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# Glen Canyon Dam Technical Working Group

## Basin Hydrology, Operations and Water Quality

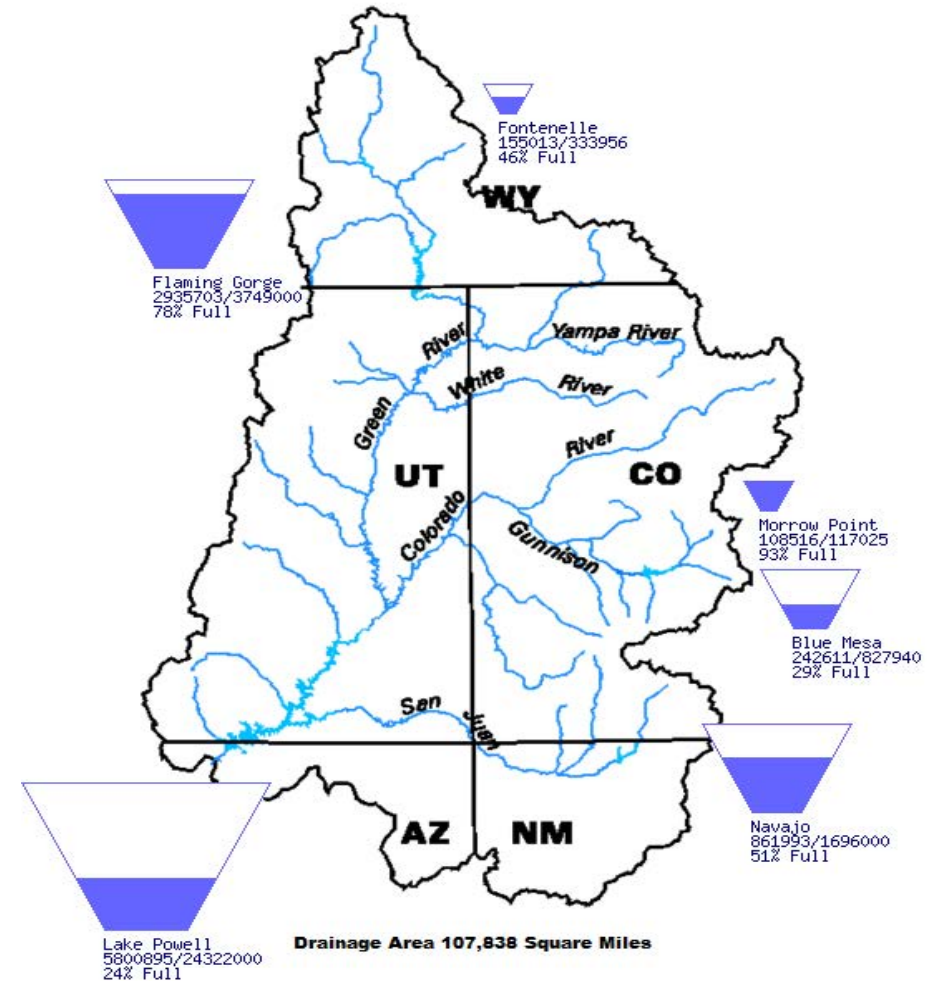
April 12, 2022

# Upper Basin Storage (as of April 11, 2022)

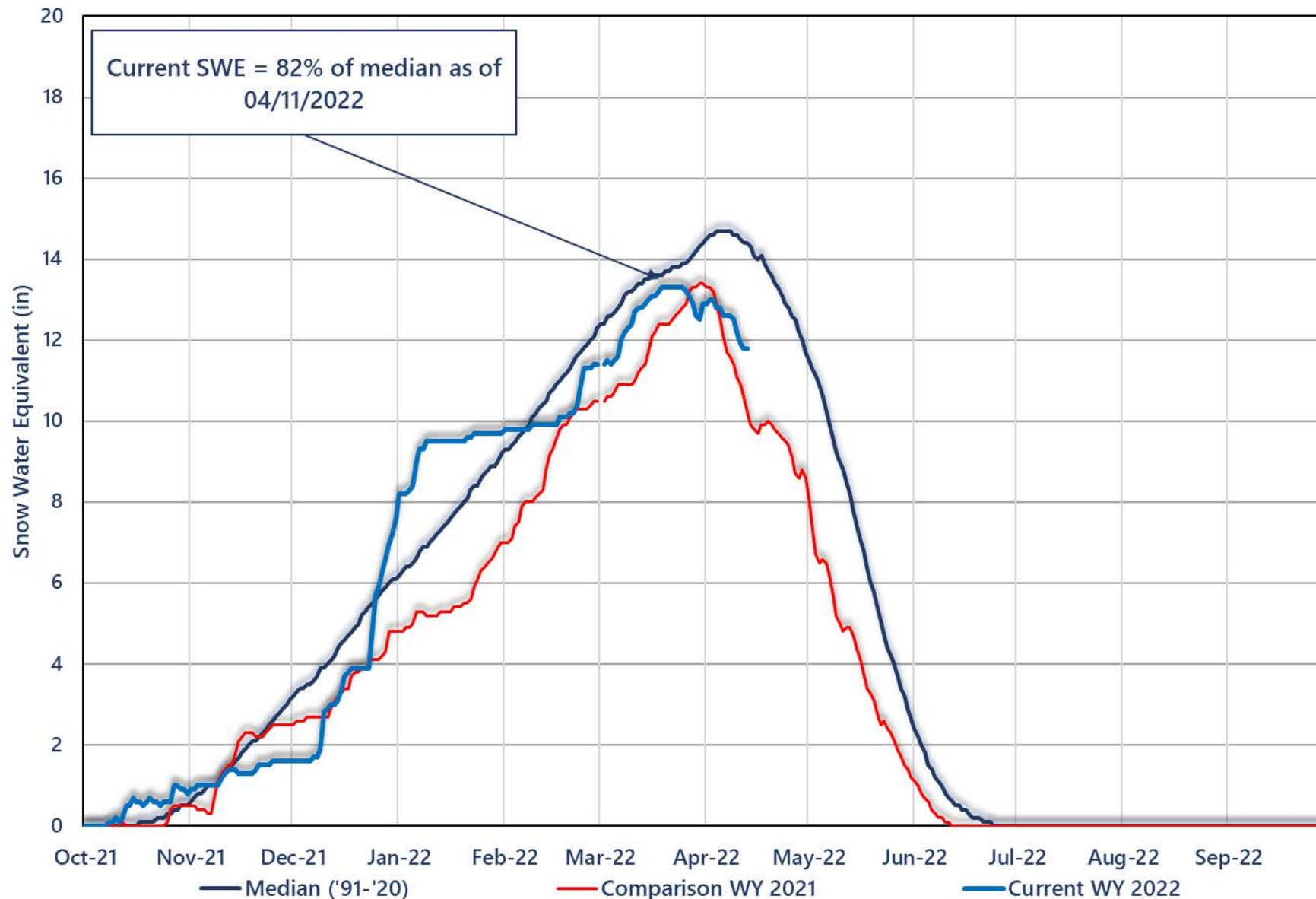
Data Current as of:  
04/10/2022

Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	46	0.16	0.33	6,479.37
Flaming Gorge	78	2.93	3.75	6,018.71
Blue Mesa	29	0.24	0.83	7,436.96
Navajo	51	0.86	1.70	6,019.67
Lake Powell	24	5.79	24.32	3,522.84
UC System Storage	33	10.12	30.93	



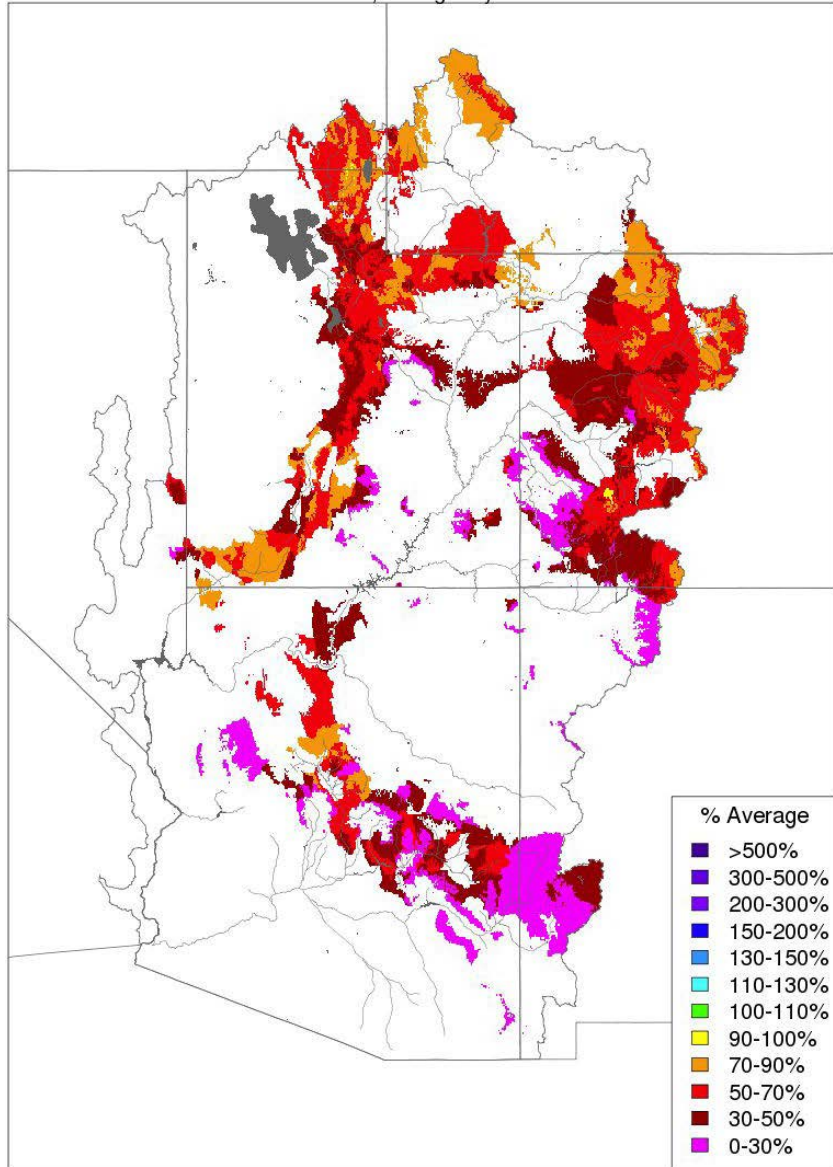
## Colorado River Basin Above Lake Powell Snow Water Equivalent



