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# Glen Canyon Monthly Operations Call

## Basin Hydrology and Operations

June 23, 2021

# Background

This briefing is being provided consistent with the provision in Section 1.1 of the LTEMP ROD which states:

“Annually, Reclamation will develop a hydrograph based on the characteristics above. Reclamation will seek consensus on the annual hydrograph through monthly operational coordination calls with governmental entities, and regular meetings of the GCDAMP Technical Working Group (TWG) and AMWG.

Reclamation will conduct monthly Glen Canyon Dam operational coordination meetings or calls with the DOI bureaus (USGS, NPS, FWS, and BIA), WAPA, and representatives from the Basin States and UCRC. The purpose of these meetings or calls is for the participants to share and seek information on Glen Canyon Dam operations. One liaison from each Basin State and from the UCRC may participate in the monthly operational coordination meetings or calls.”

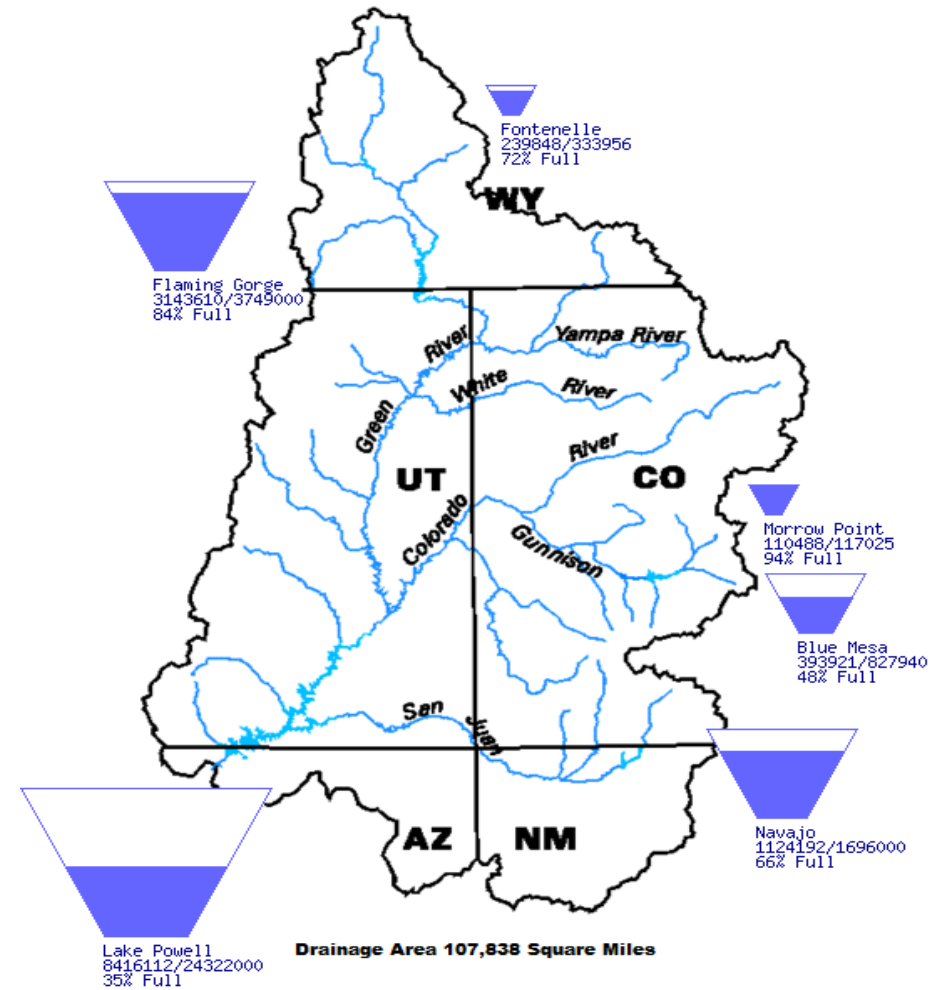


# Upper Basin Storage (as of June 22, 2021)

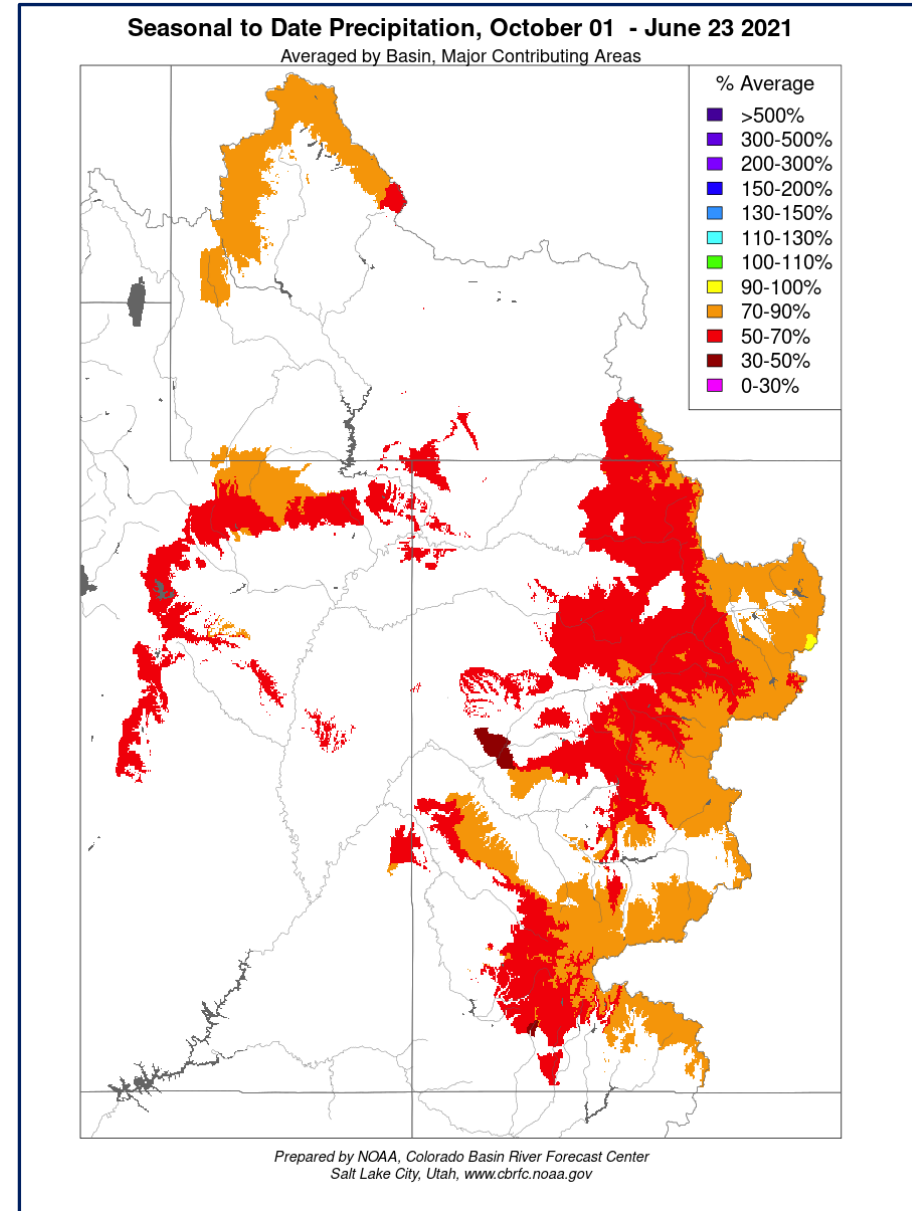
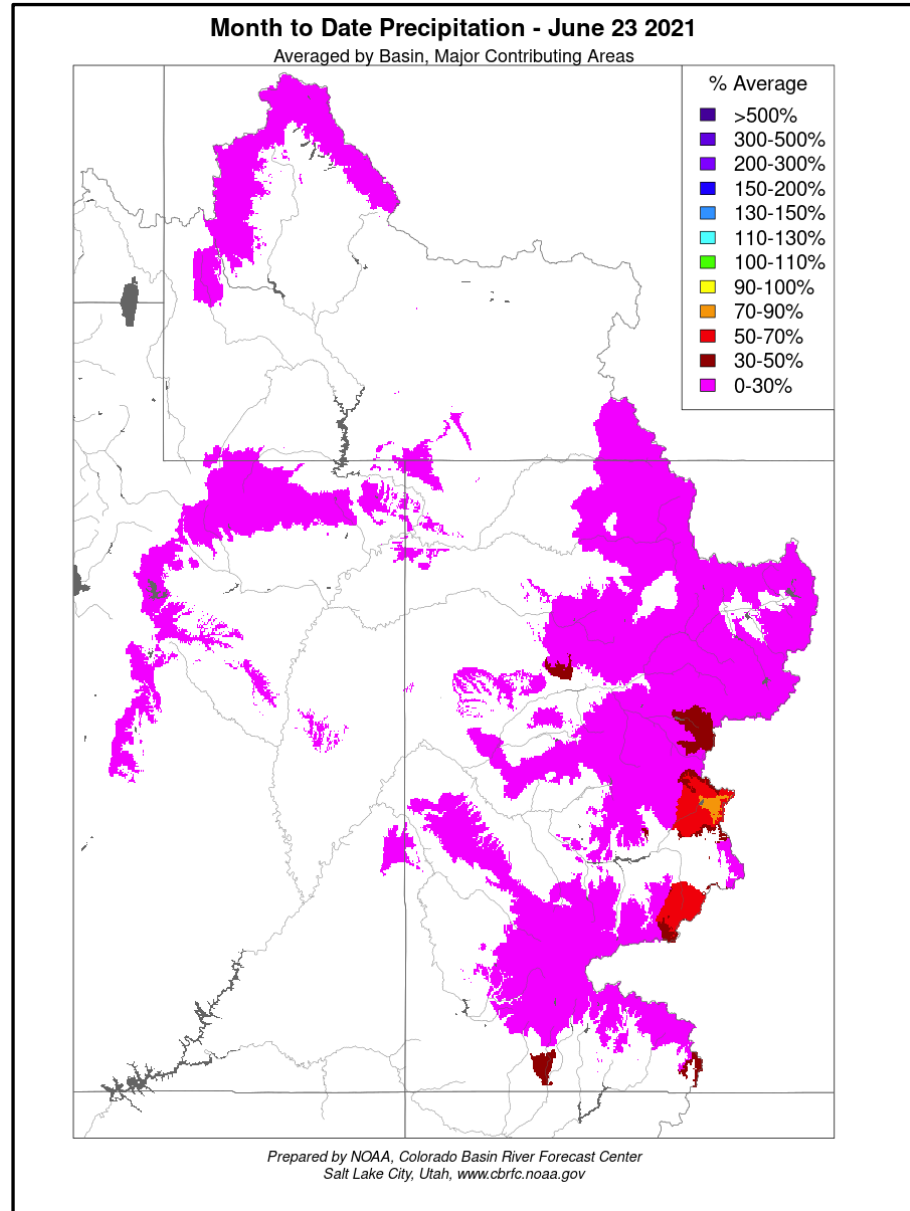
Data Current as of:  
06/22/2021

