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Colorado River Forecasting Service

Glen Canyon Dam Operations

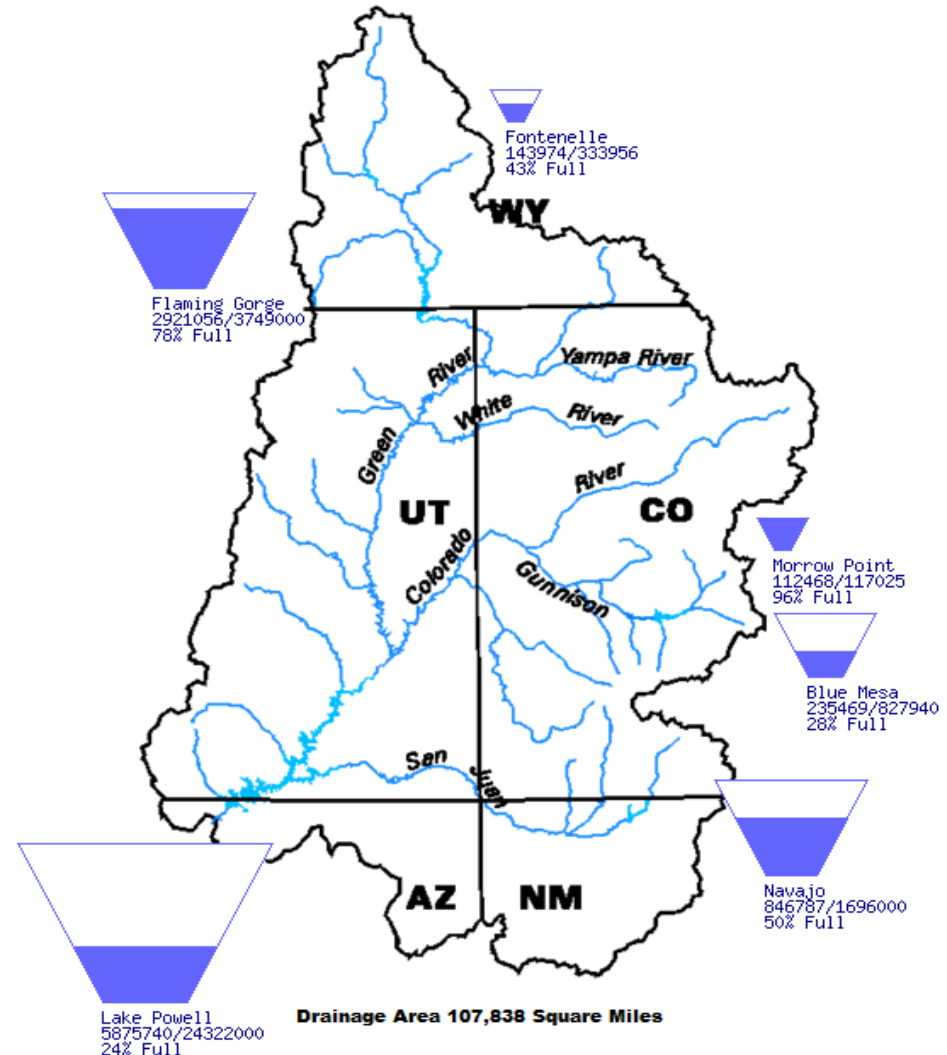
March 24, 2022

Upper Basin Storage (as of March 22, 2022)

Data Current as of:
03/21/2022

Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	43	0.14	0.33	6,477.10
Flaming Gorge	78	2.92	3.75	6,018.31
Blue Mesa	28	0.24	0.83	7,435.58
Navajo	50	0.85	1.70	6,017.80
Lake Powell	24	5.87	24.32	3,524.06
UC System Storage	33	10.16	30.93	