# Fall Model Soil Moisture Conditions: 2020 vs. 2021

Soil Moisture - Fall - 2020 (November 15)

Modeled, Averaged by Basin



Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)

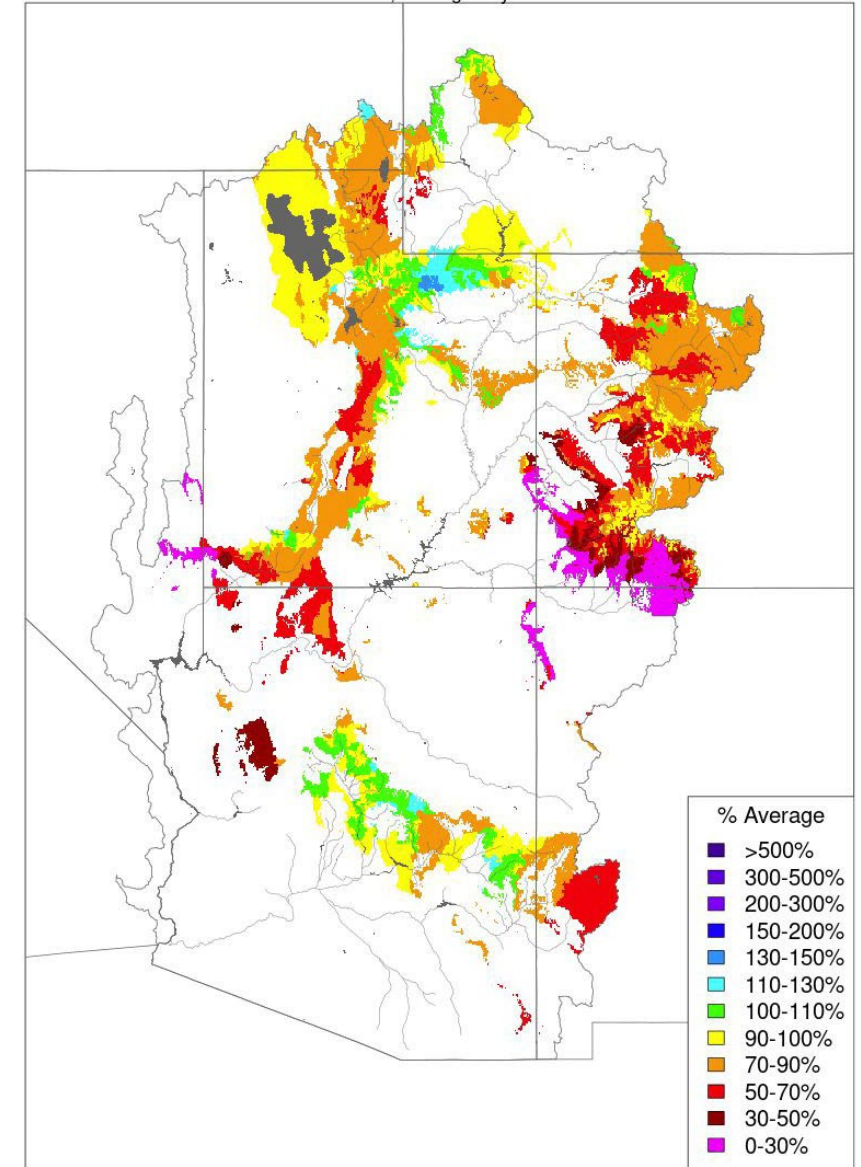
CBRFC model soil moisture conditions are improved from their record/near record dry levels a year ago but remain below to well below normal across many of the major runoff producing areas, notably western Colorado.

The timing and magnitude of spring runoff is ultimately a result of snow conditions, spring weather, and antecedent soil moisture conditions.

Basins with above average soil moisture conditions can be expected to experience more efficient runoff from rainfall or snowmelt while basins with below average soil moisture conditions can be expected to have lower runoff efficiency until soil moisture deficits are fulfilled

Soil Moisture - Fall - 2021 (November 15)

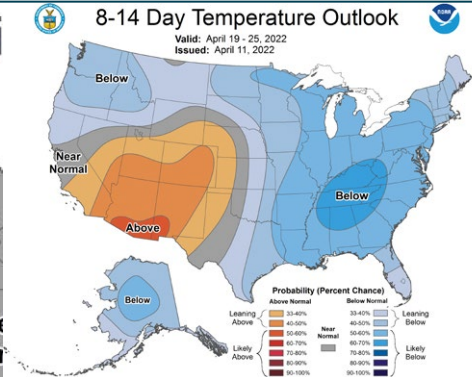
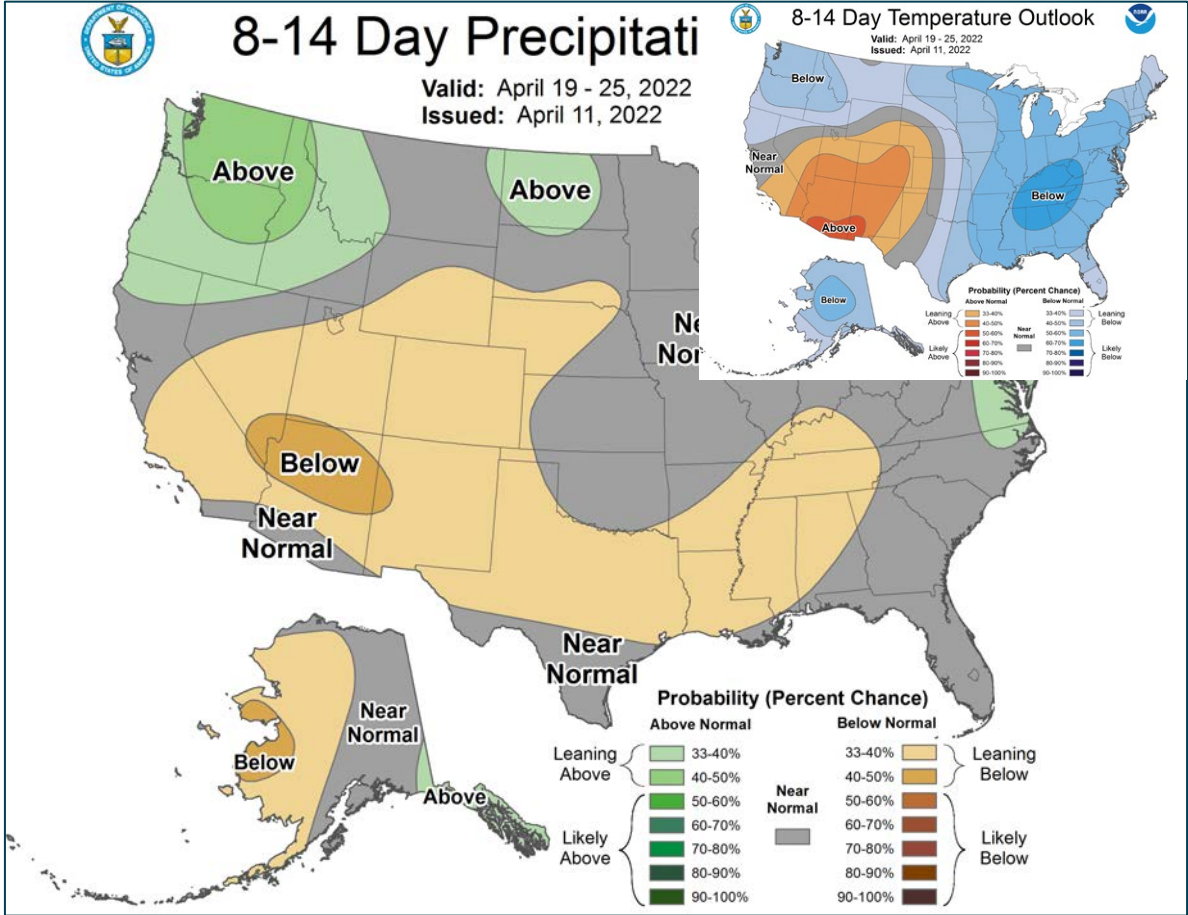
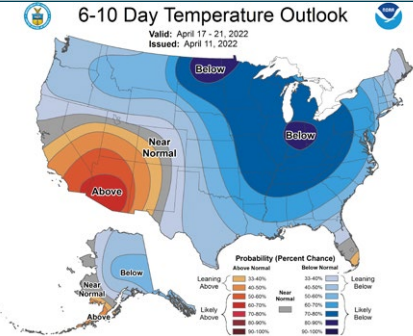
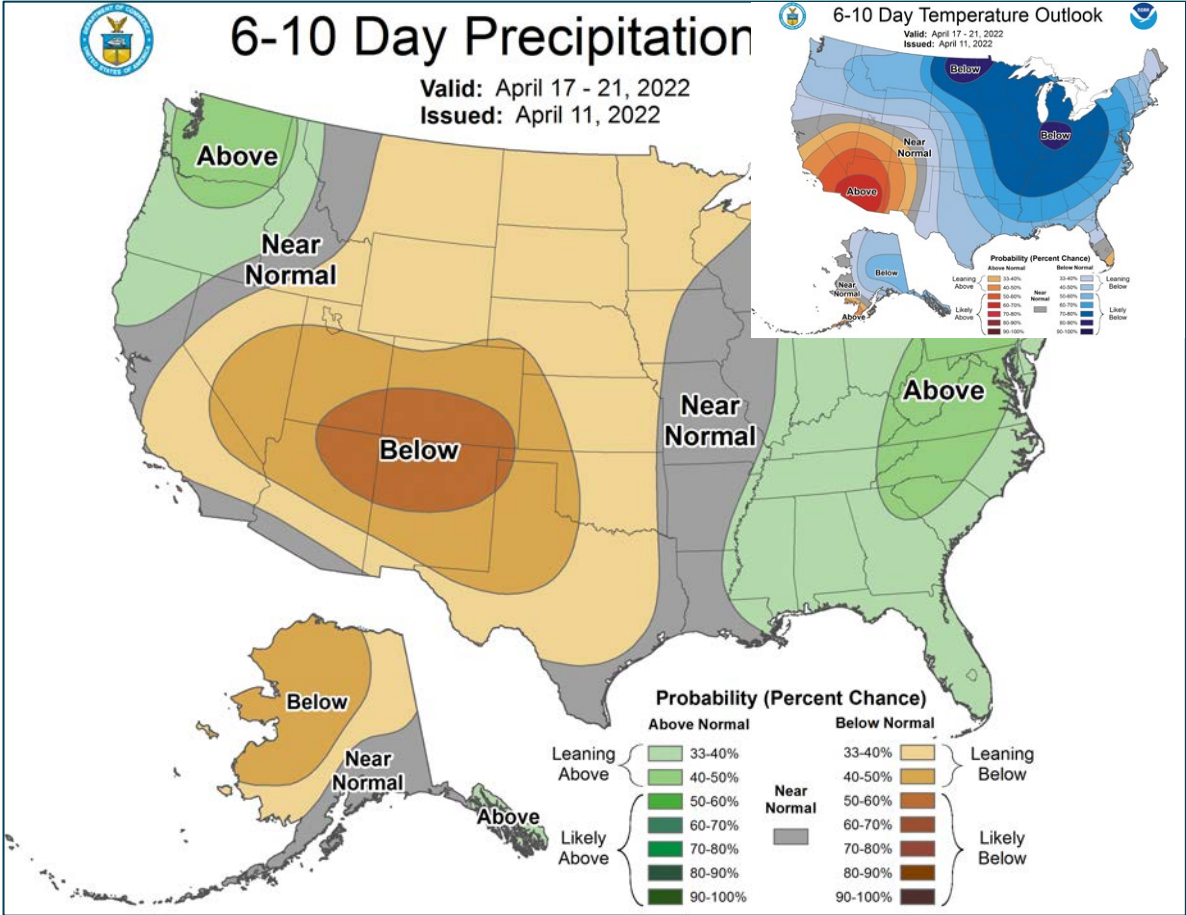
Modeled, Averaged by Basin