## Upper Colorado River Drainage Basin

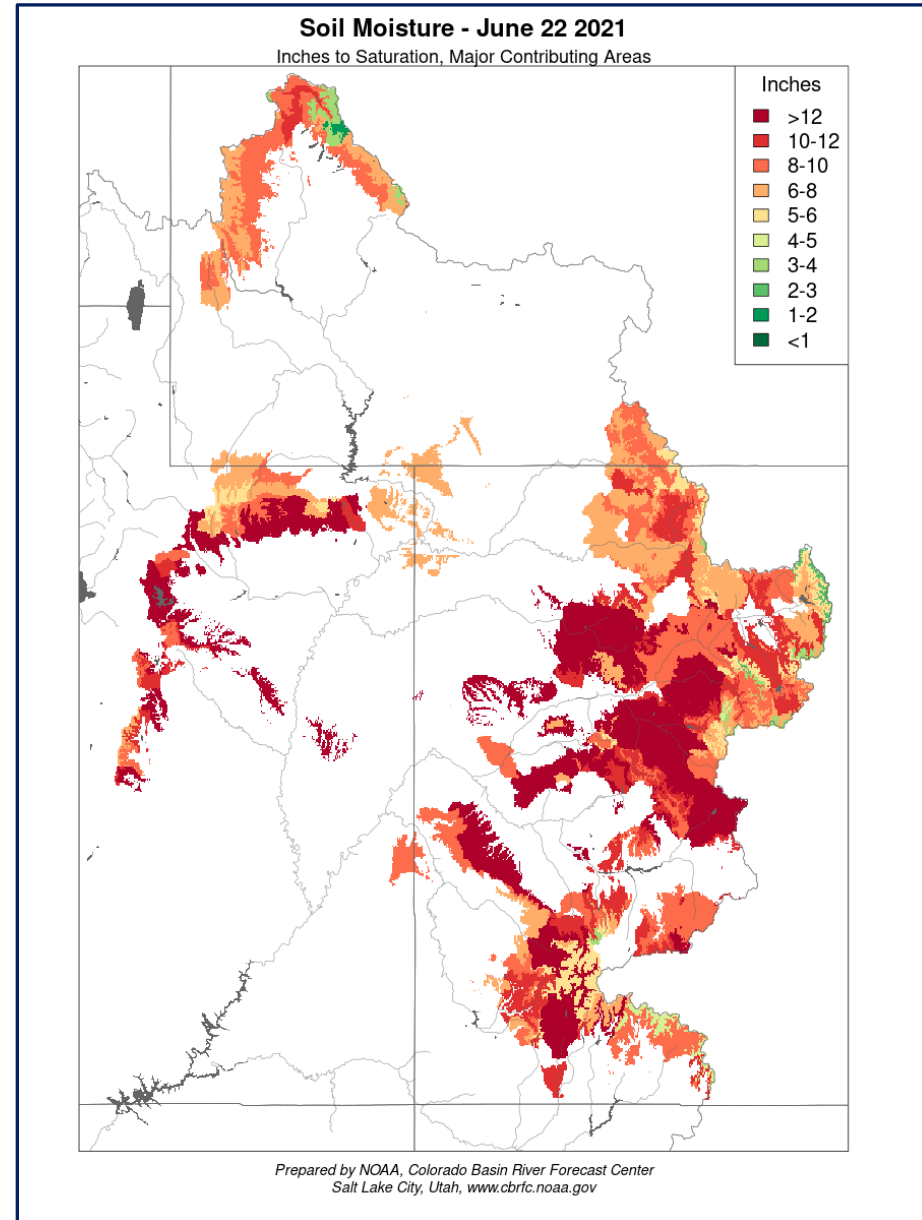
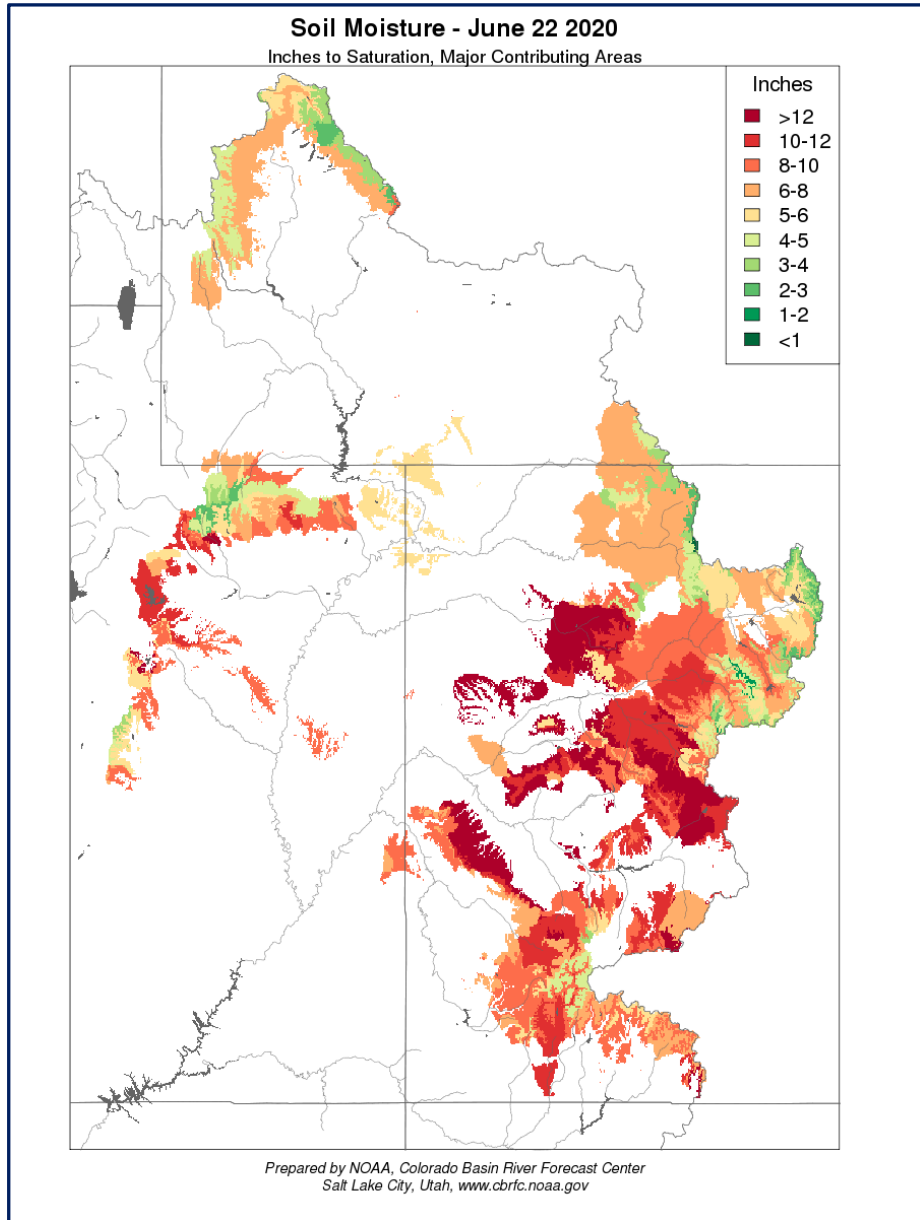
Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	72	0.24	0.33	6,493.21
Flaming Gorge	84	3.14	3.75	6,024.55
Blue Mesa	48	0.39	0.83	7,464.28
Navajo	66	1.12	1.70	6,041.05
Lake Powell	35	8.42	24.32	3,561.22
UC System Storage	43	13.45	31.09	



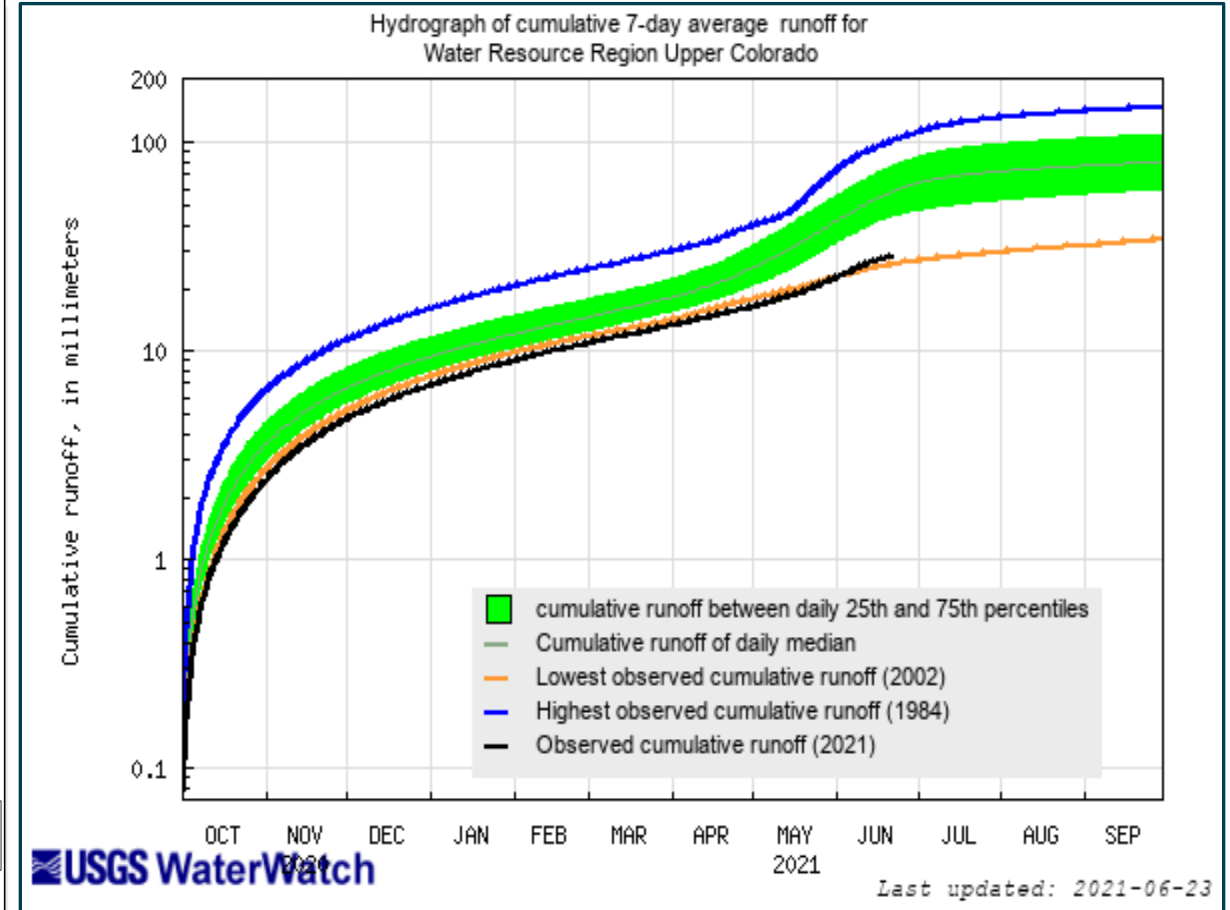
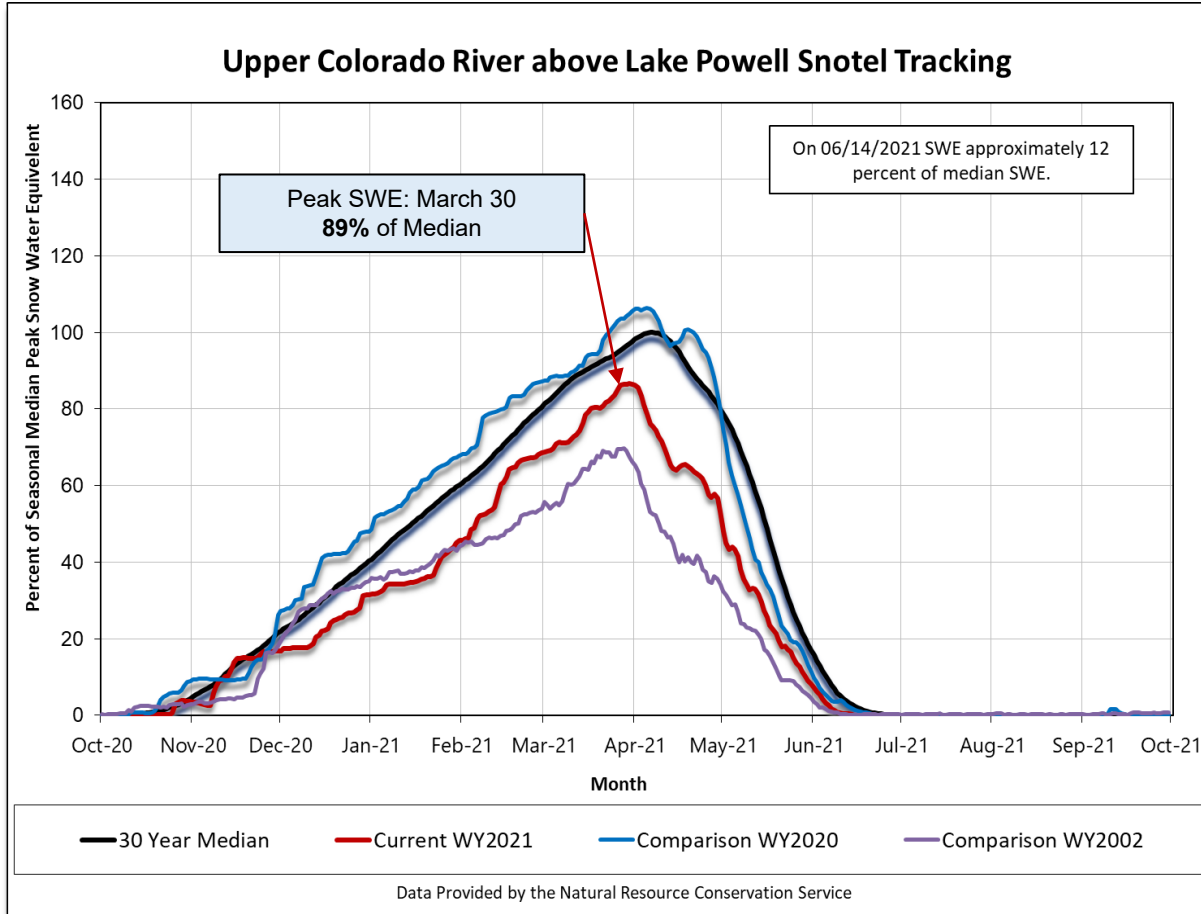
# Precipitation: June and Seasonal



