



— BUREAU OF —
RECLAMATION

Glen Canyon Monthly Operations Call

Basin Hydrology and Operations

June 22, 2022

Background

This briefing is being provided consistent with the provision in Attachment B - 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.”

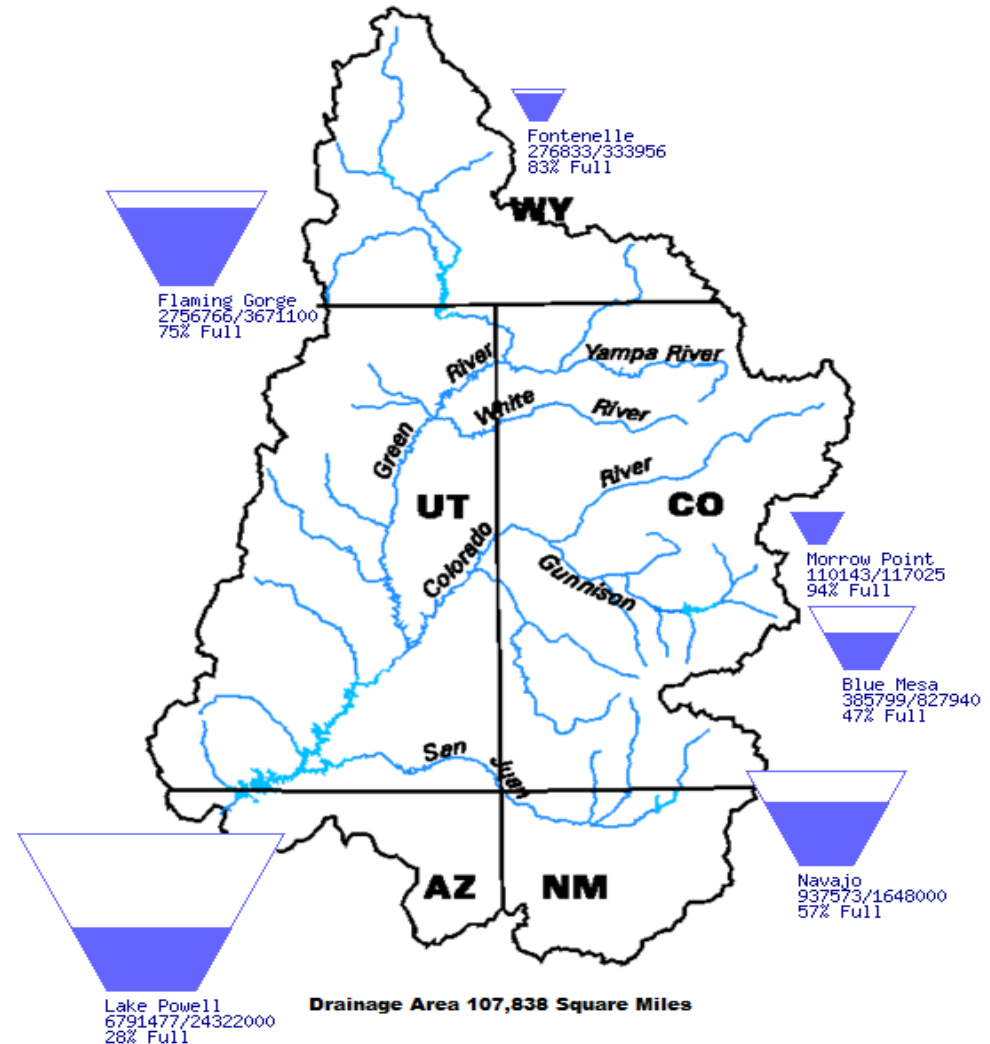


Upper Basin Storage (as of June 20, 2022)

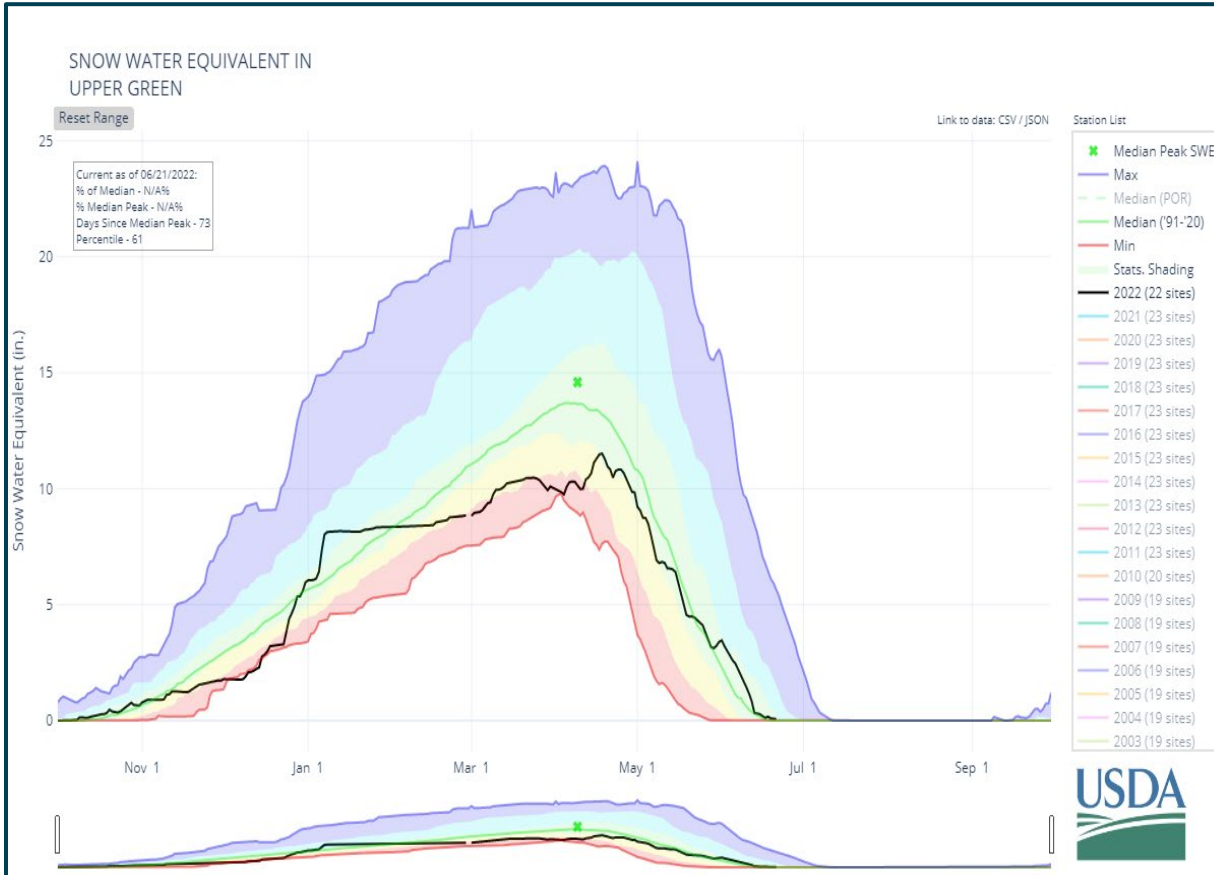
Data Current as of:
06/20/2022

Upper Colorado River Drainage Basin

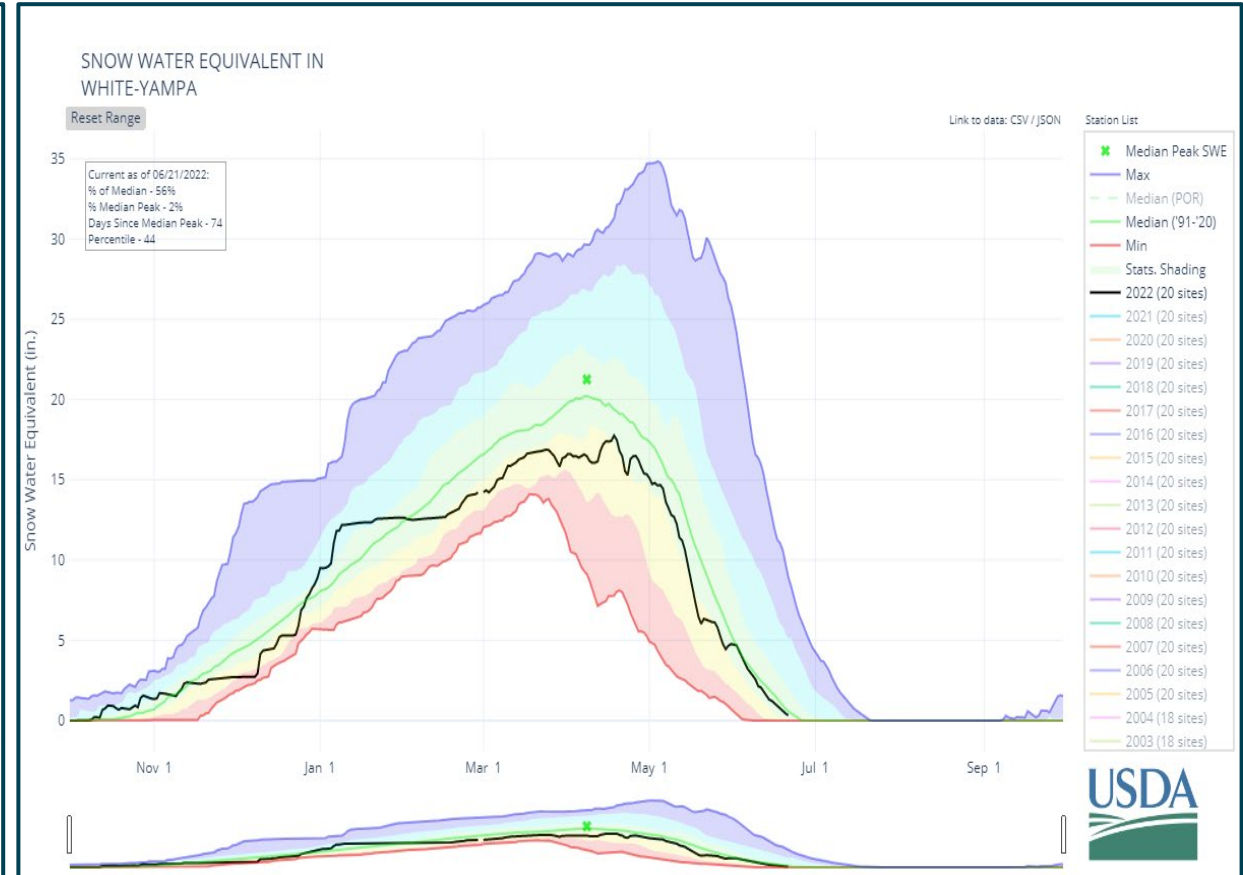
Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	83	0.28	0.33	6,498.44
Flaming Gorge	75	2.76	3.67	6,015.39
Blue Mesa	47	0.39	0.83	7,463.00
Navajo	57	0.94	1.70	6,027.72
Lake Powell	28	6.79	24.32	3,538.51
UC System Storage	36	11.28	30.94	



Flaming Gorge and Yampa River SWE



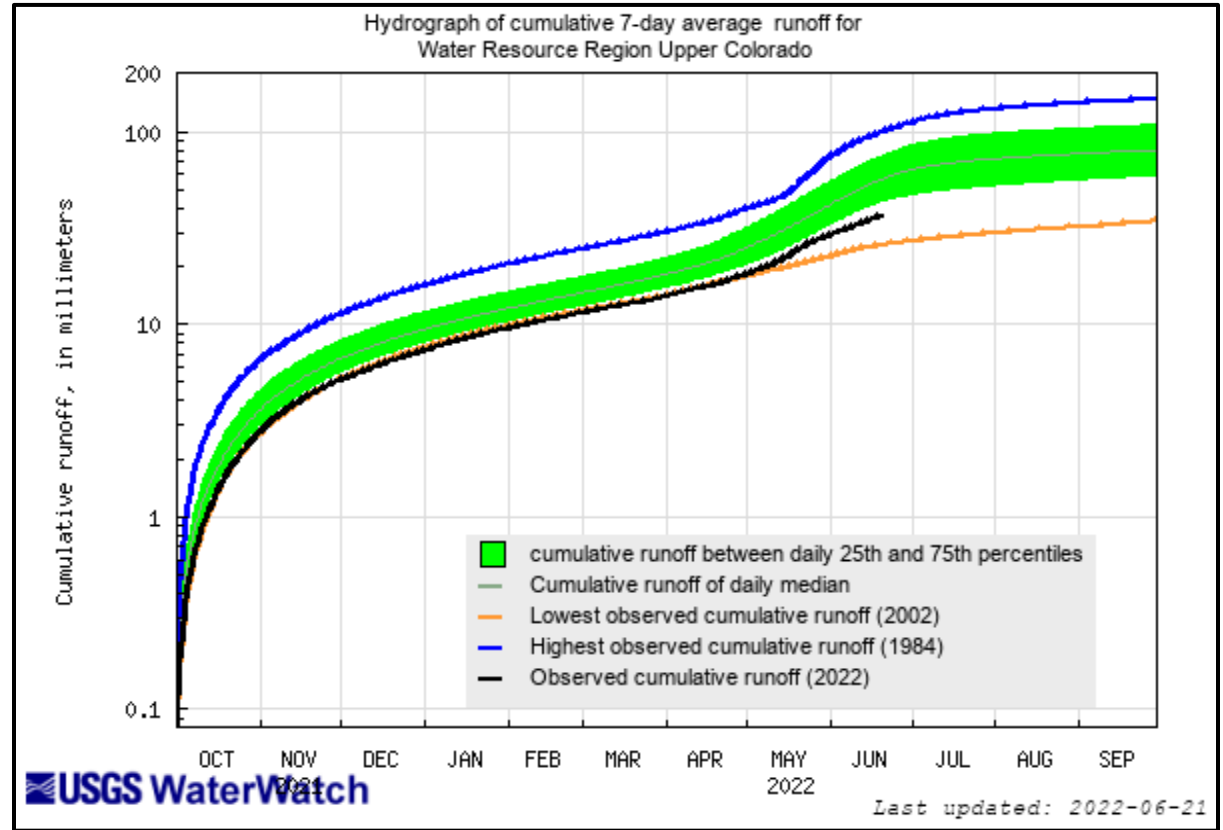
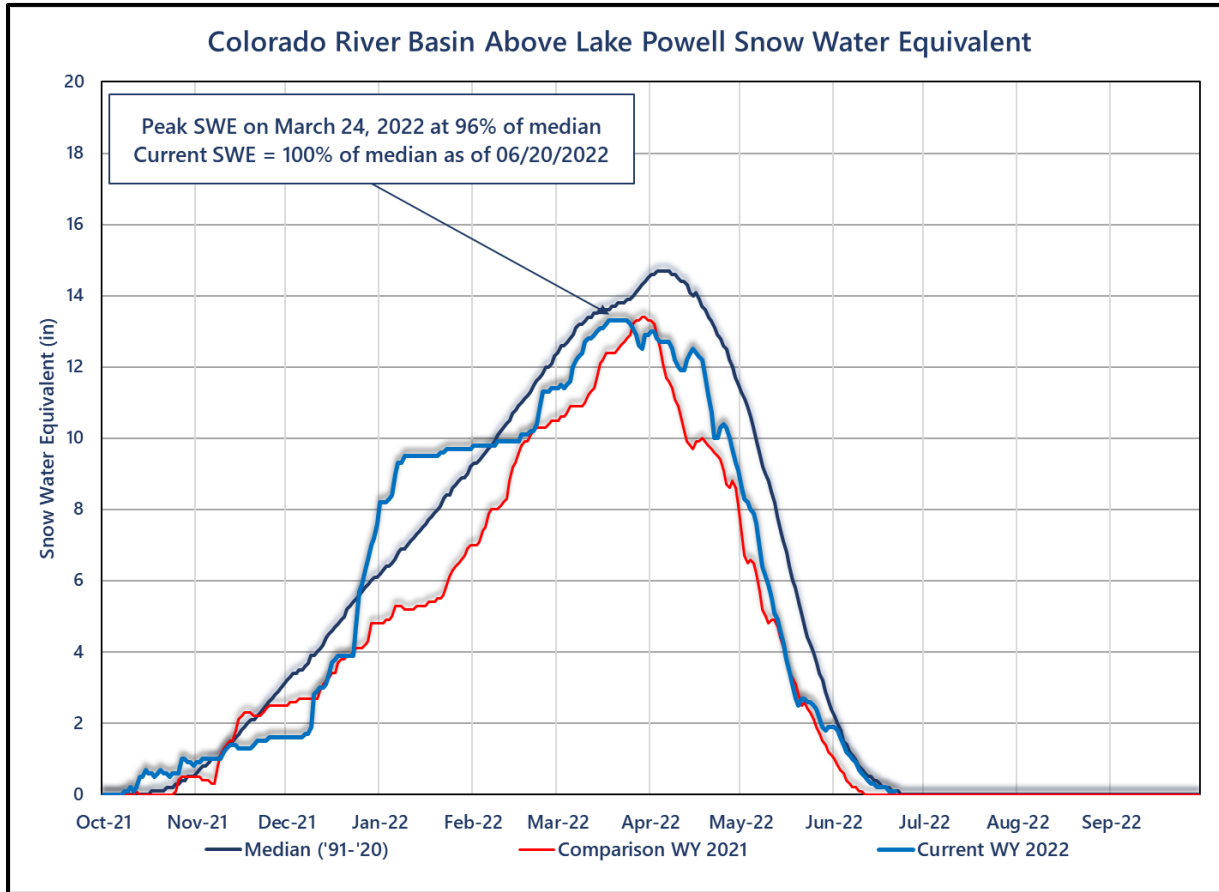
FG June April-July Forecast = 520 kaf (54% of avg)