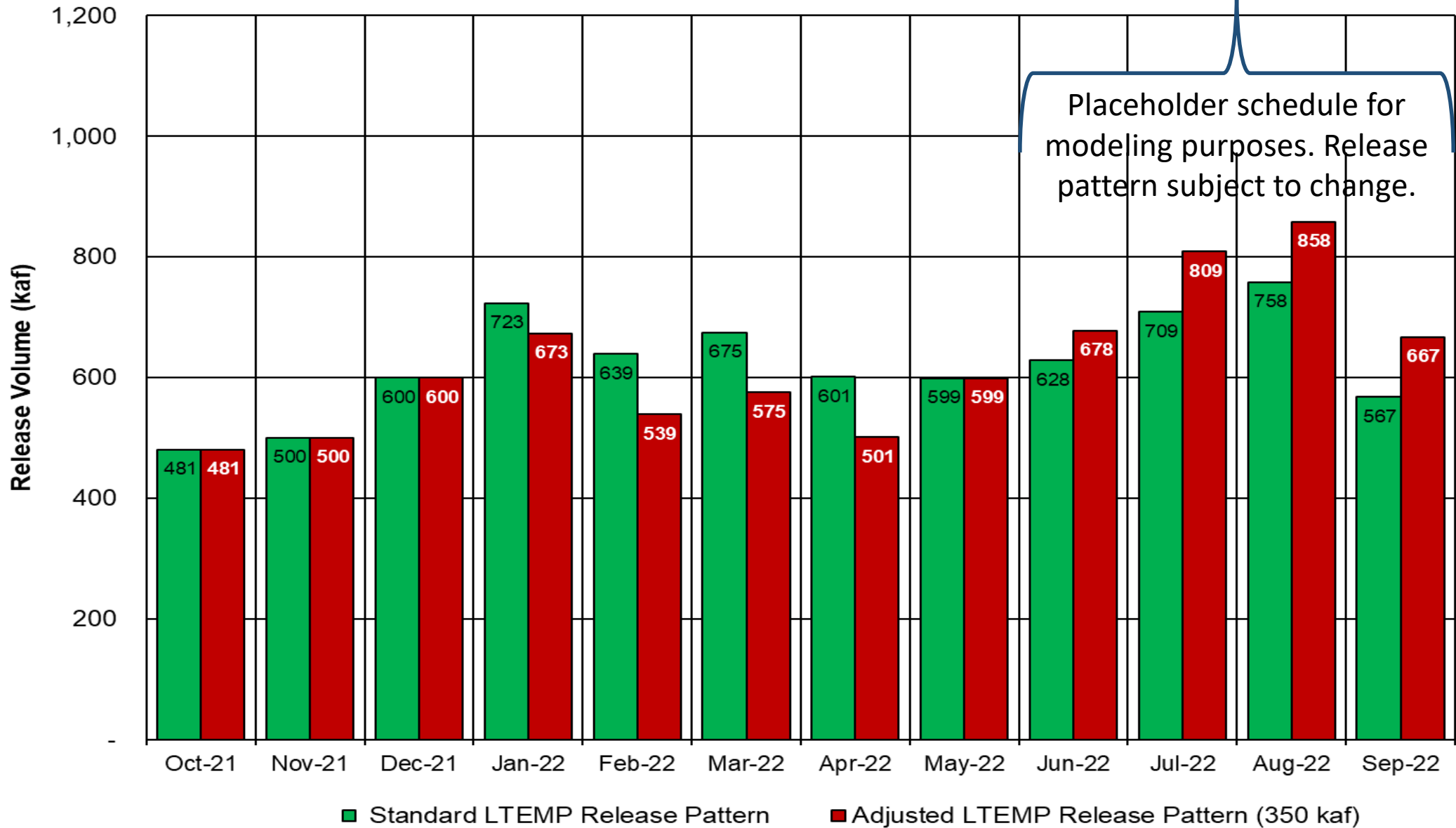


**Water Year 2022
Potential 7.48 maf
Pattern
Adjustments**



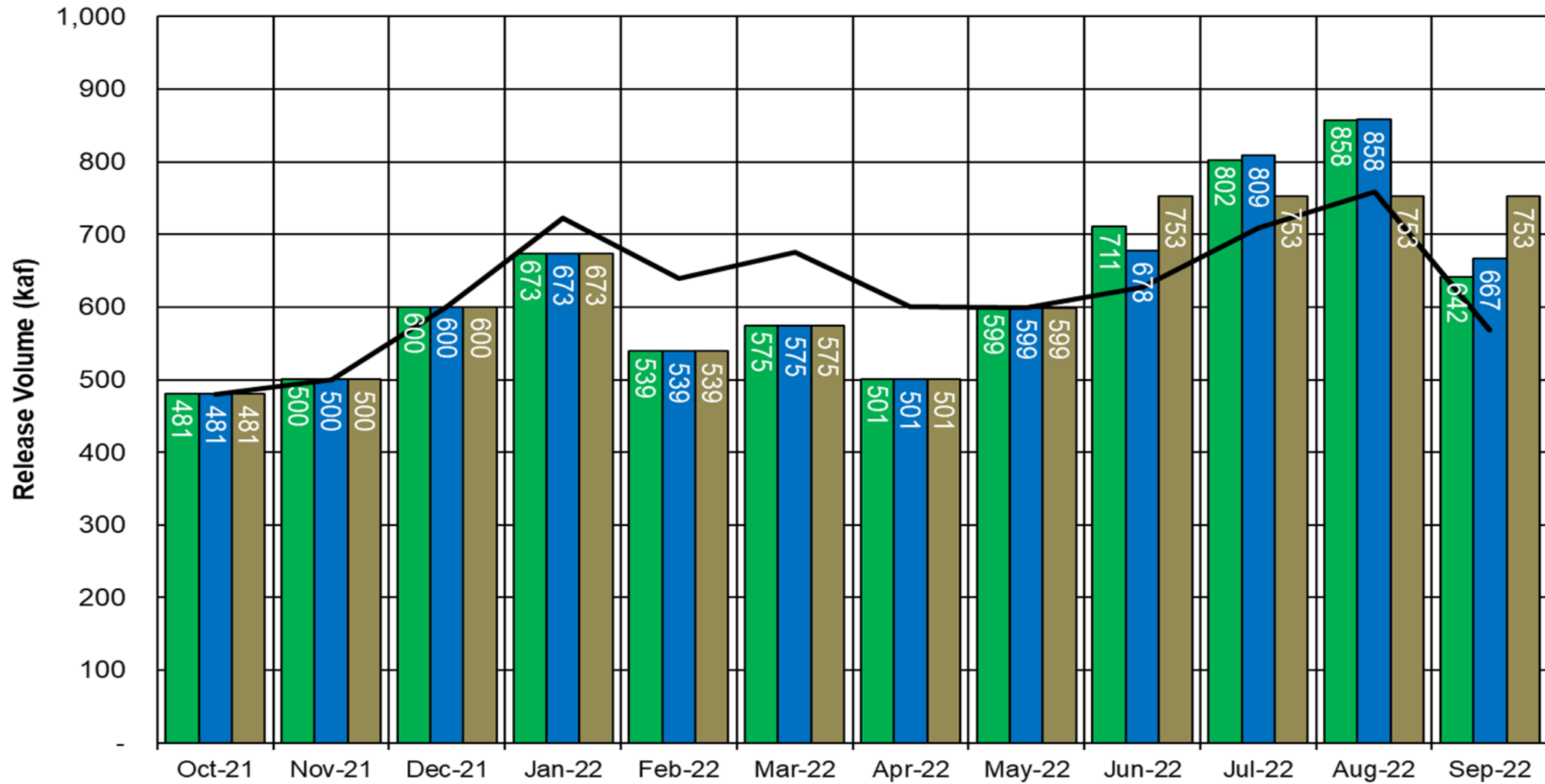
Potential Lake Powell Monthly Release Volume Distribution