# Soil Moisture Comparison: June 2020 and 2021



# Current SWE and Observed UC Runoff



Available online at: [https://waterwatch.usgs.gov/index.php?id=wwdur\\_cumrunoff](https://waterwatch.usgs.gov/index.php?id=wwdur_cumrunoff)



# Most Probable June Final Spring Forecast and WY 2021 Forecast

April – July 2021  
Forecasted Unregulated Inflow  
as of June 2, 2021

Reservoir	Unregulated Inflow (kaf) <sup>1</sup>	Percent of Average <sup>2</sup>
Fontenelle	345	48
Flaming Gorge	395	40
Blue Mesa	310	46
Navajo	335	46
Powell	1,800	25

Water Year 2021  
Forecasted Unregulated Inflow  
as of June 3, 2021

Reservoir	Unregulated Inflow (kaf)	Percent of Average <sup>1</sup>
Fontenelle	589	54
Flaming Gorge	677	46
Blue Mesa	506	53
Navajo	463	43
Powell	3,367	31

Powell decreased 1.53 maf from April Forecast of 4.9 maf (45%)

7 <sup>1</sup> April-July includes observed volumes for April and May.  
<sup>2</sup> Percent of average based on the period of record from 1981-2010.



# Most Probable June Midmonth Spring Forecast and WY 2021 Forecast

April – July 2021  
Forecasted Unregulated Inflow  
as of June 16, 2021

Reservoir	Unregulated Inflow (kaf) <sup>1</sup>	Percent of Average <sup>2</sup>
Fontenelle	320	44
Flaming Gorge	365	37
Blue Mesa	310	46
Navajo	360	49
Powell	1,800	25

Water Year 2021  
Forecasted Unregulated Inflow  
as of June 16, 2021

Reservoir	Unregulated Inflow (kaf)	Percent of Average <sup>1</sup>
Fontenelle	559	52
Flaming Gorge	642	44
Blue Mesa	506	53
Navajo	488	45
Powell	3,367	31

Powell decreased 1.53 maf from April Forecast of 4.9 maf (45%)

<sup>1</sup> April-July includes observed volumes for April and May.

<sup>2</sup> Percent of average based on the period of record from 1981-2010.





# Most and Minimum Probable WY2022 Forecast

**MOST Water Year 2022  
Forecasted Unregulated Inflow<sup>1</sup>  
as of June 3, 2021**

Reservoir	Unregulated Inflow (kaf)	Percent of Average <sup>2</sup>
Flaming Gorge	1,150	79
Blue Mesa	795	83
Navajo	830	77
Powell	8,300	77

**MINIMUM Water Year 2022  
Forecasted Unregulated Inflow<sup>1</sup>  
as of June 3, 2021**

Reservoir	Unregulated Inflow (kaf)	Percent of Average <sup>2</sup>
Flaming Gorge	880	60
Blue Mesa	630	66
Navajo	640	60
Powell	6,500	60

<sup>1</sup> WY2022 forecasted unregulated inflow is calculated from the CBRFC water year volumes with median for most probable, 75% exceedance for minimum probable and 25% exceedance for maximum probable.

<sup>2</sup> Percent of average based on the period of record from 1981-2010.





# Upper Colorado Basin

**Projected Operations  
for Water Year 2021  
Based on June 2021  
Modeling**



# Drought Response Operations Agreement (DROA)

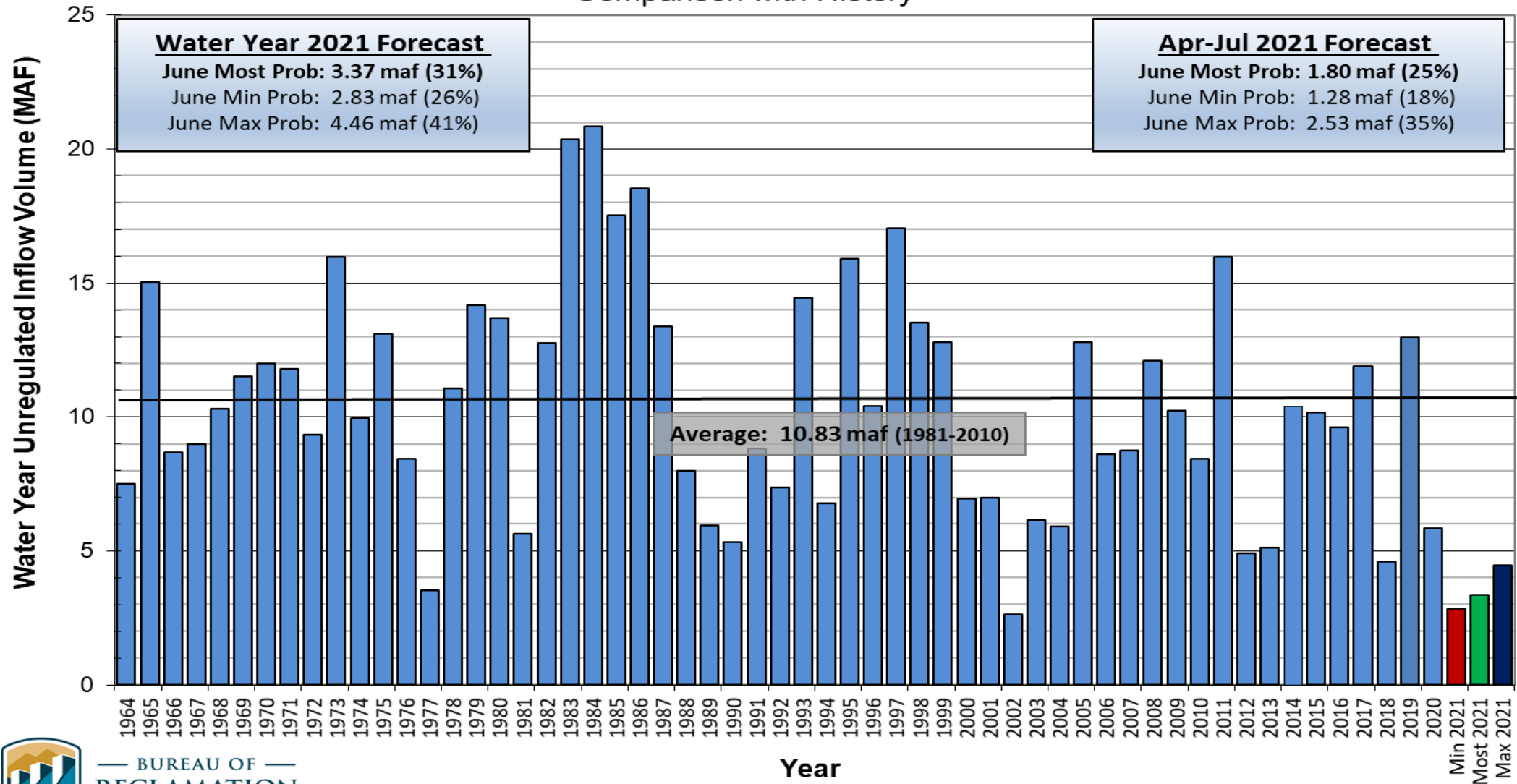
- Formal notification that the January 2021 Minimum Probable 24 Month Study (24-MS) run projected Powell to fall below 3,525 feet in 2022 was provided pursuant to the DROA.
  - February through June Minimum Probable 24-MS continued to indicate elevations below 3,525 feet in 2022.
  - Operating under enhanced monitoring and coordination under the DROA.
  - Operating with monthly analysis of min/most/max with the parties specified in the DROA.
- The May most probable 24-Month Study elevation projected Lake Powell reaching 3,525.57 feet as early as March 2022.
- The June most probable 24-Month Study elevation projects Lake Powell reaching below 3,525 feet as early as February 2022
- The UCRC announced on May 20, 2021, that the parties are beginning the process of developing a drought response operations plan in accordance with the DROA.
  - Consultation with the states of Arizona, California, and Nevada will occur prior to finalization of the developed plan.
  - The developed plan will be finalized if Reclamation's April 24-Month Study Most Probable forecast shows Lake Powell falling to a target elevation of 3,525 feet or below within a 12-month period.
  - If the Secretary of Interior determines there is imminent need to protect Lake Powell elevations from dropping below 3,525 feet, she has the discretion to take emergency action after consulting with the Colorado River Basin States.



# Lake Powell Unregulated Inflow

## Water Year 2021 Forecast *(issued June 3)*

### Comparison with History



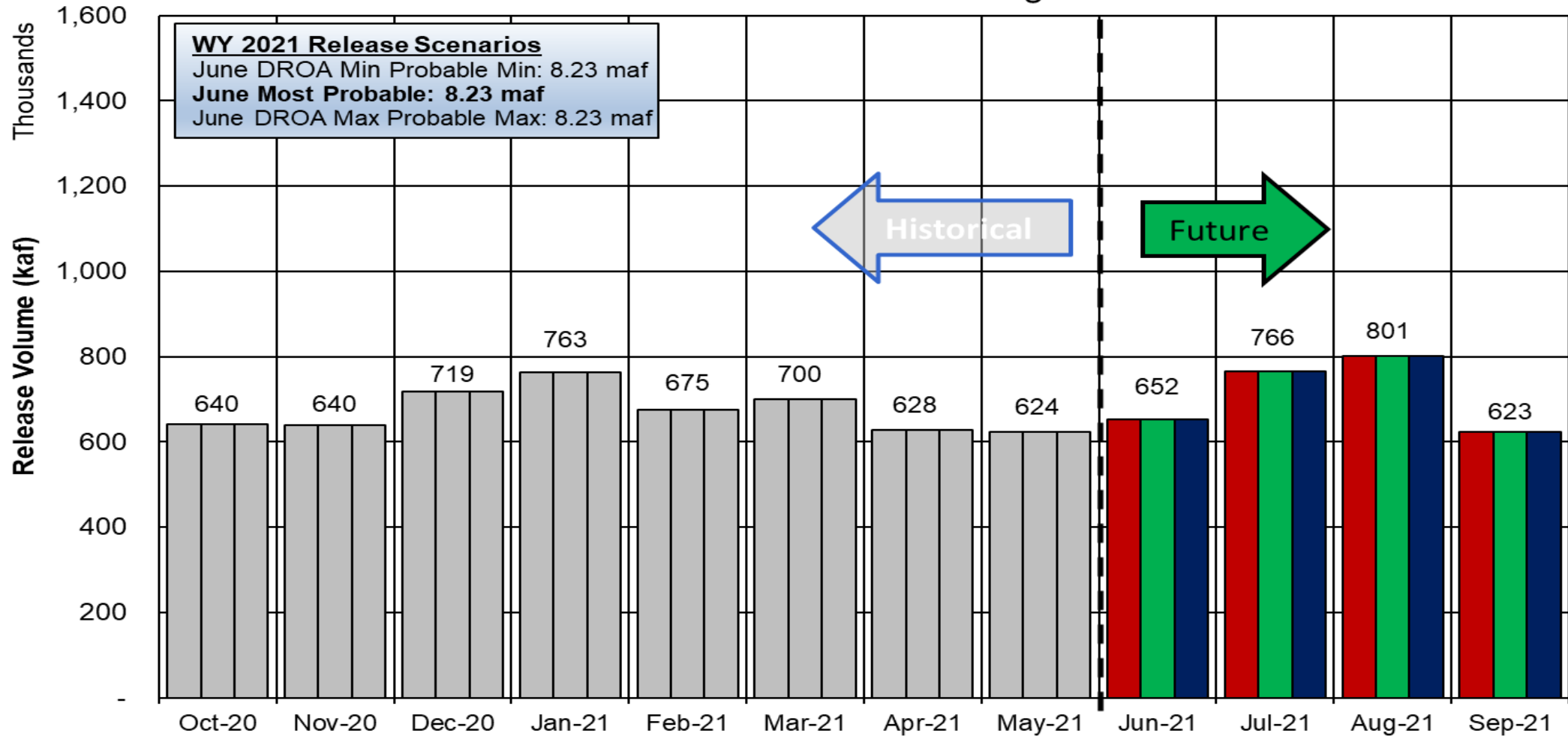
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# Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2021

