



— BUREAU OF —
RECLAMATION

Glen Canyon Monthly Operations Call

Basin Hydrology and Operations

April 20, 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.”

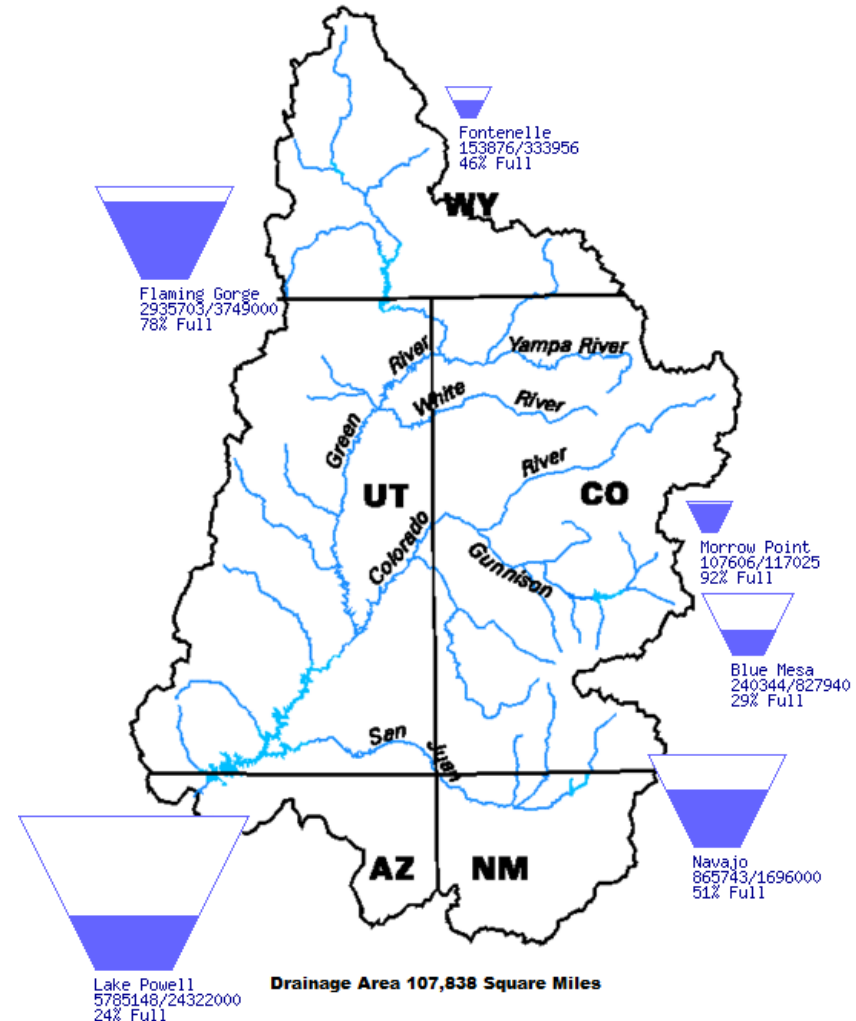


Upper Basin Storage (as of April 18, 2022)

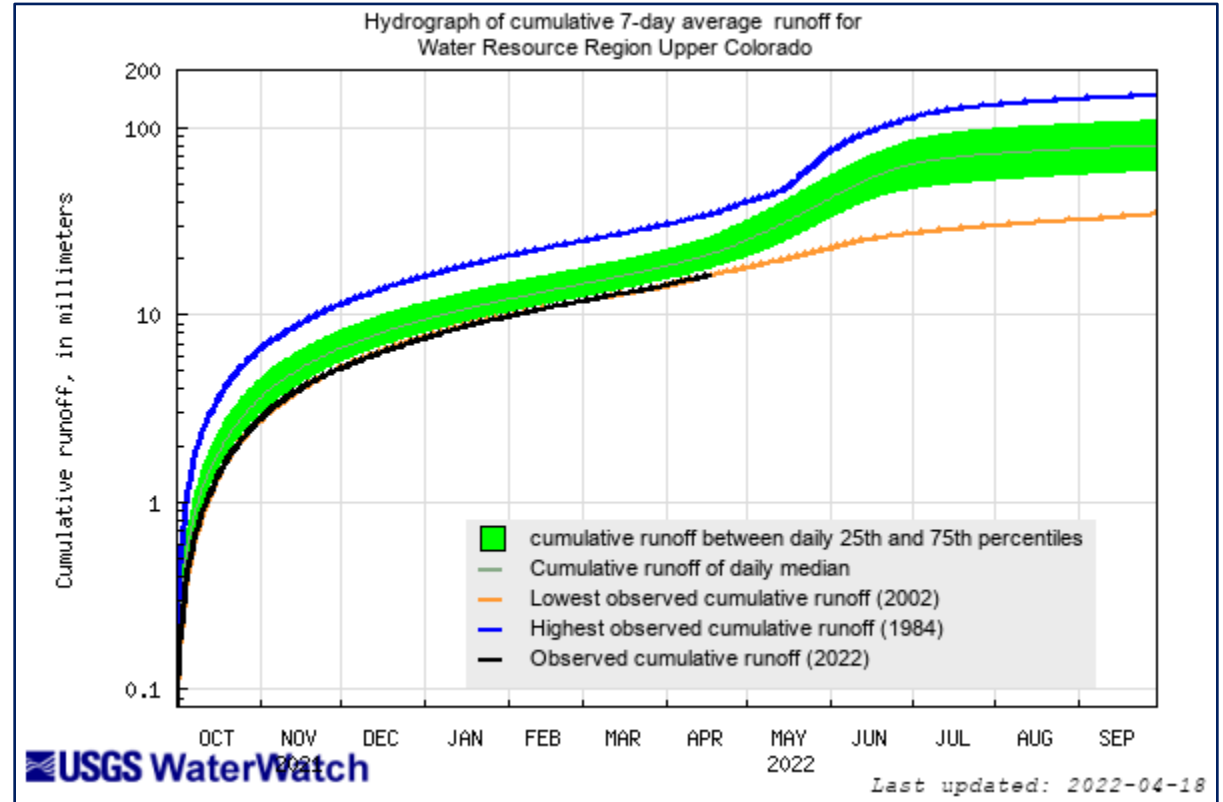
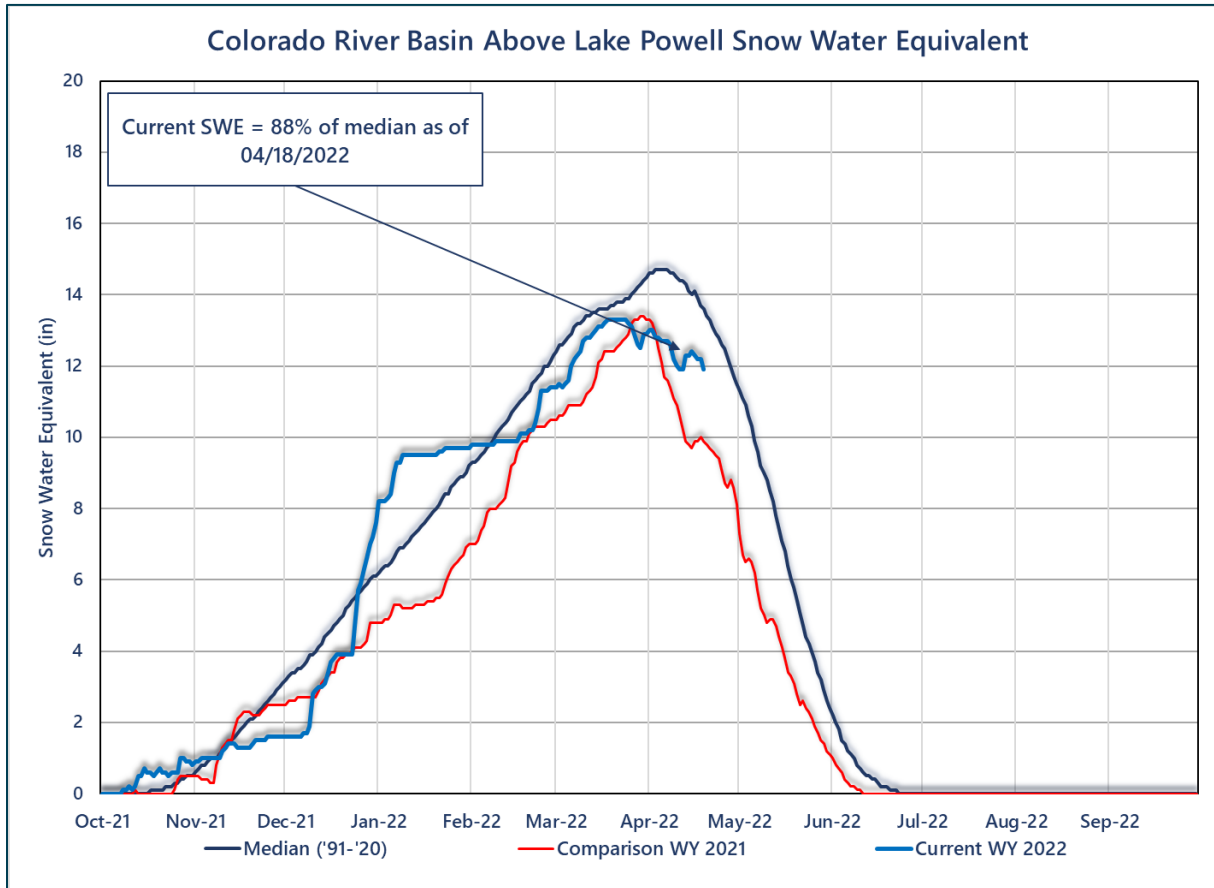
Data Current as of:
04/17/2022

Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	46	0.15	0.33	6,479.07
Flaming Gorge	78	2.93	3.75	6,018.71
Blue Mesa	29	0.24	0.83	7,436.28
Navajo	51	0.87	1.70	6,020.16
Lake Powell	24	5.78	24.32	3,522.61
UC System Storage	33	10.10	30.93	