Prepared by NOAA, Colorado Basin River Forecast Center  
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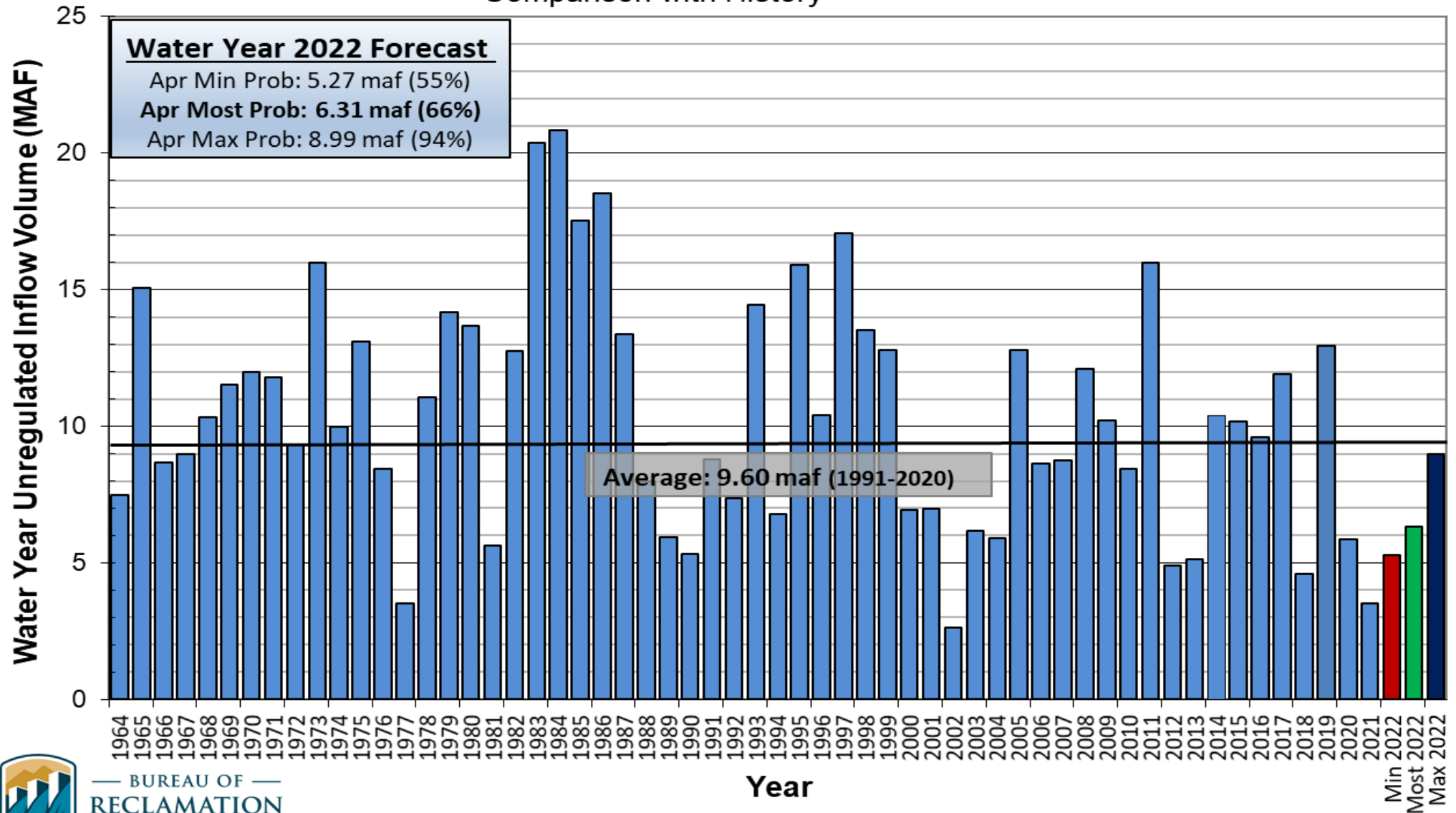
# NOAA Precipitation Outlook Comparison



# Lake Powell Unregulated Inflow

## Water Year 2022 Forecast *(issued April 5)*

### Comparison with History



# Most Probable April Forecast Water Year 2022

April – July 2022  
Forecasted Unregulated Inflow  
as of April 4, 2022

Fontenelle	435	59
Flaming Gorge	520	54
Blue Mesa	530	83
Navajo	390	62
Powell	4,100	64

Water Year 2022  
Forecasted Unregulated Inflow  
as of April 5, 2022

Fontenelle	712	66
Flaming Gorge	855	61
Blue Mesa	755	83
Navajo	555	61
Powell	6,310	66



# Current Upper Colorado Drought Response Activities

## Drought Response Operations Agreement

- Effective May 2019
- Expires after 2026 (except recovery)
- 2021 DROA release volumes of 161 kaf completed in October 2021
- Glen Canyon Dam release adjustments under LTEMP flexibility beginning in January 2022

## Drought Response Operations Plan

- Scheduled to be finalized in May 2022 after publication of the April 24-Month Study
- 2022 operational plans based on actual hydrology to be developed using April results