Based on June 2021 Modeling



**WY 2021 Release Scenarios**  
 June DROA Min Probable Min: 8.23 maf  
**June Most Probable: 8.23 maf**  
 June DROA Max Probable Max: 8.23 maf

Thousands  
 Release Volume (kaf)

Monthly Release Volumes

■ June DROA Min Probable   ■ June Most Probable   ■ June DROA Max Probable

The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>



# Lake Powell & Lake Mead Operational Table

Projected Tiers for Water/Calendar Year 2022<sup>1</sup>  
based on June 24-Month Study with an 8.23 maf release

Lake Powell			Lake Mead		
Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf) <sup>1</sup>	Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf) <sup>1</sup>
3,700	Equalization Tier Equalize, avoid spills or release 8.23 maf	24.3	1,220	Flood Control Surplus or Quantified Surplus Condition Deliver > 7.5 maf	25.9
3,636 - 3,666 (2008-2026)	Upper Elevation Balancing Tier <sup>2</sup> Release 8.23 maf; if Lake Mead < 1,075 feet, balance contents with a min/max release of 7.0 and 9.0 maf	15.5 - 19.3 (2008-2026)	1,200 (approx.) <sup>2</sup>	Domestic Surplus or ICS Surplus Condition Deliver > 7.5 maf	22.9 (approx.) <sup>2</sup>
3,575			1,145	15.9	
	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5	1,105	Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	11.9
			1,075	<b>1,070.26 ft</b>	
	<b>3,528.15 ft</b>		1,075	Shortage Condition Deliver 7.167 <sup>4</sup> maf	9.4
3,525	<b>Jan 1, 2022 Projection</b>	5.9	1,050	Shortage Condition Deliver 7.083 <sup>5</sup> maf	7.5
	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	4.0	1,025	Shortage Condition Deliver 7.0 <sup>6</sup> maf	5.8
3,490			1,000	4.3	
3,370		0	895	Further measures may be undertaken <sup>7</sup>	0

Diagram not to scale

<sup>1</sup> Acronym for million acre-feet

<sup>2</sup> This elevation is shown as approximate as it is determined each year by considering several factors including Lake Powell and Lake Mead storage, projected Upper Basin and Lower Basin demands, and an assumed inflow.

<sup>3</sup> Subject to April adjustments which may result in a release according to the Equalization Tier

<sup>4</sup> Of which 2.48 maf is apportioned to Arizona, 4.4 maf to California, and 0.287 maf to Nevada

<sup>5</sup> Of which 2.40 maf is apportioned to Arizona, 4.4 maf to California, and 0.283 maf to Nevada

<sup>6</sup> Of which 2.32 maf is apportioned to Arizona, 4.4 maf to California, and 0.280 maf to Nevada

<sup>7</sup> Whenever Lake Mead is below elevation 1,025 feet, the Secretary shall consider whether hydrologic conditions together with anticipated deliveries to the Lower Division States and Mexico is likely to cause the elevation at Lake Mead to fall below 1,000 feet. Such consideration, in consultation with the Basin States, may result in the undertaking of further measures, consistent with applicable Federal law.





# Lake Powell WY 2022 Operating Tier Scenarios

Based on June 2021 24-Month Study Inflow Scenarios

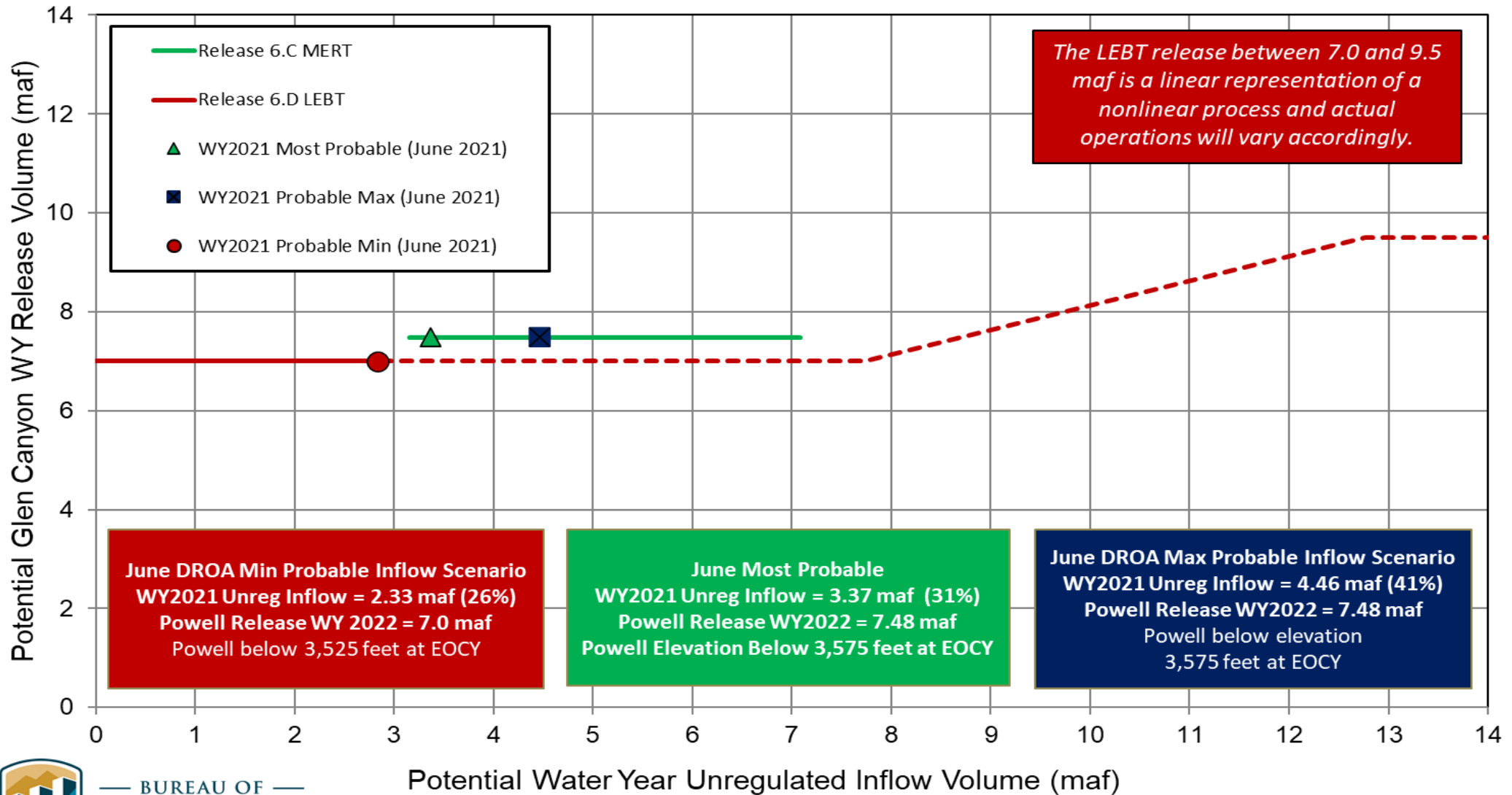
Inflow Scenario	Operating Tier/ Release Volume
June DROA* Minimum Probable	Lower Elevation Balancing 7.00 maf
June Most Probable	Mid-Elevation Release 7.48 maf
June DROA* Maximum Probable	Mid-Elevation Release 7.48 maf

\*The Drought Response Operations Agreement (DROA) can be found online at:  
<https://www.usbr.gov/dcp/finaldocs.html>.



# Lake Powell Release Scenarios under Section 6.C and 6.D

Water Year 2022 Release Volume as a Function of Mid Elevation Release Tier and Lower Elevation Balancing Tier based on June 2021 24-Month Study Conditions



*The LEBT release between 7.0 and 9.5 maf is a linear representation of a nonlinear process and actual operations will vary accordingly.*



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\*The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>

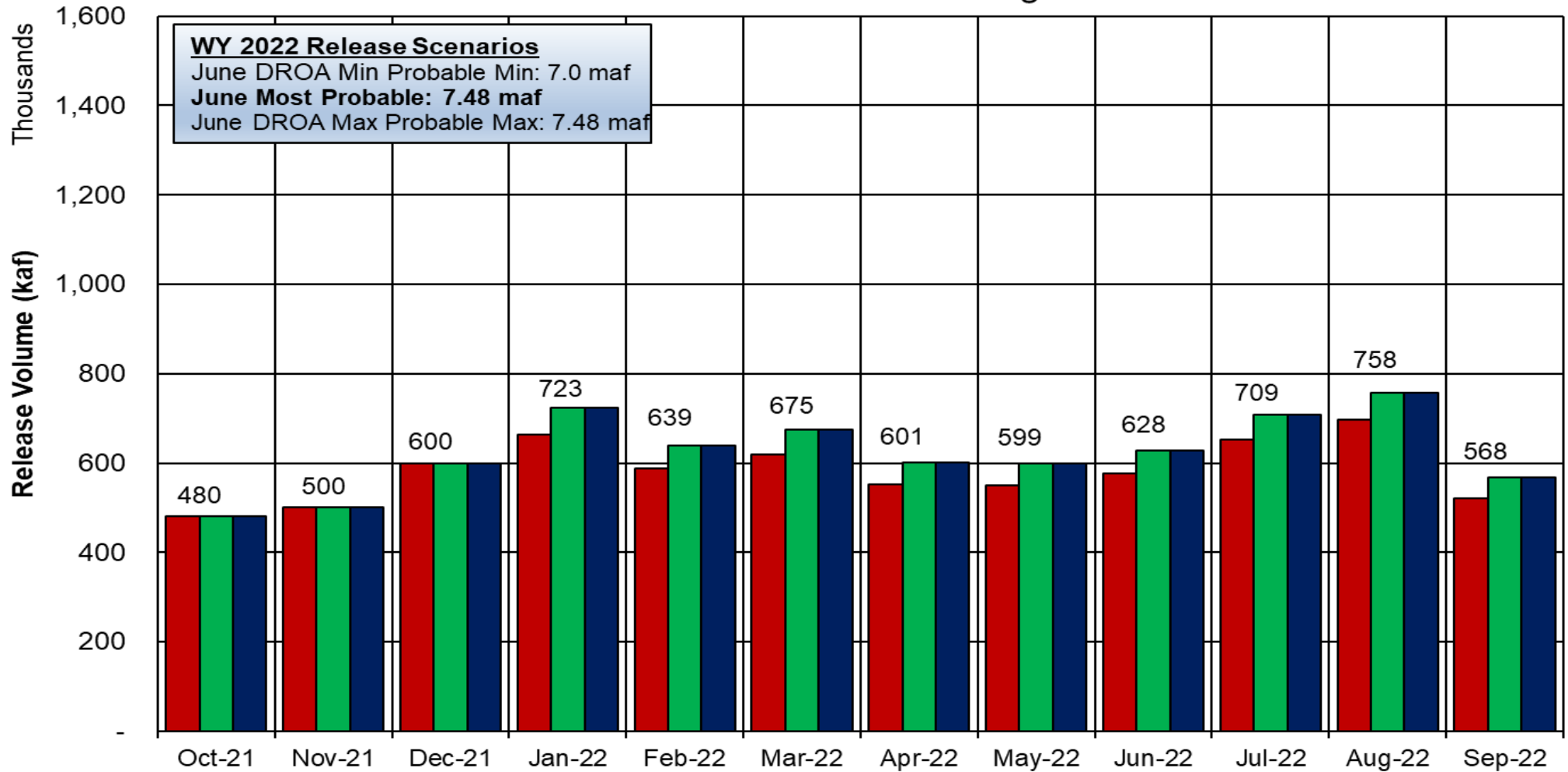




# Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on June 2021 Modeling



**WY 2022 Release Scenarios**  
 June DROA Min Probable Min: 7.0 maf  
**June Most Probable: 7.48 maf**  
 June DROA Max Probable Max: 7.48 maf