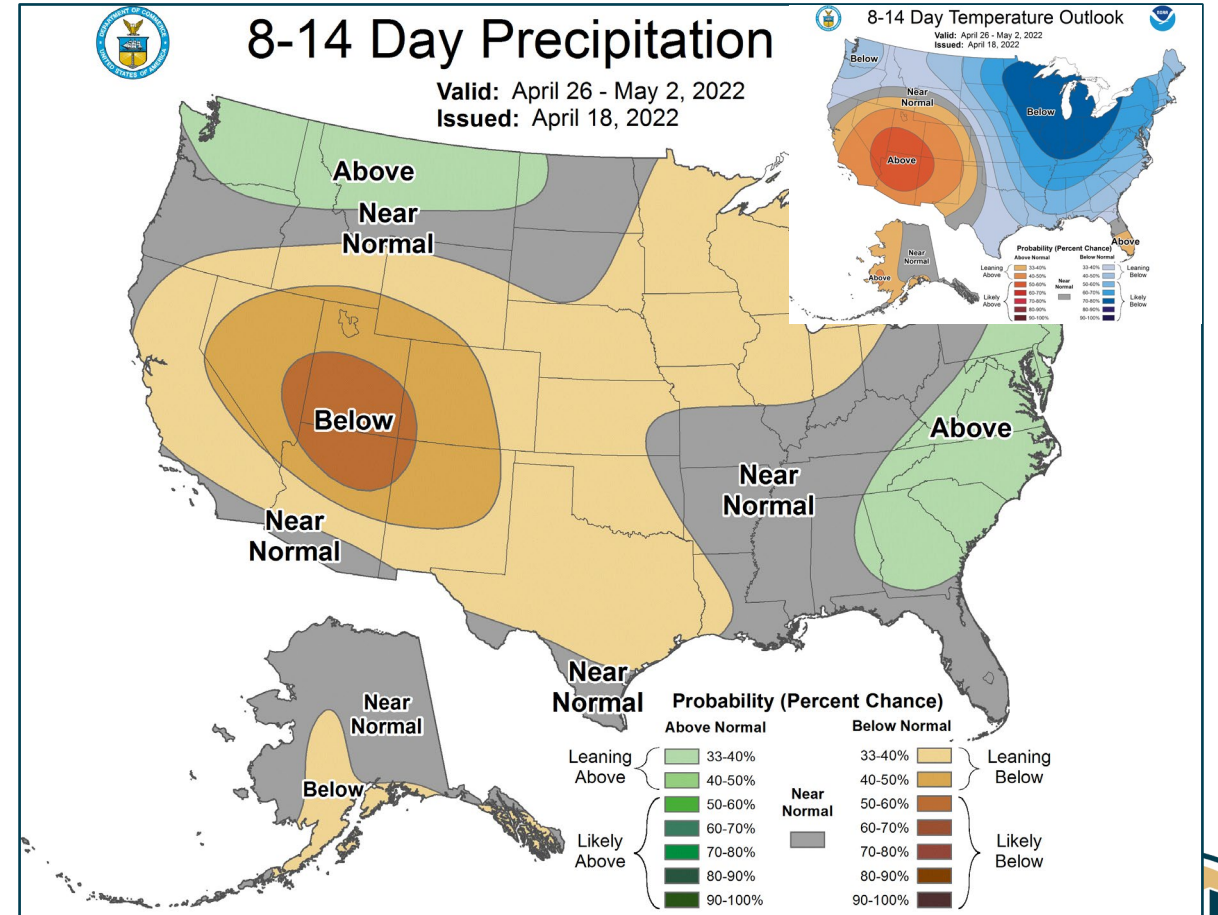
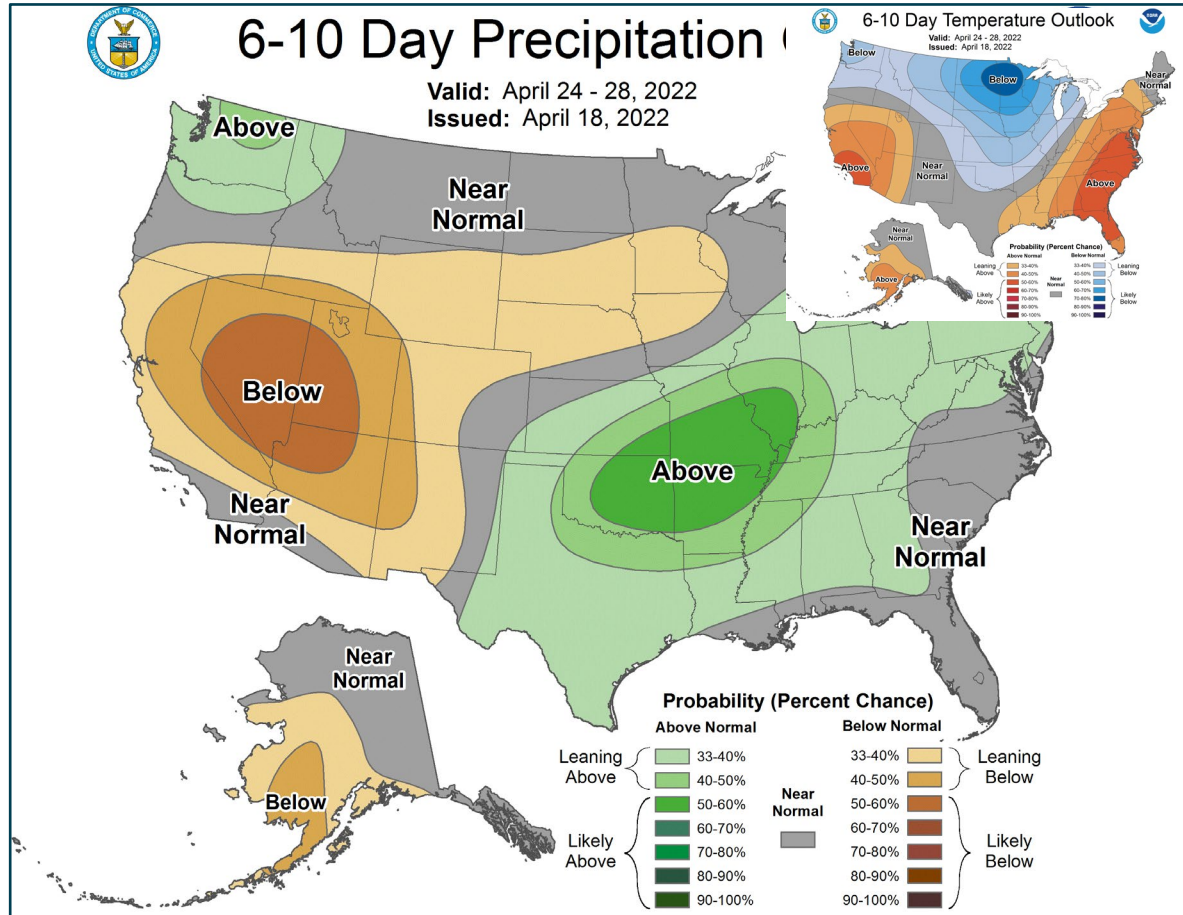
Upper Colorado SWE and Observed Inflows



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



NOAA Precipitation Outlook Comparison



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





Upper Colorado Basin

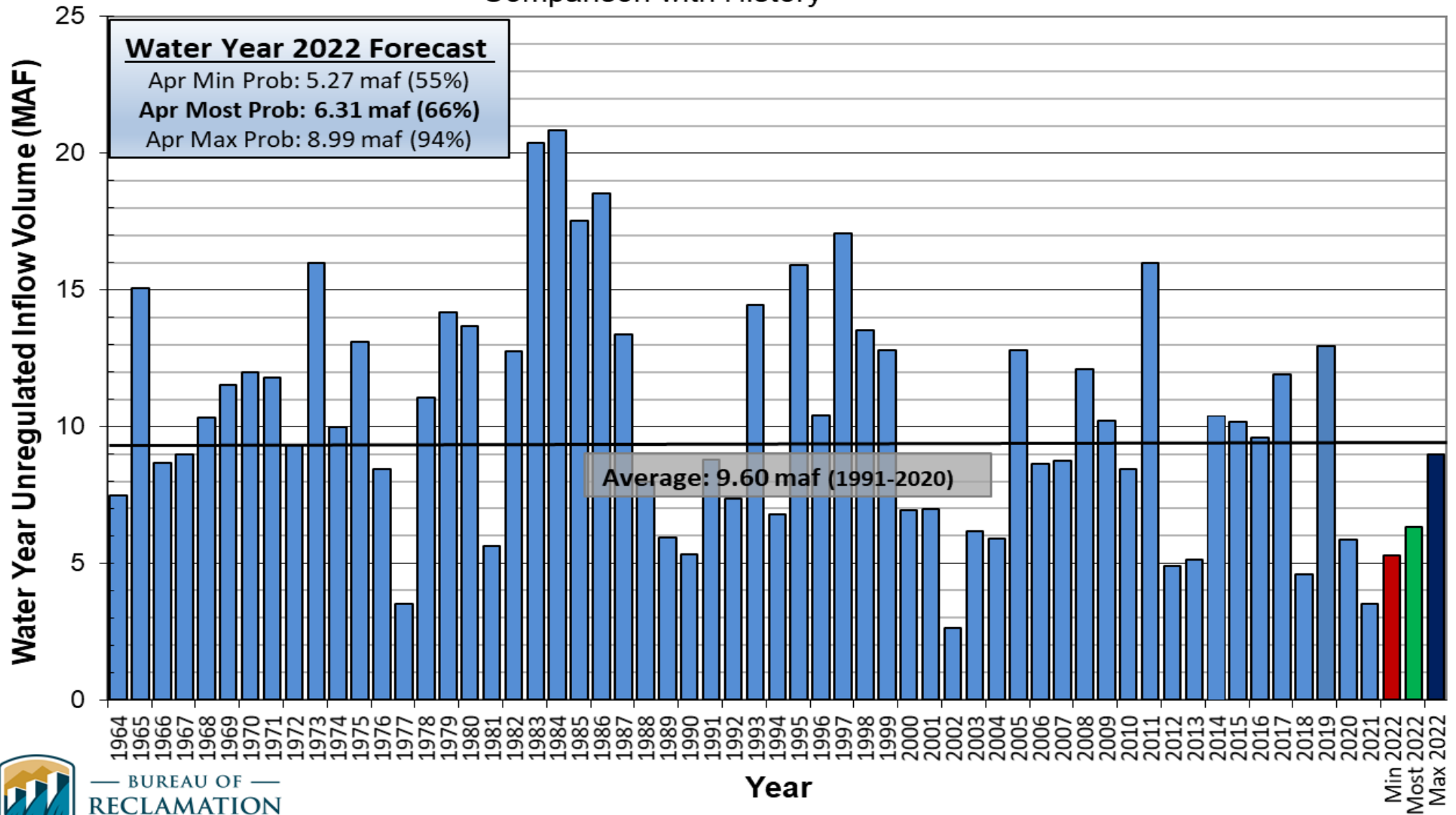
**Projected Operations
for Water Year 2022
Based on March 2022
Modeling**



Lake Powell Unregulated Inflow

Water Year 2022 Forecast (issued April 5)

Comparison with History



BUREAU OF RECLAMATION



Most Probable April Forecast Water Year 2022

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

Reservoir	Unregulated Inflow (kaf)	1991-2020 Percent of Avg
Fontenelle	435	59
Flaming Gorge	520	54
Blue Mesa	530	83
Navajo	390	62
Powell	4,100	69

Water Year 2022
Forecasted Unregulated Inflow
as of April 5, 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	6,310	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) 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 Tier ³ 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	Mid-Elevation Release Tier Release 7.48 maf; if Lake Mead < 1,025 feet, release 8.23 maf	9.5	1,145	Normal or ICS Surplus Condition Deliver ≥ 7.5 maf	15.9
	3,535.40 ft		1,105		11.9
			1,075	1,065.85 ft	9.4
	Jan 1, 2022 Projection			Shortage Condition Deliver 7.167 ⁴ maf	Jan 1, 2022 Projection
3,525		5.9	1,050		7.5
	Lower Elevation Balancing Tier Balance contents with a min/max release of 7.0 and 9.5 maf		1,025	Shortage Condition Deliver 7.083 ⁵ maf	5.8
3,490		4.0	1,000	Shortage Condition Deliver 7.0 ⁶ maf Further measures may be undertaken ⁷	4.3
3,370		0	895		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.

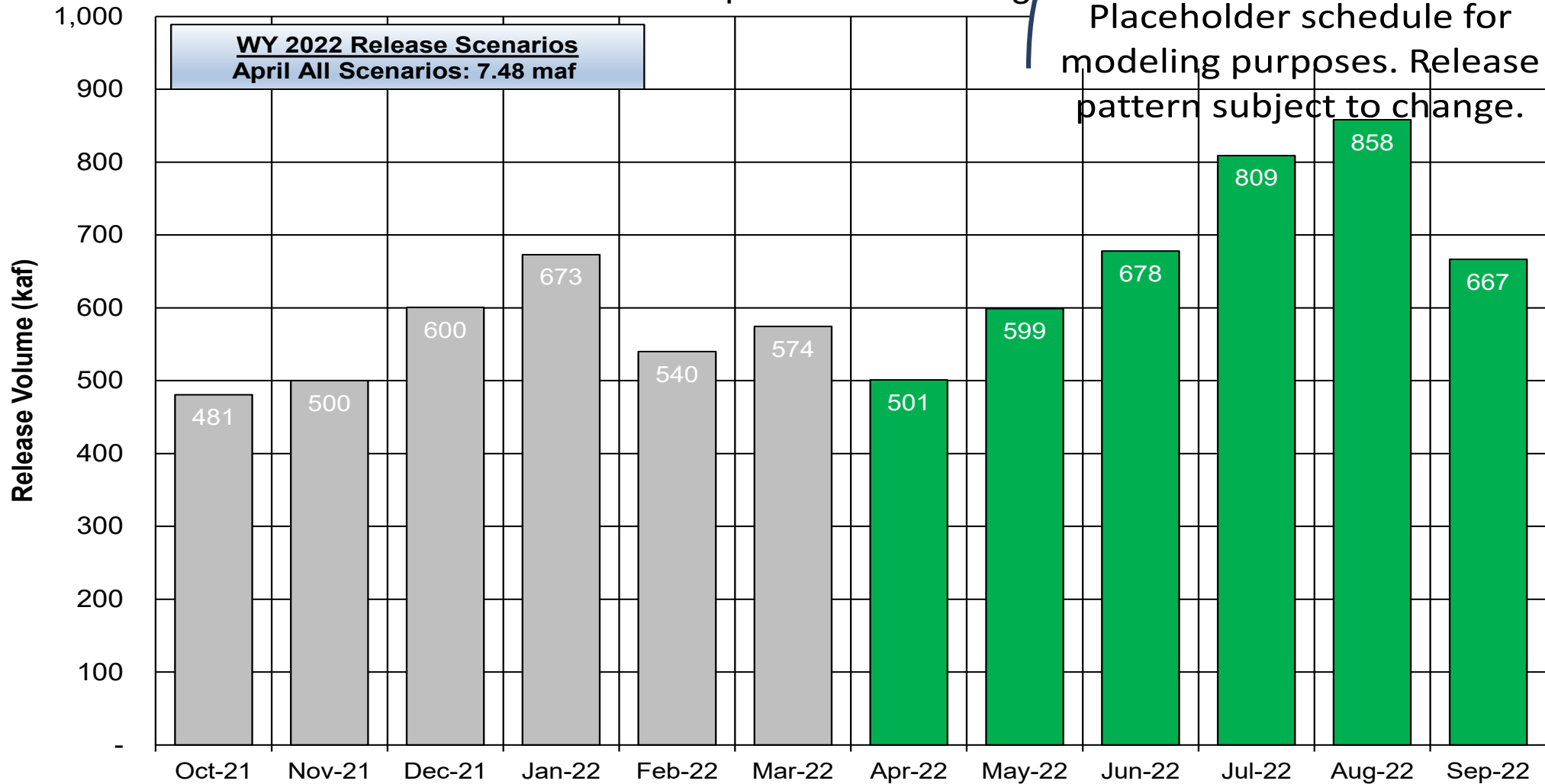
¹ Lake Powell and Lake Mead operating determinations are based on August 2021 24-Month Study projections consistent with the 2007 Interim Guidelines and 2019 Drought Contingency Plans. These determinations will be documented in the 2022 Annual Operating Plan for Colorado River Reservoirs.