7.48 MAF Release Pattern for Water Year 2022



Potential Lake Powell Monthly Release Volume Distribution

DROA Release Scenarios for Water Year 2022



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

■ 350 kaf LTEMP Adjusted
 ■ Alternative A
 ■ Alternative B
 — Standard LTEMP



Current Upper Colorado Drought Response Activities

Drought Response Operations Agreement

- Effective May 2019
- Continues through 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 April 2022
- Draft framework document circulating for review
- Webinar in late January to be followed by comment period
- 2022 operational plans based on actual hydrology to be developed February through April





Upper Colorado Basin

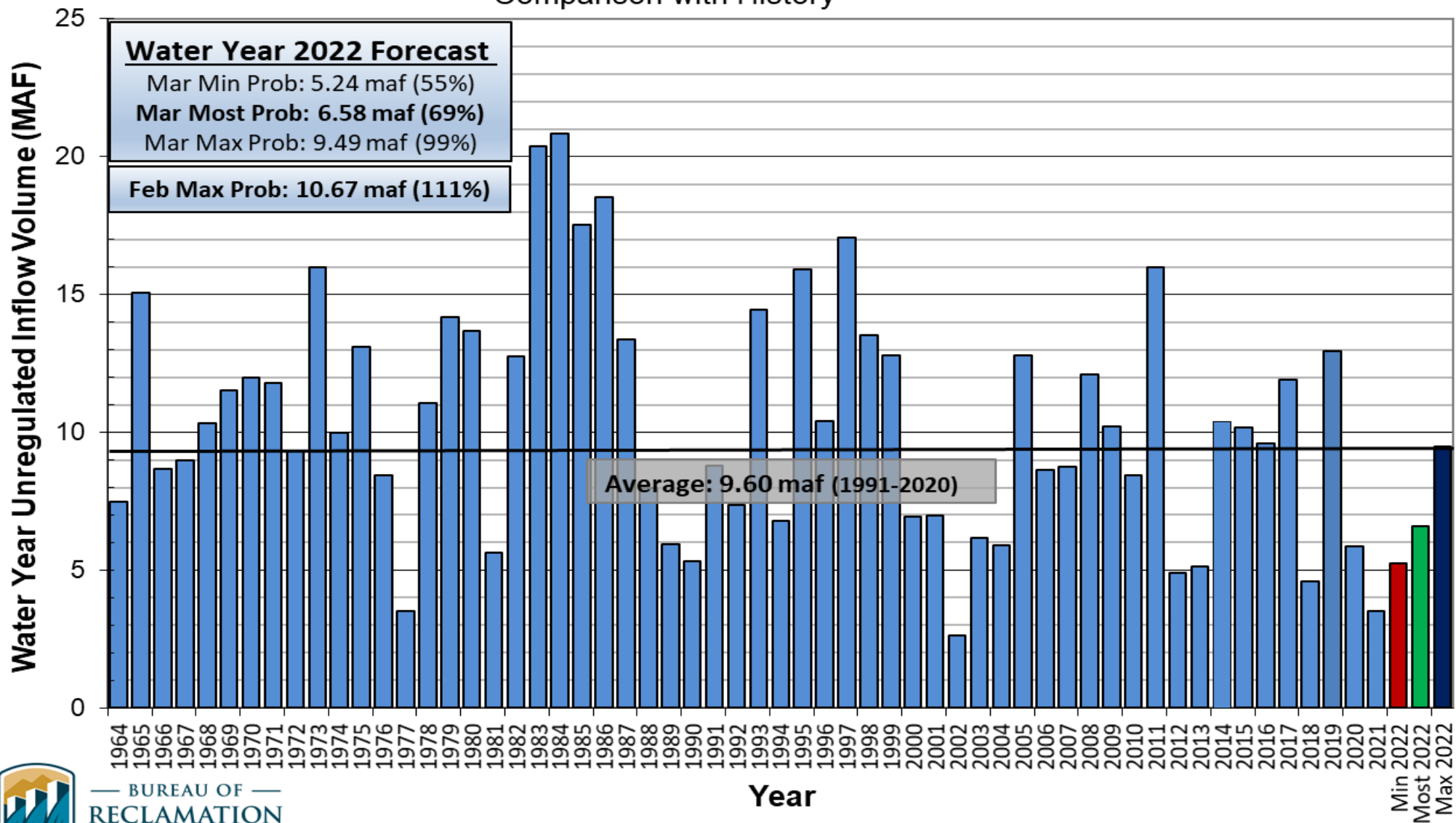
**Projected Operations
for Water Year 2022
Based on March 2022
Modeling**