Yampa June April-July Forecast = 880 kaf (74% of avg)



Upper Colorado SWE and Observed Inflows



<https://waterwatch.usgs.gov/index.php>



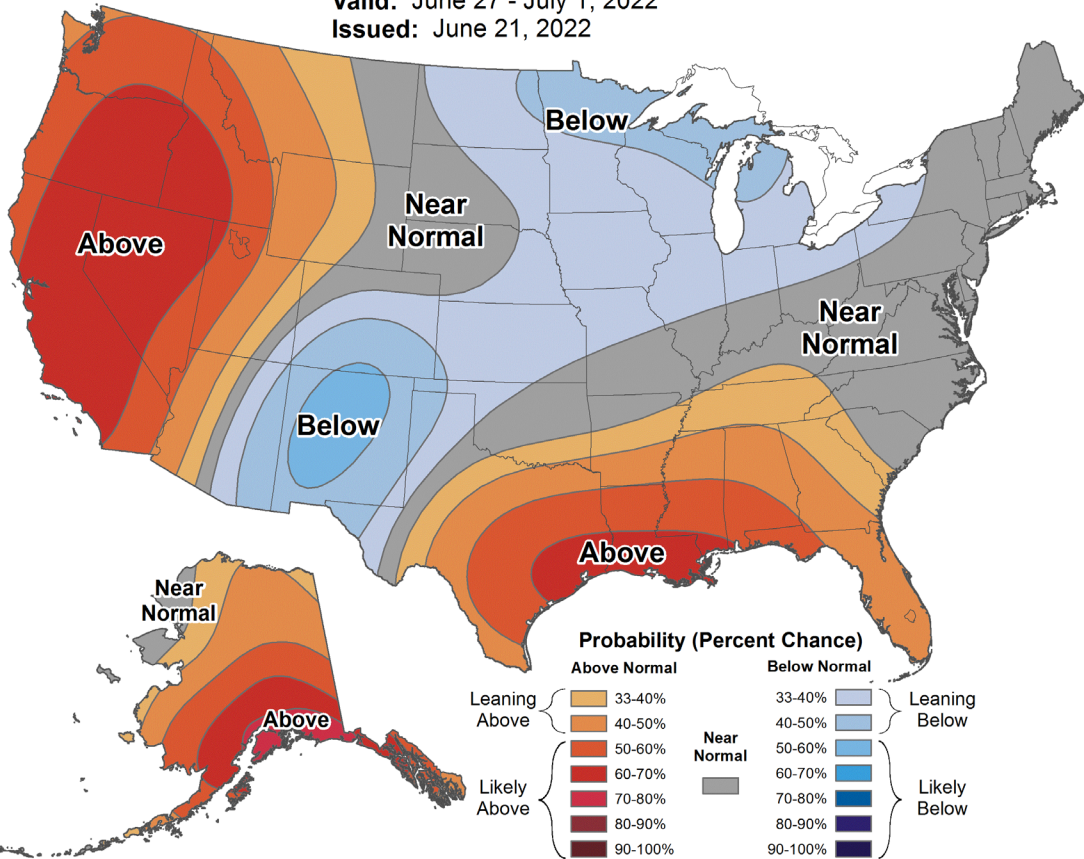
Precipitation and Temperature Outlook



6-10 Day Temperature Outlook



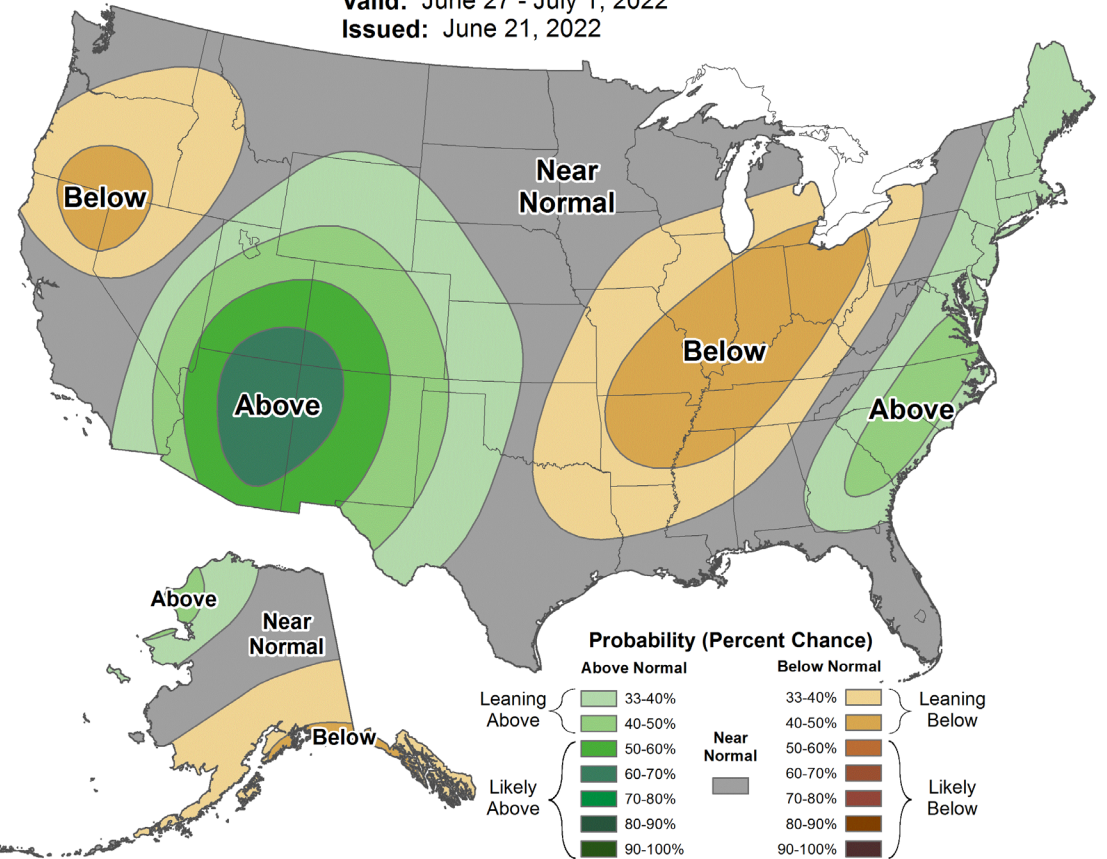
Valid: June 27 - July 1, 2022
 Issued: June 21, 2022



6-10 Day Precipitation Outlook



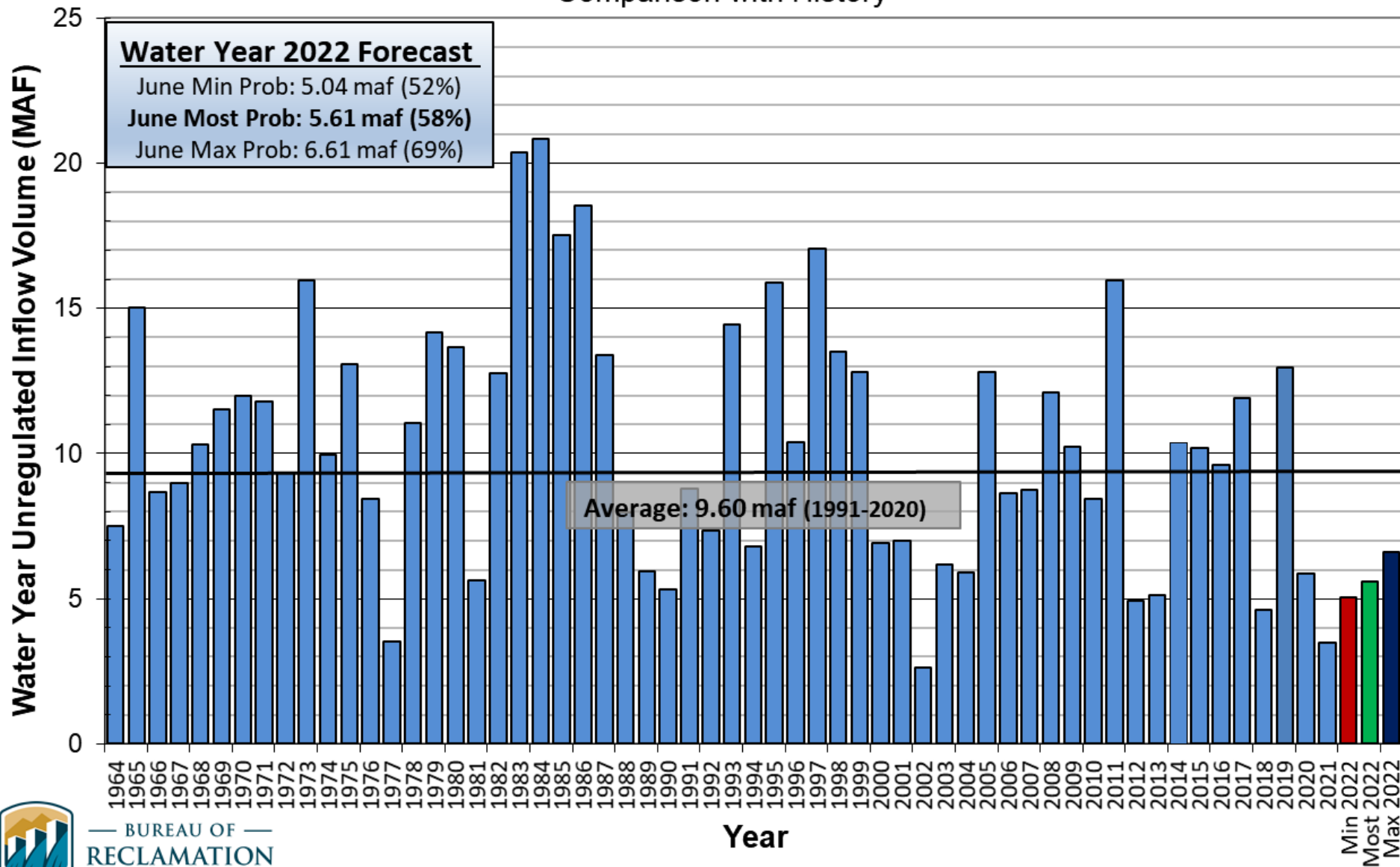
Valid: June 27 - July 1, 2022
 Issued: June 21, 2022



Lake Powell Unregulated Inflow

Water Year 2022 Forecast (issued June 3)

Comparison with History



Most Probable June Forecast Water Year 2022

April – July 2022
Forecasted Unregulated Inflow
as of June 2, 2022

Reservoir	Unregulated Inflow (kaf)	Percent of Avg
Fontenelle	435	59
Flaming Gorge	520	54
Blue Mesa	430	68
Navajo	310	49
Powell	3,500	55

Water Year 2022
Forecasted Unregulated Inflow
as of June 3, 2022

Reservoir	Unregulated Inflow (kaf)	Percent of Avg
Fontenelle	717	67
Flaming Gorge	861	61
Blue Mesa	637	70
Navajo	457	50
Powell	5,610	58