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2022

Based on April 2022 Modeling



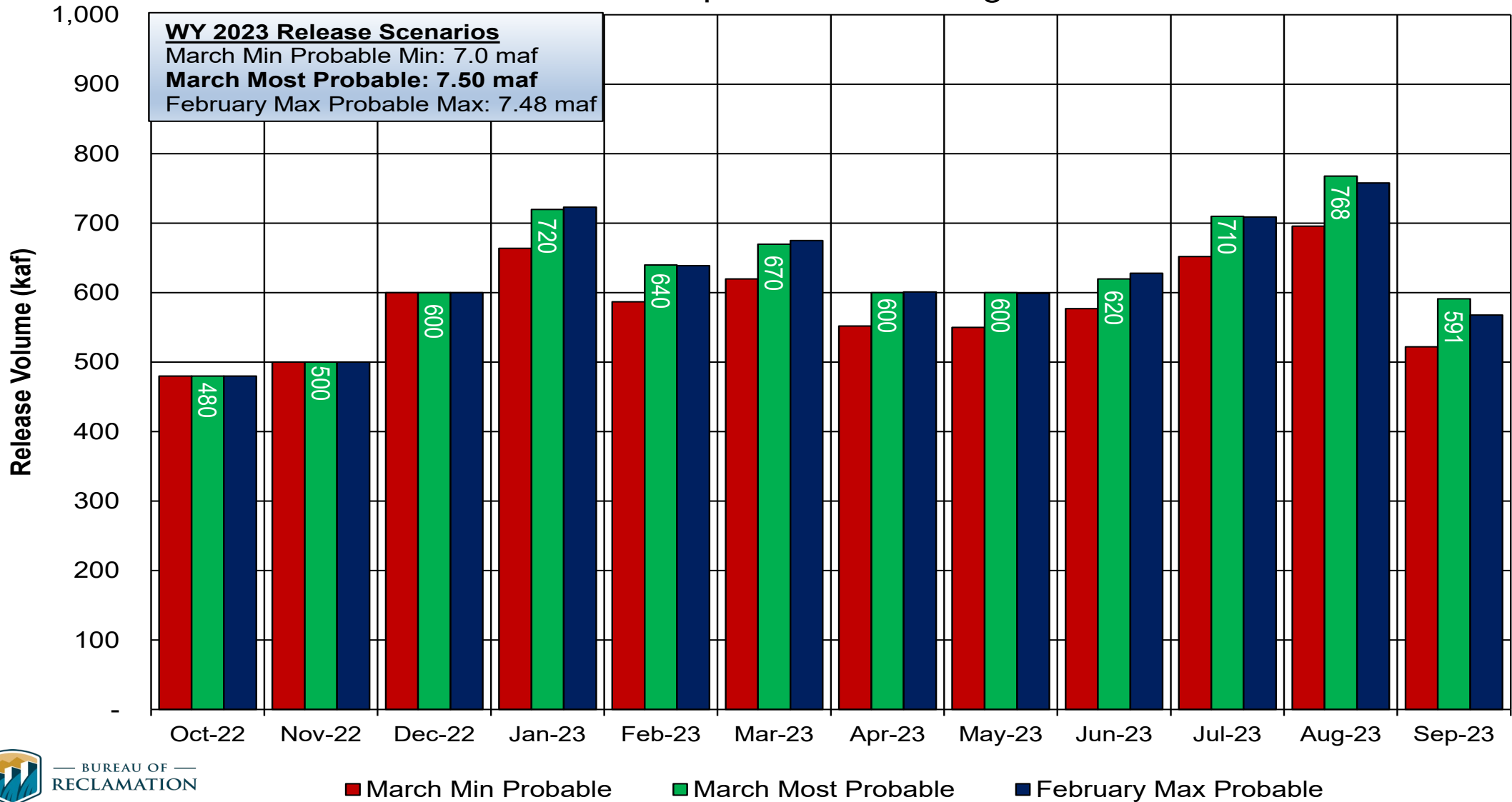
The Drought Response Operations Agreement (DROA) can be found here: <https://www.usbr.gov/dcp/finaldocs.html>



Potential Lake Powell Monthly Release Volume Distribution

Release Scenarios for Water Year 2023

Based on April 2022 Modeling



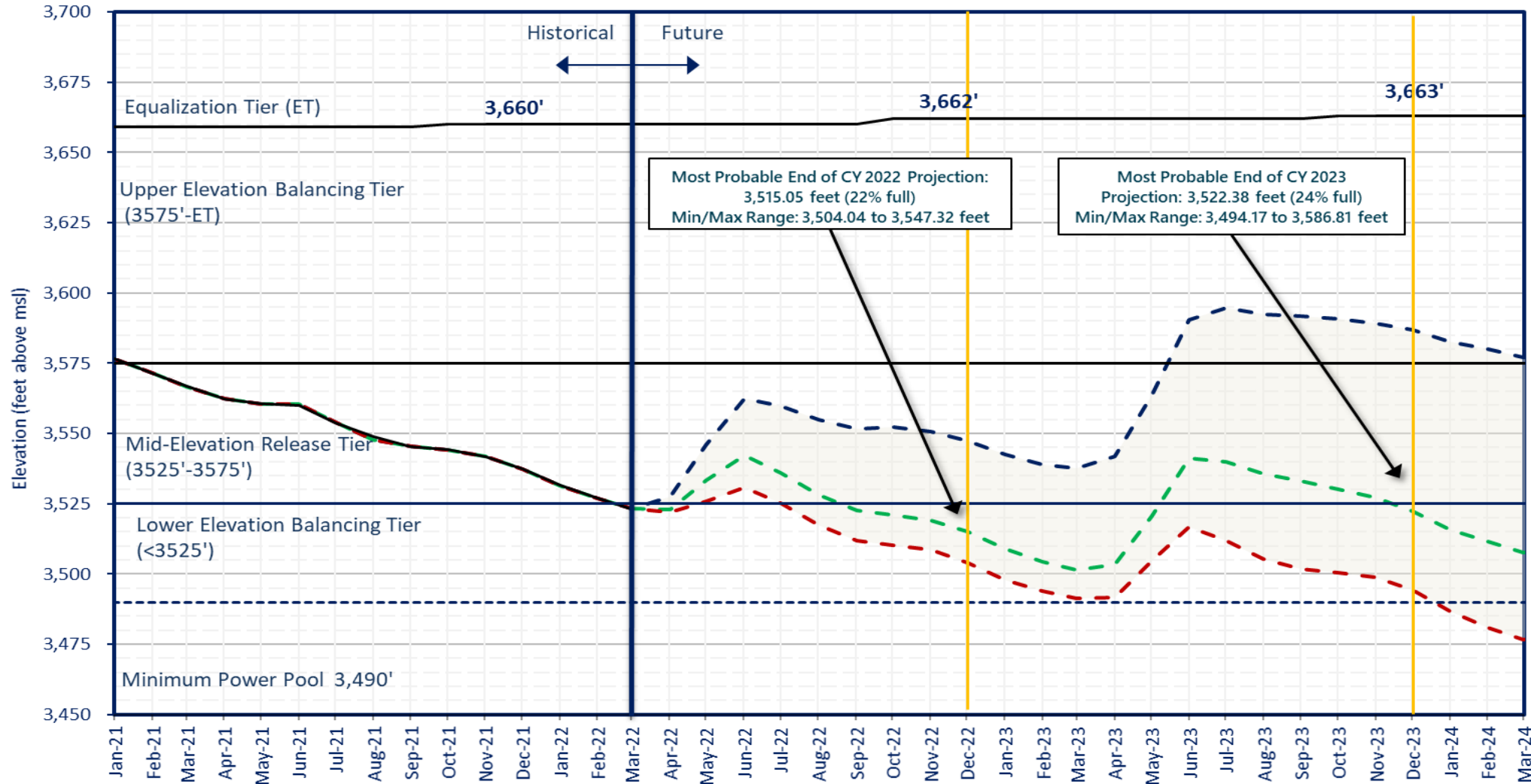
Reclamation Operational Modeling Model Comparison

	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)	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 Elevations

Projections from the April 2022 24-Month Study Inflow Scenarios



Most Probable End of CY 2022 Projection:
3,515.05 feet (22% full)
Min/Max Range: 3,504.04 to 3,547.32 feet

Most Probable End of CY 2023
Projection: 3,522.38 feet (24% full)
Min/Max Range: 3,494.17 to 3,586.81 feet



BUREAU OF RECLAMATION

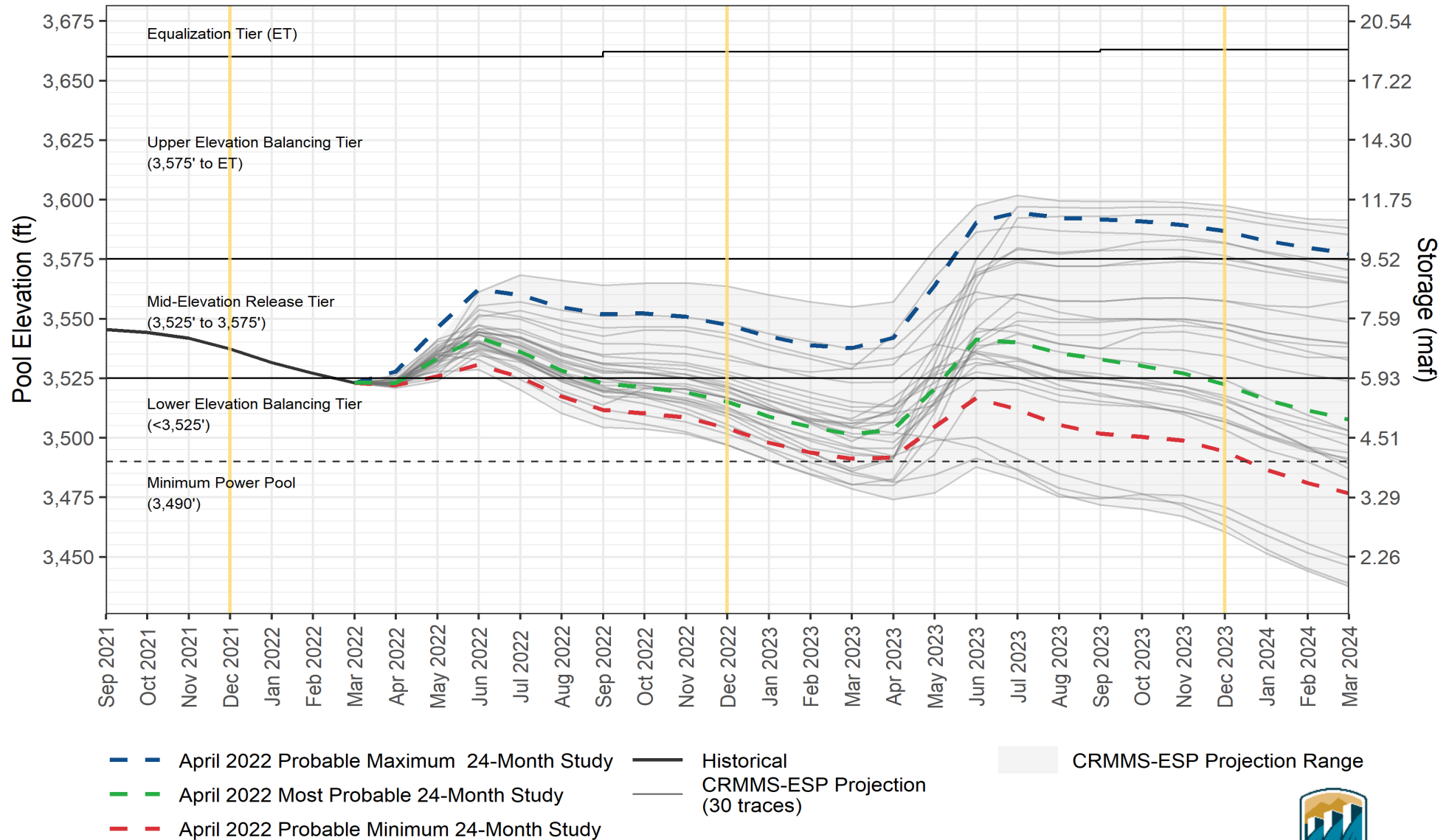
- April 2022 Maximum Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.48 maf in WY2023
- April 2022 Most Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.50 maf in WY2023
- April 2022 Minimum Probable Inflow - Lake Powell release of 7.48 maf in WY2022 and 7.0 maf in WY2023
- Historical Elevations