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

Reservoir	Unregulated Inflow (kaf)	1991-2020 Percent of Avg
Fontenelle	450	61
Flaming Gorge	540	56
Blue Mesa	560	88
Navajo	455	72
Powell	4,400	69

April-July Midmonth = 4,600 (72%)

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

Water Year Midmonth = 6,783 (71%)



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) ¹	Elevation (feet)	Operation According to the Interim Guidelines	Live Storage (maf) ¹
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 Tier³ 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.) ²	Domestic Surplus or ICS Surplus Condition Deliver > 7.5 maf	22.9 (approx.) ²
3,575			1,145		
	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		
	3,535.40 ft			1,065.85 ft	
3,525	Jan 1, 2022 Projection	5.9	1,050	Shortage Condition Deliver 7.167 ⁴ 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 7.083 ⁵ maf	5.8
3,490			1,000		
3,370		0	895	Shortage Condition Deliver 7.0 ⁶ maf Further measures may be undertaken ⁷	0

Diagram not to scale

¹ Acronym for million acre-feet

² 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.

³ Subject to April adjustments which may result in a release according to the Equalization Tier

⁴ Of which 2.48 maf is apportioned to Arizona, 4.4 maf to California, and 0.287 maf to Nevada

⁵ Of which 2.40 maf is apportioned to Arizona, 4.4 maf to California, and 0.283 maf to Nevada

⁶ Of which 2.32 maf is apportioned to Arizona, 4.4 maf to California, and 0.280 maf to Nevada

⁷ 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.