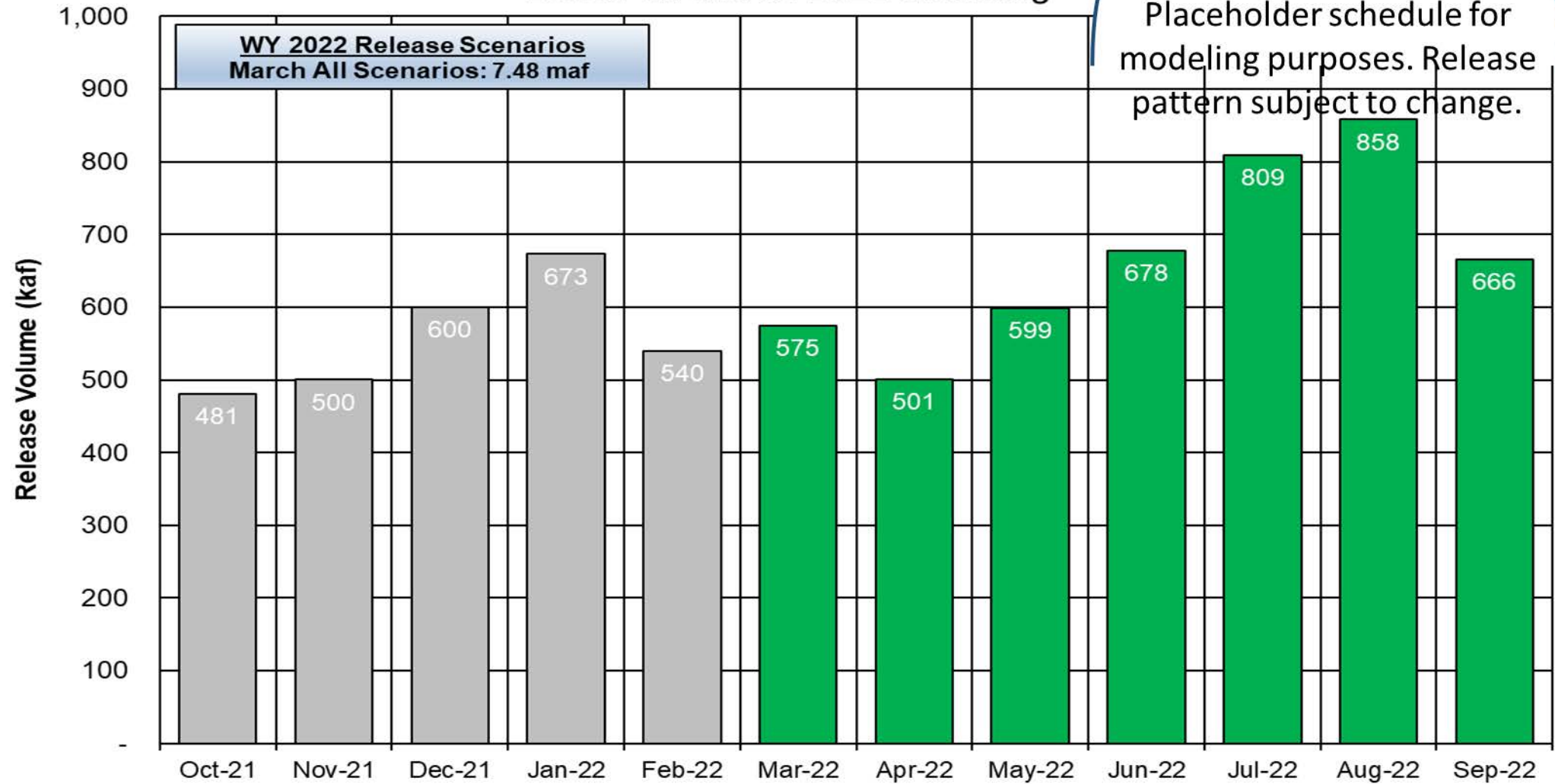




# Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on March 2022 Modeling



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





# Upper Colorado Basin

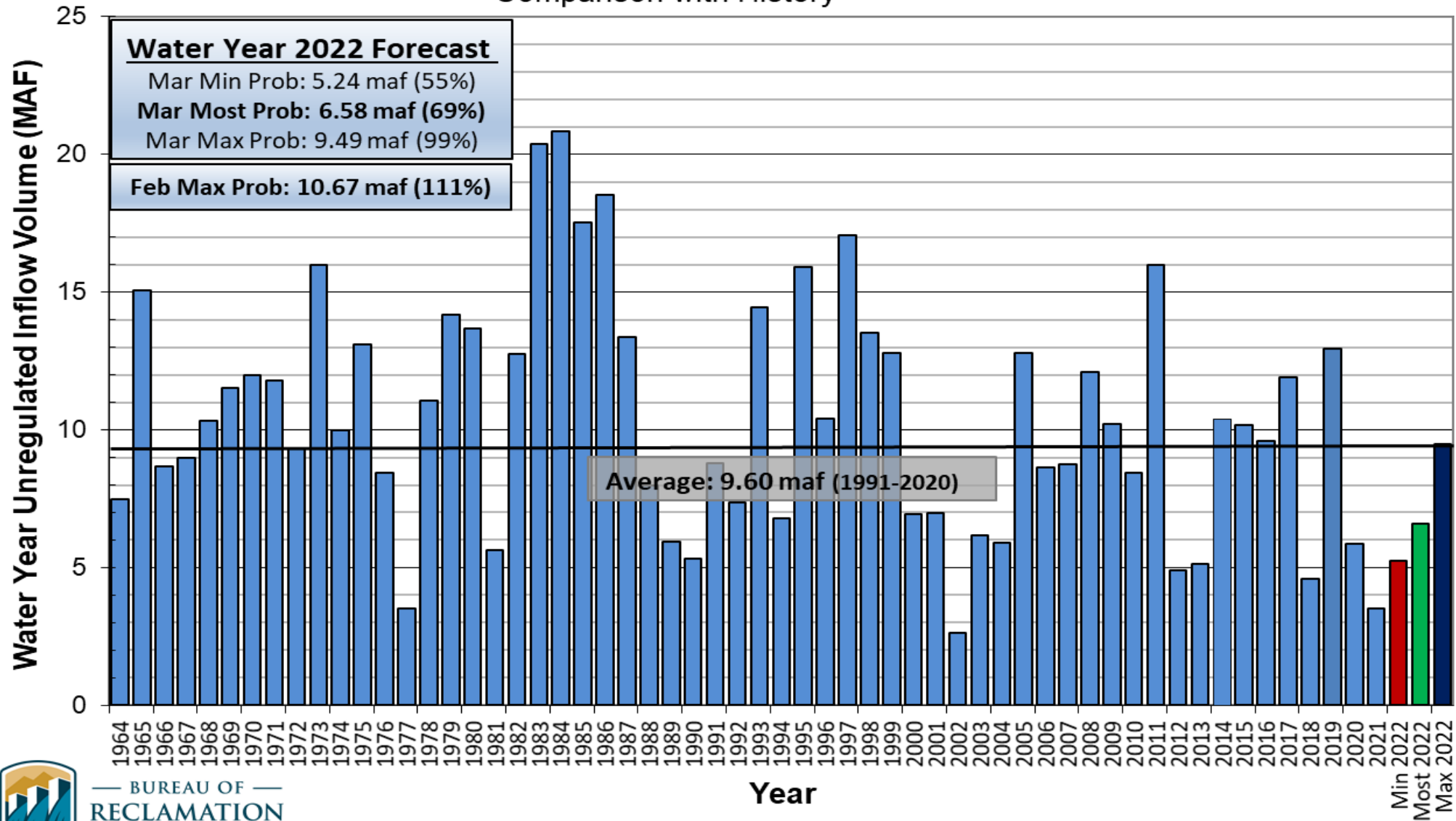
**Projected Operations  
for Water Year 2022  
Based on March 2022  
Modeling**



# Lake Powell Unregulated Inflow

## Water Year 2022 Forecast (issued March 3)

### Comparison with History



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# Most Probable March Forecast Water Year 2022

April – July 2022  
Forecasted Unregulated Inflow  
as of March 3, 2022

Fontenelle	450	61
Flaming Gorge	540	56
Blue Mesa	560	88
Navajo	455	72
Powell	4,400	69

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

Reservoir	Unregulated Inflow (kaf)	1991-2020 Percent of Avg
Fontenelle	726	68
Flaming Gorge	884	63
Blue Mesa	783	87
Navajo	614	67
Powell	6,583	69





# Lake Powell & Lake Mead Operational Table

## Operating Determinations for Water Year/Calendar Year 2022

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	Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	15.9
			1,105		11.9
	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5	1,075	<b>1,065.85 ft</b>	
	<b>3,535.40 ft</b>			Shortage Condition Deliver 7.167 <sup>4</sup> maf	<b>Jan 1, 2022 Projection</b>
3,525	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf	5.9	1,050	Shortage Condition Deliver 7.083 <sup>5</sup> maf	7.5
			1,025		5.8
3,490		4.0	1,000	Shortage Condition Deliver 7.0 <sup>6</sup> maf Further measures may be undertaken <sup>7</sup>	4.3
3,370		0	895		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.