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



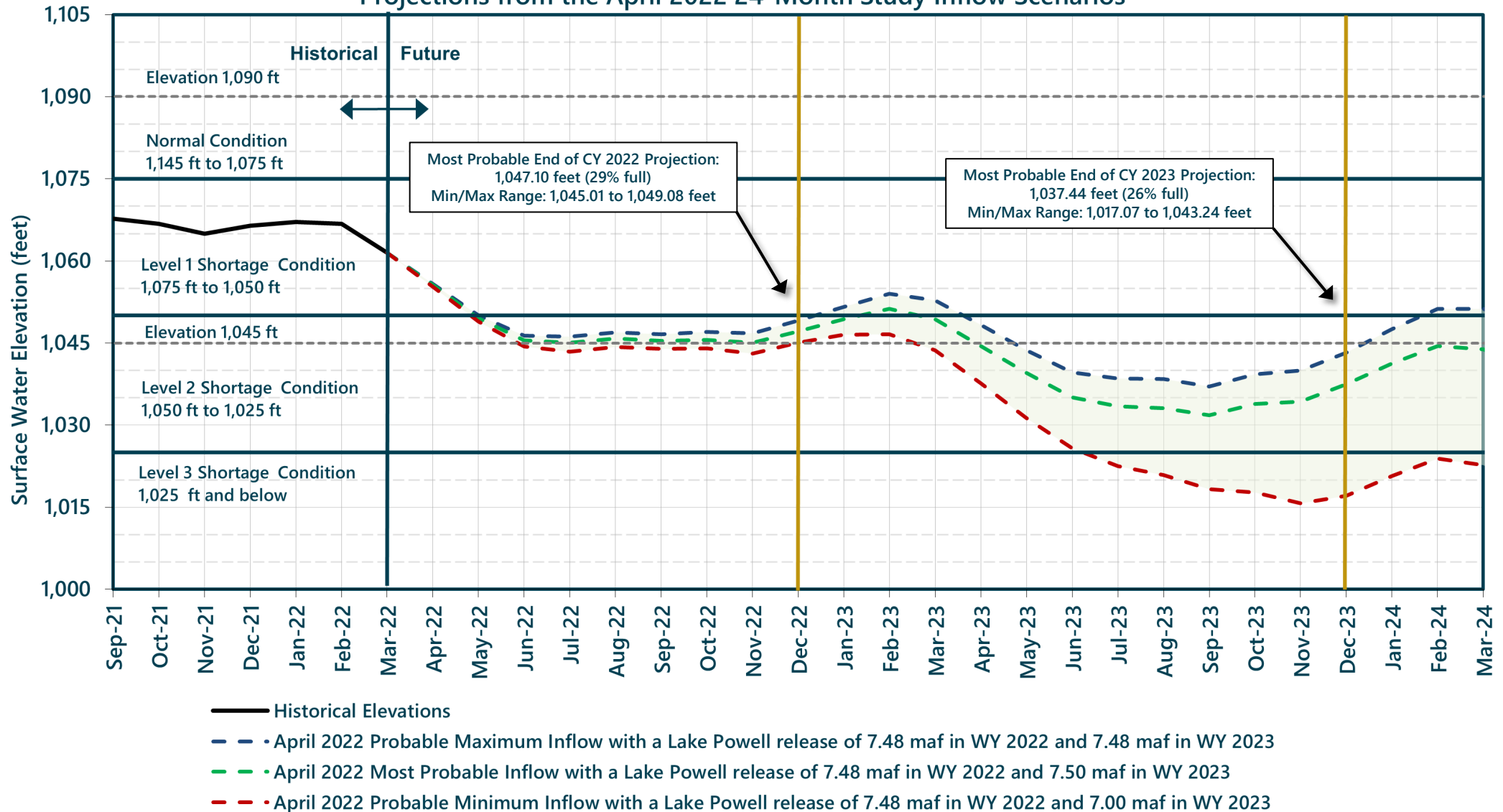
Lake Powell End-of-Month Elevations

CRMMS Projections from April 2022



Lake Mead End of Month Elevations

Projections from the April 2022 24-Month Study Inflow Scenarios

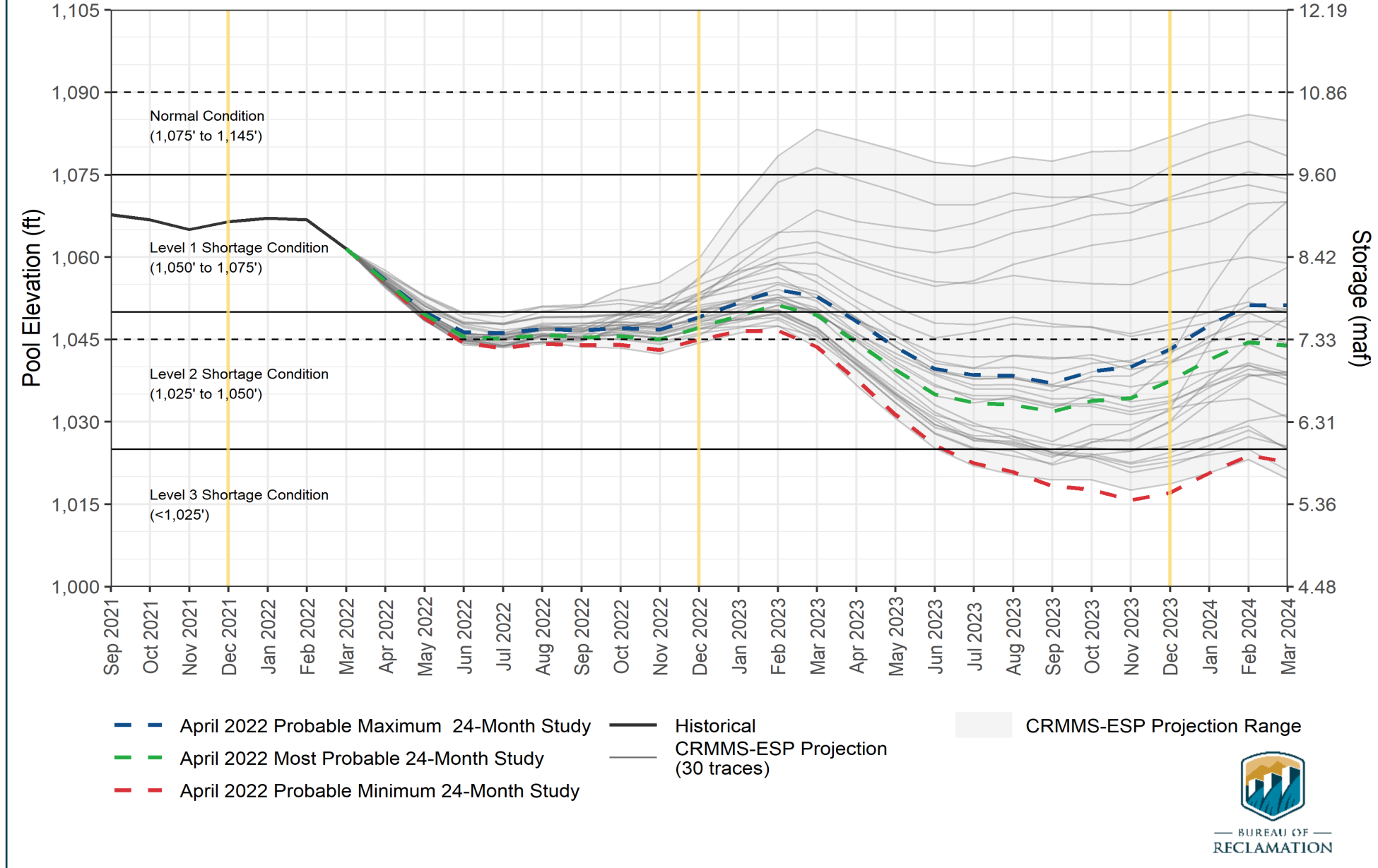


The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.



Lake Mead End-of-Month Elevations

CRMMS Projections from April 2022





Upper Colorado Basin

Hydropower Maintenance



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)	14,750	18,000	17,900	17,700	17,500	17,400	17,500	18,000	18,700	18,650	18,500	11,650
Capacity (kaf/month)	940	1,070	1,100	1,070	910	1,070	1,040	1,110	1,110	1,150	1,140	760
Max (kaf) ¹	480	500	600	723	639	675	601	599	628	709	758	568
Most (kaf) ¹	480	500	600	720	640	670	600	600	620	710	768	591
Min (kaf) ¹	480	500	600	664	587	620	552	550	577	652	696	522

APR MOST²

APR MOST

7.48 maf

7.50 maf

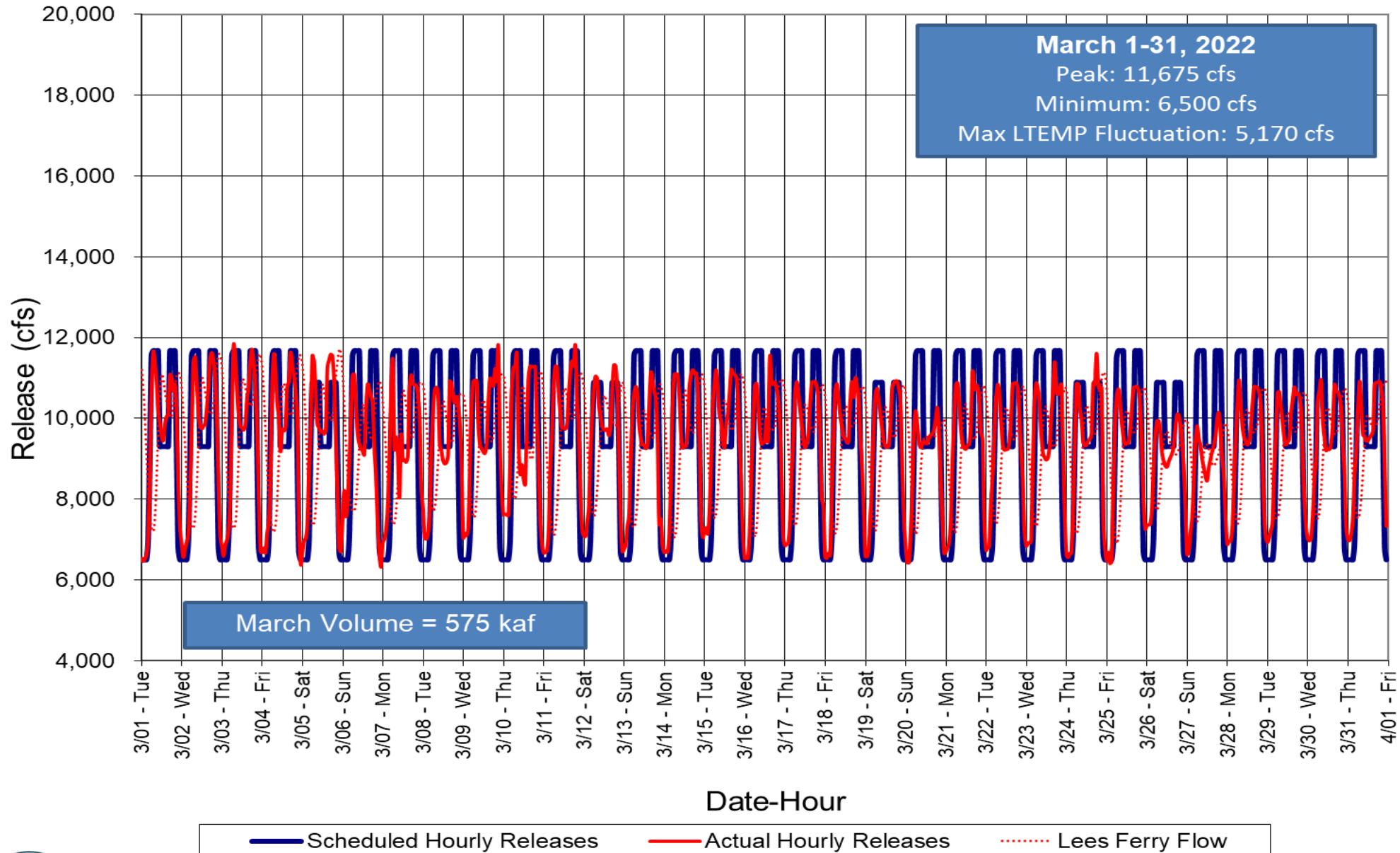
7.0 maf

(updated 04-18-2022)