Upper Colorado Basin

**Projected Operations
for Water Years 2022
and 2023 Based on and
June 2022 Modeling**



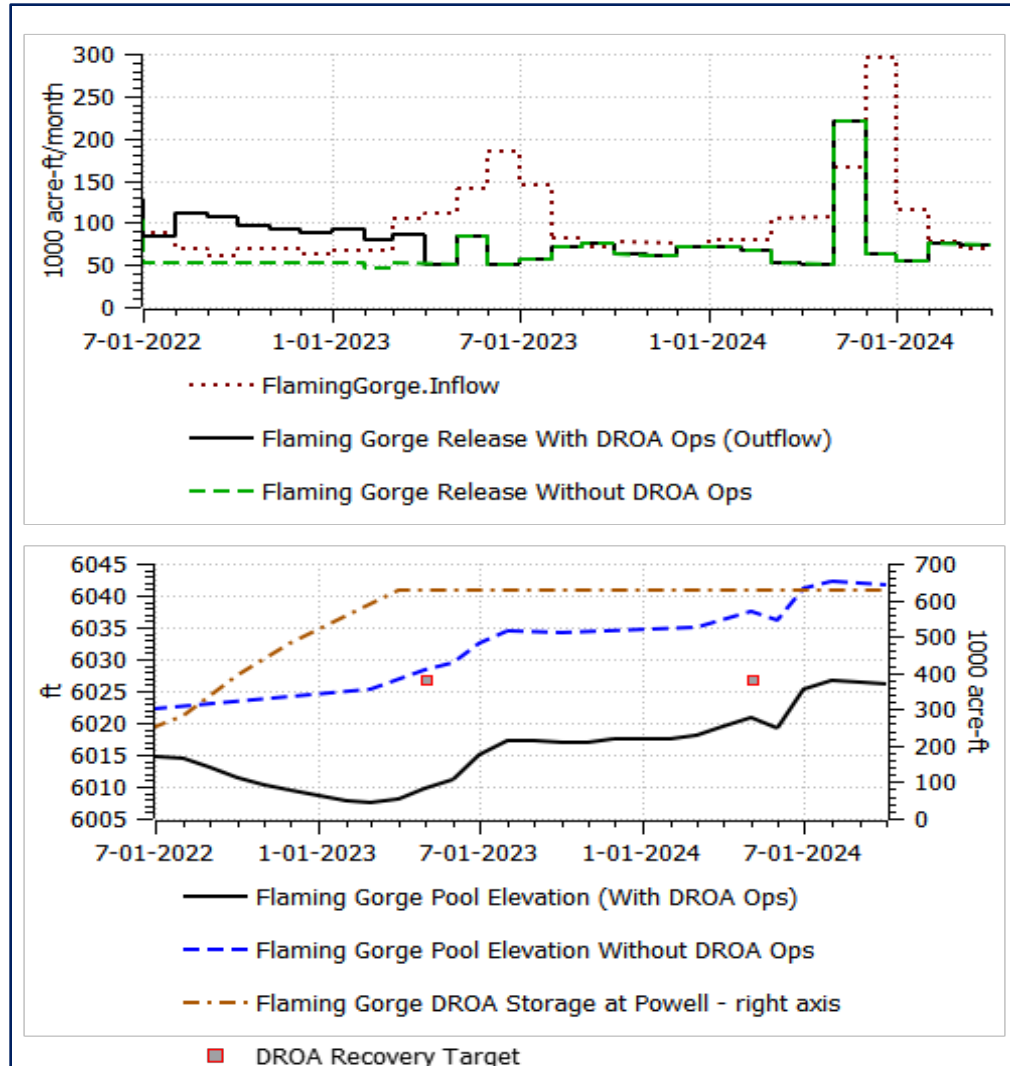
Upper Basin Drought Response Actions

- The Bureau of Reclamation announced on May 3, 2022, two separate urgent drought response actions that will help prop up Lake Powell by nearly 1 million acre-feet (maf) of water over the next 12 months (May 2022 through April 2023). To protect Lake Powell, more water will flow into the lake from upstream reservoirs and less water will be released downstream:
 - Under a Drought Contingency Plan adopted in 2022, approximately 500 thousand acre-feet (kaf) of water will come from Flaming Gorge Reservoir, located approximately 455 river miles upstream of Lake Powell (2022 Plan).
 - For more information: <https://www.usbr.gov/uc/DocLibrary/Plans/20220429-2022DroughtResponseOperationsPlan-ApprovalMemo-508-DOI.pdf>.
 - Another 480 kaf will be left in Lake Powell by reducing Glen Canyon Dam's annual release volume from 7.48 maf to 7.00 maf (GC Operational Adjustment), in accordance with Sections 6 and 7.D of the 2007 Interim Guidelines.
 - For more information: <https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf>

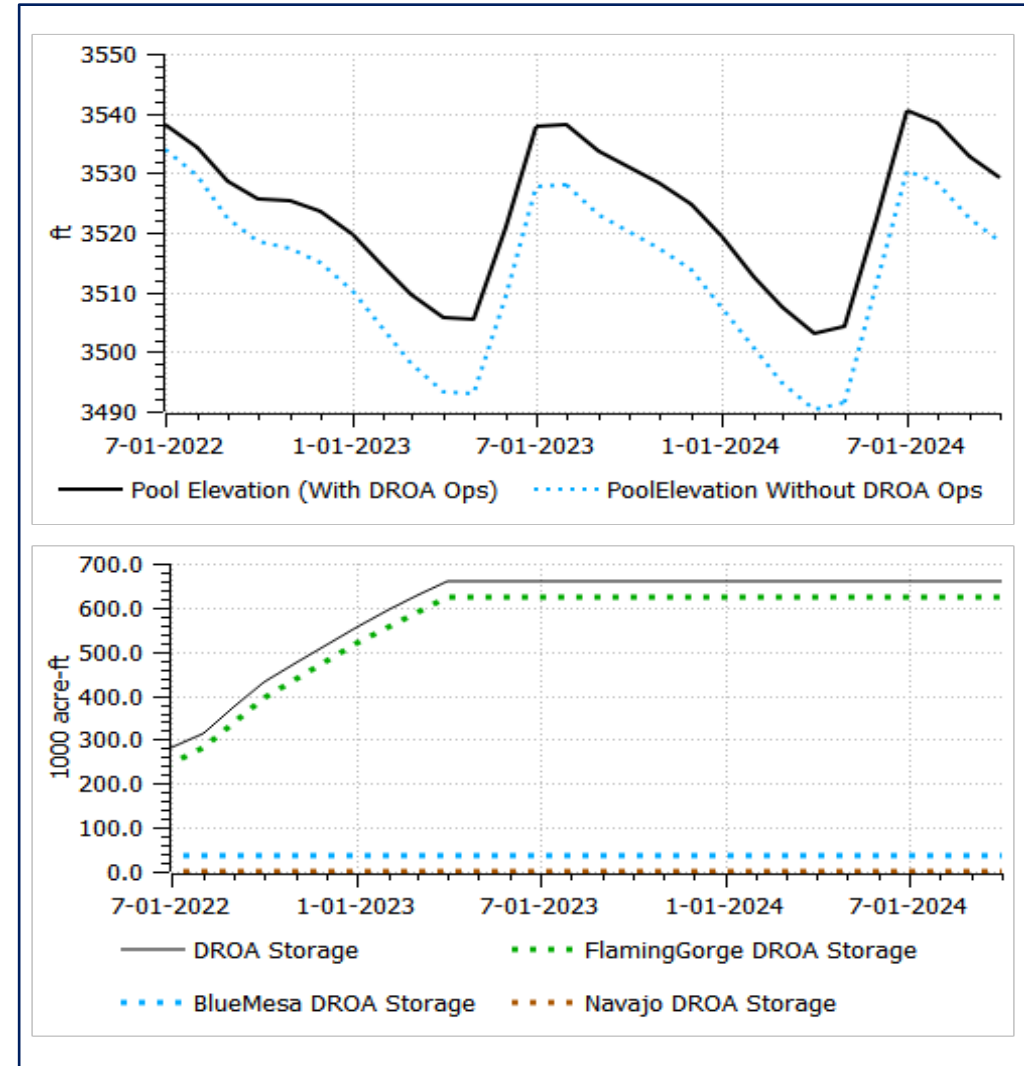


June 2022 24MS 2022 Plan Operations

Flaming Gorge Operations

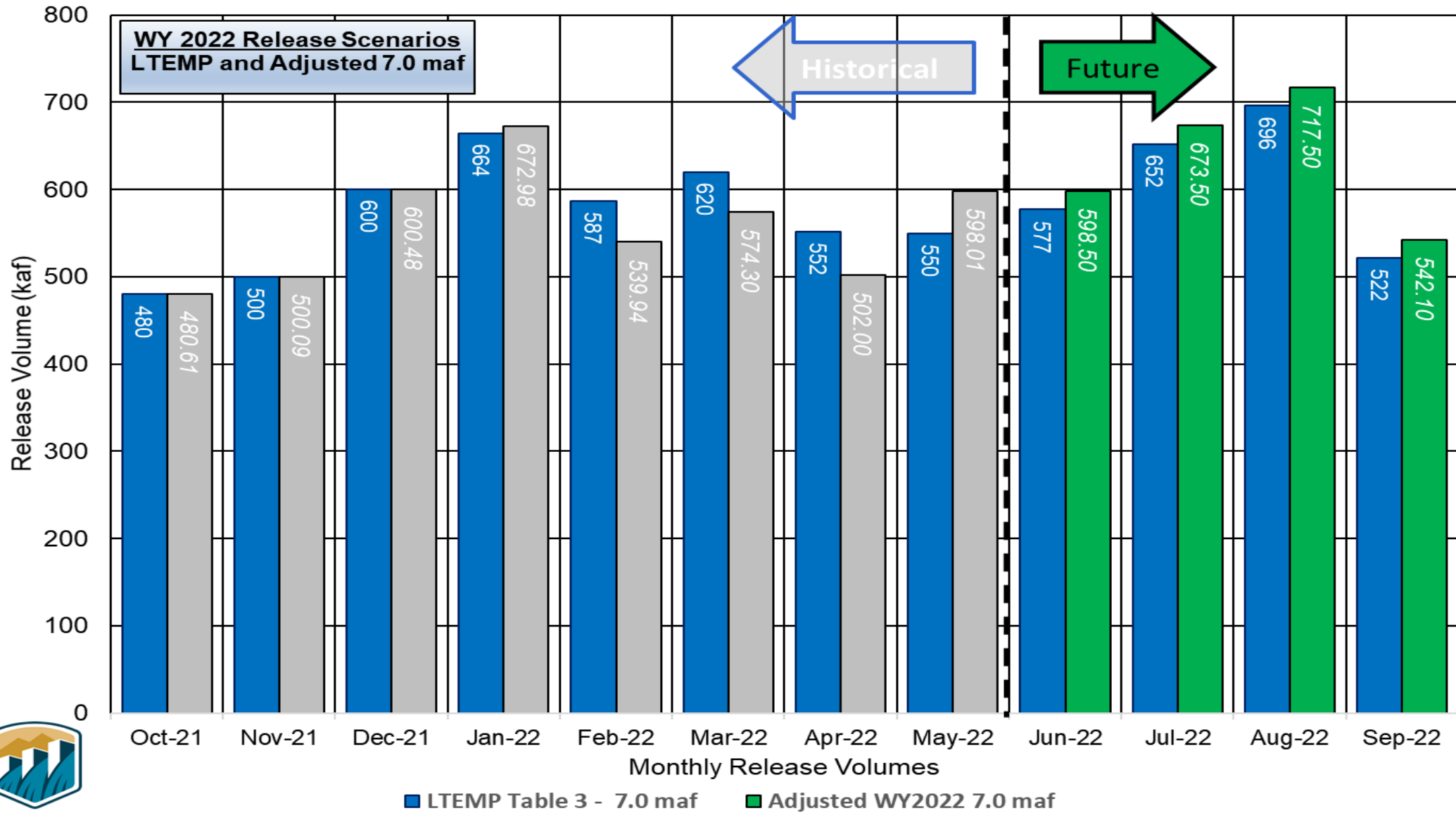


Lake Powell Operations



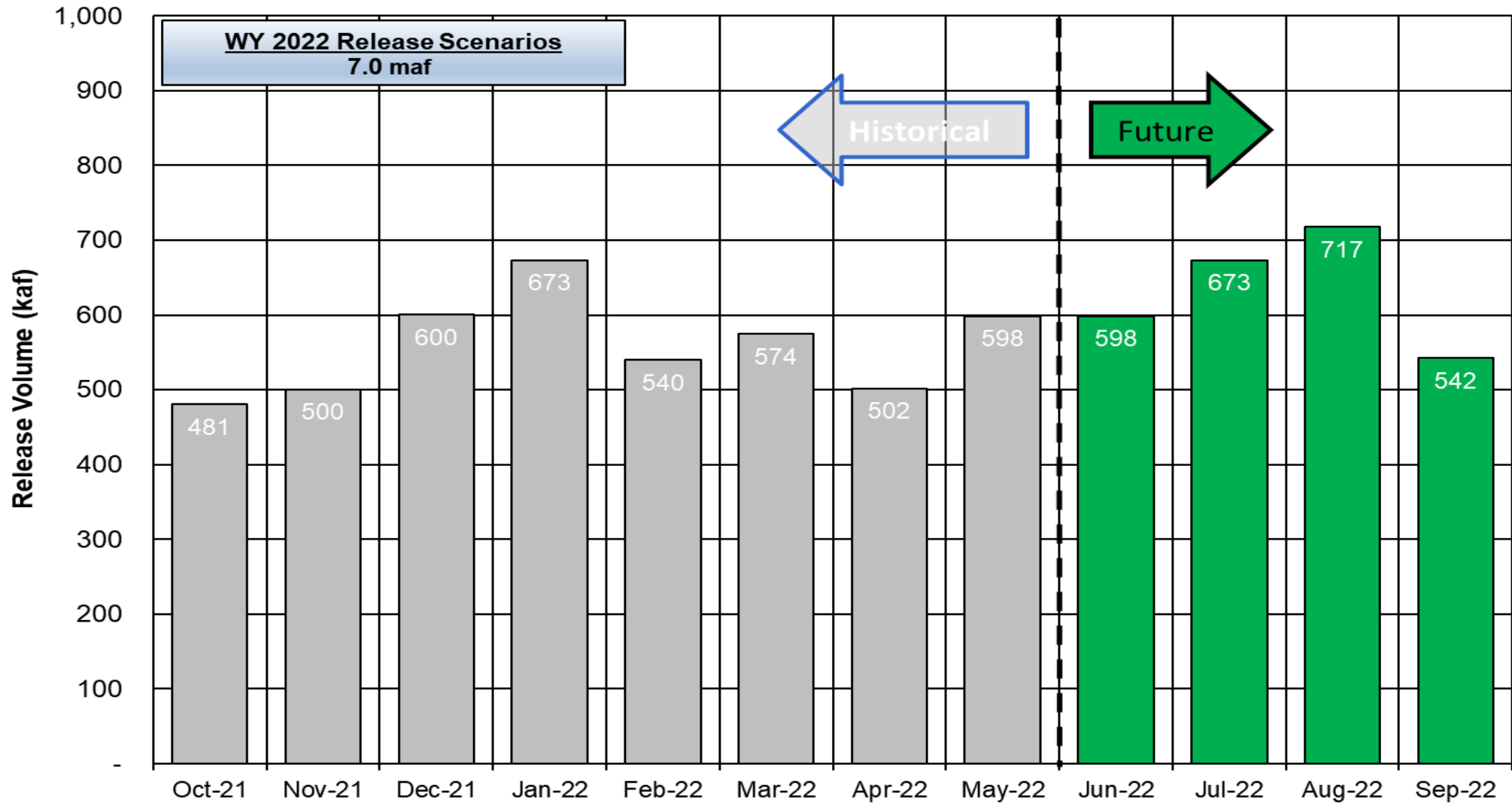
Lake Powell Monthly Release Volume Distribution