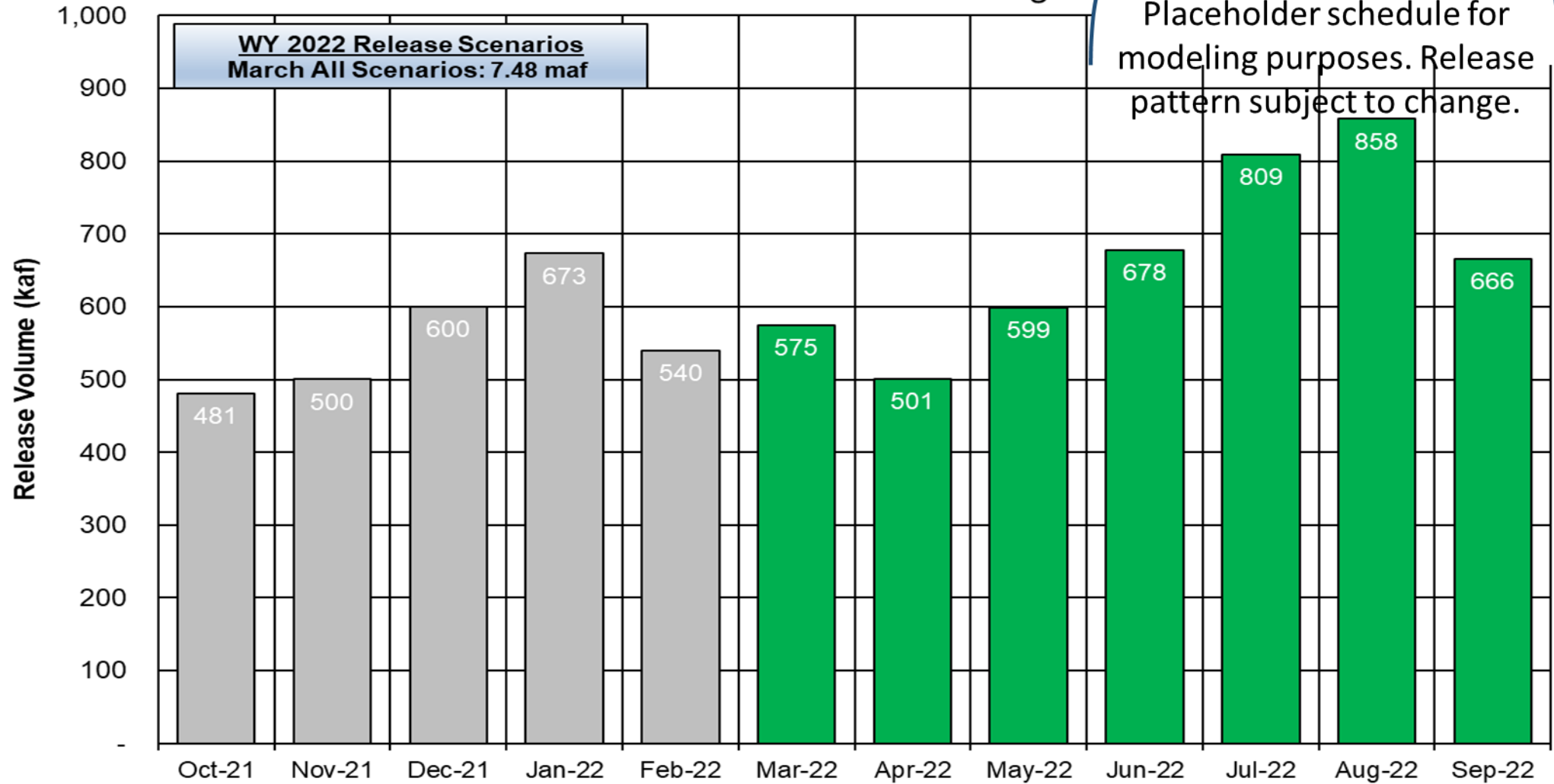
¹ Lake Powell and Lake Mead operating determinations are based on August 2021 24-Month Study projections consistent with the 2007 Interim Guidelines and 2019 Drought Contingency Plans. These determinations will be documented in the 2022 Annual Operating Plan for Colorado River Reservoirs.



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on March 2022 Modeling



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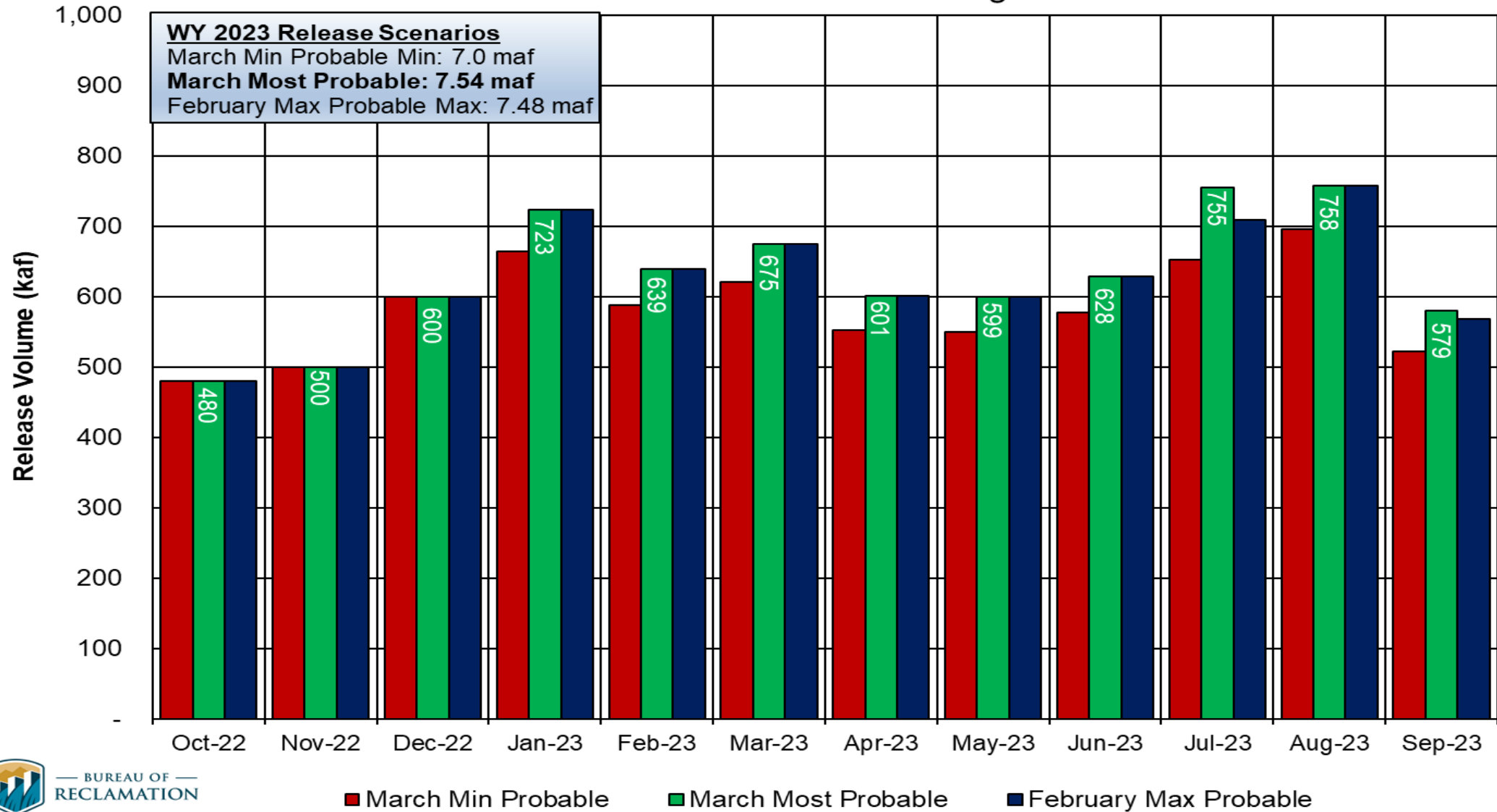
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Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023