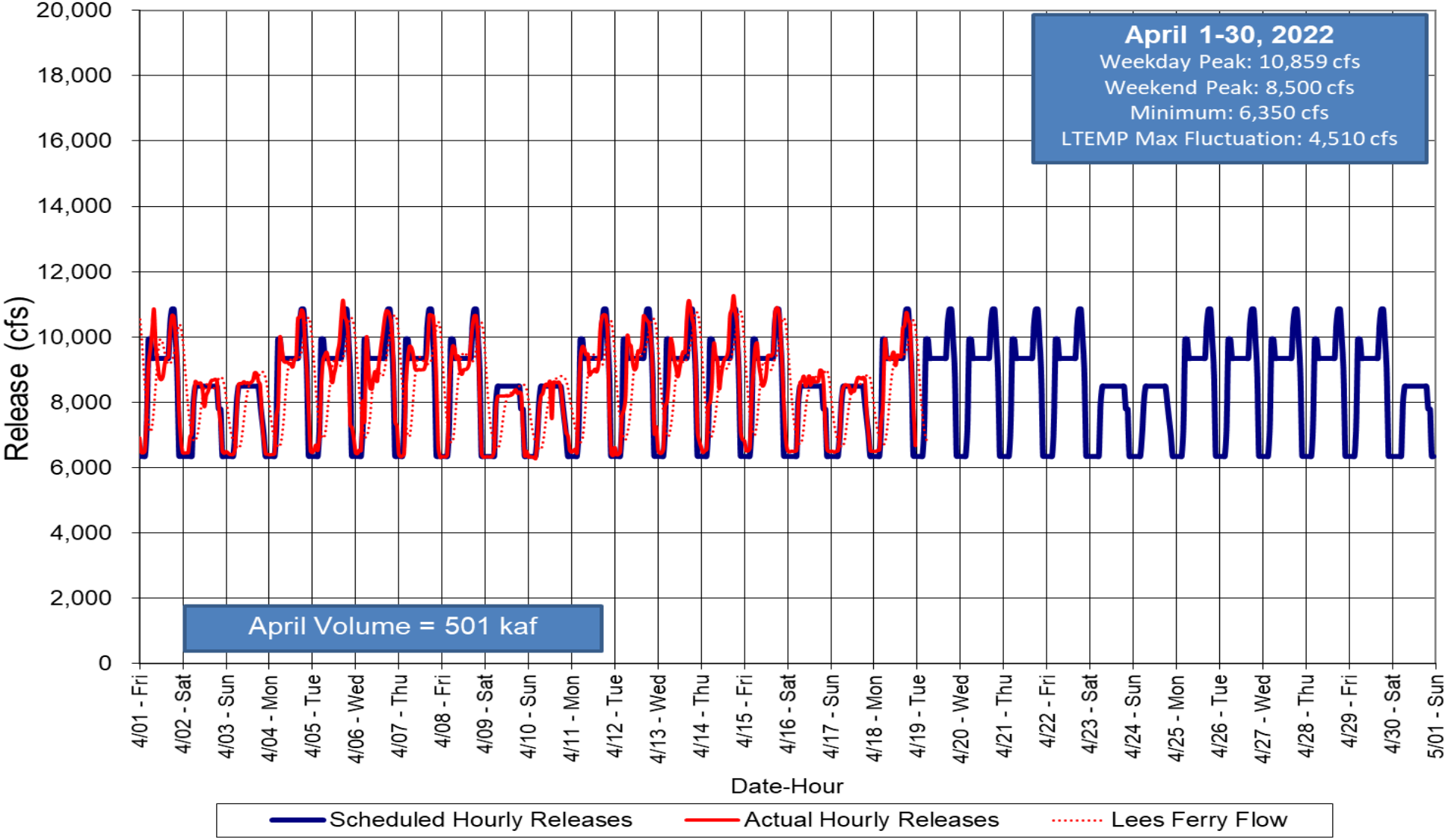
1 Projected release, based on April 2022 minimum, most maximum probable Inflow Projections and 24-Month Study model runs.
 2 Dependent upon availability to shift contingency reserves, which will increase capacity by 30-40MW (3%) at current efficiency.



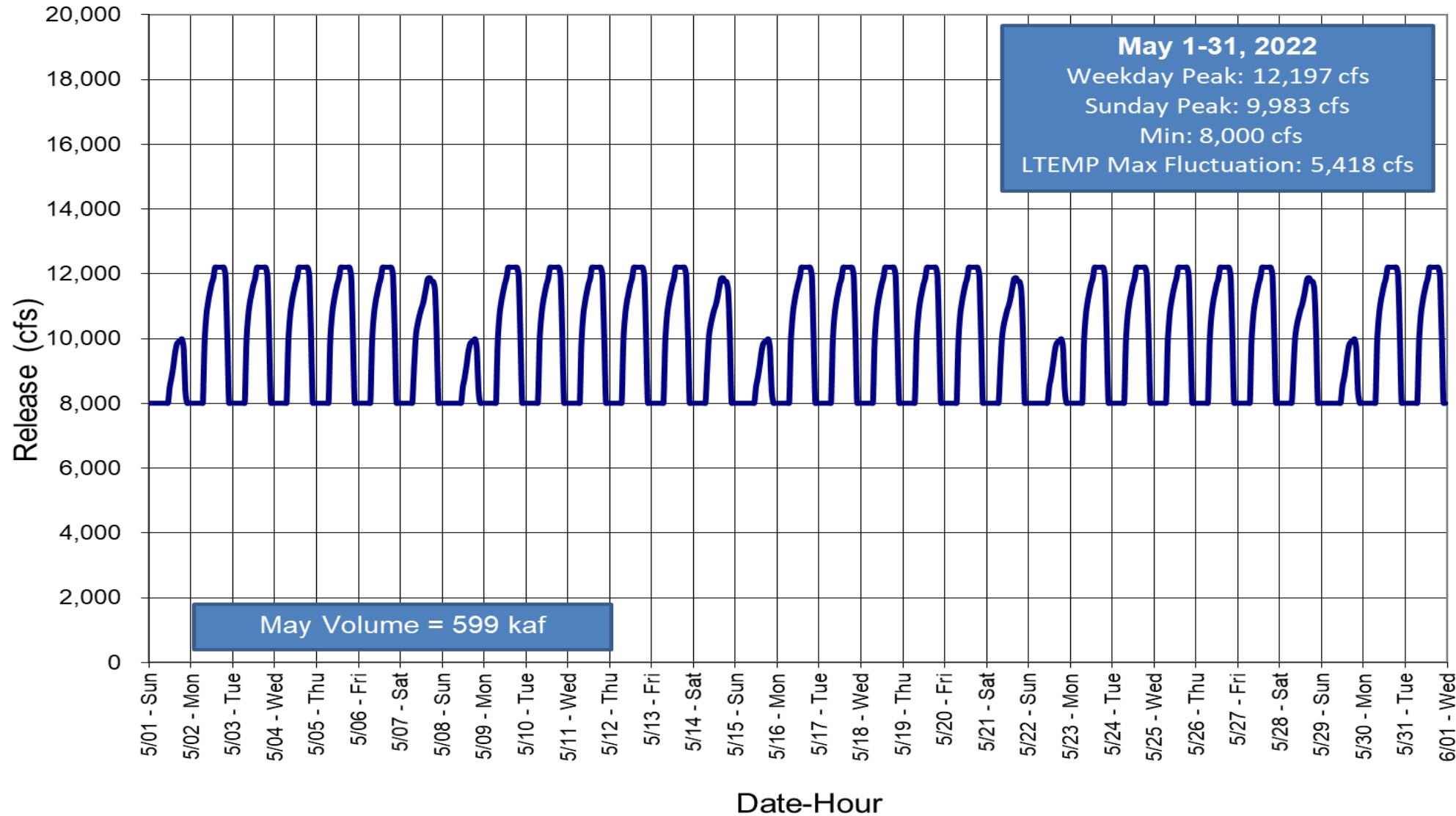
Glen Canyon Dam Hourly Release Pattern March 2022



Glen Canyon Dam Hourly Release Pattern April 2022



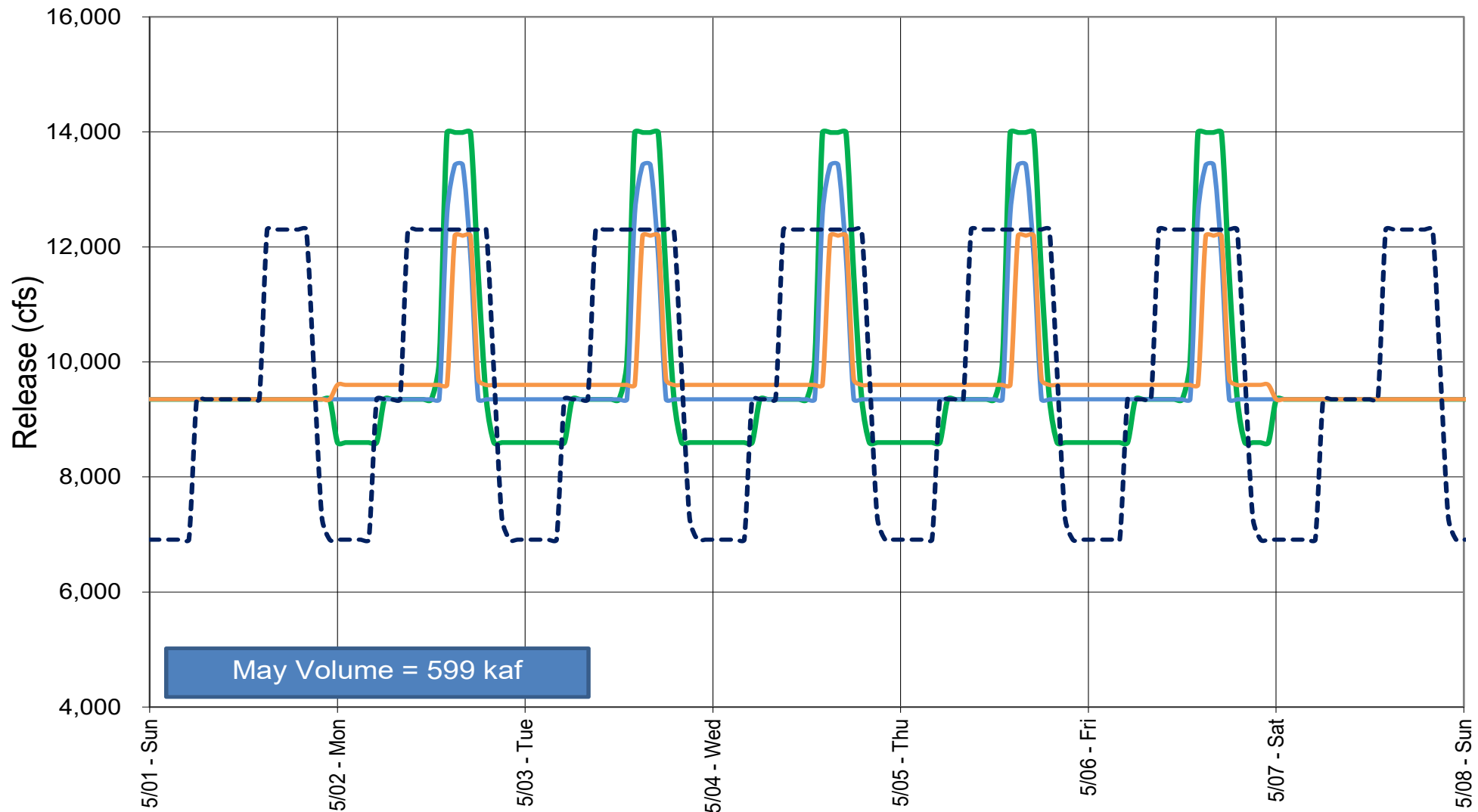
Glen Canyon Dam Hourly Release Pattern May 2022



— Scheduled Hourly Releases — Actual Hourly Releases Lees Ferry Flow



Glen Canyon Dam Hourly Proposed Macroinvertebrate Release Patterns during May 2022