June 2022 Modeling of 7.0 maf Pattern for Water Year 2022



Potential Lake Powell Monthly Release Volume Distribution

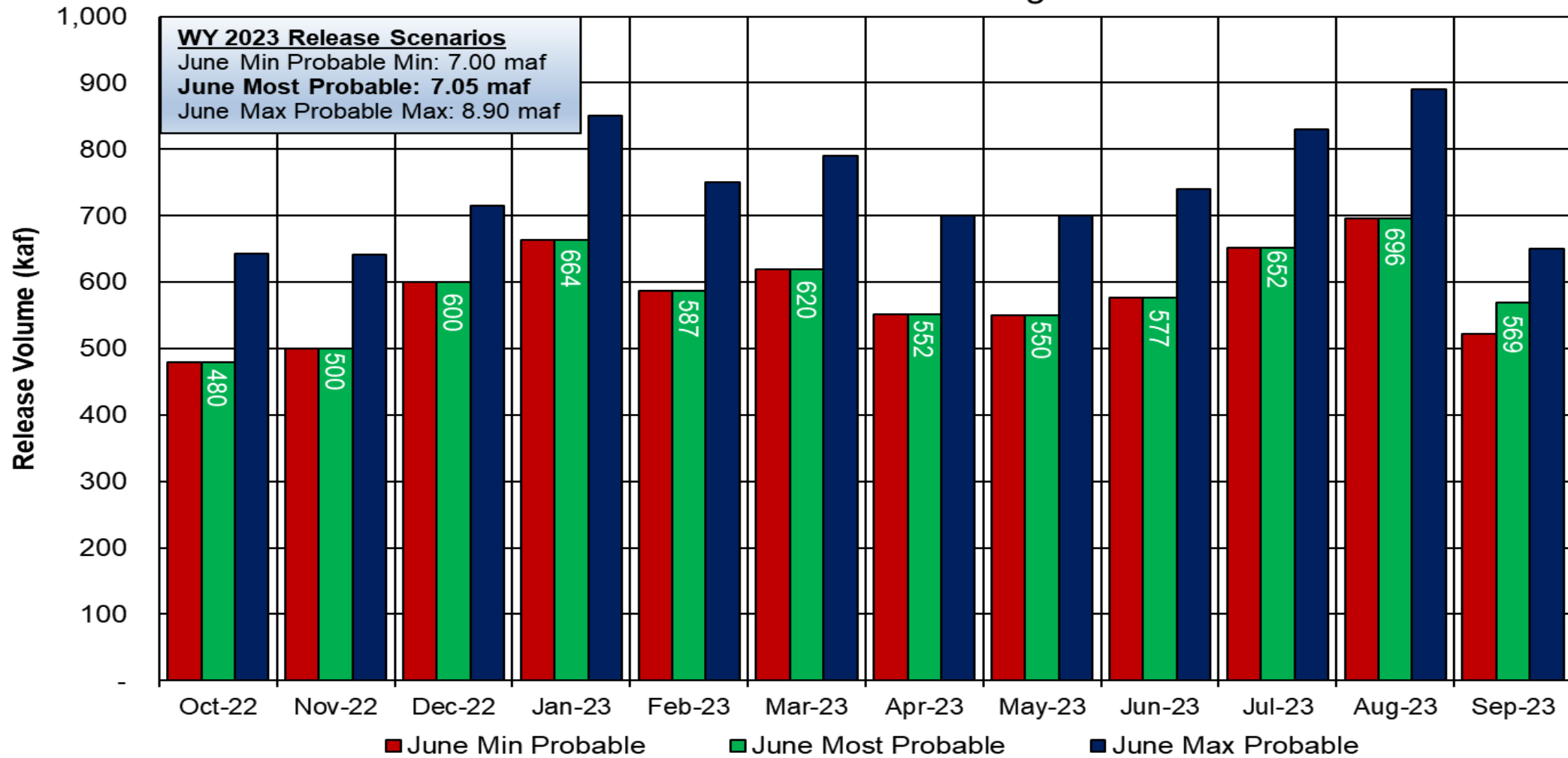
June 2022 Modeling of Release Scenarios for Water Year 2022



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023

Based on June 2022 Modeling



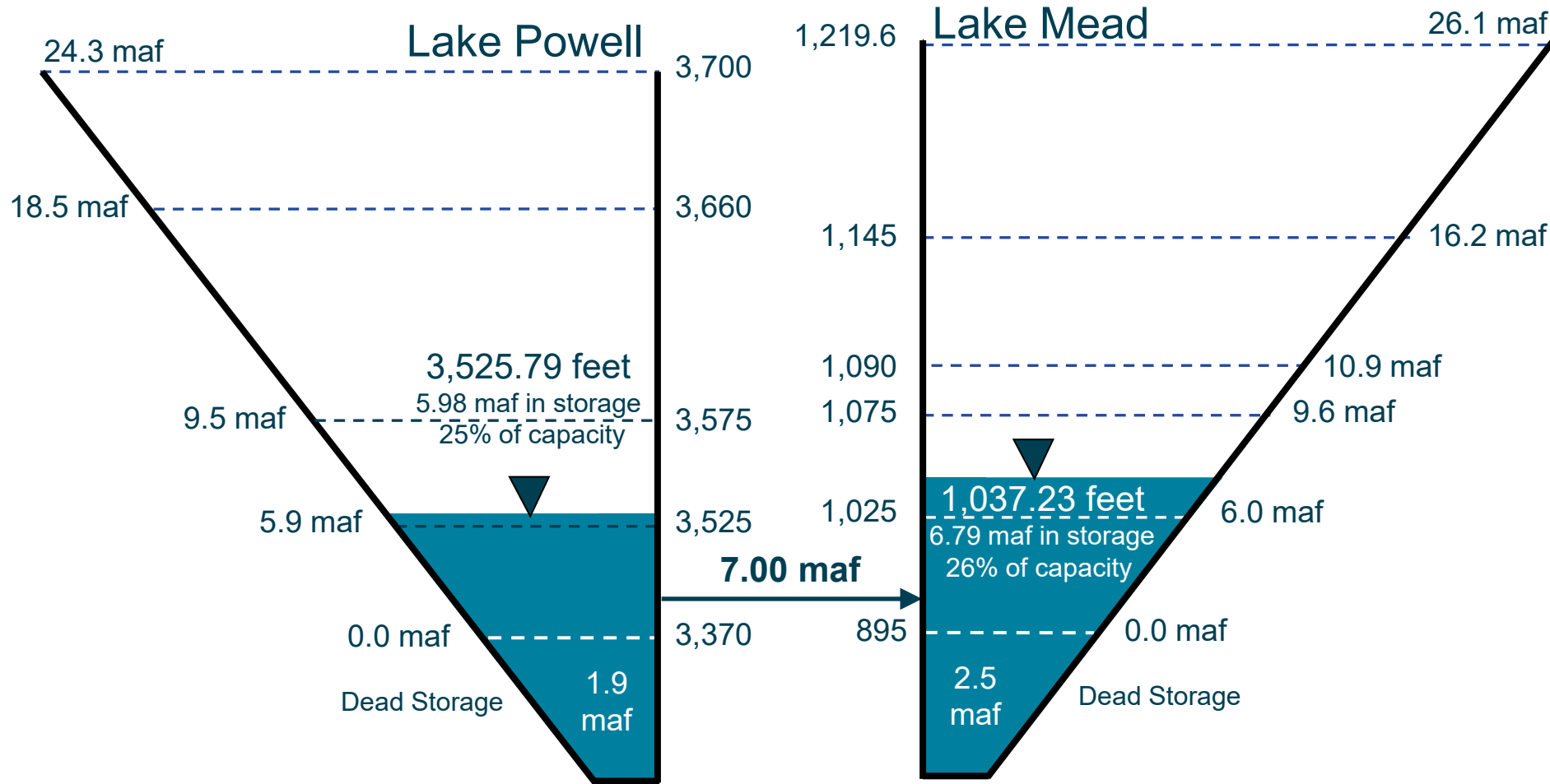
The operating determination for upcoming years will be based on a projected “tier” elevation in the August 2022 24-Month Study. Based on June 2022 24-Month Study modeling, Lake Powell’s operating condition for water year 2023 is projected to be within the Lower Elevation Balancing Tier. The Department of Interior and Reclamation will work with the Basin States to determine the manner in which to operate Glen Canyon Dam to ensure the benefits of the drought actions are preserved.



End of Water Year 2022 Projections

June 2022 24-Month Study Most Probable Inflow Scenario^{1, 2}

Based on a Lake Powell Unregulated Inflow Forecast of 5.61 maf (58% of average)



Not to Scale

¹ WY 2022 unregulated inflow into Lake Powell is based on the CBRFC forecast dated 6/3/22.

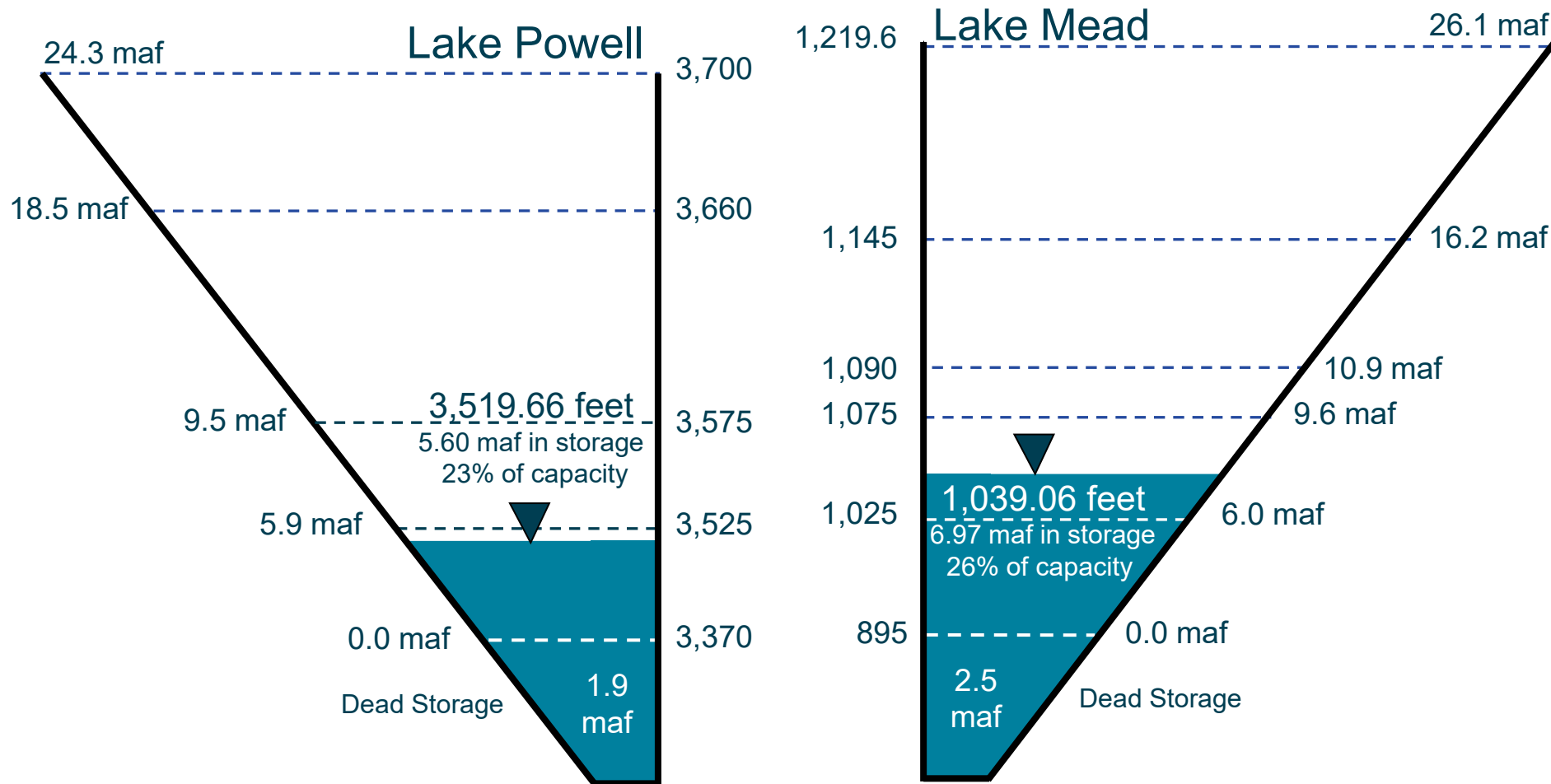
² The teacup diagram displays projected "physical" elevations and storages for Lake Powell and Lake Mead.



End of Calendar Year 2022 Projections

June 2022 24-Month Study Most Probable Inflow Scenario^{1, 2}

Based on a Lake Powell release of 7.00 maf in WY 2022 and 7.05 maf in WY 2023



Not to Scale

¹ WY 2022 & WY 2023 unregulated inflow into Lake Powell is based on the CBRFC forecast dated 6/3/22.