Monthly Release Volumes

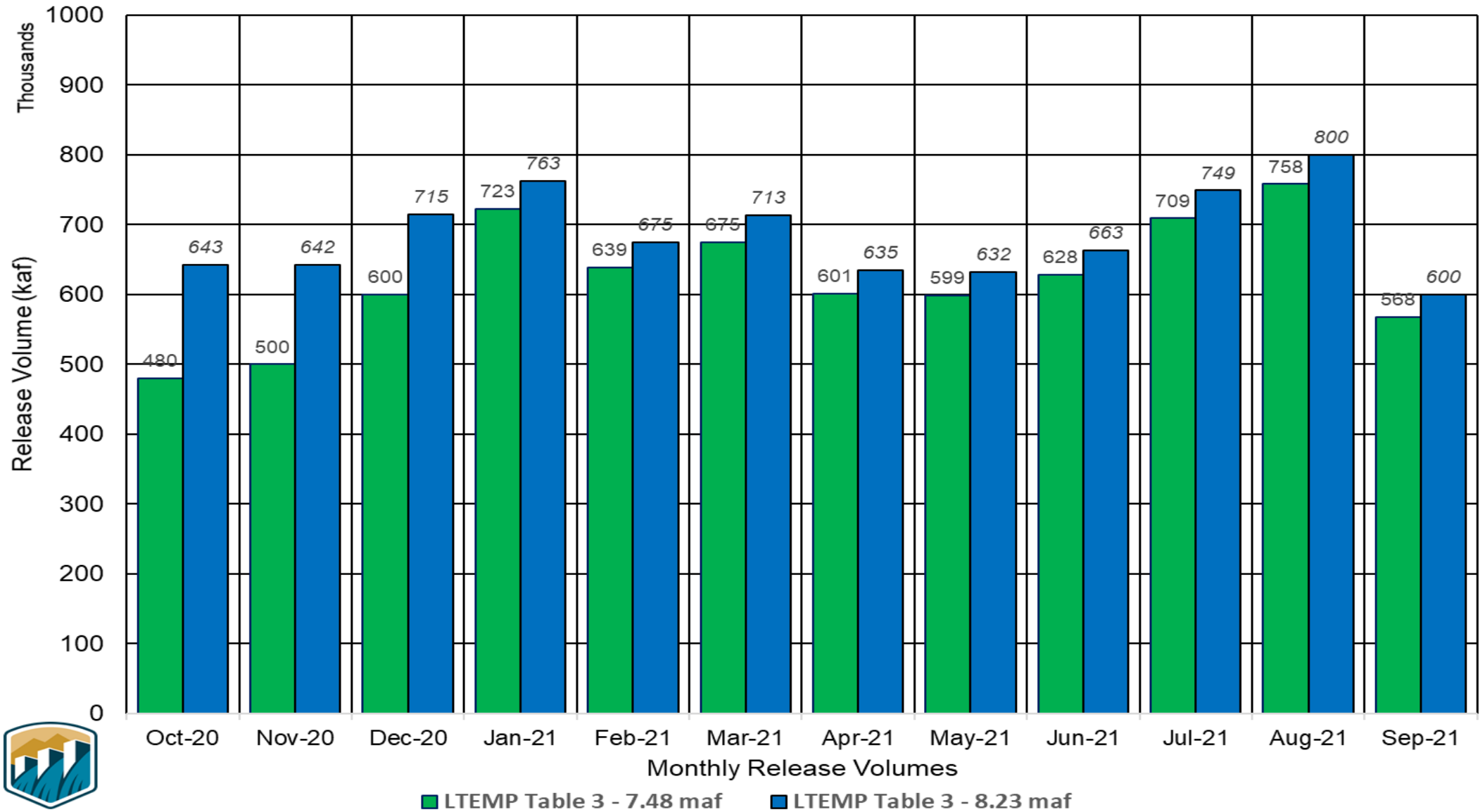
■ June DROA Min Probable   ■ June Most Probable   ■ June DROA Max Probable

The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>



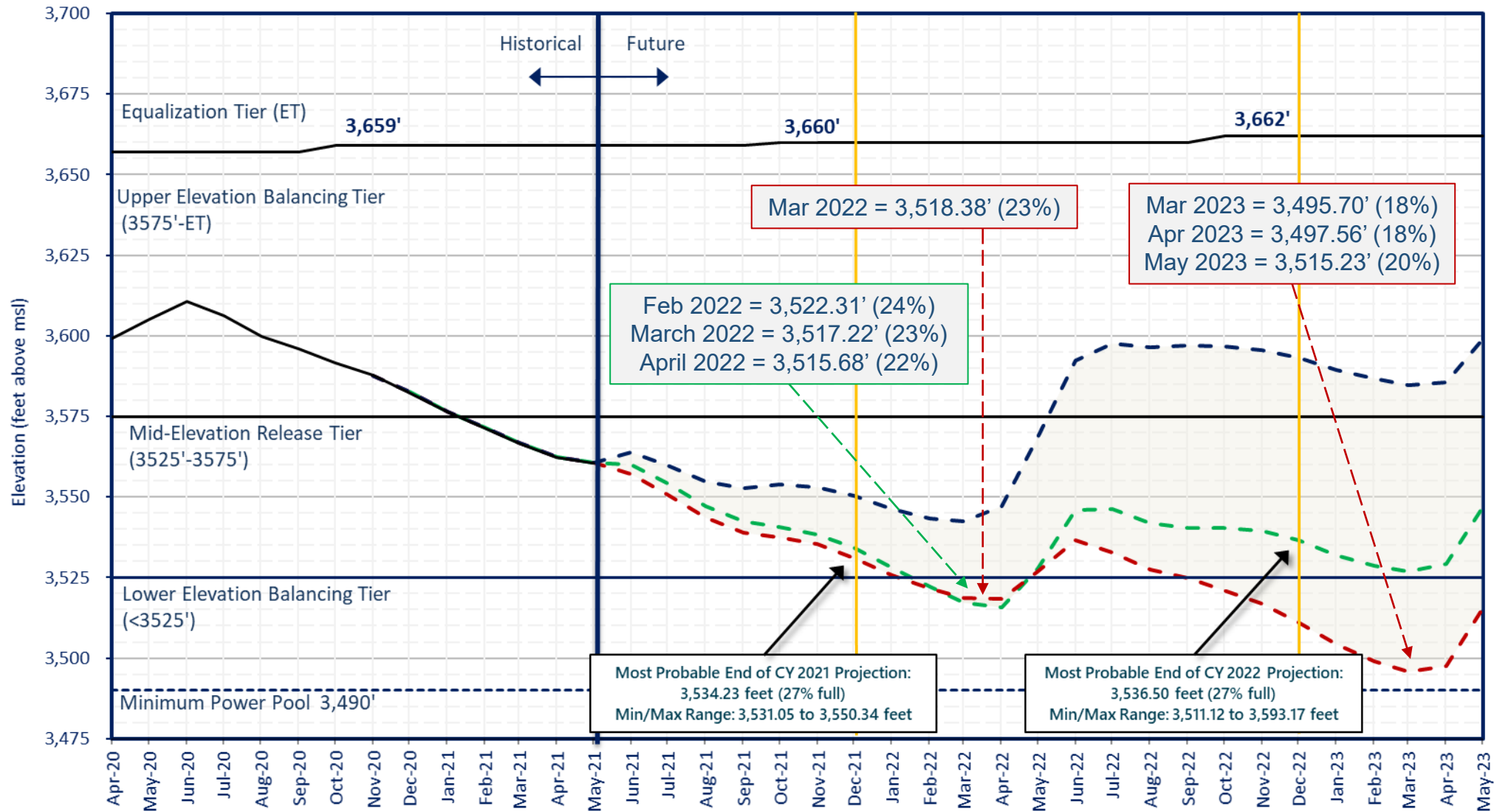
# Lake Powell Monthly Release Volume Distribution

## Annual Release Patterns from LTEMP Table 3



# Lake Powell End of Month Elevations

Projections from the June 2021 24-Month Study Inflow Scenarios



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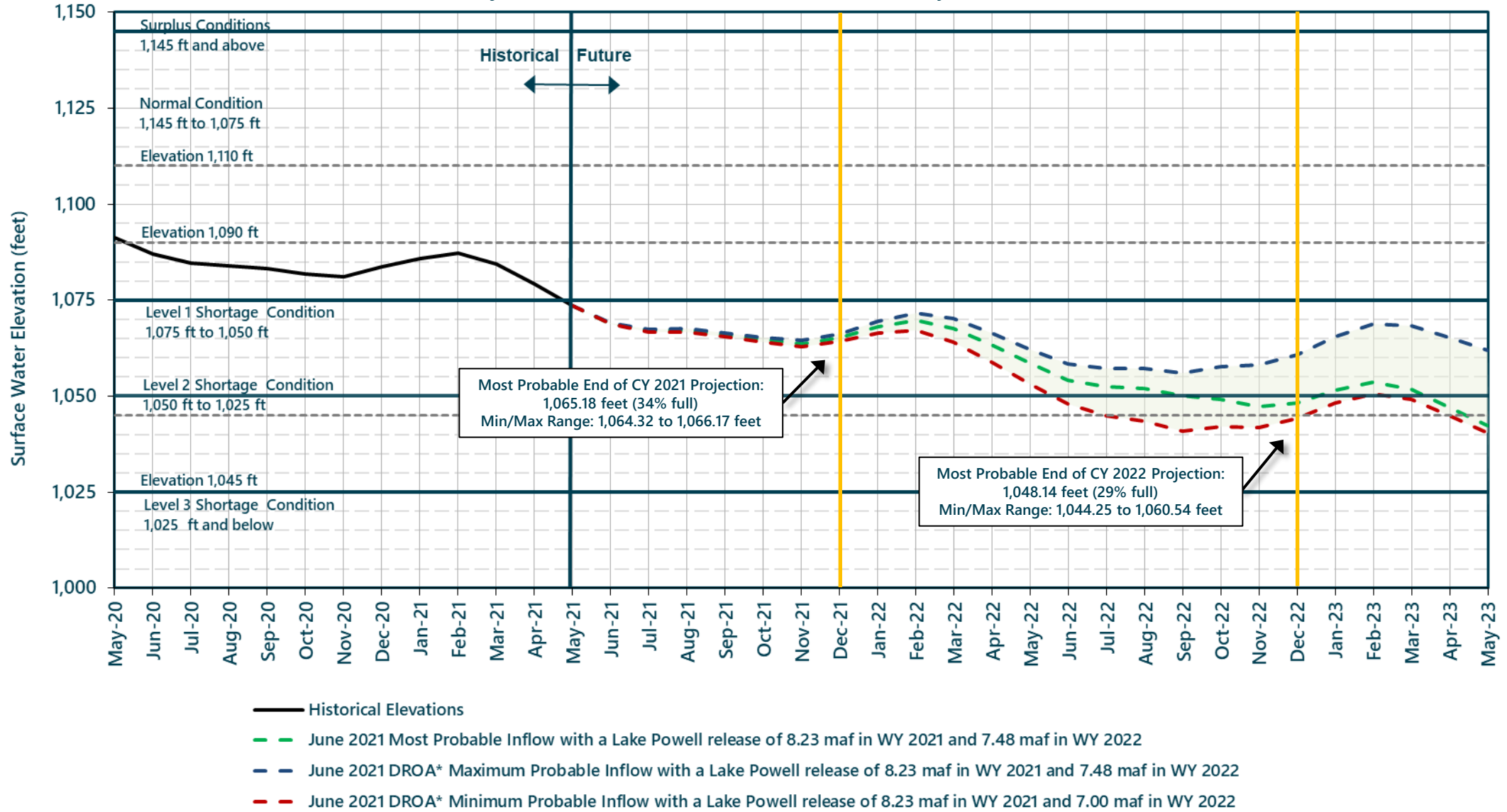
- June 2021 Most Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- June 2021 DROA\* Minimum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.0 maf in WY2022
- June 2021 DROA\* Maximum Probable - Lake Powell release of 8.23 maf in WY2021 and 7.48 maf in WY2022
- Historical Elevations

\*The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>



# Lake Mead End of Month Elevations

Projections from the June 2021 24-Month Study Inflow Scenarios



\*The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.