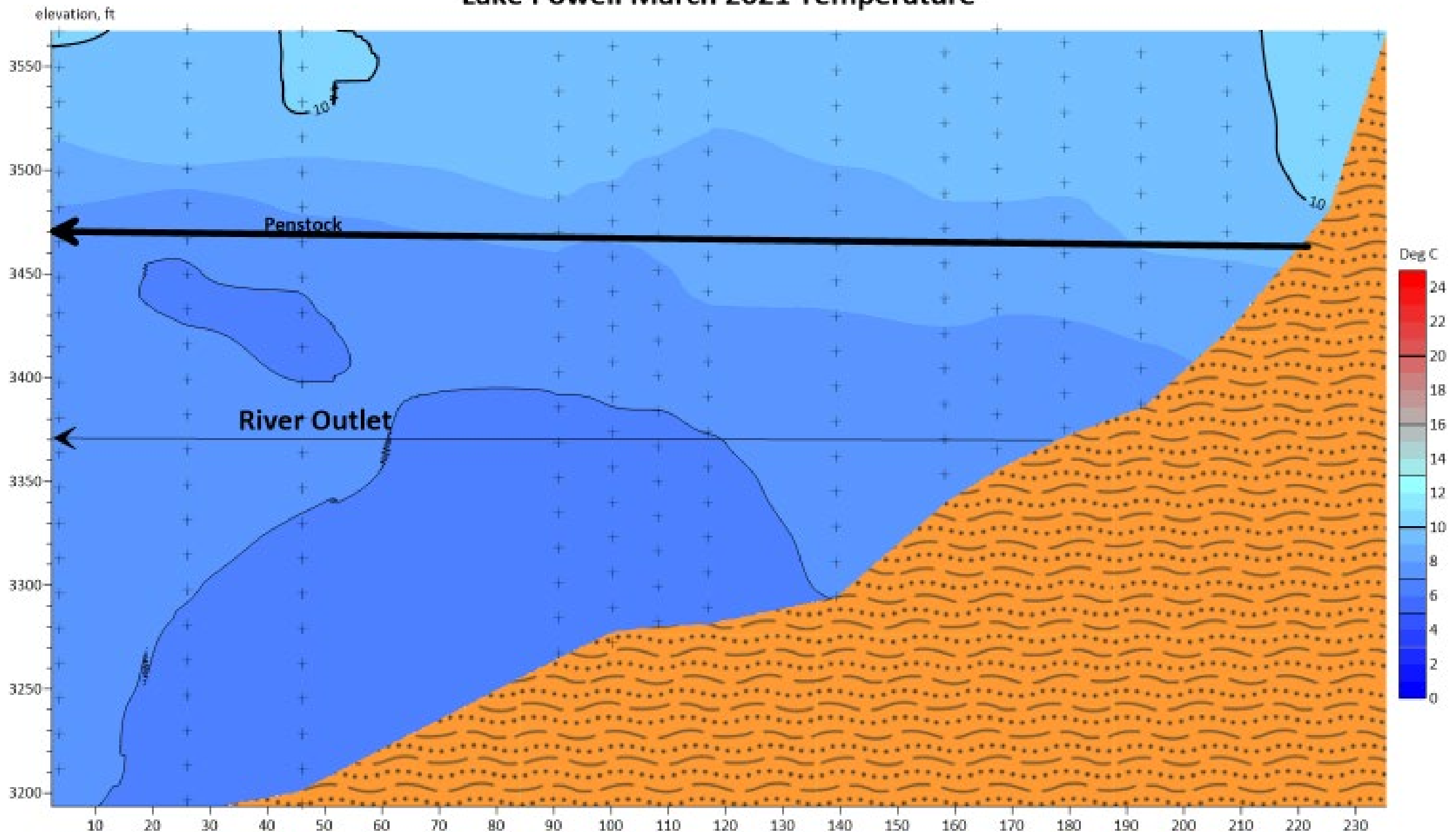
May Volume = 599 kaf



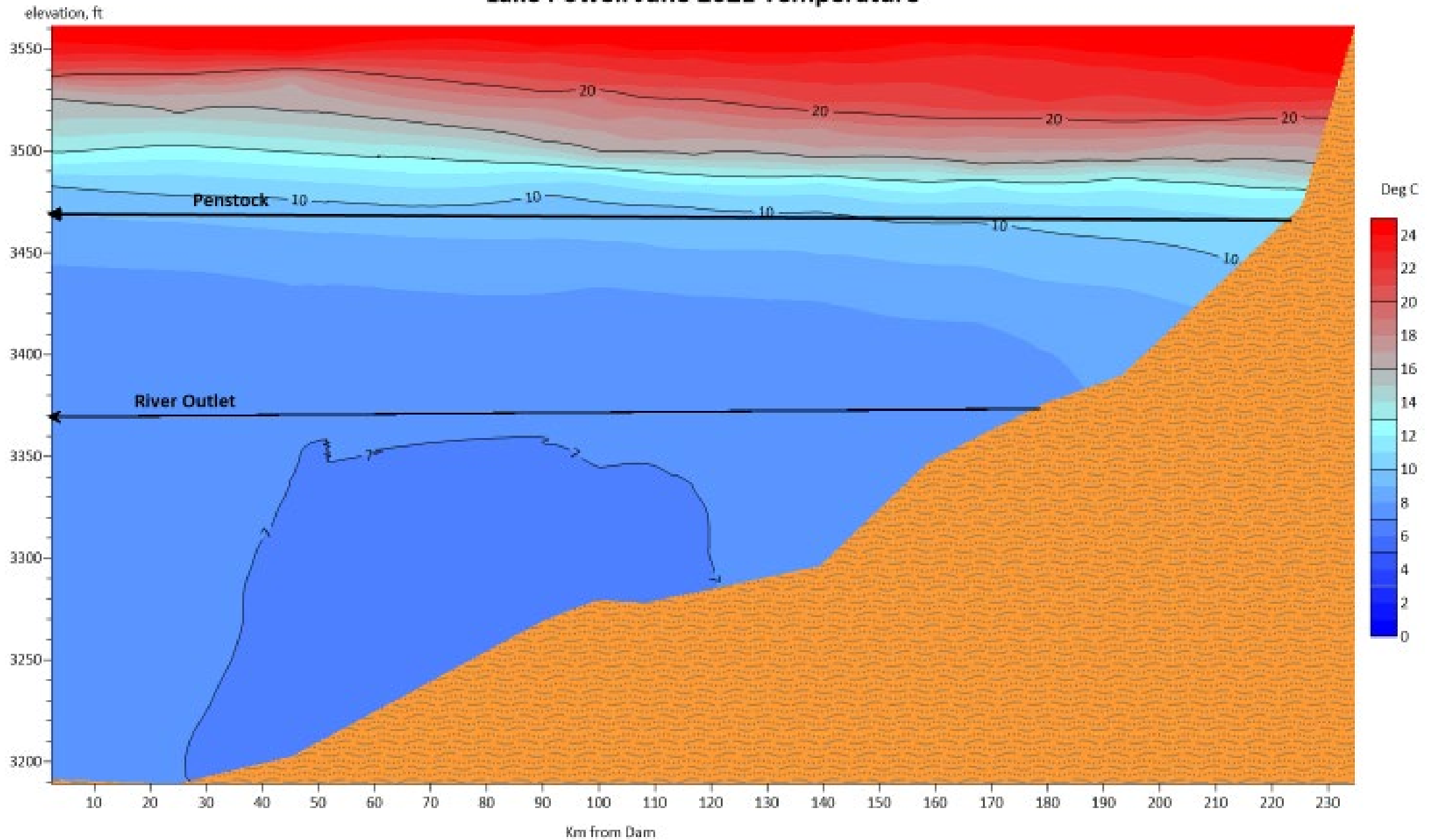
Water Quality



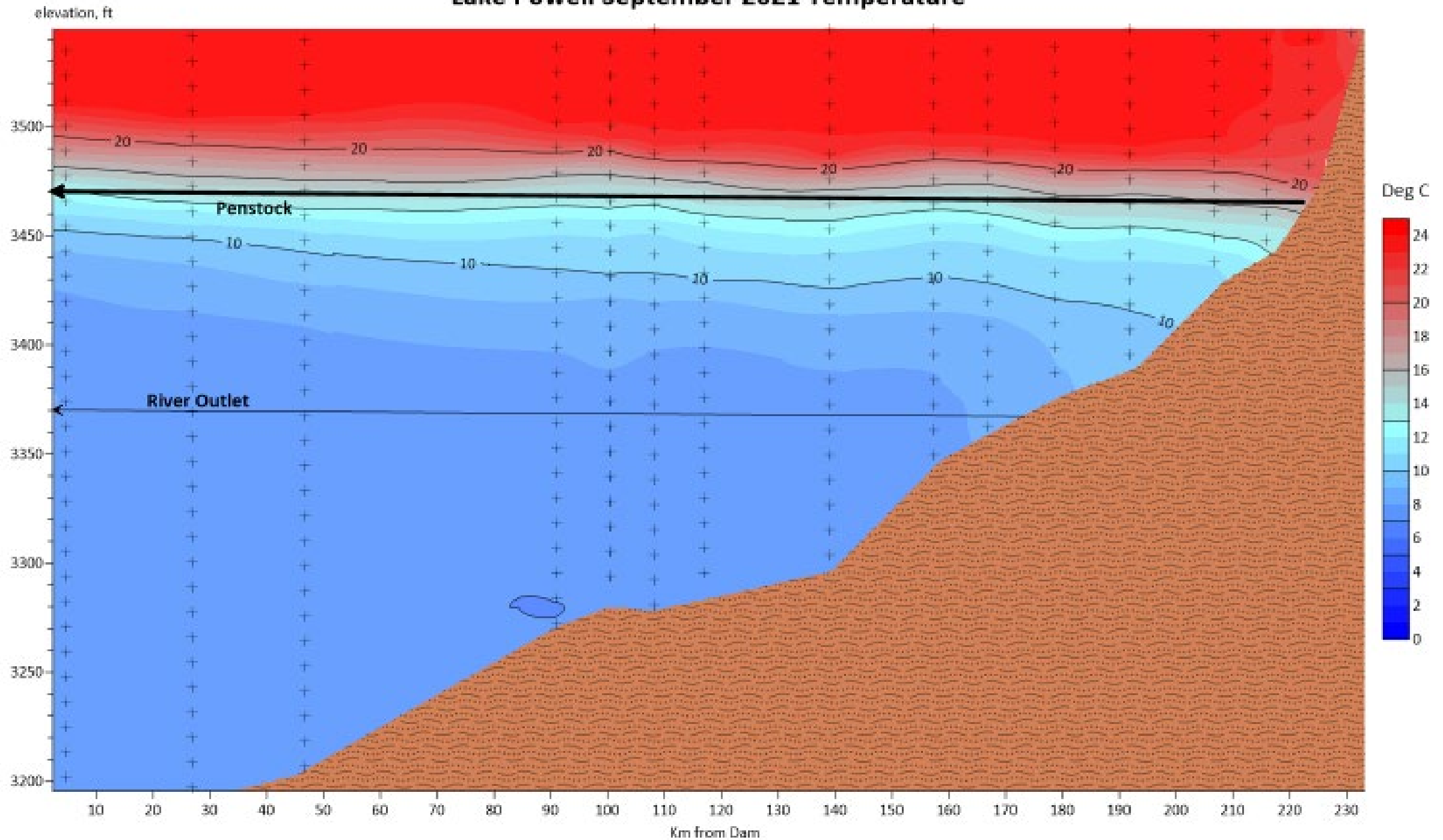
Lake Powell March 2021 Temperature



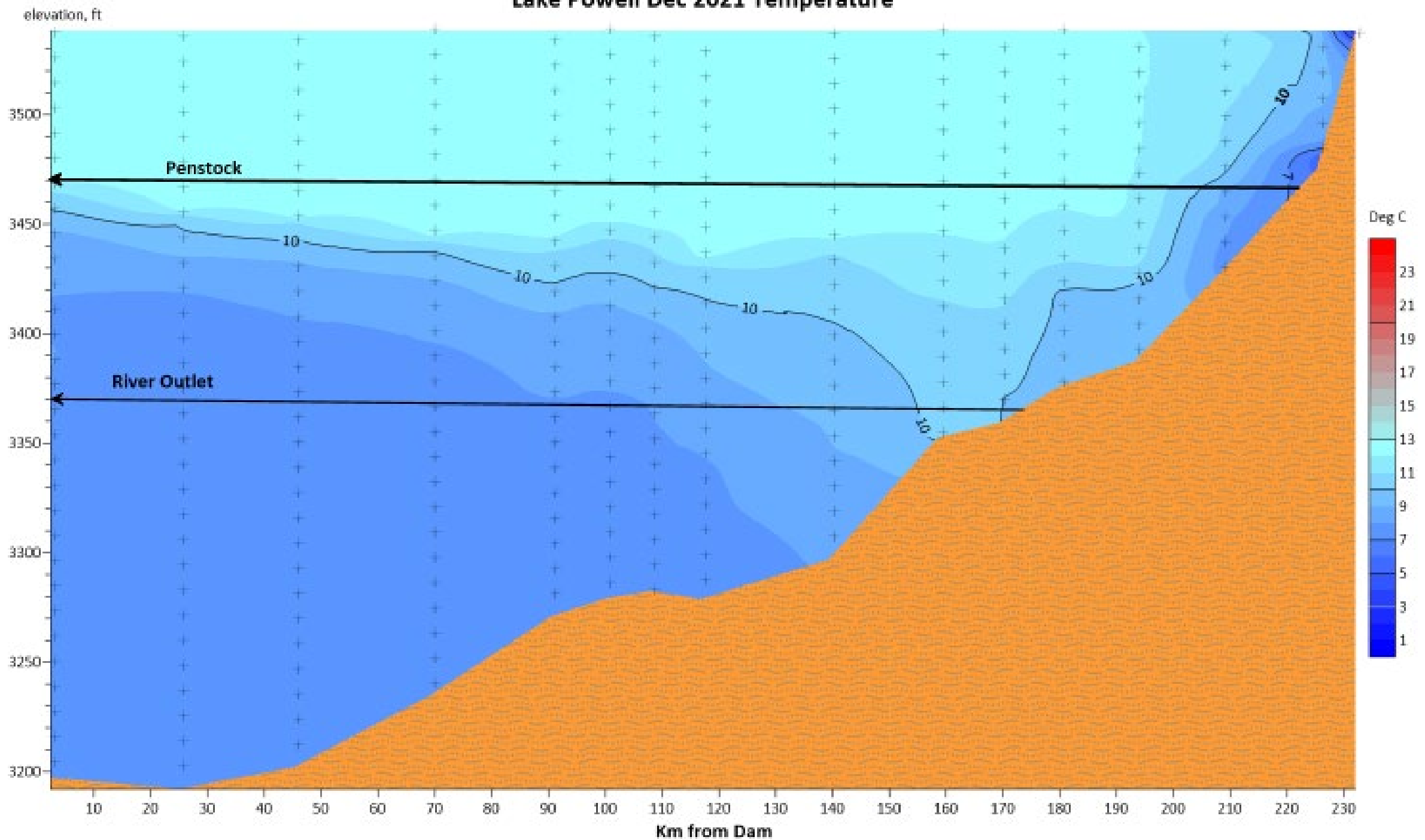
