>/Maximum<sup>6</sup>/Minimum<sup>7</sup> Summer-to-Winter Base Flows in the Green River Downstream from Flaming Gorge Dam, including  
3 the Transition Period and Annual Volume.<sup>8</sup>

Flow and Temperature Characteristics	Summer <sup>9</sup> <sup>10</sup>	Autumn (October – November) <sup>5</sup>	Winter (December – February) <sup>11</sup>	Transition Period <sup>12</sup>	May - April Volume <sup>13</sup>
Wet (0–10% Exceedance)	Reach 1 Normal 1990 cfs (1620-2380 cfs) <sup>14</sup> Max <sup>15</sup> 3550 cfs (3170-3920 cfs) <sup>16</sup> Min <sup>17</sup> 1600 cfs (1220-1980 cfs) <sup>18</sup> Reach 2 <sup>19</sup> 2560 <sup>20</sup> cfs (2170 – ≤ 4200 cfs) <sup>21</sup>	Reach 1 Normal 3090 cfs (2930-3260 cfs) Max 3300 cfs (3130-3470 cfs) Min 2130 cfs (1960-2290 cfs) Reach 2 3950 cfs (2990 - ≤ 4200 cfs)	Reach 1 Normal 3200 cfs (3120-3280 cfs) Max 3200 cfs (3120-3280 cfs) Min 2650 cfs (2570-2730 cfs) Reach 2 3740 cfs (3190 - ≤ 3750 cfs)	Reach 1 Normal 1650 cfs Max 4600 cfs Min 800 cfs	Reach 1 Normal 2390 KAF (2220 - 2810 KAF) Max 2630 KAF (2460 - 3050 KAF) Min 2290 KAF (2120 - 2710 KAF)
Moderately Wet (10–30% Exceedance)	Reach 1 Normal 2030 cfs (1840-2160 cfs) Max 3700 cfs (3510-3830 cfs)	Reach 1 Normal 2670 cfs (2420-2820 cfs) Max 3340 cfs (3090-3490 cfs)	Reach 1 Normal 3000 cfs (2820-3170 cfs) Max 3050 cfs (2870-3220 cfs)	Reach 1 Normal 1650 cfs Max 4600 cfs	Reach 1 Normal 2090 KAF (1910 - 2500 KAF) Max 2600 KAF (2410 - 3009 KAF)

<sup>5</sup> Normal denotes what would be expected in a non DROA scenario, i.e., a Most 24 Month Study scenario.

<sup>6</sup> Maximum denotes the maximum release per the ROD/FEIS.

<sup>7</sup> Minimum denotes the minimum release per the ROD/FEIS.

<sup>8</sup> Reclamation retains the authority to modify this table as needed and may change due to hydrologic conditions.

<sup>9</sup> Summer base flow is initiated dependent on Hydrologic Classification (HC), per Muth et al. Dry HC about June 15, Moderately Dry HC about July 1, Average HC about July 15, Moderately Wet HC about August 1, and Wet HC about August 15.

<sup>10</sup> A +/-40% of base flow period per Muth et al.

<sup>11</sup> A +/-25% of base flow period per Muth et al.

<sup>12</sup> Per FEIS, transition starts March 1 through mid to late May, there are no specific flow requirements specified in the Muth et al. Minimum and Maximum powerplant releases were used. To make consistent calculation, for the ‘normal’, 1650 cfs was used in each scenario due to high variability in the yearly forecast.

<sup>13</sup> Annual volumes with Spring Releases to achieve Muth et al. targets as well as other seasonal periods.

<sup>14</sup> Ranges within HC, because of both a wetter and dryer condition for the Yampa flows.

<sup>15</sup> Releases to achieve the upper +40% or +25% base flow range, pending seasonal base flow period, flow targets in Reach 2.

<sup>16</sup> Ranges to achieve the upper +40% or +25% base flow range, pending seasonal base flow period, flow targets in Reach 2, because of both a wetter and dryer condition for the Yampa flows.

<sup>17</sup> Releases to achieve the lower -40% or -25% base flow range, pending seasonal base flow period, flow targets in Reach 2.

<sup>18</sup> Ranges to achieve the lower -40% or -25%, pending seasonal base flow period, flow targets in Reach 2.

<sup>19</sup> Muth et al. base flow upper range in Reach 2 is 3000 cfs in Wet HC. Applying the +40% and the +25%, pending base flow season, the base flow range exceeds 3000 cfs in the Average to Wet HC in Reach 2. Consultation will occur with FWS.

<sup>20</sup> Reach 2 targeted flow under ‘normal’ conditions.