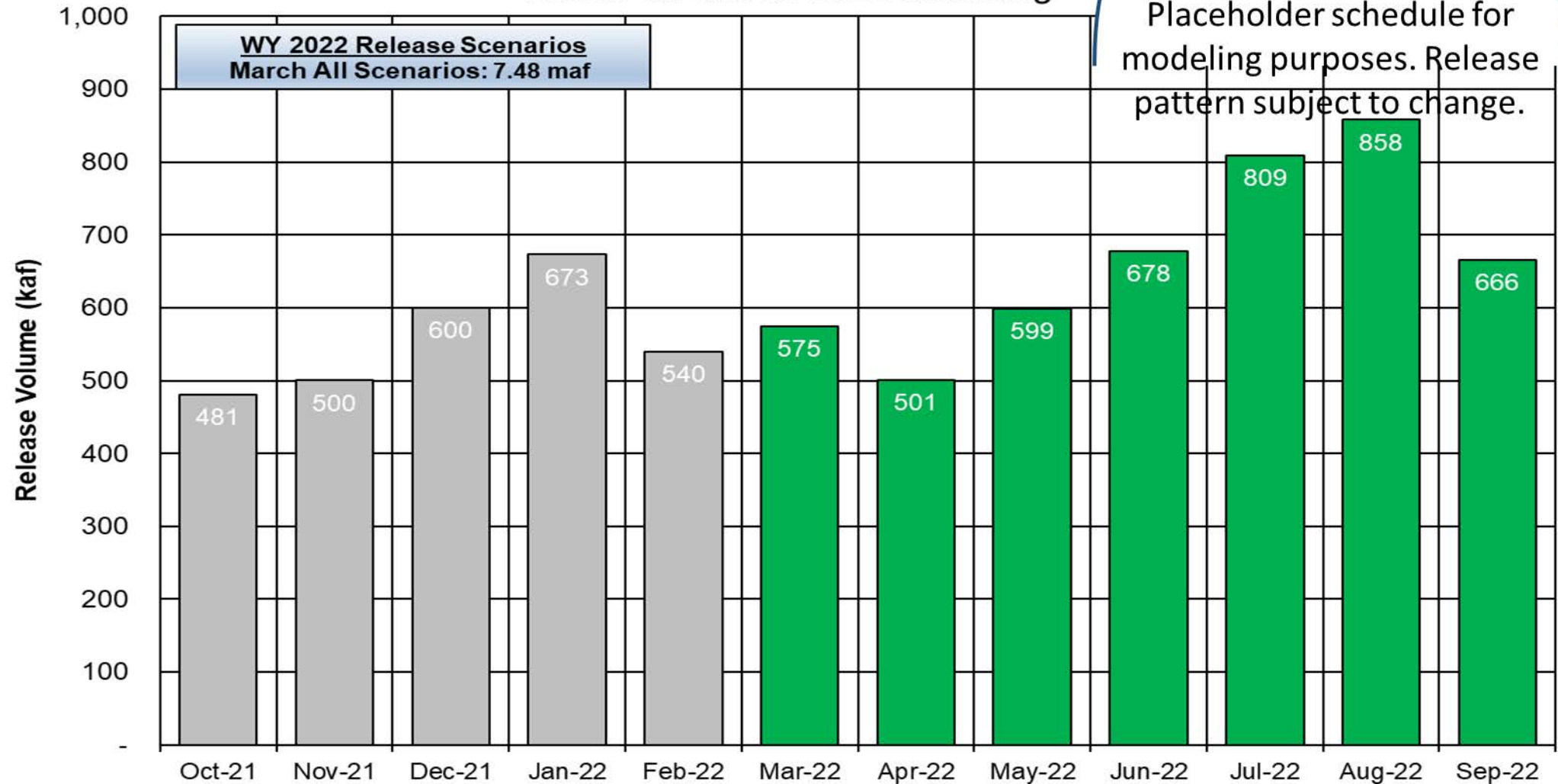
<sup>1</sup> Lake Powell and Lake Mead operating determinations are based on August 2021 24-Month Study projections consistent with the 2007 Interim Guidelines and 2019 Drought Contingency Plans. These determinations will be documented in the 2022 Annual Operating Plan for Colorado River Reservoirs.



# Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on March 2022 Modeling



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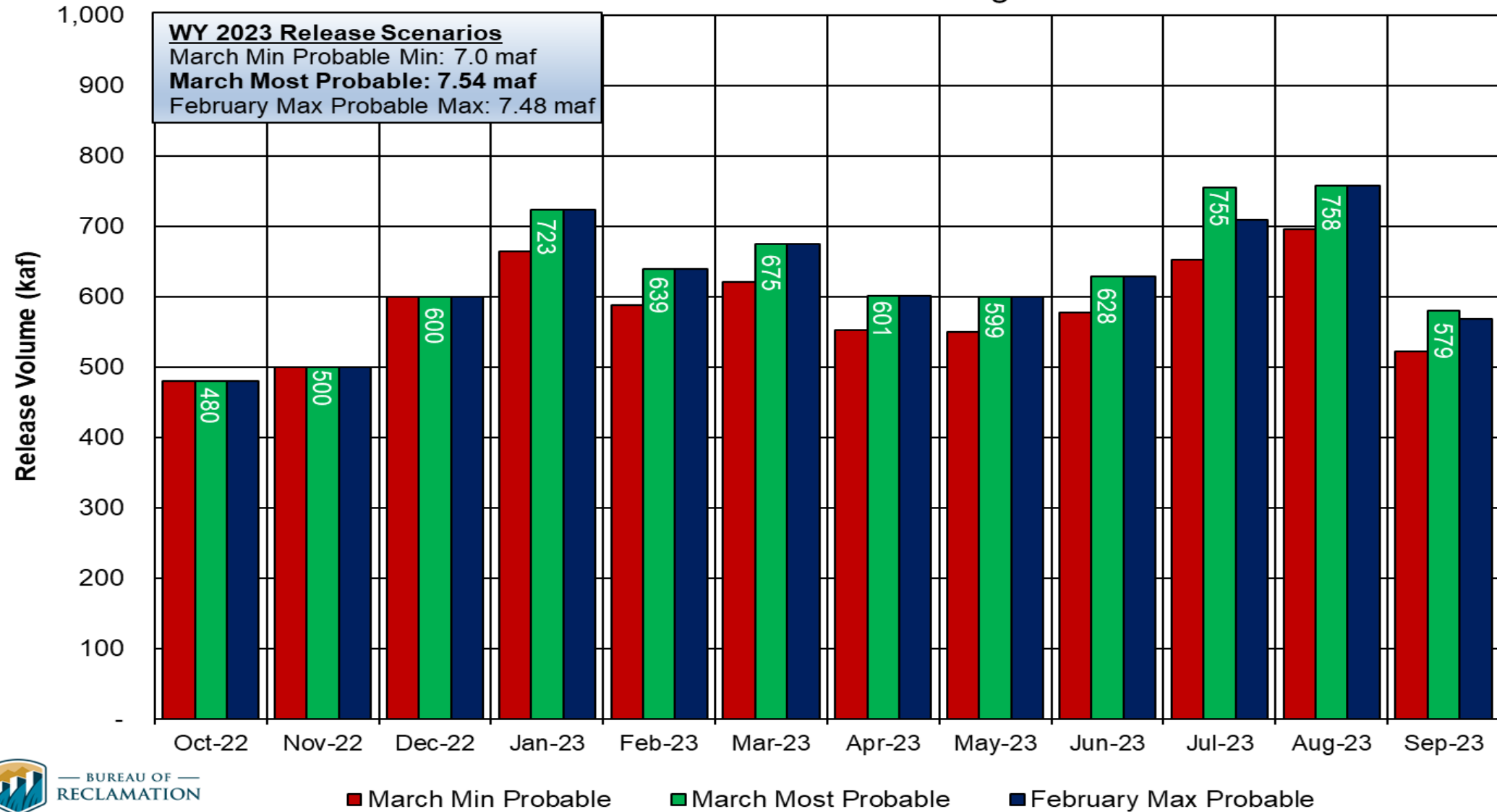
The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>




# Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023

Based on March 2022 Modeling



# Reclamation Operational Modeling Model Comparison

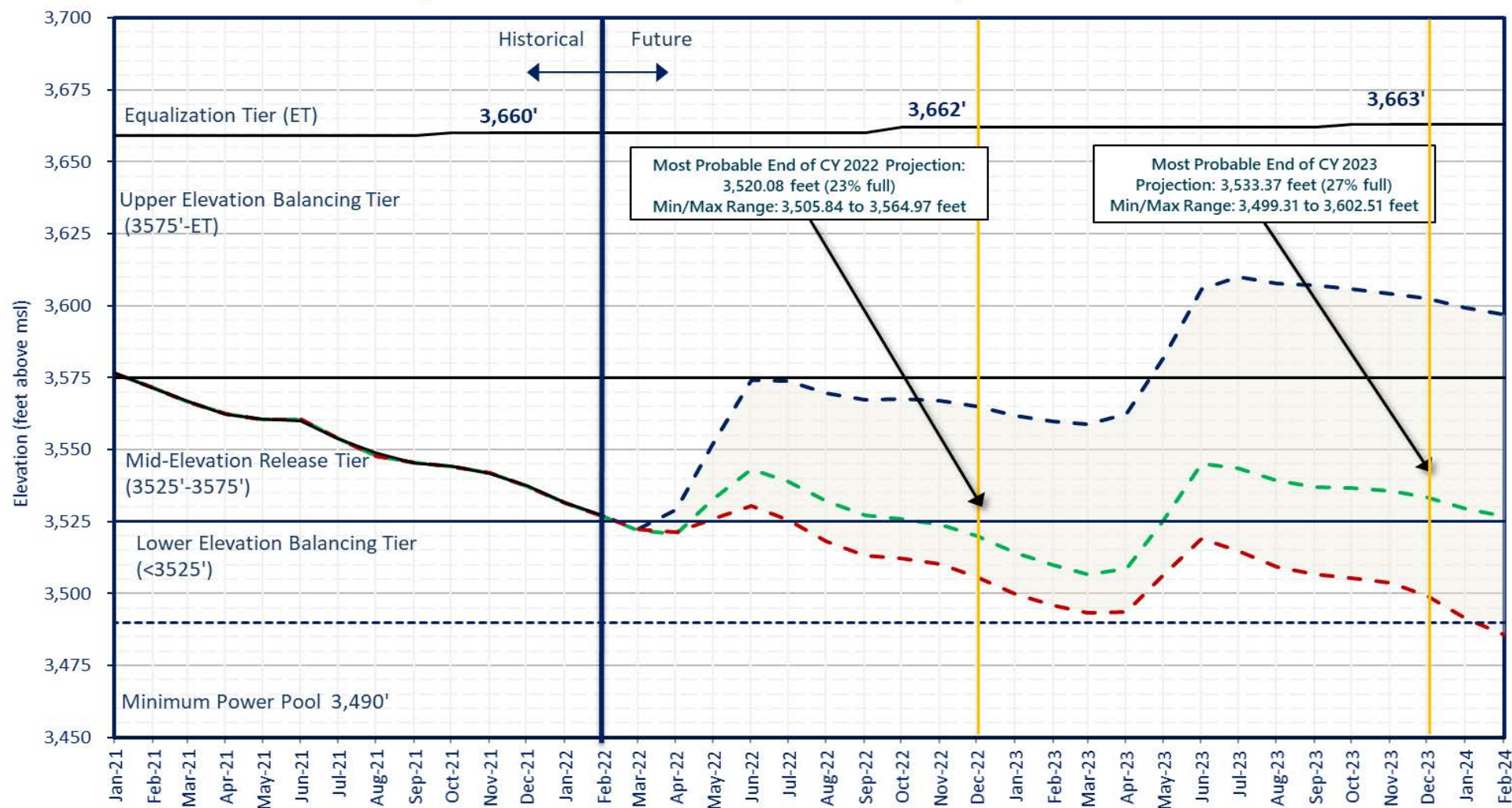
	Colorado River Mid-term Modeling System (CRMMS)		CRSS
	24-Month Study Mode (Manual Mode)	Ensemble Mode (Rule-based Mode)	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir 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)			
Upper Basin Inflow	Unregulated forecast, 1 trace	Unregulated ESP forecast, 35 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 Elevations

Projections from the March 2022 24-Month Study Inflow Scenarios



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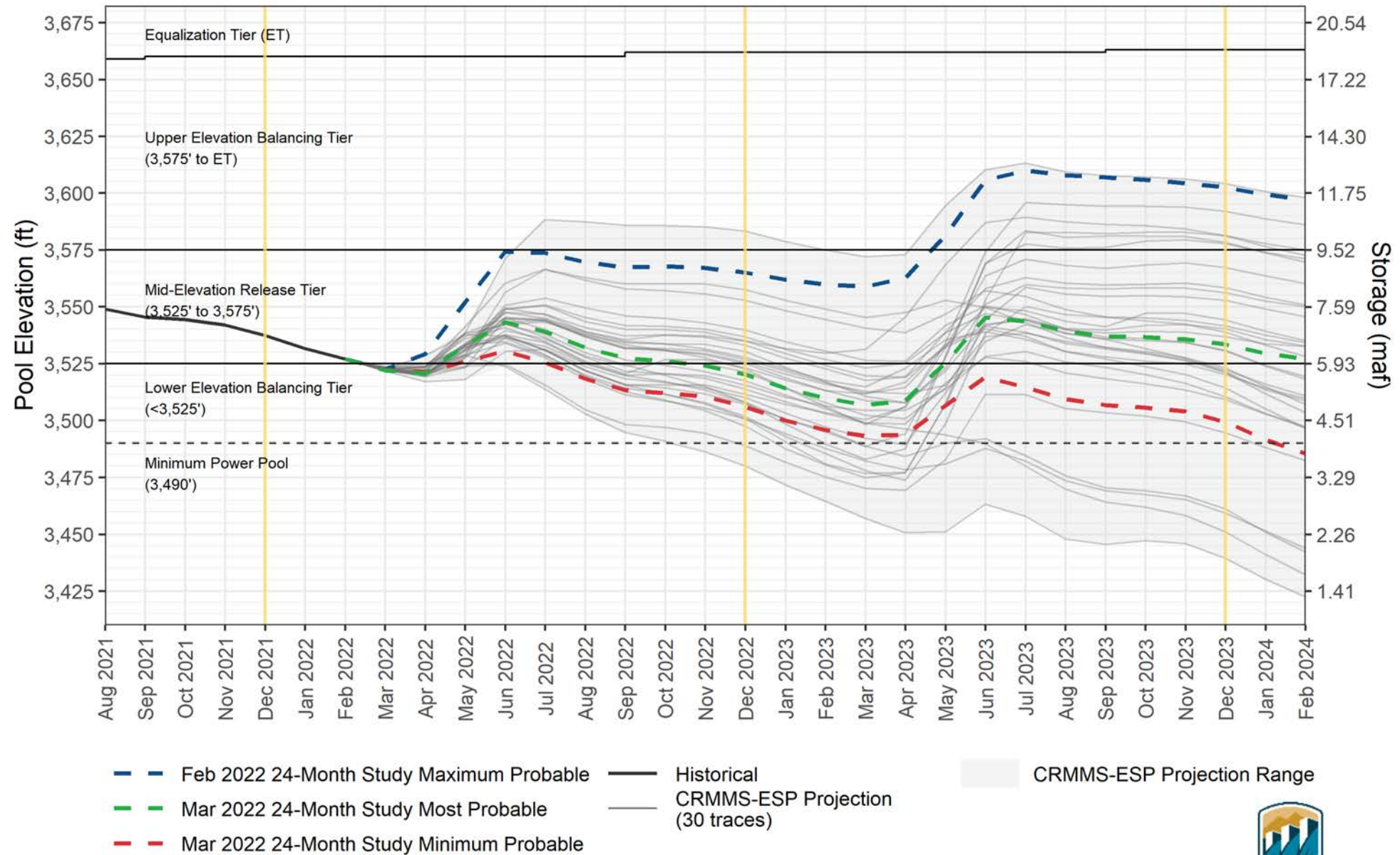
- February 2022 Maximum Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.48 maf in WY2023
- March 2022 Most Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.54 maf in WY2023
- March 2022 Minimum Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.0 maf in WY2023
- Historical Elevations