Lake Powell June 2021 Temperature



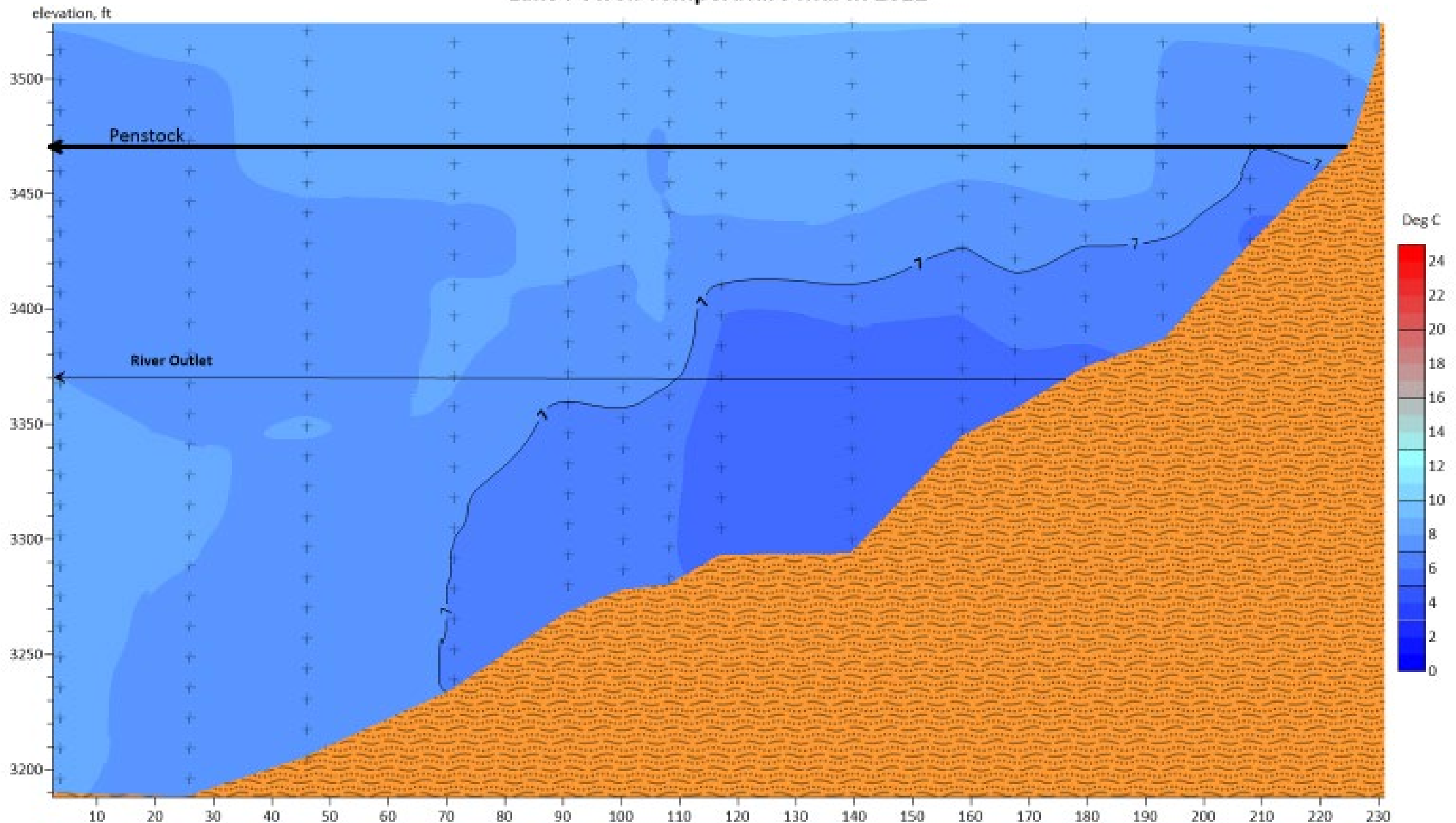
Lake Powell September 2021 Temperature



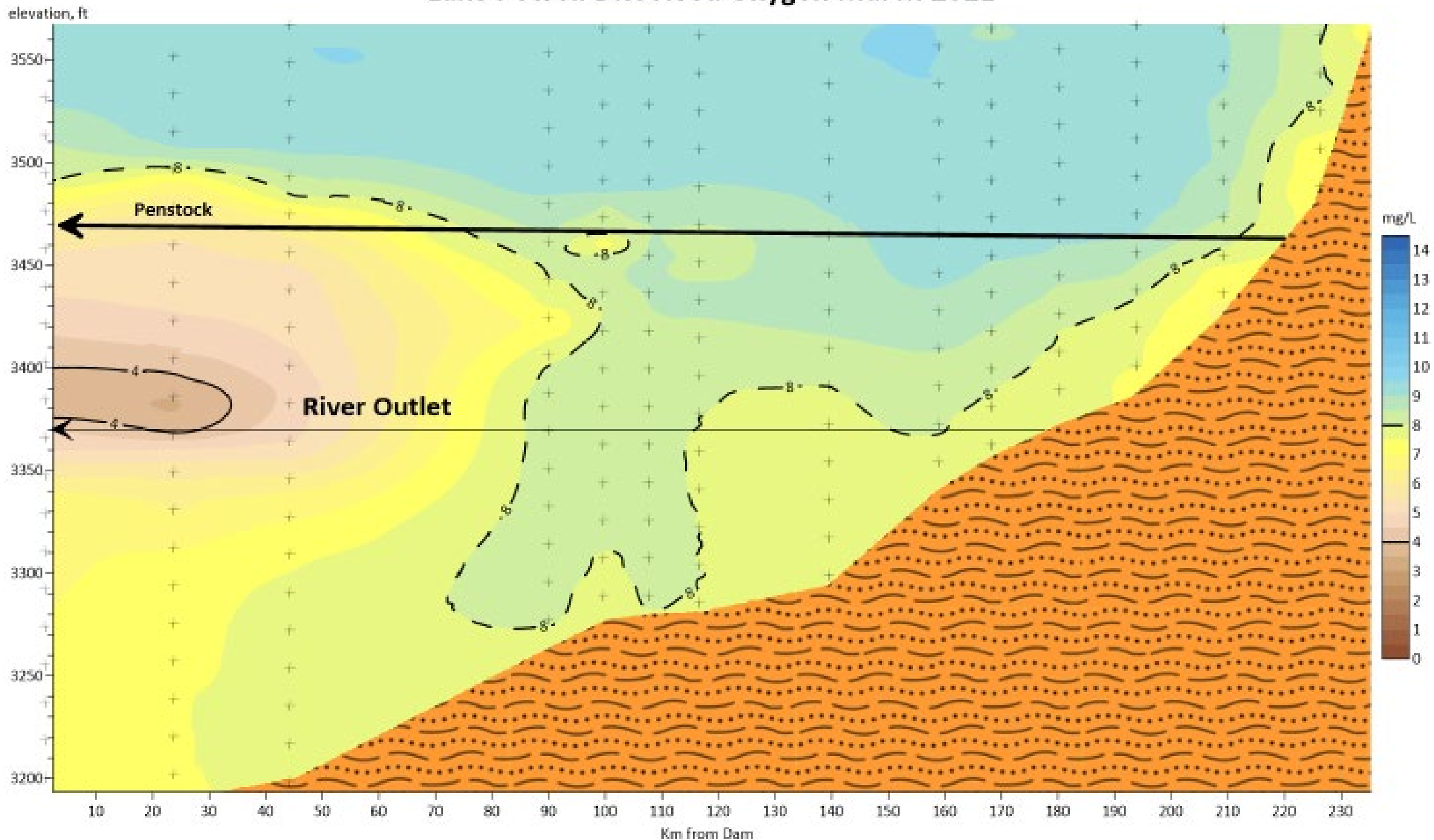
Lake Powell Dec 2021 Temperature



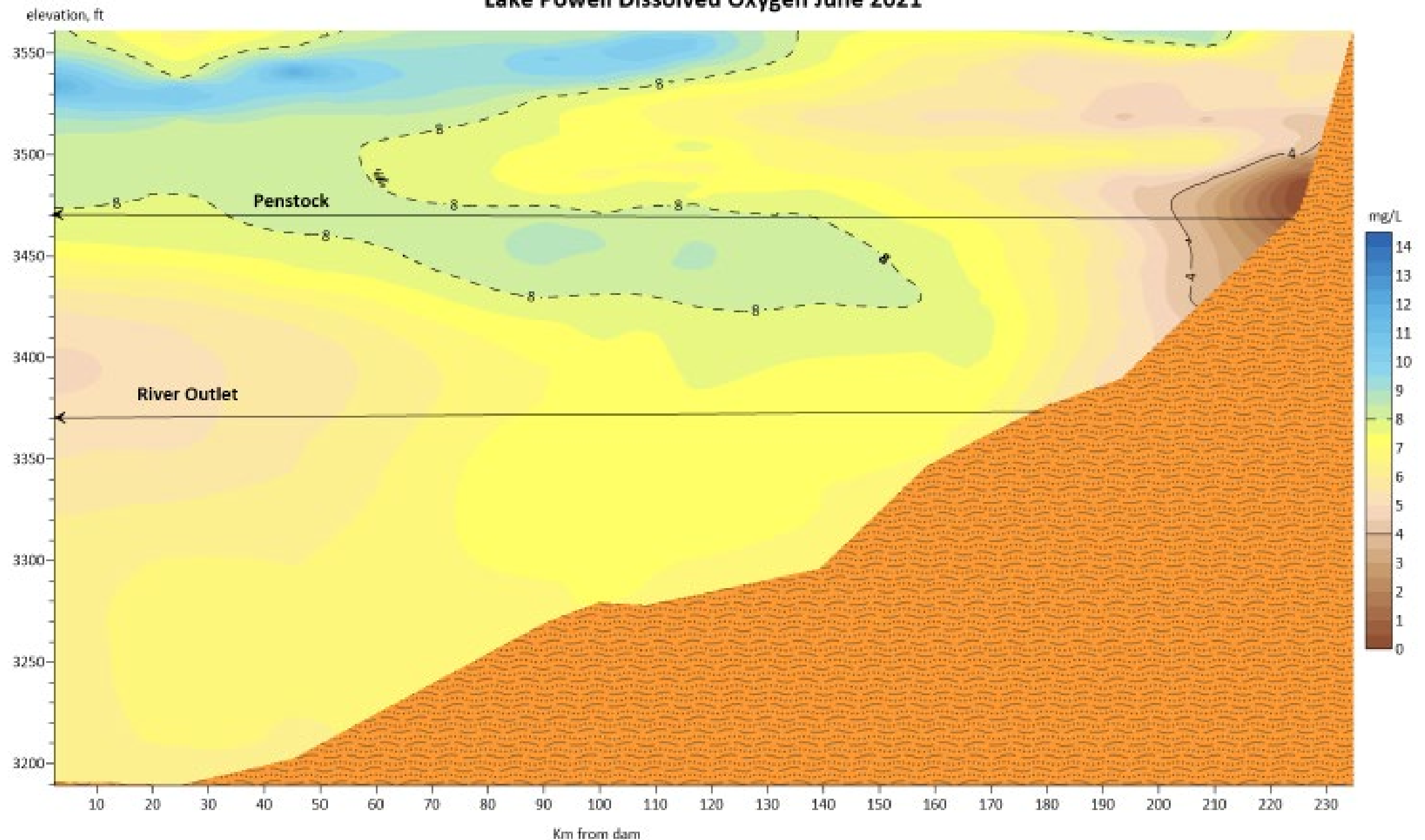
Lake Powell Temperature March 2022