# Glen Canyon Dam Power Plant Unit Outage Schedule for 2021

Unit Number	Oct 2020	Nov 2020	Dec 2020	Jan 2021	Feb 2021	Mar 2021	Apr 2021	May 2021	Jun 2021	Jul 2021	Aug 2021	Sep 2021	
1	[Outage]											[Outage]	
2	[Outage]											[Outage]	
3	[Outage]											[Outage]	
4	[Outage]											[Outage]	
5		[Outage]						[Outage]					
6		[Outage]											
7	[Outage]						[Outage]						
8							[Outage]						
Units Available	5	5/4	6	6	6	6/4	4	5	6	6	6	4	
Capacity (cfs)	16,400	16,400/ 12,200	19,800	19,600	19,500	19,400 (20,150) <sup>4</sup>	19,200	15,700	19,200	19,000	18,800	11,800	JUN MOST <sup>3</sup>
Capacity (kaf/month)	1,040	1,140	1,250	1,220	1,080	1,540	1,140	1,050	1,140	1,170	1,150	990	JUN MOST
Max (kaf) <sup>2</sup>	640	640	720	763	675	700	628	624	652	766	801	623	8.23
Most (kaf) <sup>1</sup>	640	640	720	763	675	700	628	624	652	766	801	623	8.23
Min (kaf) <sup>2</sup>	640	640	720	760	680	700	628	624	652	766	801	623	8.23
										(updated 06-11-2021)			

- 1 Projected release, based on June 2021 Most Probable Inflow Projections and 24-Month Study model runs.
- 2 Projected release, based on June 2021 DROA Min and Max Probable Inflow Projections and 24-Month Study model runs. The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>.
- 3 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.
- 4 Increased capacity available from shifting contingency reserves for Spring Disturbance Flow.



# Glen Canyon Dam Power Plant Unit Outage Schedule for 2022

Unit Number	Oct 2021	Nov 2021	Dec 2021	Jan 2022	Feb 2022	Mar 2022	Apr 2022	May 2022	Jun 2022	Jul 2022	Aug 2022	Sep 2022
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	4/6	6/5	5/6	6/4	4	6	6	5	6	6	8	6
Capacity (cfs)	11,700	15,100	15,000	11,400	11,300	17,800	17,700	14,800	18,700	18,700	25,500	18,600
Capacity (kaf/month) <sup>+  →</sup>	940	990	1,060	1,100	690	1,090	1,050	940	1,110	1,180	1,570	1,160
Max (kaf) <sup>2</sup>	480	500	600	723	639	675	601	599	628	709	758	568
Most (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568
Min (kaf) <sup>2</sup>	480	500	600	664	587	620	552	550	577	652	696	522
											(updated 06-11-2021)	

JUN MOST<sup>3</sup>

JUN MOST

7.48

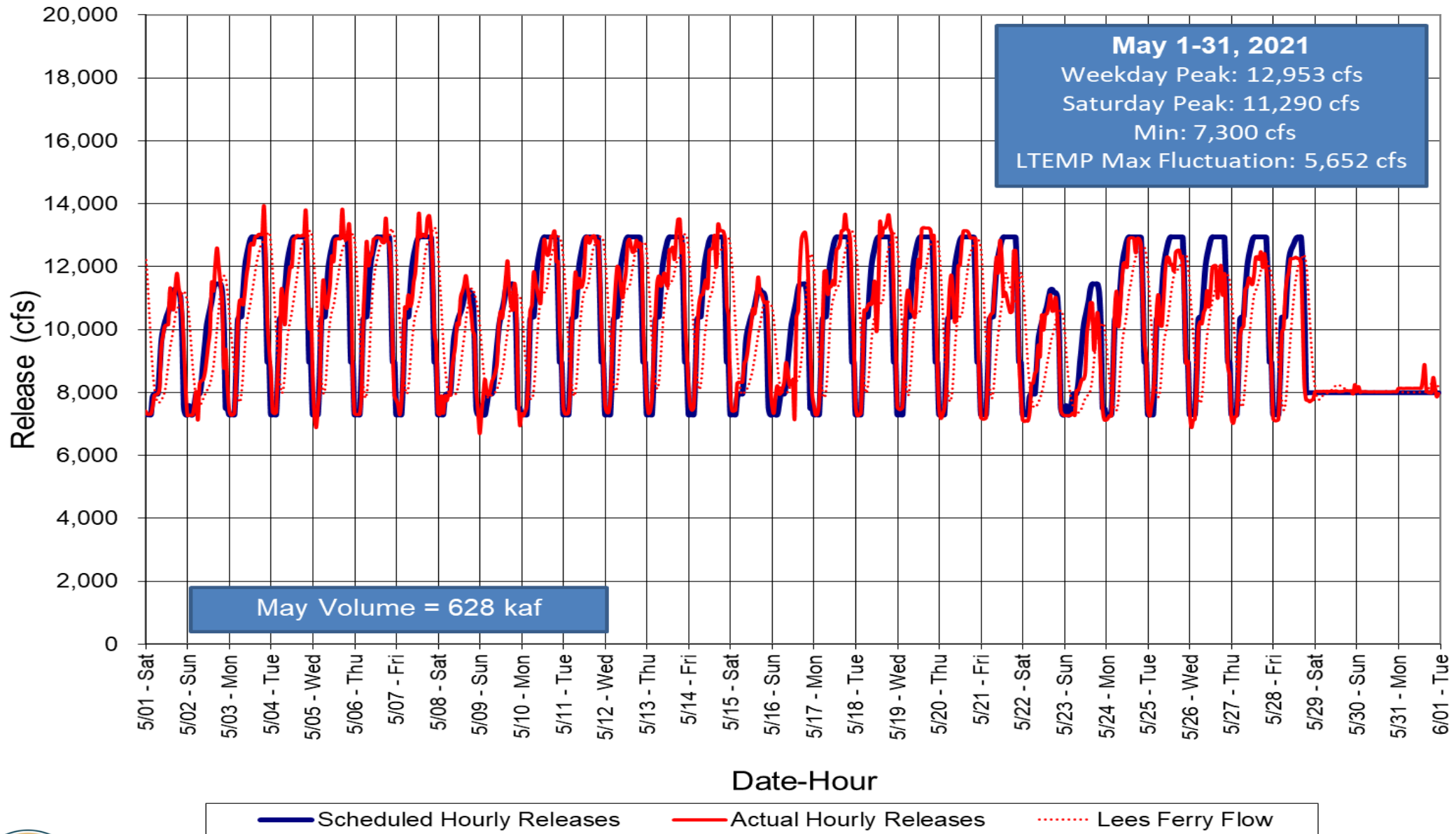
7.48

7.0

1 Projected release, based on June 2021 Most Probable Inflow Projections and 24-Month Study model runs.  
 2 Projected release, based on June 2021 DROA Min and Max Probable Inflow Projections and 24-Month Study model runs. The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dco/finaldocs.html>.  
 3 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.