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



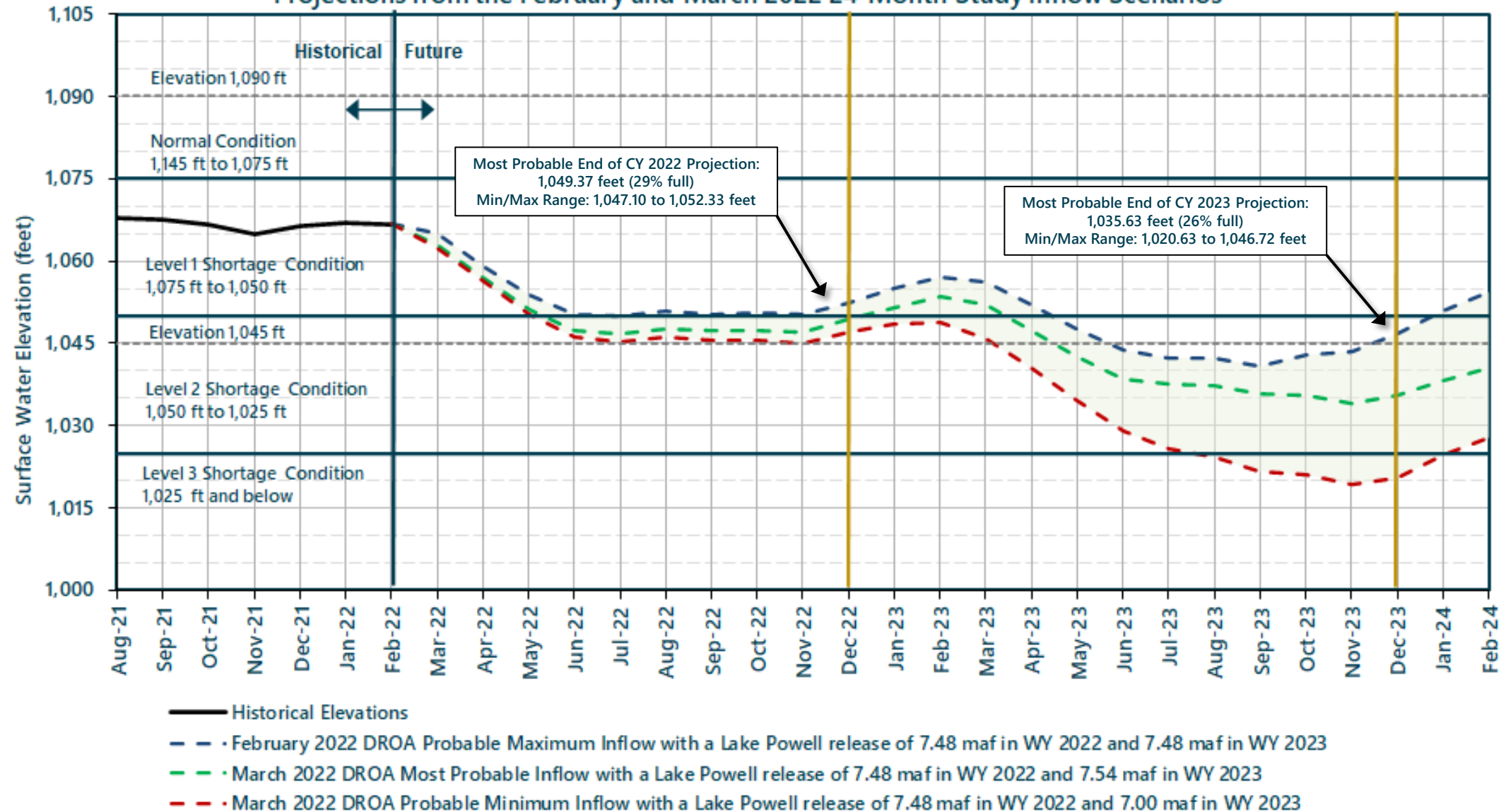
# Lake Powell End-of-Month Elevations

CRMMS Projections from March 2022



# Lake Mead End of Month Elevations

Projections from the February and March 2022 24-Month Study Inflow Scenarios



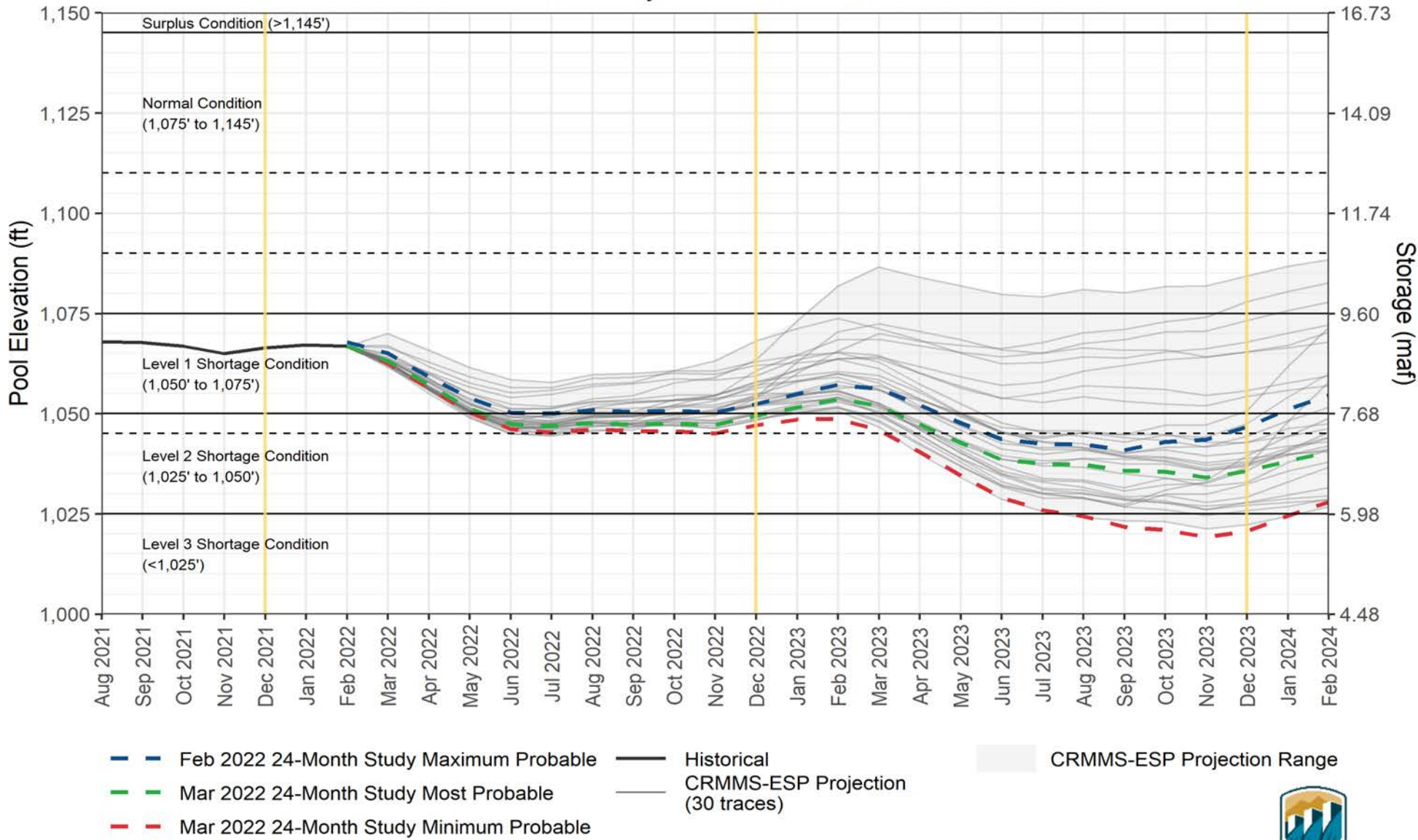
The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.





# Lake Mead End-of-Month Elevations

CRMMS Projections from March 2022



CRMMS 2-Year Probabilistic Projections are available online at: <https://www.usbr.gov/lc/region/g4000/riverops/crmms-2year-projections.html>





# 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													
2													
3													
4													
5													
6													
7													
8													
Units Available	6	6	6	6	5	4	6	5	6	6	6	6	
Capacity (cfs)	18,700	18,600	11,700	18,700	14,800	11,300	18,000	14,900	18,600	18,500	18,300	18,100	MAR MOST <sup>2</sup>
Capacity (kaf/month)	1,150	1,110	1,110	1,160	810	980	1,100	970	1,090	1,140	1,120	1,080	MAR MOST
Max (kaf) <sup>1</sup>	481	500	600	673	540	575	501	599	678	809	858	666	7.48 maf
Most (kaf) <sup>1</sup>	481	500	600	673	540	575	501	599	678	809	858	666	7.48 maf
Min (kaf) <sup>1</sup>	481	500	600	673	540	575	501	599	678	809	858	666	7.48 maf
										(updated 03-22-2022)			

1 Projected release, based on March 2022 minimum and most and February 2022 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

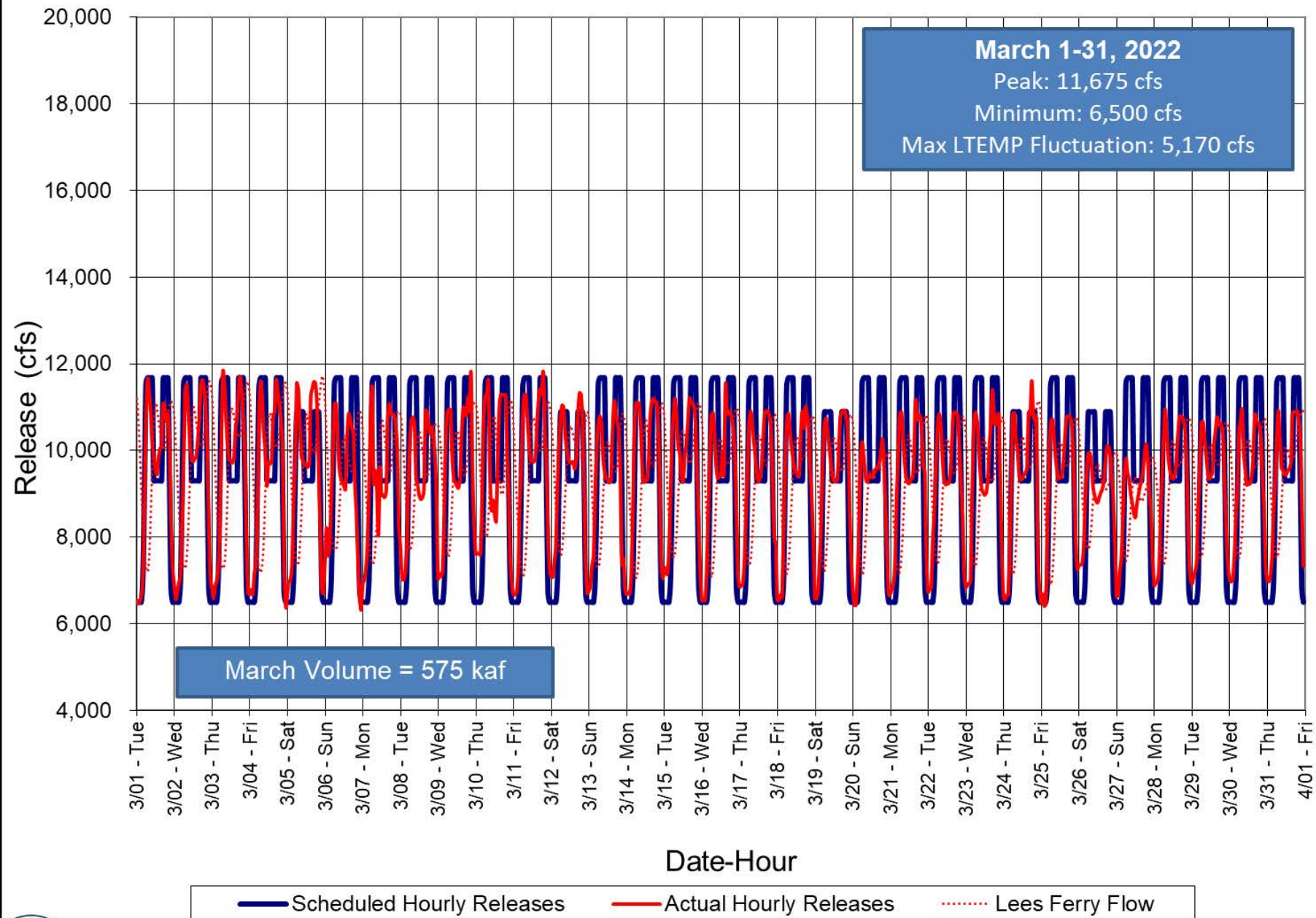
Unit Number	Oct 2022	Nov 2022	Dec 2022	Jan 2023	Feb 2023	Mar 2023	Apr 2023	May 2023	Jun 2023	Jul 2023	Aug 2023	Sep 2023
1												
2												
3												
4												
5												
6												
7												
8												
Units Available	5	6	6	6	4	6	6	6	6	6	6	4
Capacity (cfs)	14,750	18,000	17,700	17,800	11,000	17,400	17,500	18,000	18,700	18,650	18,500	11,650
Capacity (kaf/month)	940	1,070	1,100	1,440	740	1,070	1,040	1,110	1,110	1,150	1,140	770
Max (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	770	758	568
Most (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	755	758	579
Min (kaf) <sup>1</sup>	480	500	600	664	587	620	552	550	577	652	696	522
(updated 03-22-2022)												