² The teacup diagram displays projected "physical" elevations and storages for Lake Powell and Lake Mead. The operating determinations for upcoming years, however, will be determined by projected "effective" elevations. Based on June 2022 24-Month Study modeling, the effective elevations for end of calendar year 2022 for Lake Powell is 3,511.37 feet and 1,045.95 feet for Lake Mead.



End of Calendar Year 2022 Projections: Effective and Tier Determination Elevations

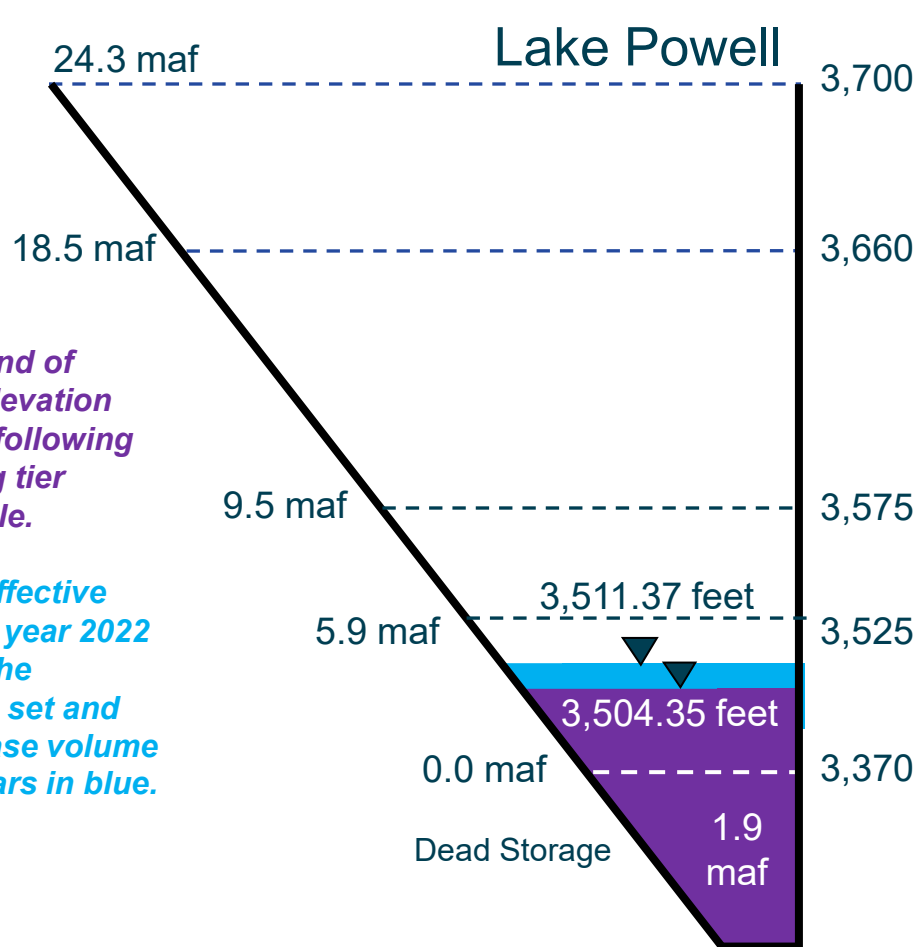
June 2022 24-Month Study Most Probable Inflow Scenario¹

Based on a Lake Powell release of 7.00 maf in WY 2022 and 7.05 maf in WY 2023

Lake Powell

The projected end of calendar year elevation used to set the following year's operating tier appears in purple.

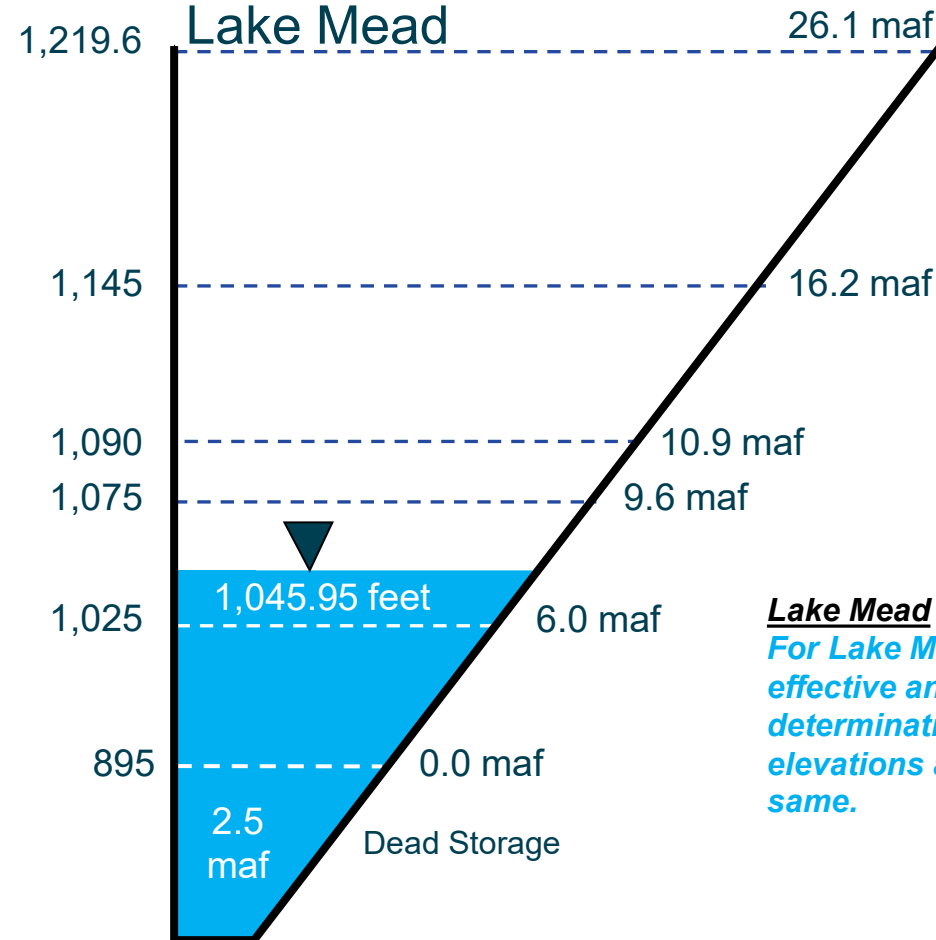
The projected effective end of calendar year 2022 elevation after the operating tier is set and the annual release volume is revised appears in blue.



Lake Mead

Lake Mead

For Lake Mead, the effective and tier determination elevations are the same.



Not to Scale

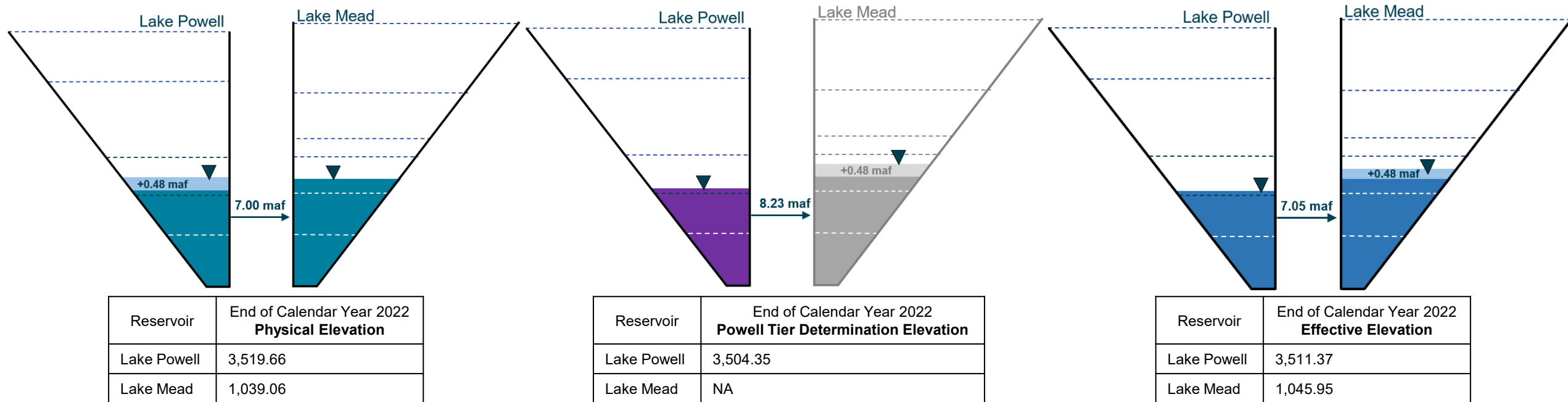


End of Calendar Year 2022 Lake Powell and Lake Mead Elevations^{1,2}

Physical Elevations: Real-time or projected elevations based on a 7.00 maf release from Lake Powell in WY 2022 and 7.05 maf in WY 2023.

Powell Tier Determination: Projected elevation “as if” the additional 0.48 maf were released from Powell in WY 2022 and with an 8.23 maf WY 2023 Powell release.

Effective Elevation & Mead Operating Condition Determination: Projected elevation “as if” the additional 0.48 maf were released from Powell in WY 2022, with an adjusted WY 2023 Powell release of 7.05 maf.



¹ For more information: <https://www.usbr.gov/uc/DocLibrary/Plans/20220503-2022DROA-GlenCanyonDamOperationsDecisionLetter-508-DOI.pdf>.

² Both the Powell Tier Determination and Effective Elevations are “as if” the additional 0.48 maf were released from Powell in WY 2022. Powell’s Tier Determination elevation is used to set the WY 2023 operating tier. For Mead, the Effective Elevation is used to set the CY 2023 operating condition. The Department of Interior and Reclamation will work with the Basin States to



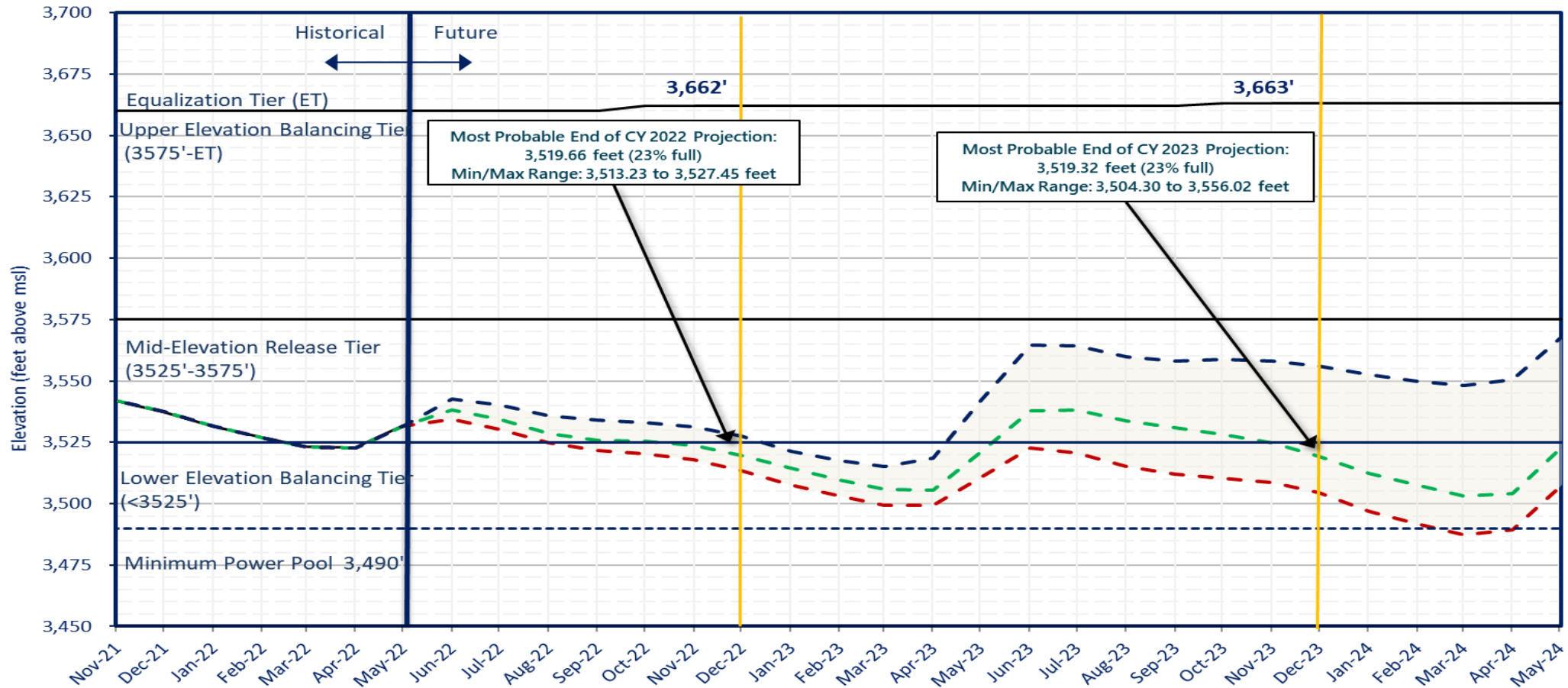
Reclamation Operational Modeling Model Comparison

	Colorado River Mid-term Modeling System (CRMMS)		CRSS
	24-Month Study Mode (Manual Mode)	Ensemble Mode (Rule-based Mode)	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir Operations	Operations input manually	Rule-driven operations	
Probabilistic or Deterministic	Deterministic – single hydrologic trace	Deterministic OR Probabilistic 30 (or more) hydrologic traces	Probabilistic – 100+ traces
Time Horizon (years)	1 - 2	1 - 5	1 - 50
Upper Basin Inflow	Unregulated forecast, 1 trace	Unregulated ESP forecast, 30 traces	Natural flow; historical, paleo, or climate change hydrology
Upper Basin Demands	Implicit, in unregulated inflow forecast		Explicit, 2016 UCRC assumptions
Lower Basin Demands	Official approved or operational		Developed with LB users