Based on March 2022 Modeling



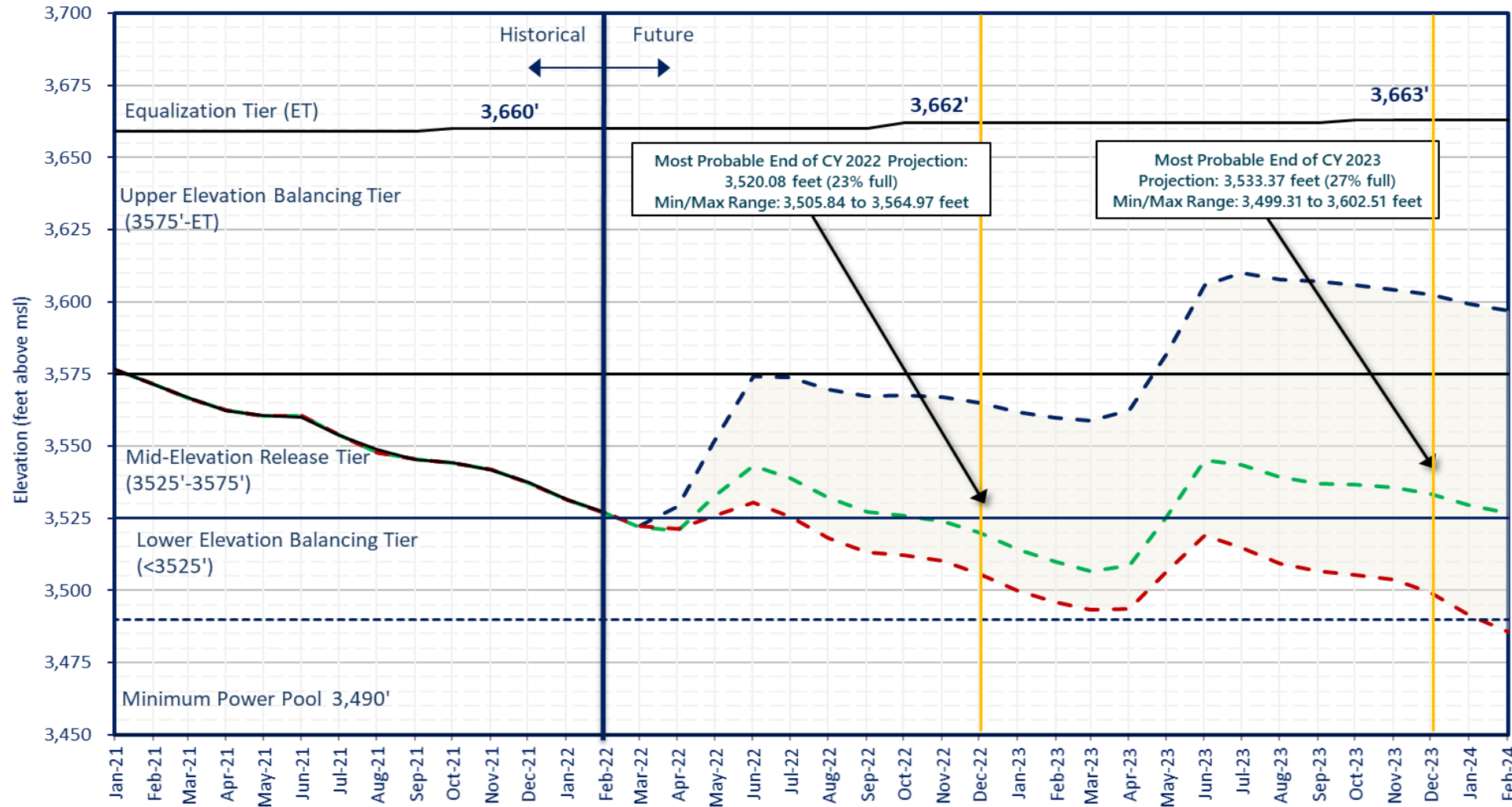
Reclamation Operational Modeling Model Comparison