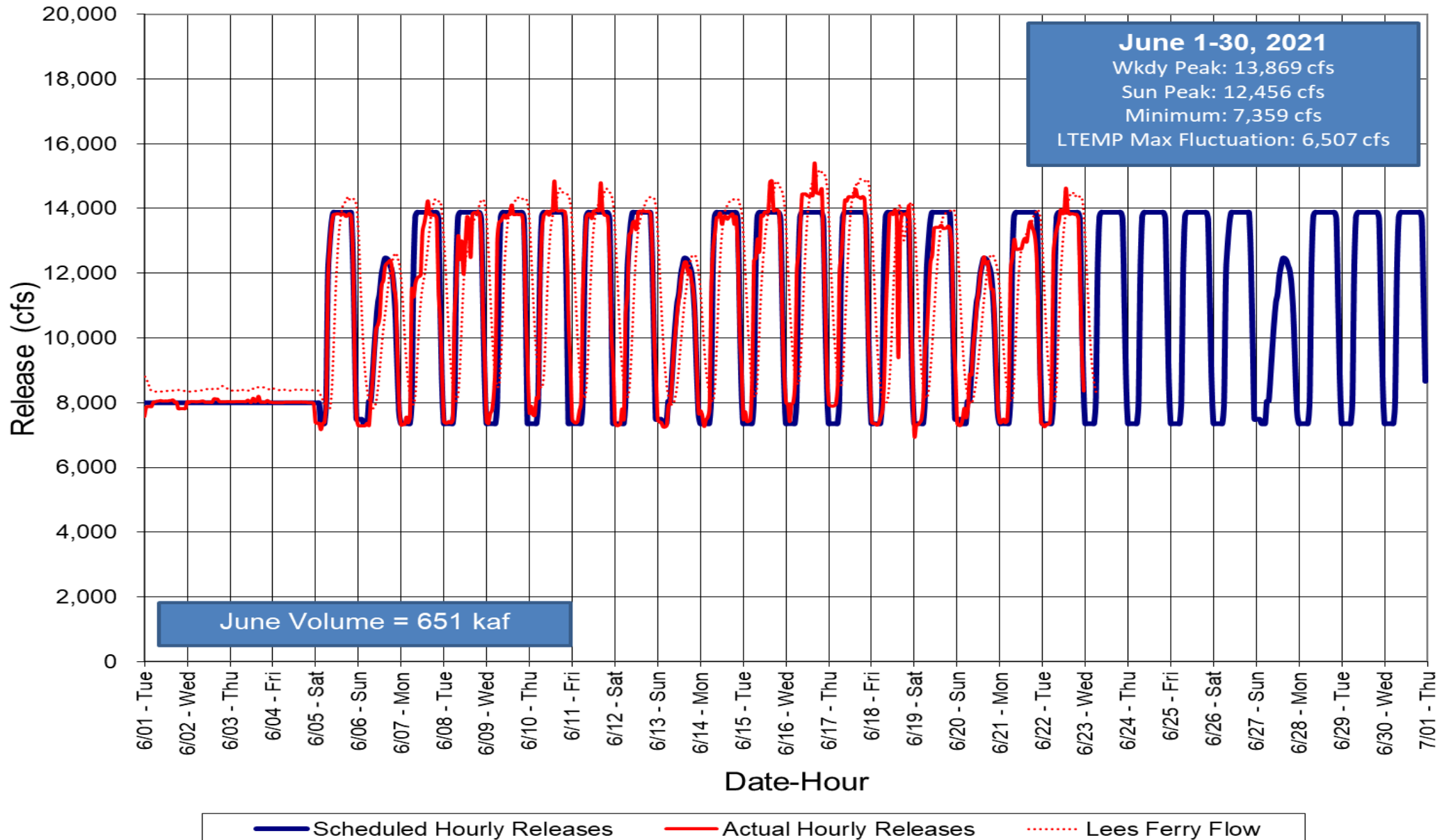


# Glen Canyon Dam Hourly Release Pattern May 2021





# Glen Canyon Dam Hourly Release Pattern June 2021

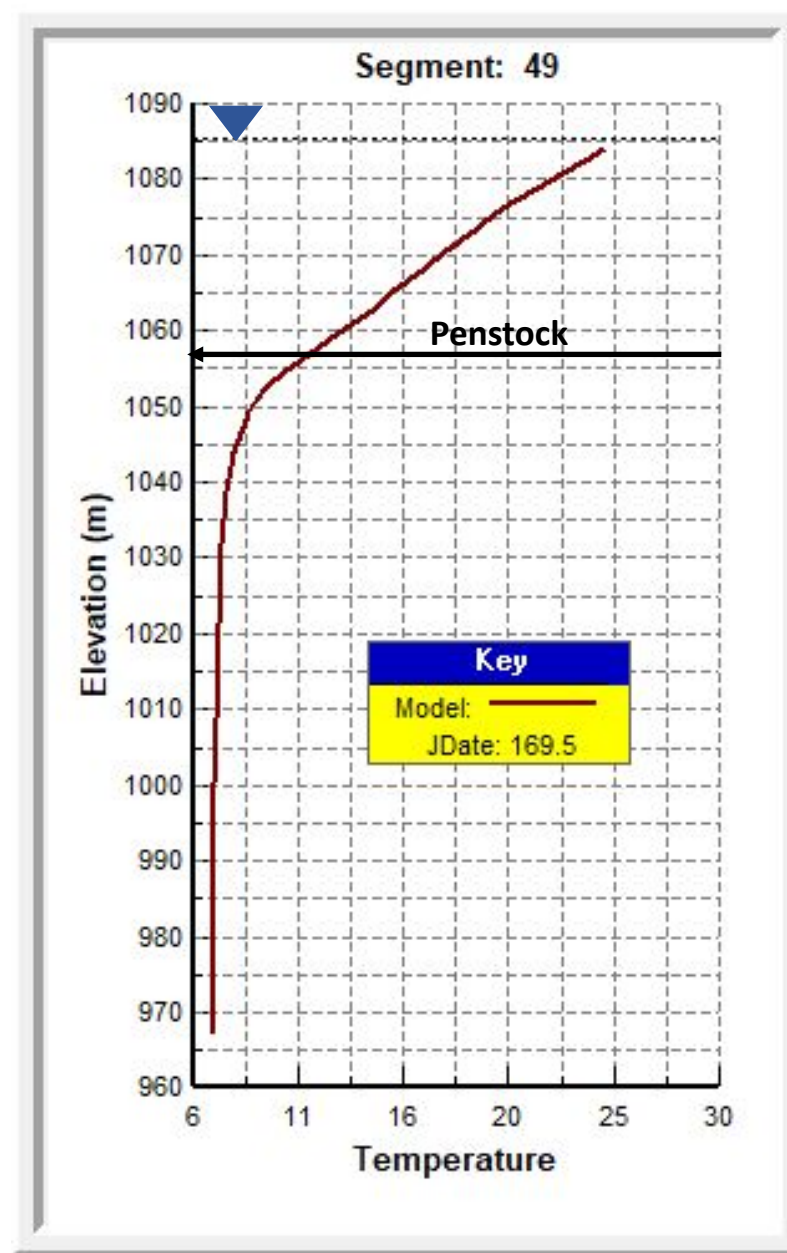




# Water Quality

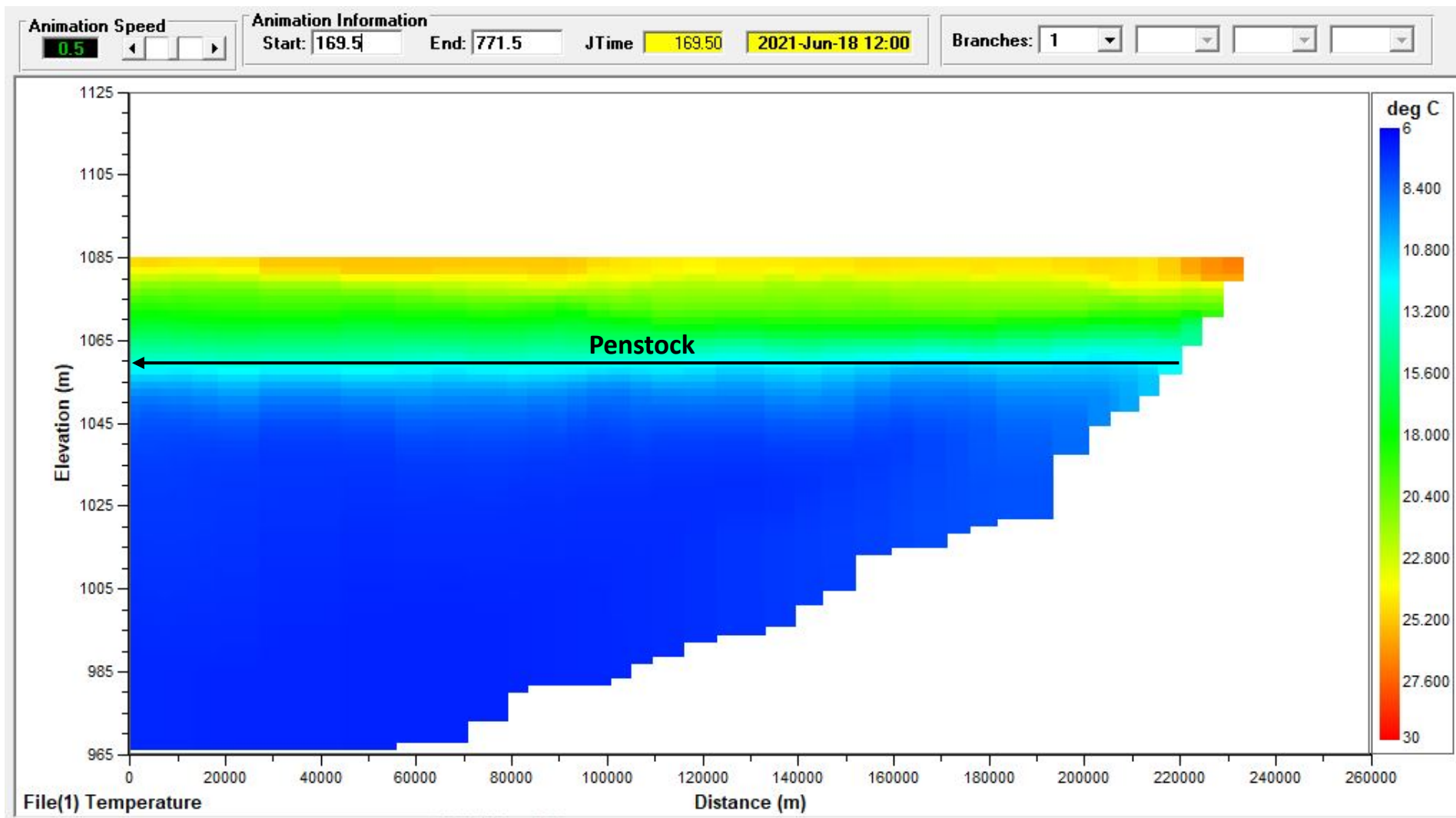


Temperature Profile of Lake Powell near Glen Canyon Dam  
6/18/2021

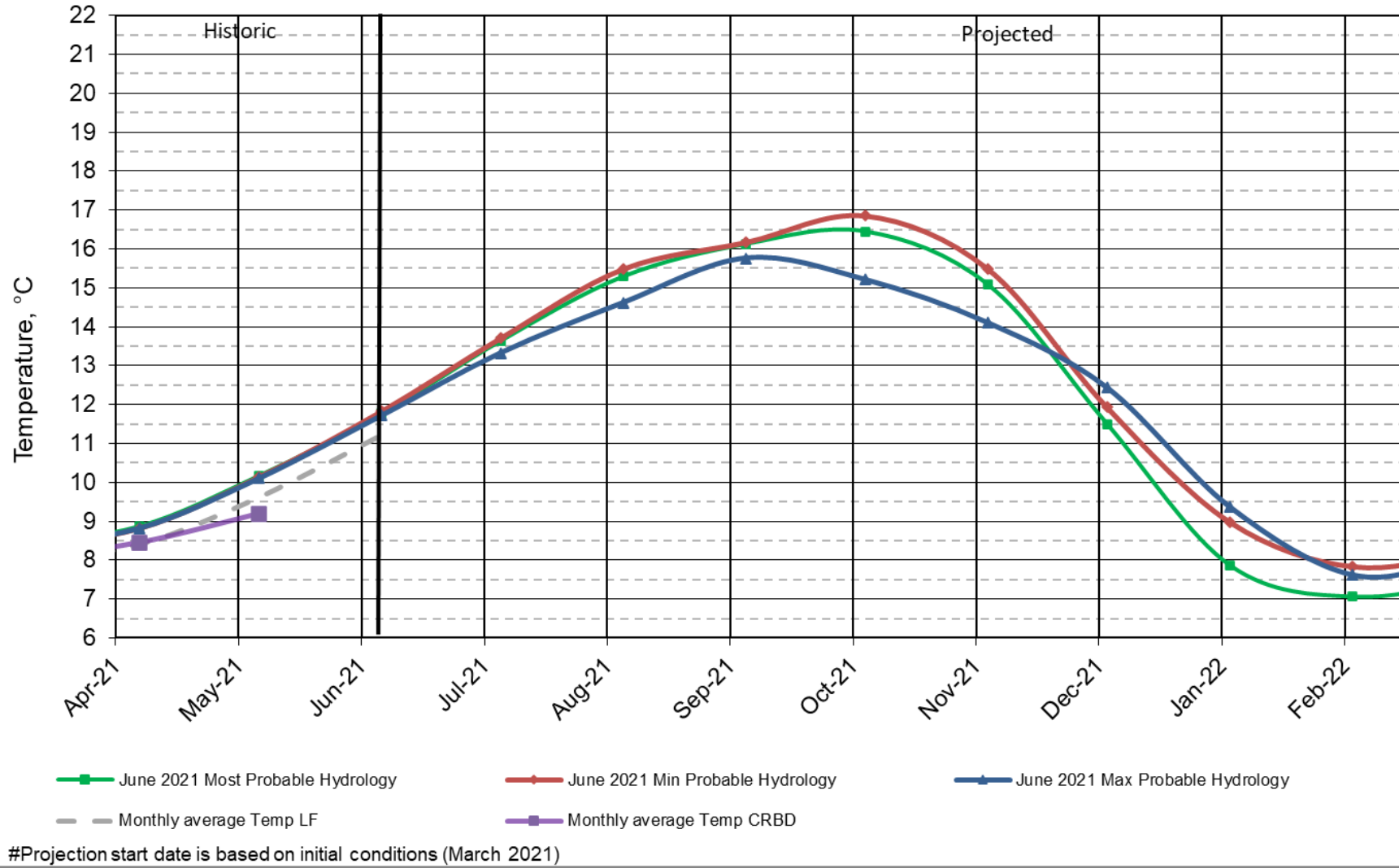


# Cross Sectional Temperature Profile of Lake Powell

6/18/2021

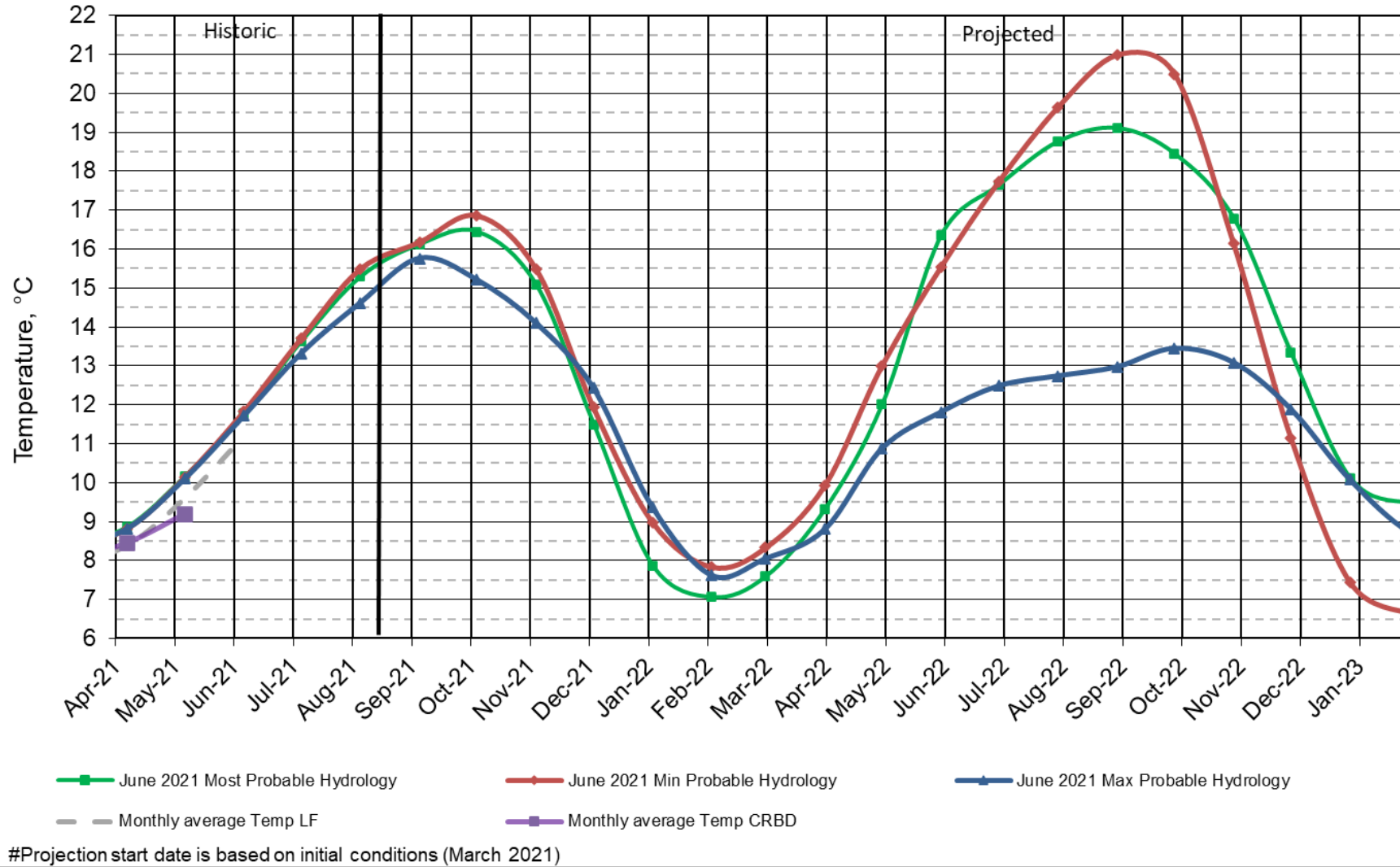


## Lake Powell Release Temperature Projected Temperature based on June 2021 Forecast



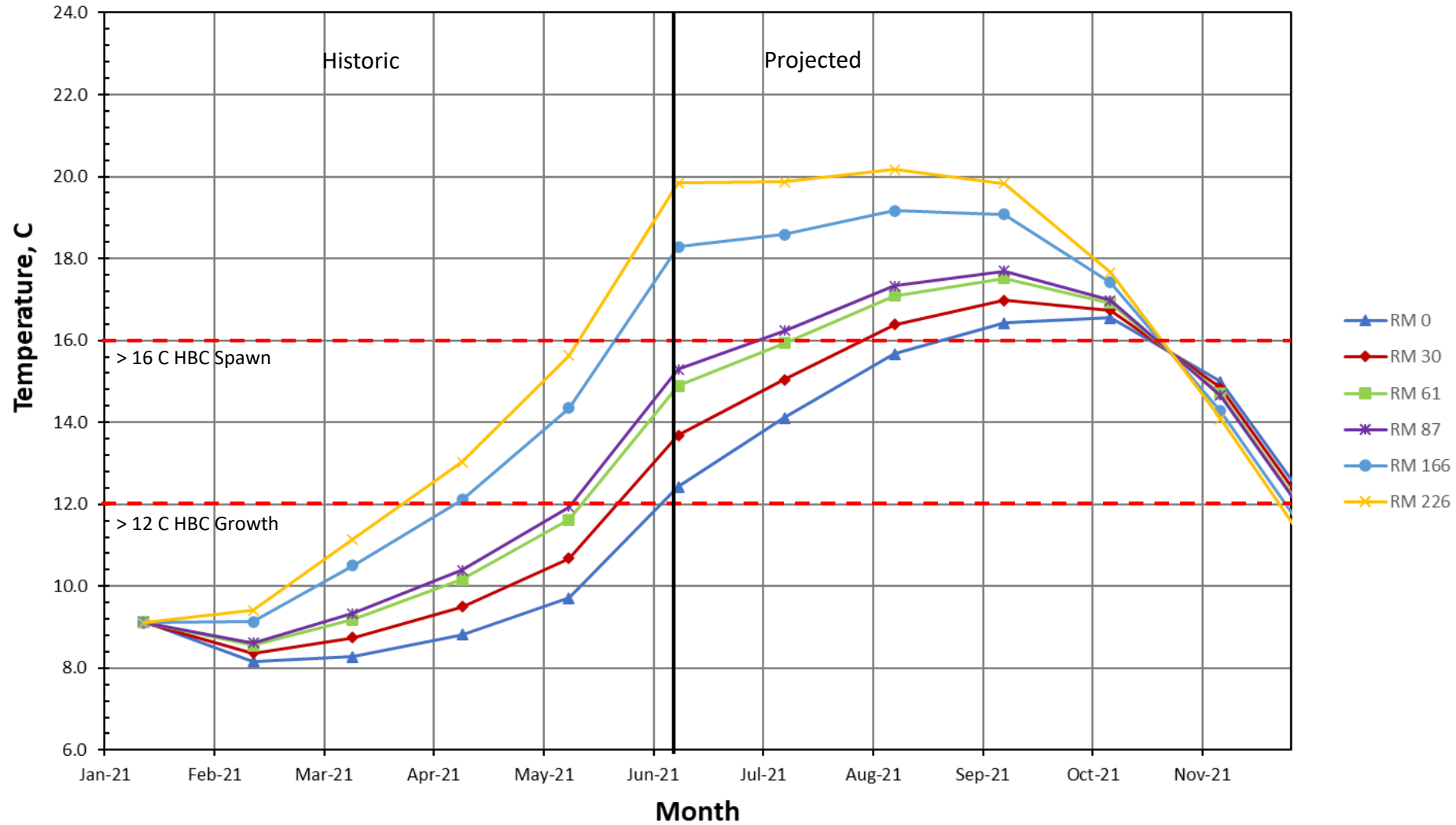