Lake Powell End of Month Elevations¹

Projections from the June 2022 24-Month Study Inflow Scenarios



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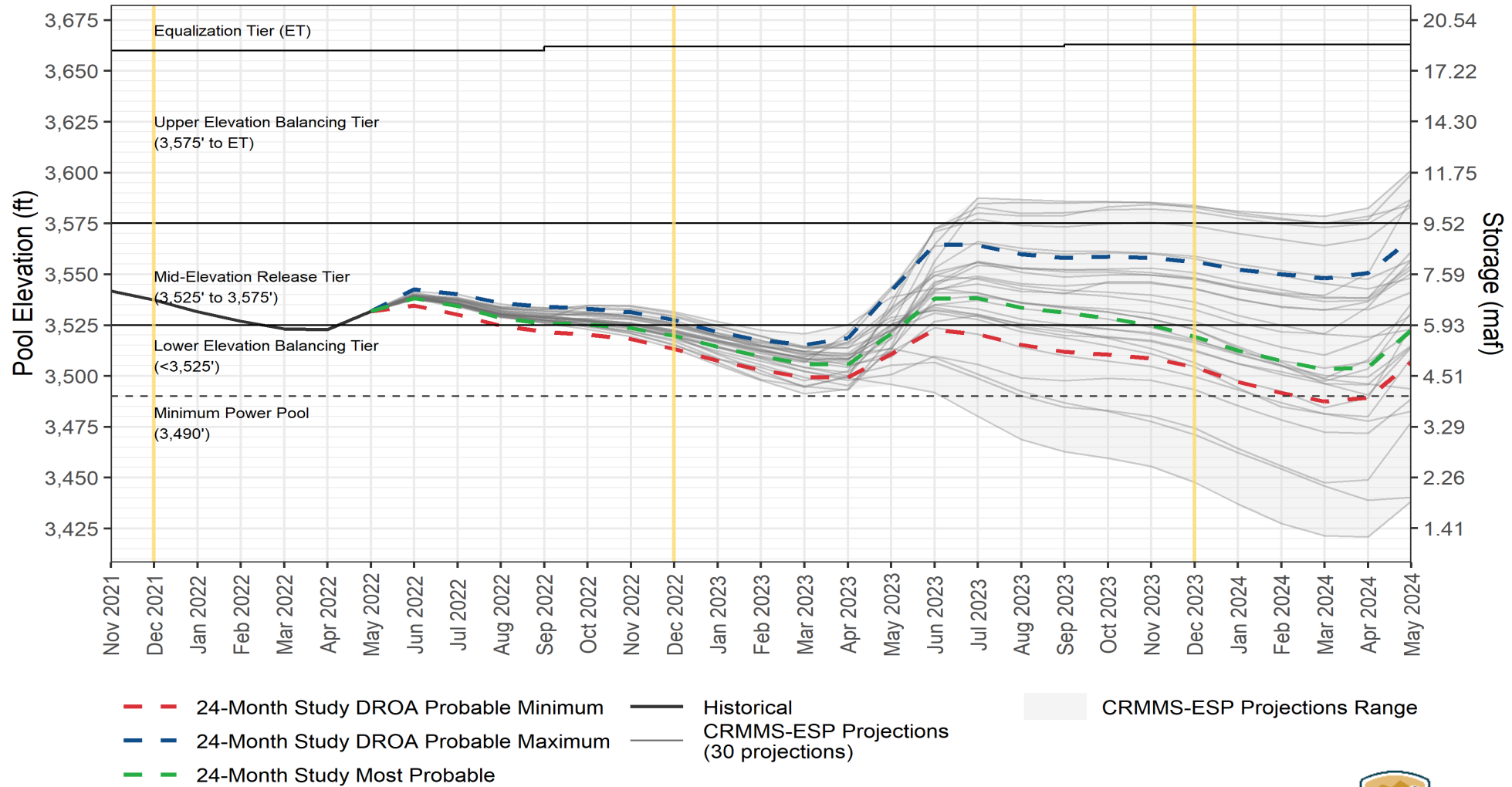
- Historical Elevations
 - - June 2022 Most Probable Inflow - Lake Powell release of 7.0 maf in WY2022 and 7.05 maf in WY2023
 - - June 2022 Minimum Probable Inflow - Lake Powell release of 7.0 maf in WY2022 and 7.0 maf in WY2023
 - - June 2022 Maximum Probable Inflow - Lake Powell release of 7.0 maf in WY2022 and 8.90 maf in WY2023
- ¹Projected Lake Powell end-of-month physical elevations from the latest 24-Month Study inflow scenarios. Additional information can be found here: <https://www.usbr.gov/dcp/droa.html>

The chart above displays projected “physical” elevations for Lake Powell. The operating determination for upcoming years, however, will be based on a projected “tier” elevation in the August 2022 24-Month Study. Based on June 2022 24-Month Study modeling, Lake Powell’s operating condition for water year 2023 is projected to be within the Lower Elevation Balancing Tier. The Department of Interior and Reclamation will work with the Basin States to determine the manner in which to operate Glen Canyon Dam to ensure the benefits of the drought actions are preserved.



Lake Powell End-of-Month Elevations¹

CRMMS Projections from June 2022



¹ Projected Lake Powell end-of-month physical elevations from the latest CRMMS-ESP and 24-Month Study inflow scenarios.

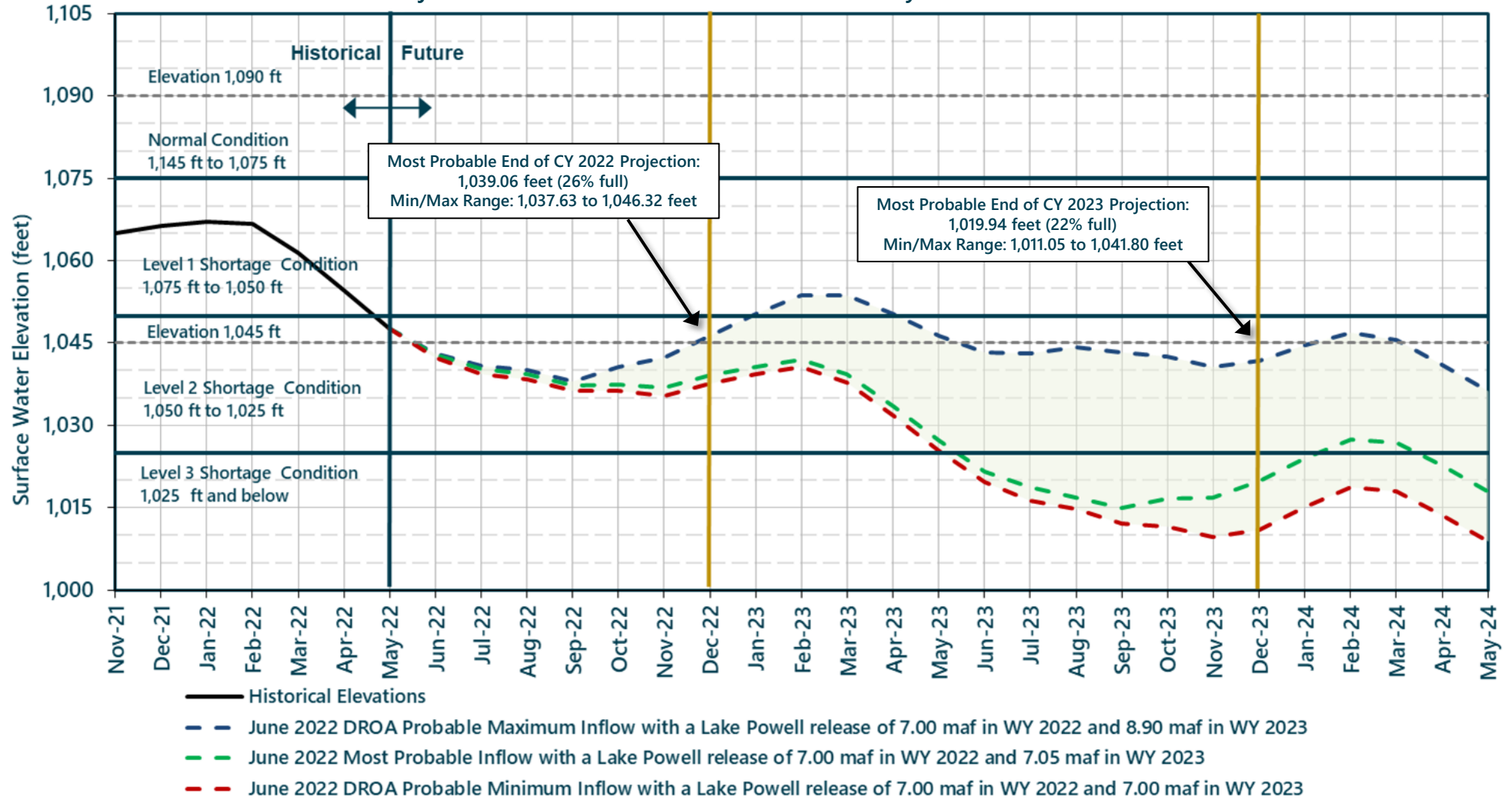


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The chart above displays projected “physical” elevations for Lake Powell. The operating determination for upcoming years, however, will be based on a projected “tier” elevation in the August 2022 24-Month Study. Based on June 2022 24-Month Study modeling, Lake Powell’s operating condition for water year 2023 is projected to be within the Lower Elevation Balancing Tier. The Department of Interior and Reclamation will work with the Basin States to determine the manner in which to operate Glen Canyon Dam to ensure the benefits of the drought actions are preserved.

Lake Mead End of Month Elevations¹

Projections from the June 2022 24-Month Study Inflow Scenarios



¹ Projected Lake Mead end of month physical elevations from the latest 24-Month Study inflow scenarios.

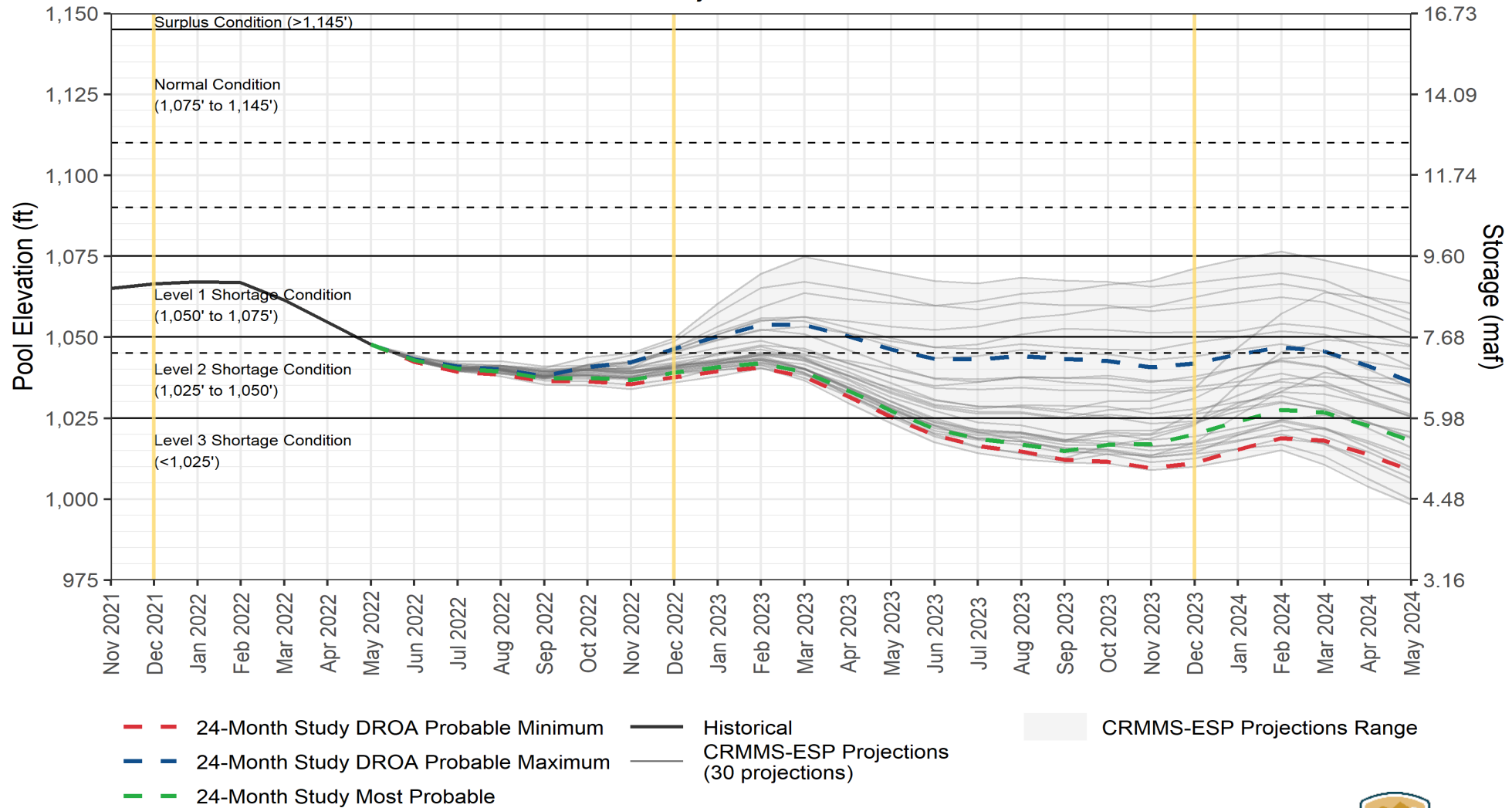
The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.

The chart above displays projected “physical” elevations for Lake Mead. The operating determination for upcoming years, however, will be based on a projected “effective” elevation in the August 2022 24-Month Study. Based on June 2022 24-Month Study modeling, Lake Mead’s operating condition for calendar year 2023 is projected to be within the 1,045 – 1,050 elevation band.



Lake Mead End-of-Month Elevations¹

CRMMS Projections from June 2022



¹ Projected Lake Mead end-of-month physical elevations from the latest CRMMS-ESP and 24-Month Study inflow scenarios.



The chart above displays projected “physical” elevations for Lake Mead. The operating determination for upcoming years, however, will be based on a projected “effective” elevation in the August 2022 24-Month Study. Based on June 2022 24-Month Study modeling, Lake Mead’s operating condition for calendar year 2023 is projected to be within the 1,045 – 1,050 elevation band.



Upper Colorado Basin

Hydropower Maintenance



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					[Outage]								
2													
3													
4													
5								[Outage]					
6								[Outage]					
7	[Outage]												
8	[Outage]												
Units Available	6	6	6	6	5	4	6	6	6	6	6	6	
Capacity (cfs)	18,700	18,600	11,700	18,700	14,800	11,300	17,900	14,900	18,500	18,370	18,170	18,080	JUN MOST ²
Capacity (kaf/month)	1,150	1,110	1,110	1,160	810	980	1,000	1,050	1,110	1,130	1,120	1,080	JUN MOST
Max (kaf) ¹	481	500	600	673	540	575	502	598	598	673	717	542	7.0 maf
Most (kaf) ¹	481	500	600	673	540	575	502	598	598	673	717	542	7.0 maf
Min (kaf) ¹	481	500	600	673	540	575	502	598	598	673	717	542	7.0 maf
										(updated 06-14-2022)			

1 Projected release, based on June 2022 minimum, most and maximum probable inflow projections and 24-Month Study model runs.