	<i>Colorado River Mid-term Modeling System (CRMMS)</i>		CRSS
	<i>24-Month Study Mode (Manual Mode)</i>	<i>Ensemble Mode (Rule-based Mode)</i>	
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



Most Probable End of CY 2022 Projection:
3,520.08 feet (23% full)
Min/Max Range: 3,505.84 to 3,564.97 feet

Most Probable End of CY 2023
Projection: 3,533.37 feet (27% full)
Min/Max Range: 3,499.31 to 3,602.51 feet



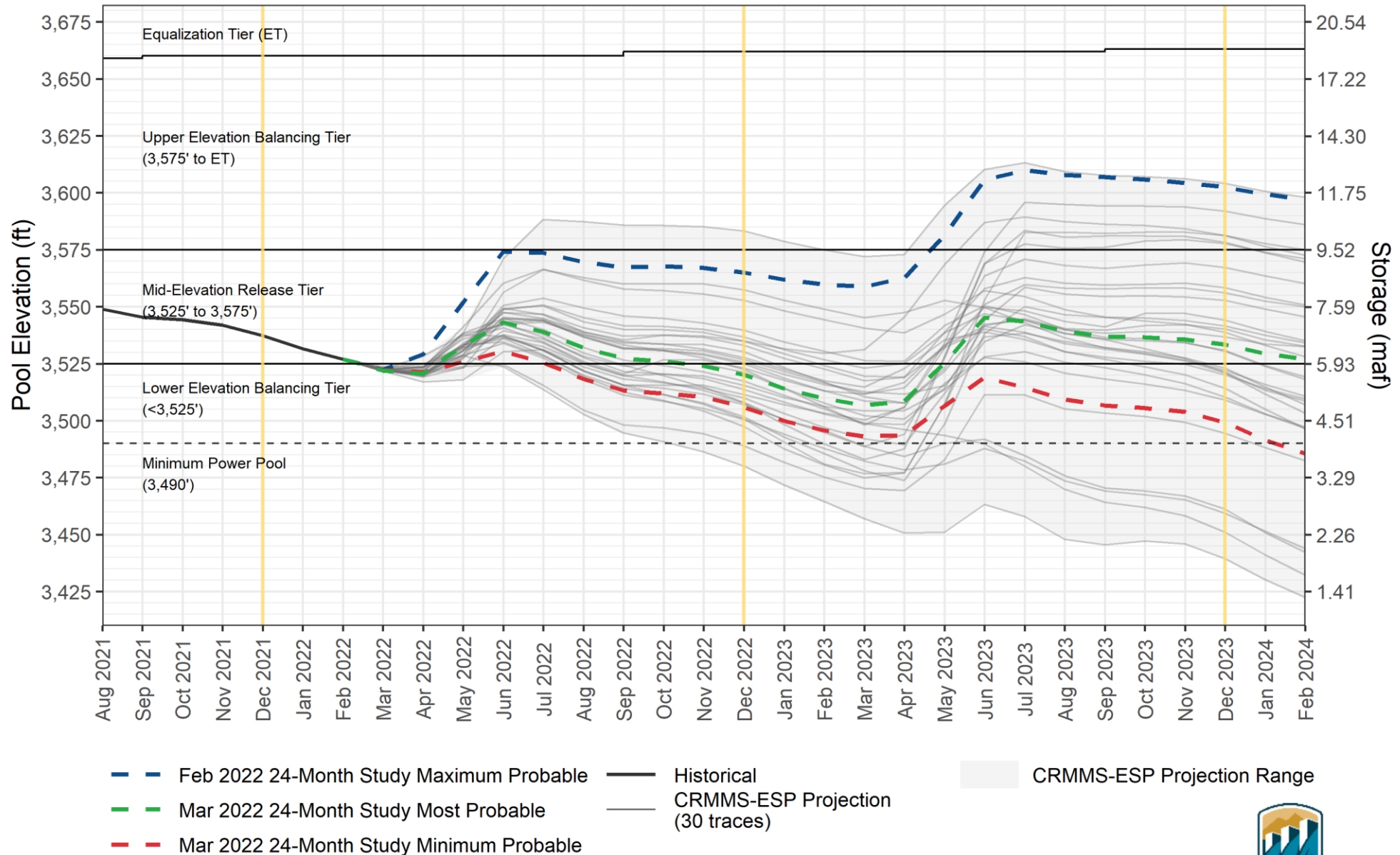
- February 2022 Maximum Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.48 maf in WY2023
- March 2022 Most Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.54 maf in WY2023
- March 2022 Minimum Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.0 maf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