# Lake Powell Release Temperature

## Projected Temperature based on June 2021 Forecast

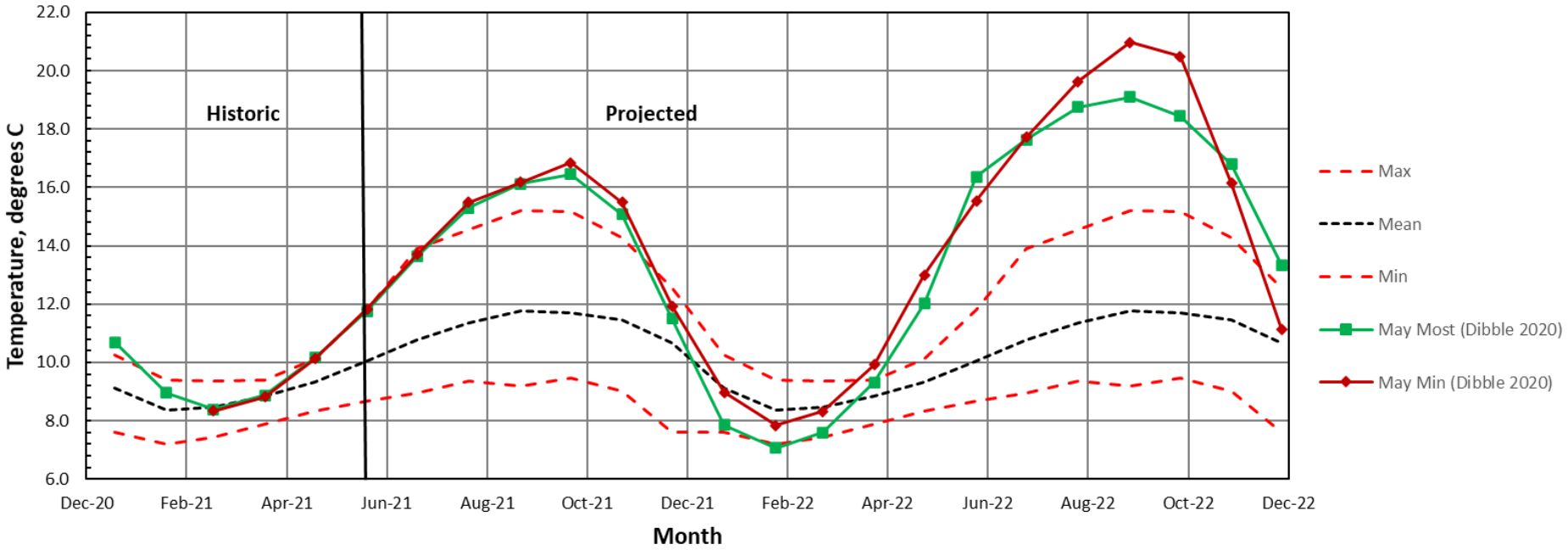


# Colorado River, Grand Canyon Water Temperatures

Projections based on June 2021, Most Probable Hydrology (Dibble 2020)



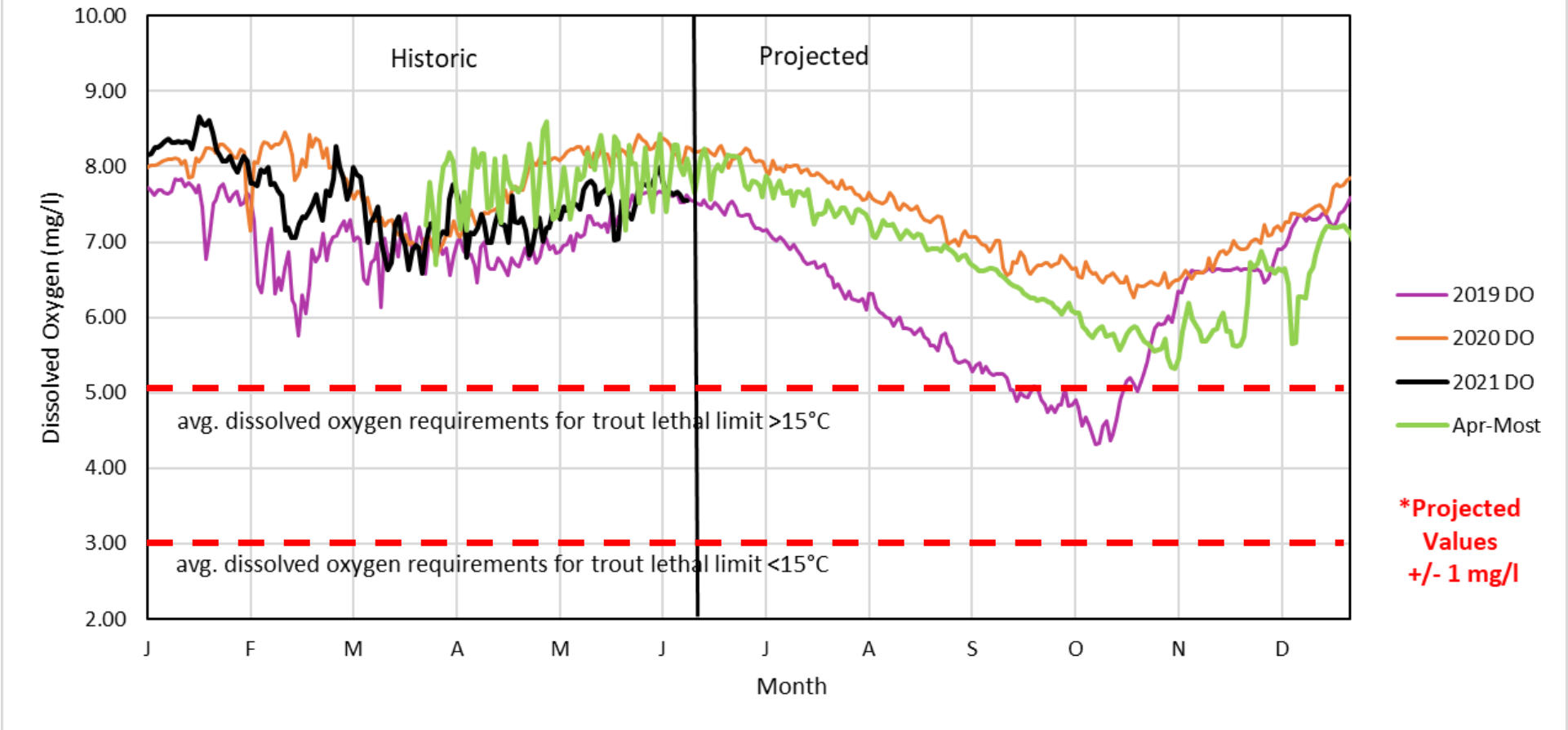
**Lees Ferry Gage USGS 0938000  
Mean Monthly Temperatures**



Data used from years: 1986,1987, 1989, 1990, 1993-2020.  
Not all years have a full data set.



DO Concentration at Glen Canyon Dam years 2019, 2020, and 2021





# Questions/Discussion



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