<sup>21</sup> Reach 2 +/- 40% or +/-25% base flow targets.

	Min 1700 cfs (1510-1830 cfs) Reach 2 2200 cfs (1930 – ≤ 3920 cfs)	Min 1630 cfs (1380-1780 cfs) Reach 2 3230 cfs (2190 - ≤ 3920 cfs)	Min 2150 cfs (1970-2320 cfs) Reach 2 3430 cfs (2580 - ≤ 3500 cfs)	Min 800 cfs	Min 1730 KAF (1550 - 2140 KAF)
Average (30-50% Exceedance)	Reach 1 Normal 1680 cfs (1360-1870 cfs) Max 3000 cfs (2680-3180 cfs) Min 1680 cfs (1360-1870 cfs) Reach 2 2030 cfs (2030 – ≤ 3360 cfs)	Reach 1 Normal 1280 cfs (1060-1400 cfs) Max 2780 cfs (2560-2890 cfs) Min 1170 cfs (950-1290 cfs) Reach 2 1830 cfs (1720 - ≤ 3360 cfs)	Reach 1 Normal 2150 cfs (2040-2260 cfs) Max 2550 cfs (2440-2660 cfs) Min 1800 cfs (1690-1910 cfs) Reach 2 2600 cfs (2250 - ≤ 3000 cfs)	Reach 1 Normal 1650 cfs Max 4600 cfs Min 800 cfs	Reach 1 Normal 1470 KAF (1260 - 1890 KAF) Max 2130 KAF (1930 - 2555 KAF) Min 1390 KAF (1190 - 1810 KAF)
Average (50–70% Exceedance)	Reach 1 Normal 1840 cfs (1710-1920 cfs) Max 3160 cfs (3040-3240 cfs) Min 1840 cfs (1710-1920 cfs) Reach 2 2030 cfs (2030 - ≤ 3360 cfs)	Reach 1 Normal 1520 cfs (1230-1710 cfs) Max 2890 cfs (2540-3070 cfs) Min 1350 cfs (1050-1530 cfs) Reach 2 1940 cfs (1760 - ≤ 3360 cfs)	Reach 1 Normal 2650 cfs (2590-2700 cfs) Max 2650 cfs (2590-2700 cfs) Min 2250 cfs (2190-2300 cfs) Reach 2 3000 cfs (2600 - ≤ 3000 cfs)	Reach 1 Normal 1650 cfs Max 4600 cfs Min 800 cfs	Reach 1 Normal 1470 KAF (1280 - 1870 KAF) Max 2190 KAF (2000 - 2600 KAF) Min 1370 KAF (1190 - 1780 KAF)
Moderately Dry (70–90% Exceedance)	Reach 1 Normal 1620 cfs (1470-1730 cfs) Max 1870 cfs (1720-1980 cfs) Min 1370 cfs (1220-1480 cfs) Reach 2 1820 cfs (1570 - ≤ 2100 cfs)	Reach 1 Normal 910 cfs (800-1100 cfs) Max 1640 cfs (1390-1820 cfs) Min 870 cfs (800-1060 cfs) Reach 2 1320 cfs (1280 - ≤ 2100 cfs)	Reach 1 Normal 850 cfs (800-950 cfs) Max 1480 cfs (1220-1580 cfs) Min 850 cfs (800-950 cfs) Reach 2 1220 cfs (1220-≤ 1875 cfs)	Reach 1 Normal 1650 cfs Min 800 cfs Max 4600 cfs	Reach 1 Normal 870 KAF (710 - 1290 KAF) Max 1560 KAF (1350 - 1978 KAF) Min 830 KAF (680 - 1240 KAF)
Dry (90–100% Exceedance)	Reach 1 Normal 800 cfs (800-890 cfs) Max 1420 cfs (800-1510 cfs) Min 800 cfs (800-890 cfs) Reach 2 930 cfs (930 - ≤ 1540 cfs)	Reach 1 Normal 800 cfs (800-900 cfs) Max 1150 cfs (800-1250 cfs) Min 800 cfs (800-900 cfs) Reach 2 1190 cfs (1190 - ≤ 1540 cfs)	Reach 1 Normal 800 cfs (800-1140 cfs) Max 1000 cfs (800-1070 cfs) Min 800 cfs (800-870 cfs) Reach 2 1180 cfs (1180-≤ 1375 cfs)	Reach 1 Normal 1650 cfs Min 800 cfs Max 4600 cfs	Reach 1 Normal 720 KAF (620 - 1160 KAF) Max 1340 KAF (1040 - 1739 KAF) Min 720 KAF (620 - 1110 KAF)