2 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.



Glen Canyon Dam Power Plant Unit Outage Schedule for 2023

Unit Number	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023
1												■
2												■
3							■	■	■	■	■	■
4	■						■	■	■	■	■	■
5	■	■	■	■	■	■						
6	■	■	■	■	■	■						
7						■						
8						■						
Units Available	5	6	6	6	6	6	6	6	6	6	6	4
Capacity (cfs)	14,720	18,000	17,870	17,670	17,500	17,360	17,350	17,900	18,480	18,490	18,340	11,520
Capacity (kaf/month)	940	1,070	1,100	1,090	950	990	1,020	1,100	1,100	1,140	1,130	750
Max (kaf) ¹	643	642	715	850	750	790	700	700	740	830	890	651
Most (kaf) ¹	480	500	600	664	587	620	552	550	577	652	696	569
Min (kaf) ¹	480	500	600	664	587	620	552	550	577	652	696	522

JUN MOST²

JUN MOST

8.90 maf

7.05 maf

7.0 maf

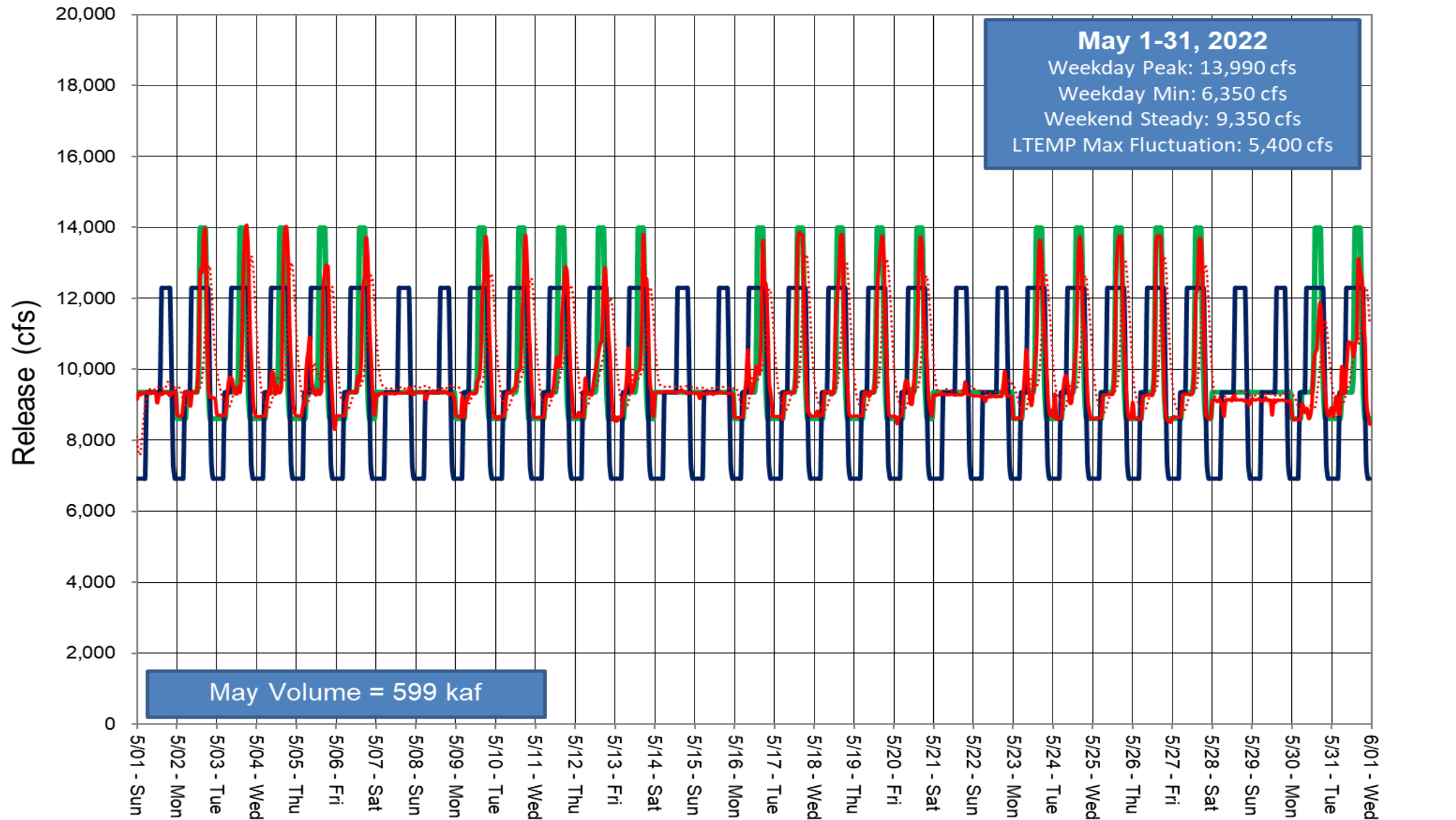
(updated 06-14-2022)

1 Projected release, based on June 2022 minimum, most and maximum probable Inflow Projections and 24-Month Study model runs.

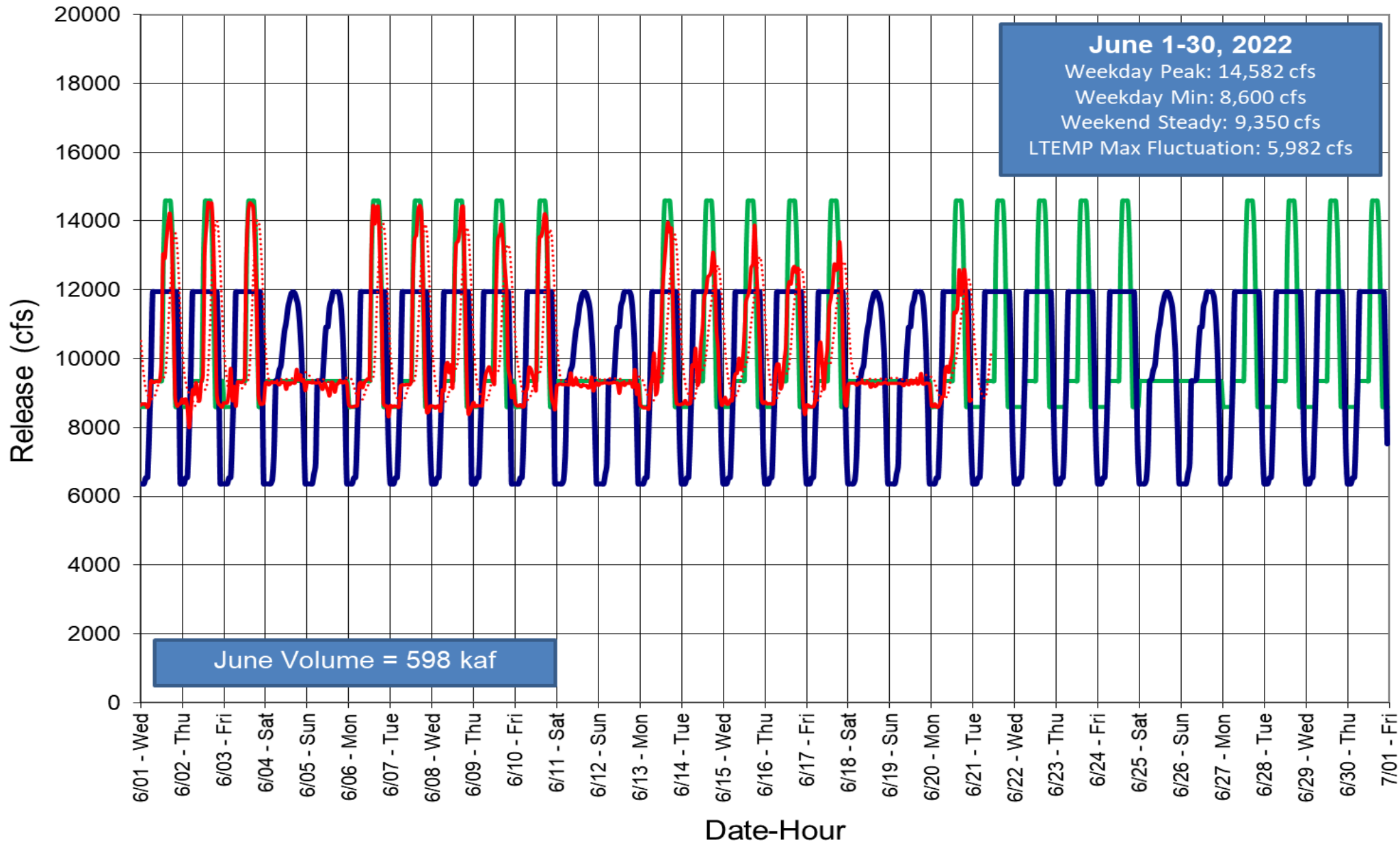
2 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.



Glen Canyon Dam Hourly Release Patterns May 2022



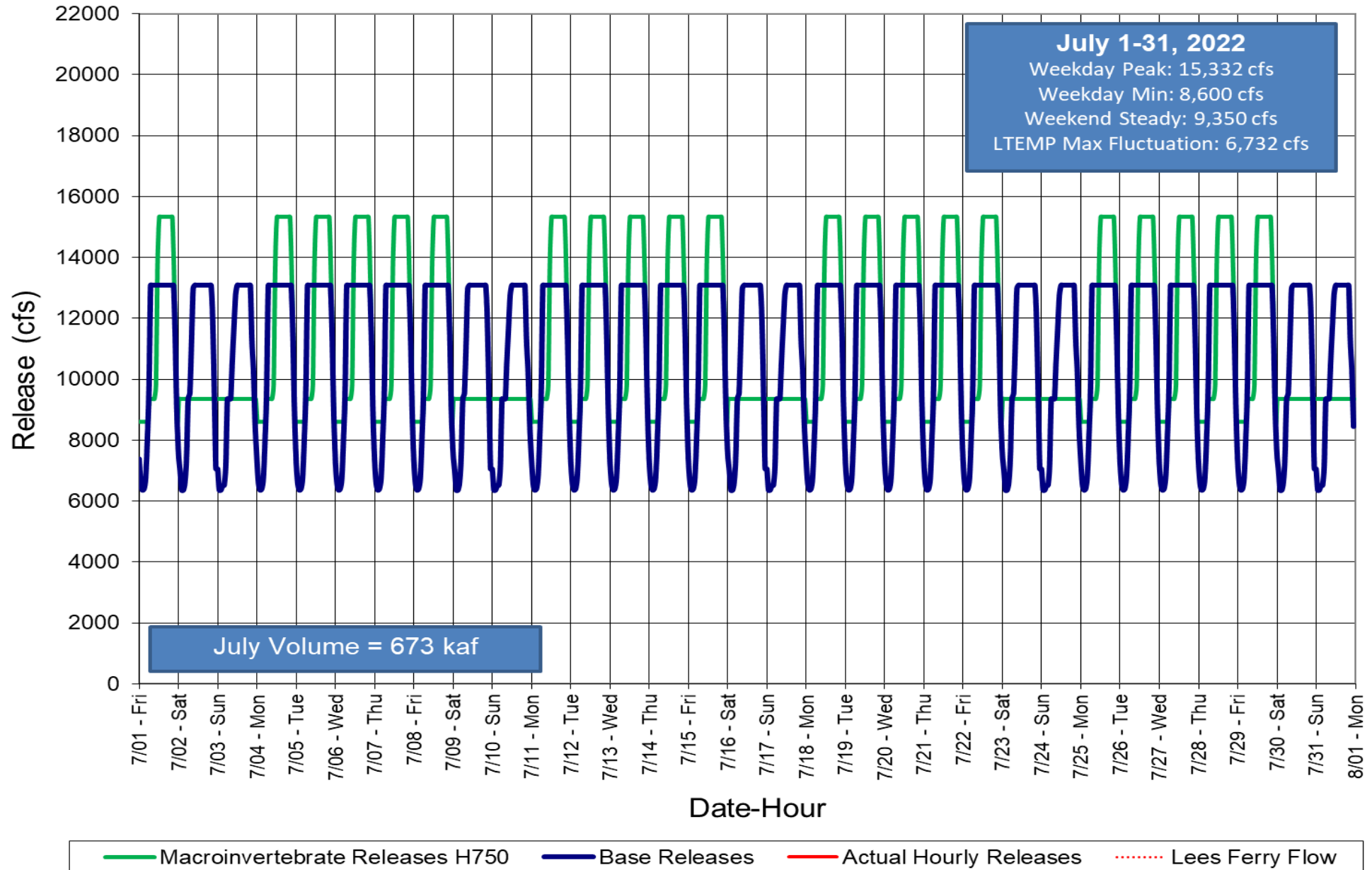
Glen Canyon Dam Hourly Release Pattern June 2022