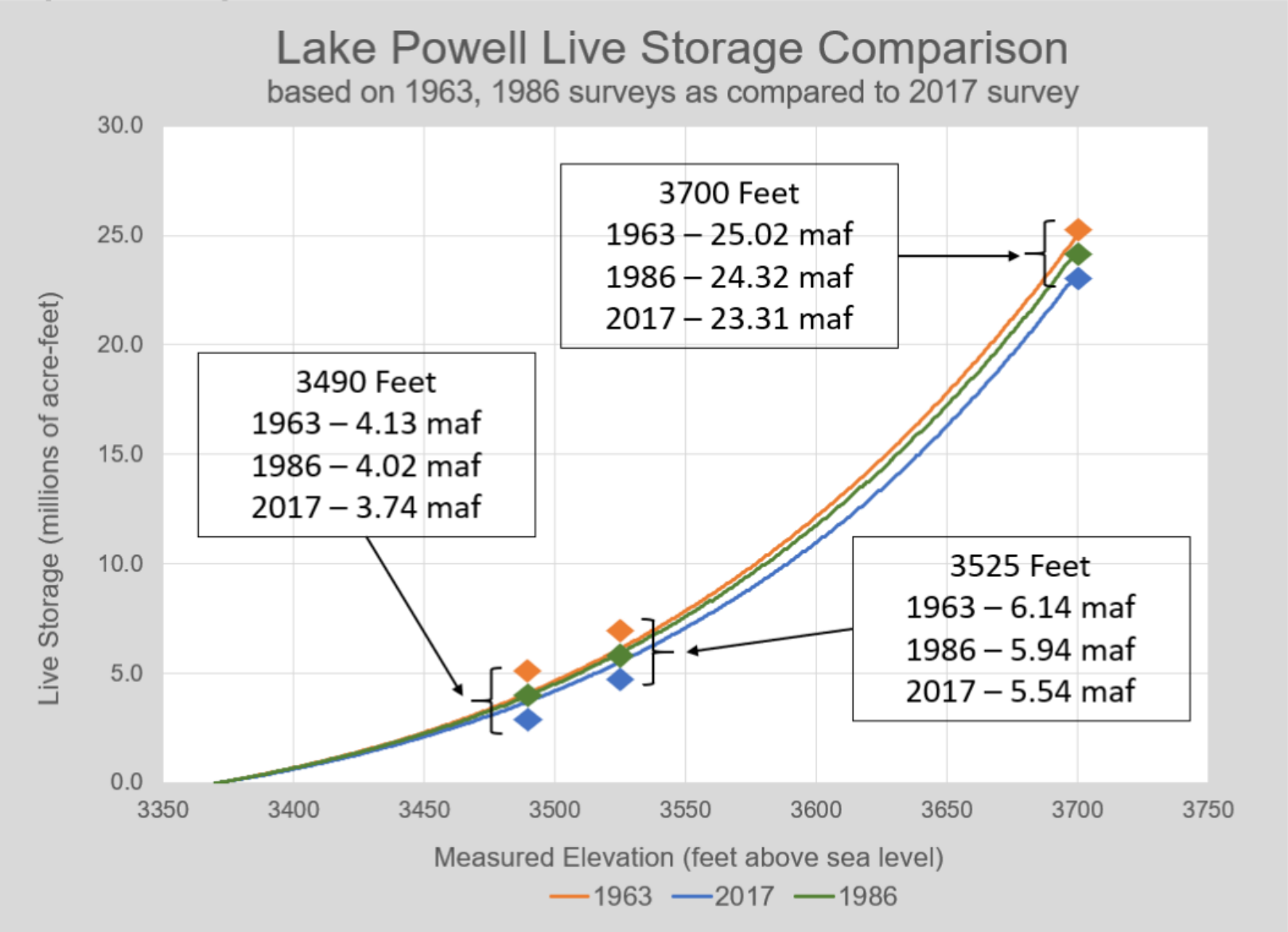
CRMMS Projections from March 2022



Powell Bathymetric Update



Area-Capacity Tables - Results



Model Comparison Sensitivity Studies

- **Colorado River Midterm Modeling System (CRMMS)**
 - Coordinate with CBRFC on re-forecasting with new bathymetry data
 - Re-forecast results using 24-Month Studies comparing 1986 (current) and 2017 (new) bathymetry data
 - 24 Month Study Mode
 - Ensemble Streamflow Prediction (ESP) Mode
- **Colorado River Simulation System (CRSS)**
 - Natural flow adjustment
 - CRSS results comparison from August 2021 official model run initialized in January 2022



Steps to Incorporate Results

- Incorporate new data and study results into operations and models
 - Sensitivity Analysis with Operation and Planning Models
 - Update ACAP tables in Models
 - Re-Forecasting 1981-2020 period by Colorado Basin River Forecast Center
 - Update Natural Flow Record
 - Officially Update ACAP tables in Reclamation Hydrologic Database (HDB)
 - Officially Update ACAP tables in CRSS and CRMMS Models



Summary and Next Steps

- **Modeling: Targeted for Completion May 2022**
 - CBRFC Re-forecasts
 - CRMMS
 - CRSS
- **Future Outreach Planned for Sharing Results of Sensitivity Analyses**
- **Operations: Targeted for Completion July 2022**



Questions?



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