1 Projected release, based on March 2022 minimum and most and February 2022 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.

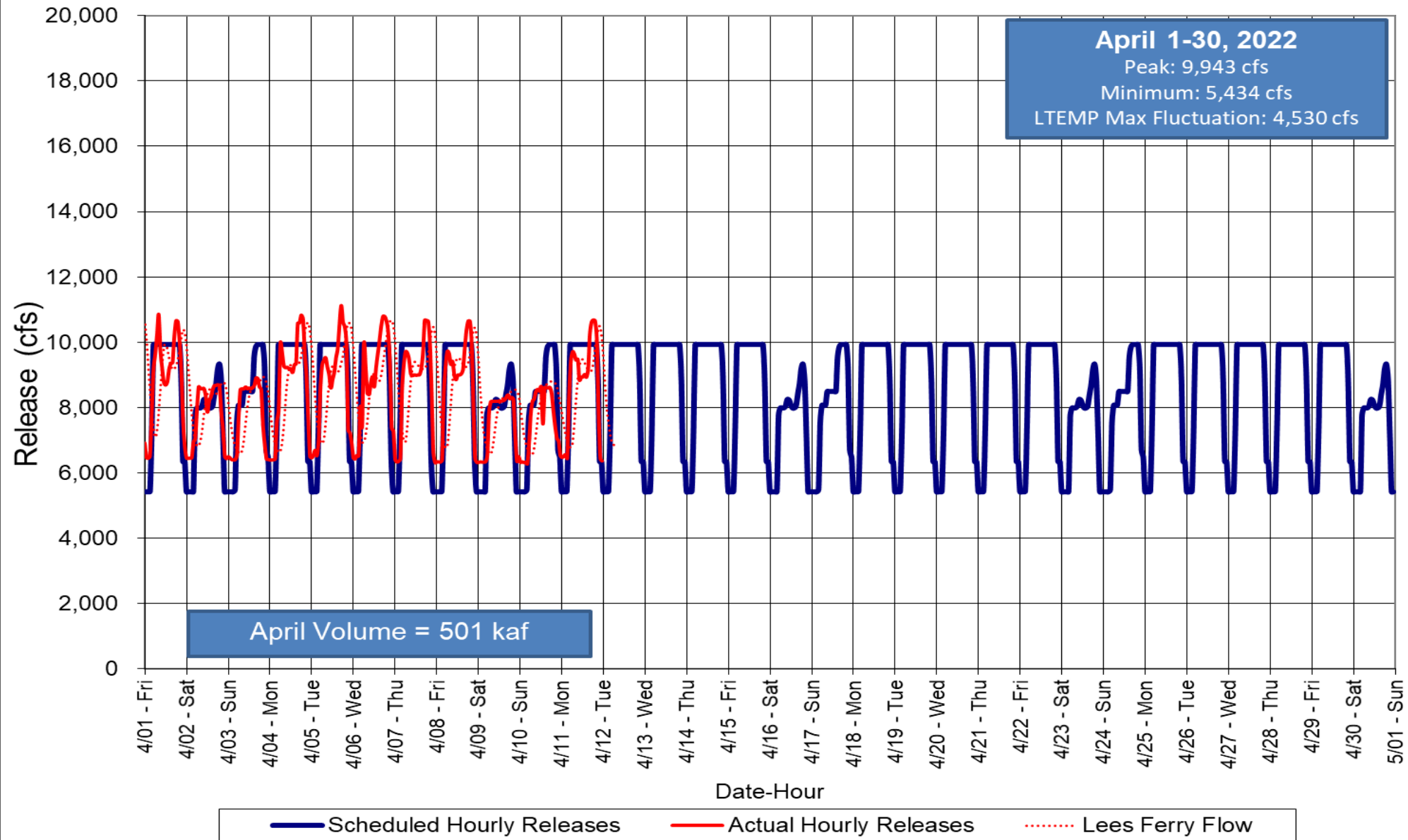


# Glen Canyon Dam Hourly Release Pattern March 2022

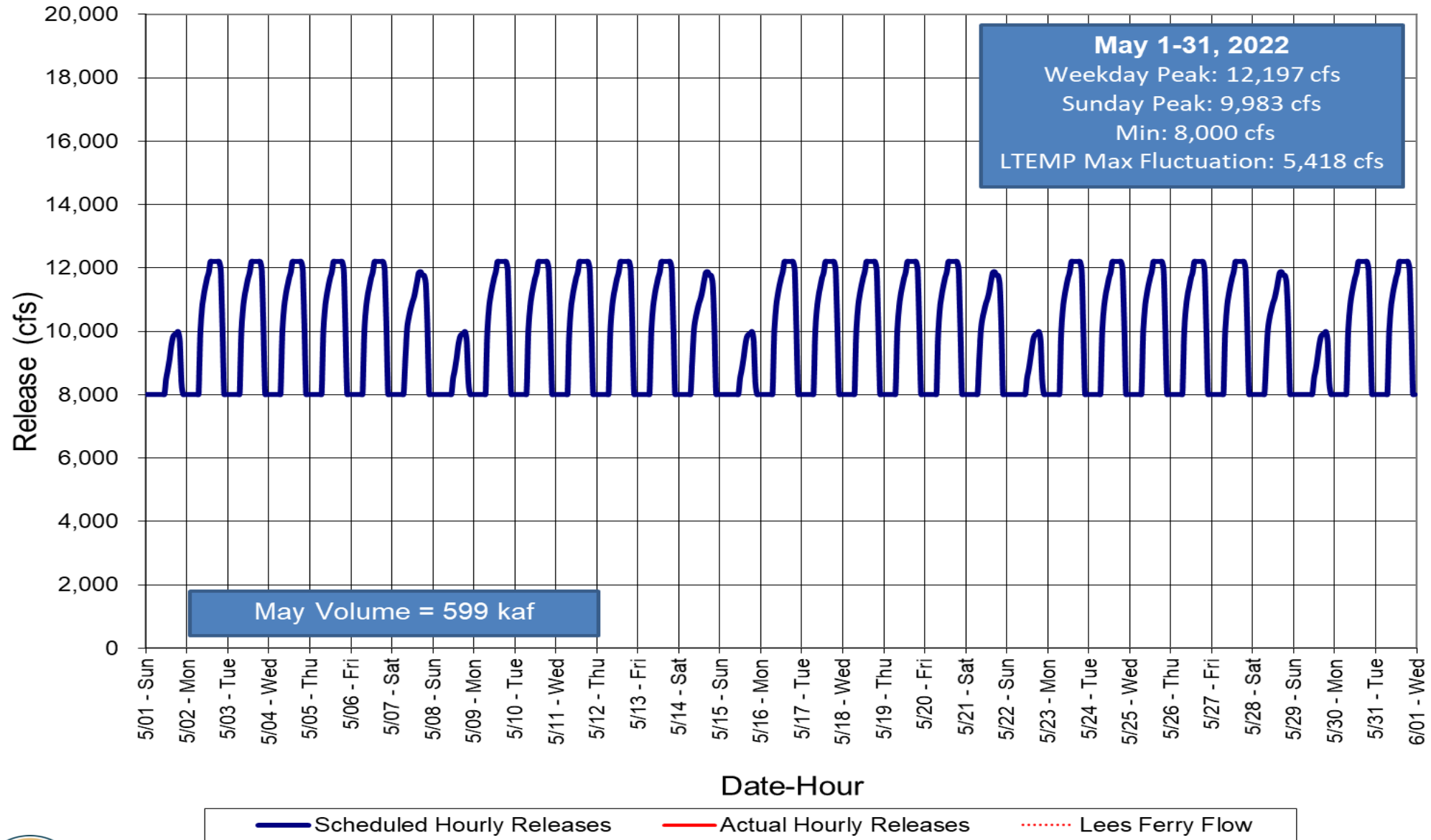




# Glen Canyon Dam Hourly Release Pattern April 2022



# Glen Canyon Dam Hourly Release Pattern May 2022





# Questions?



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