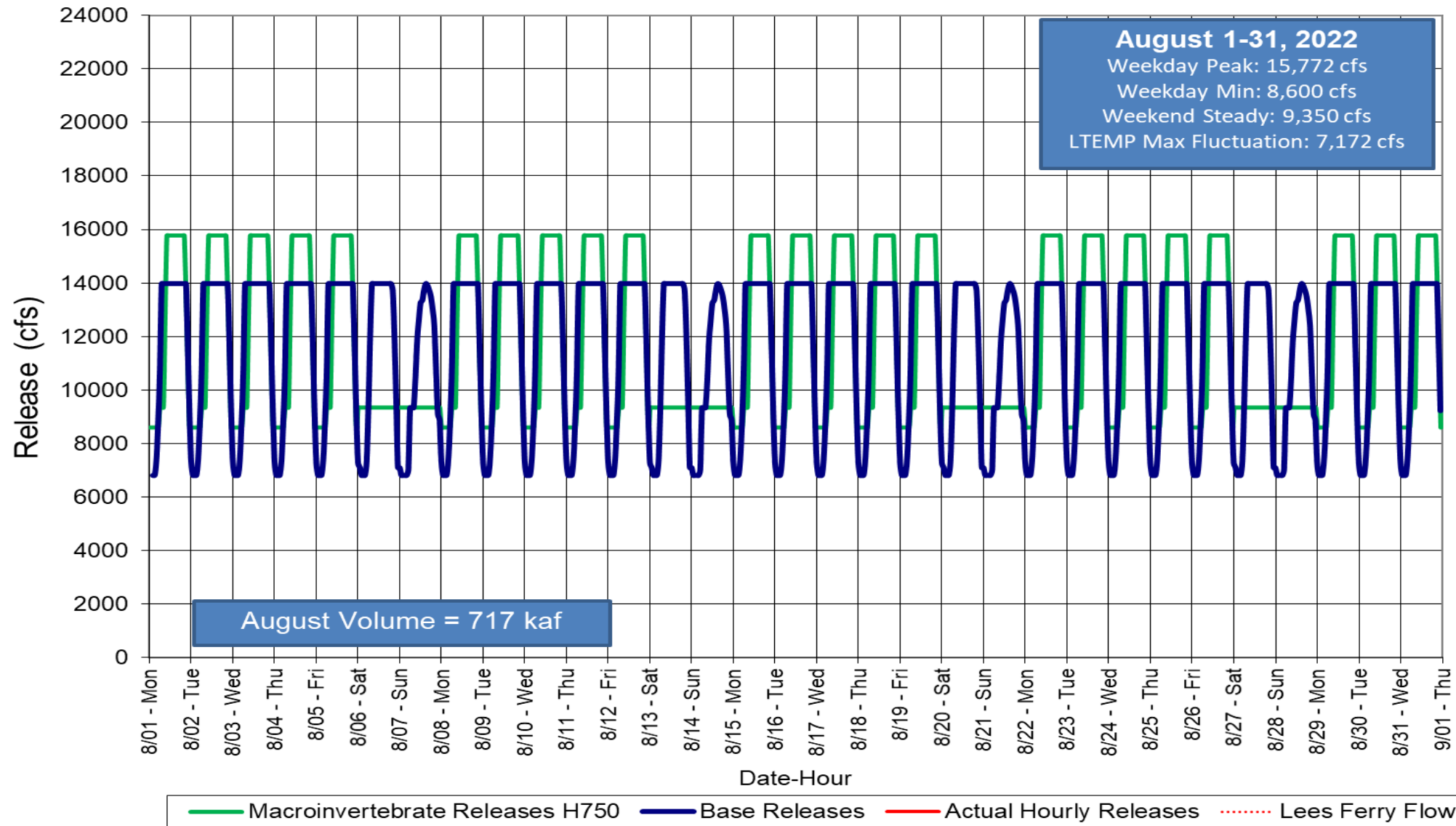
— Macroinvertebrate Releases H750 — Base Releases — Actual Hourly Releases Lees Ferry Flow



Glen Canyon Dam Hourly Release Pattern July 2022



Glen Canyon Dam Hourly Release Pattern August 2022

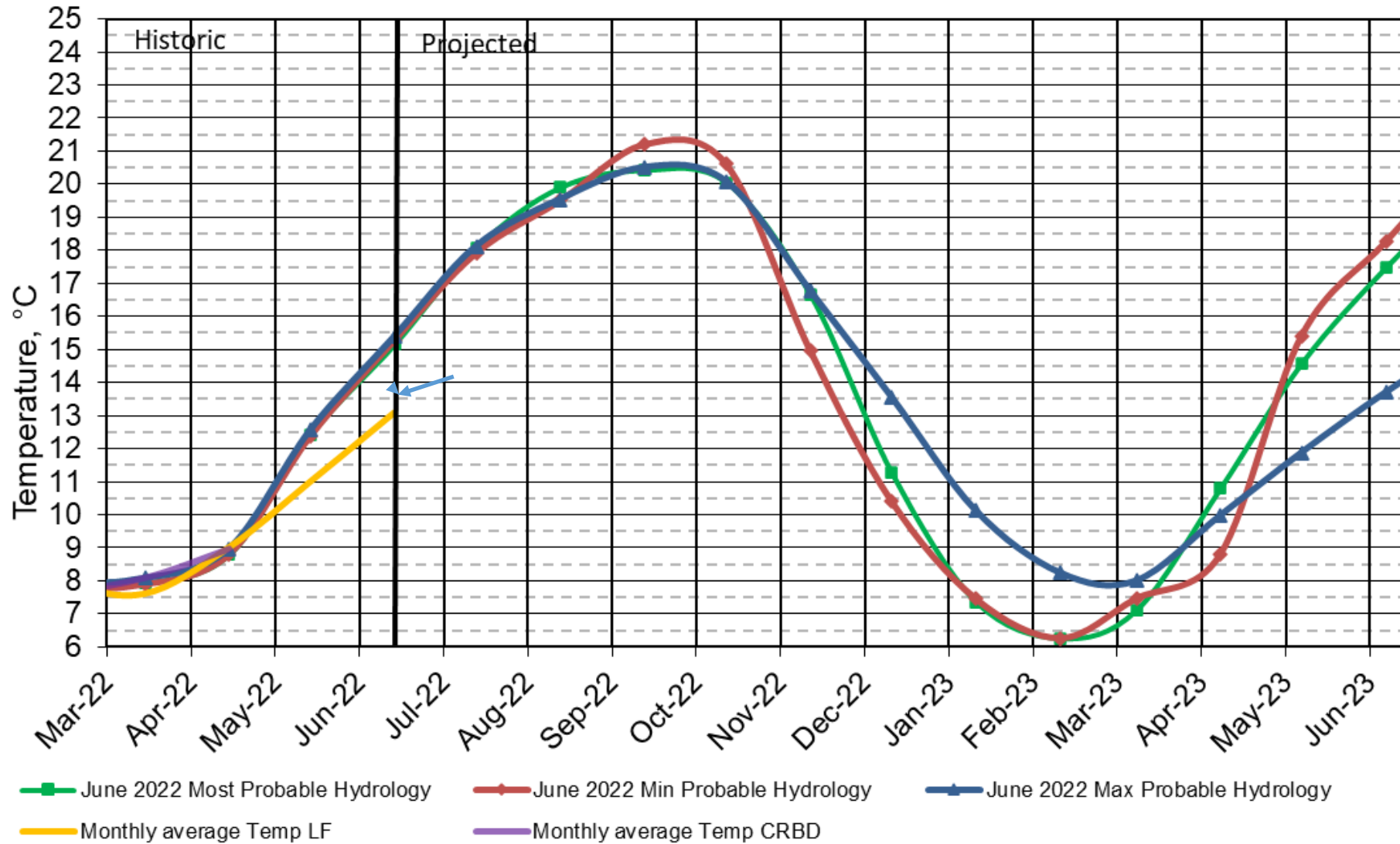


Water Quality



Lake Powell Release Temperature

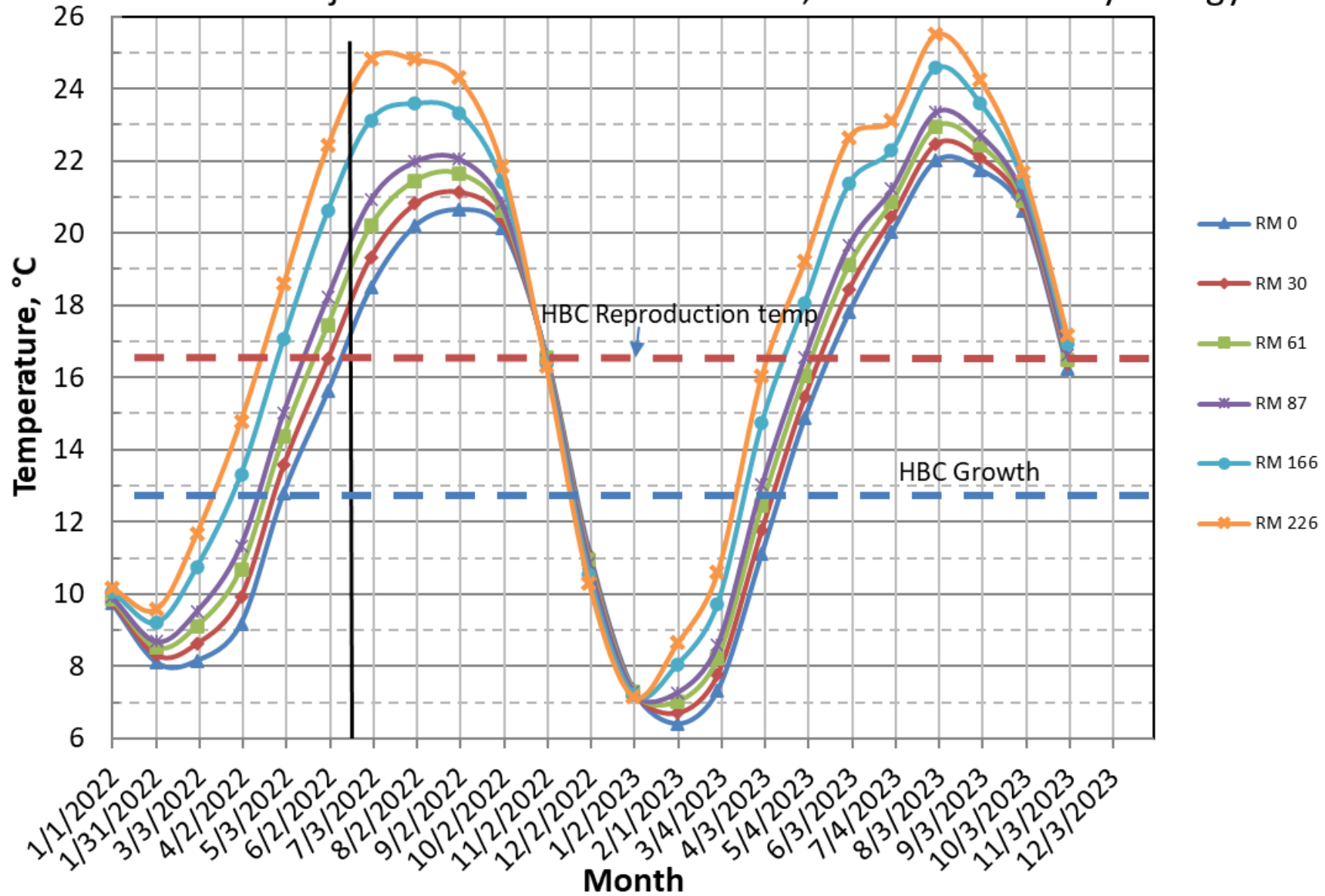
Projected Temperature based on June 2022 Forecast



#Projection start date is based on initial conditions (March 2021)

Colorado River, Grand Canyon Water Temperatures

Projections based on June 2022, Most Probable Hydrology



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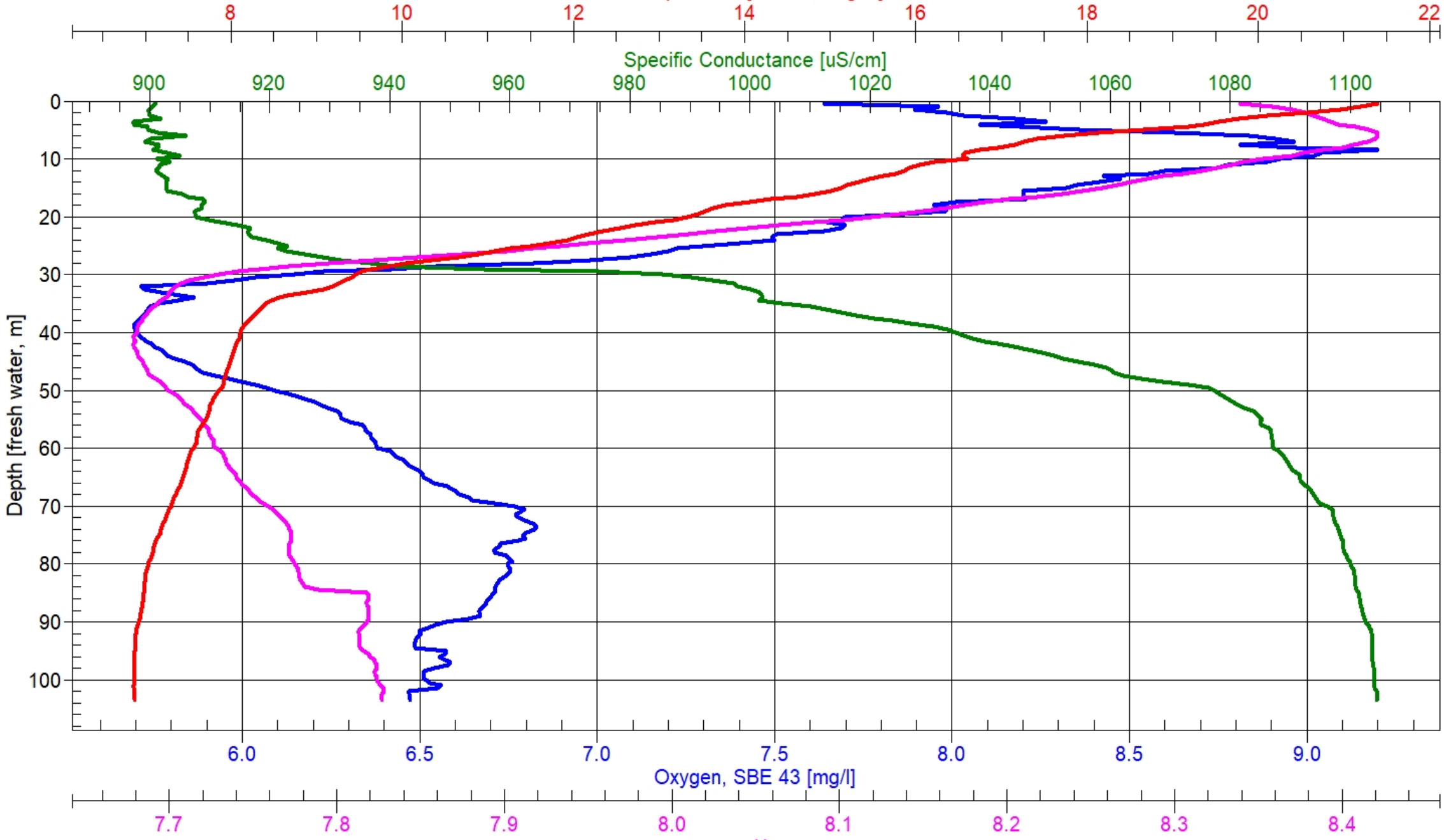
Temperature [ITS-90, deg C]

Specific Conductance [$\mu\text{S}/\text{cm}$]

Depth [fresh water, m]

Oxygen, SBE 43 [mg/l]

pH



Questions?



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