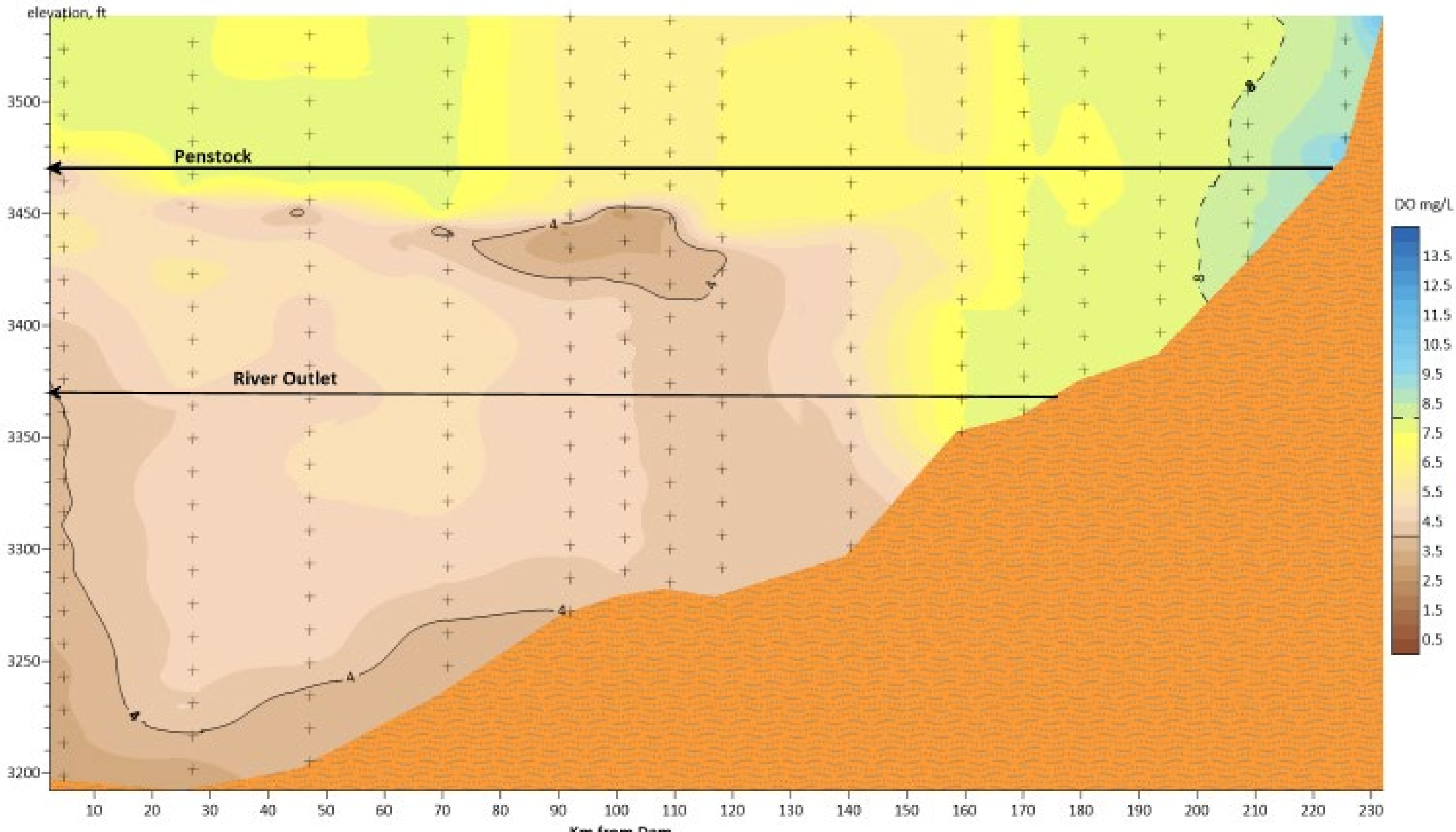
Lake Powell Dissolved Oxygen March 2021



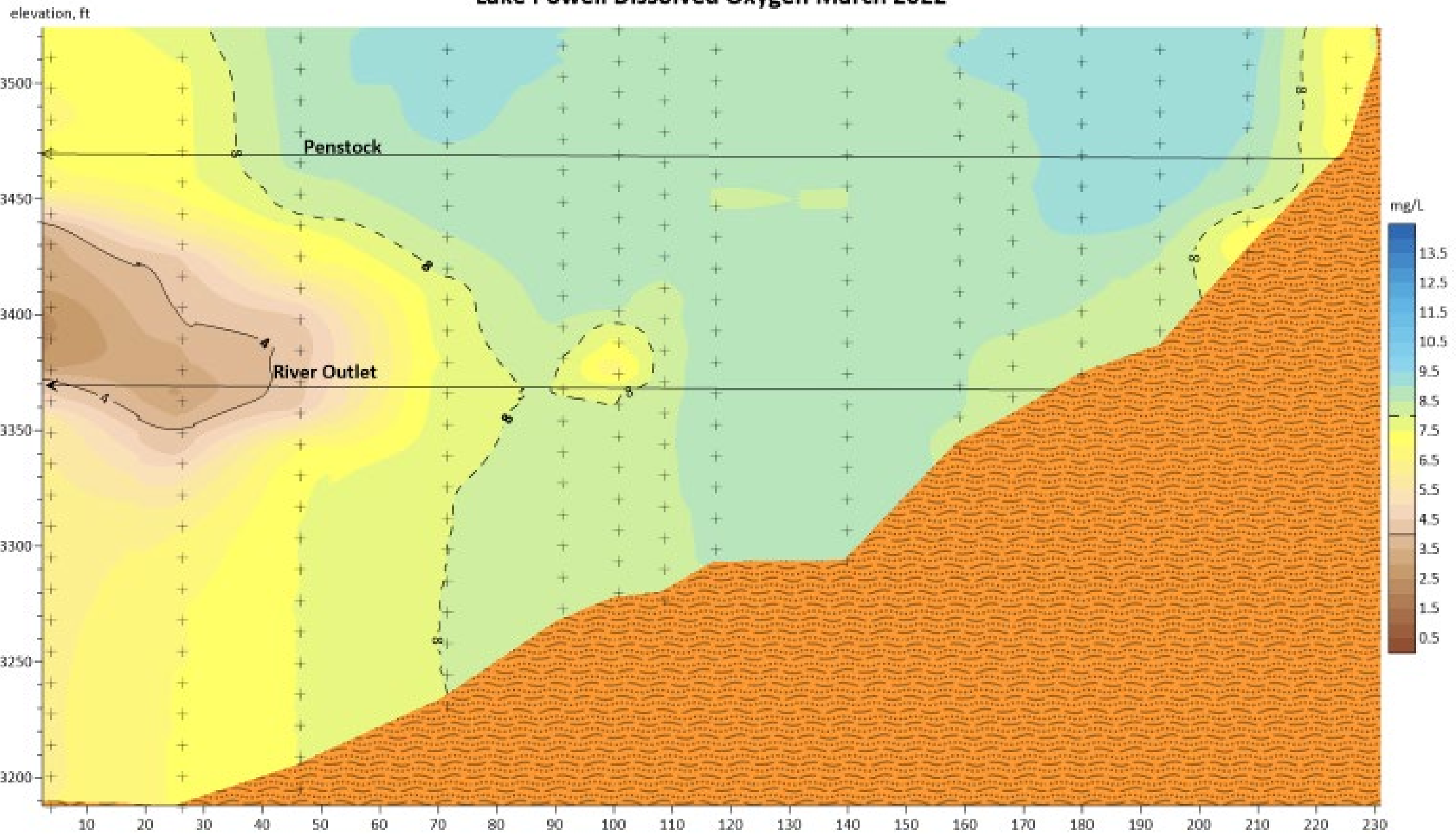
Lake Powell Dissolved Oxygen June 2021



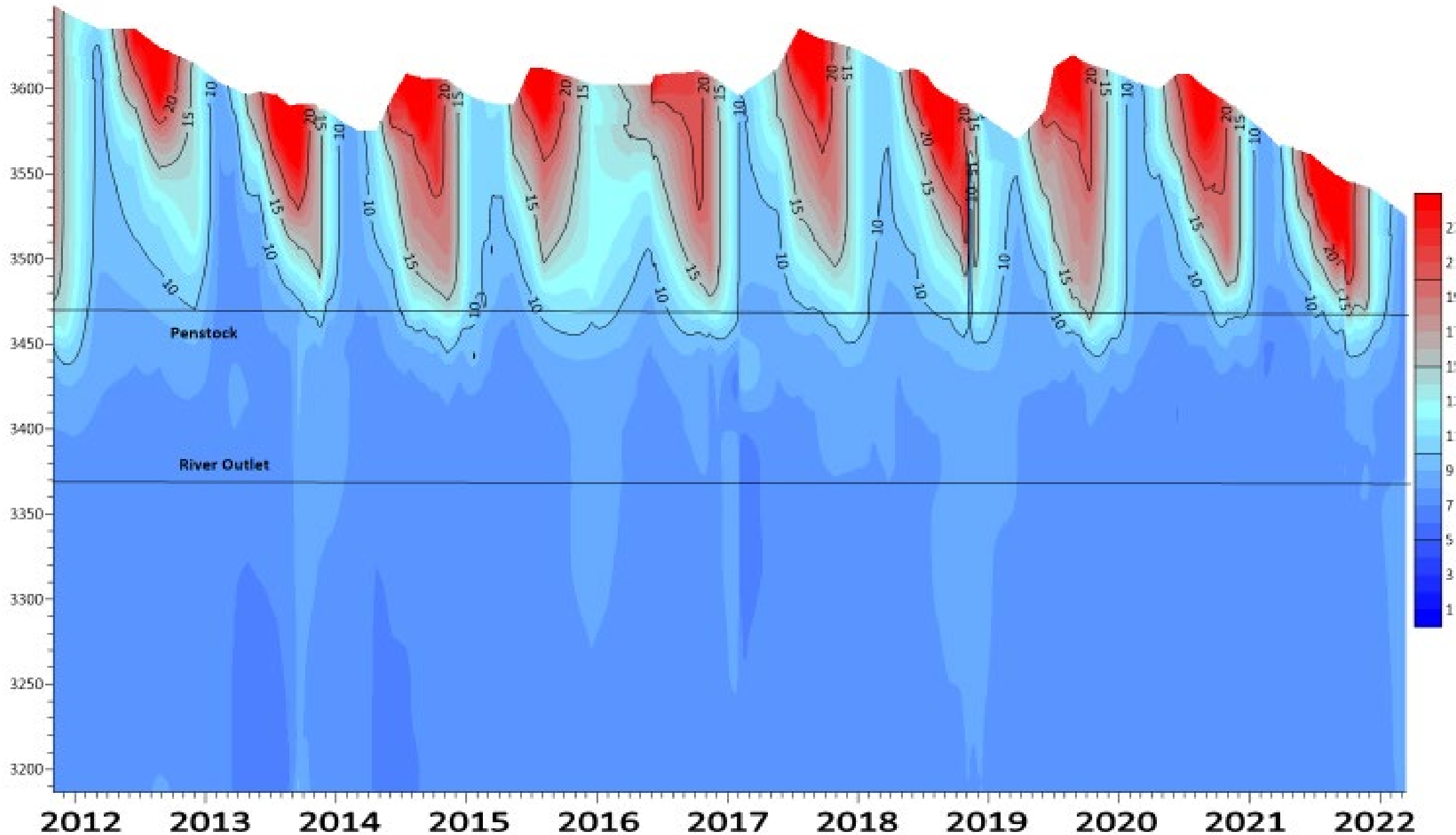
Lake Powell Dec 2021 Dissolved Oxygen



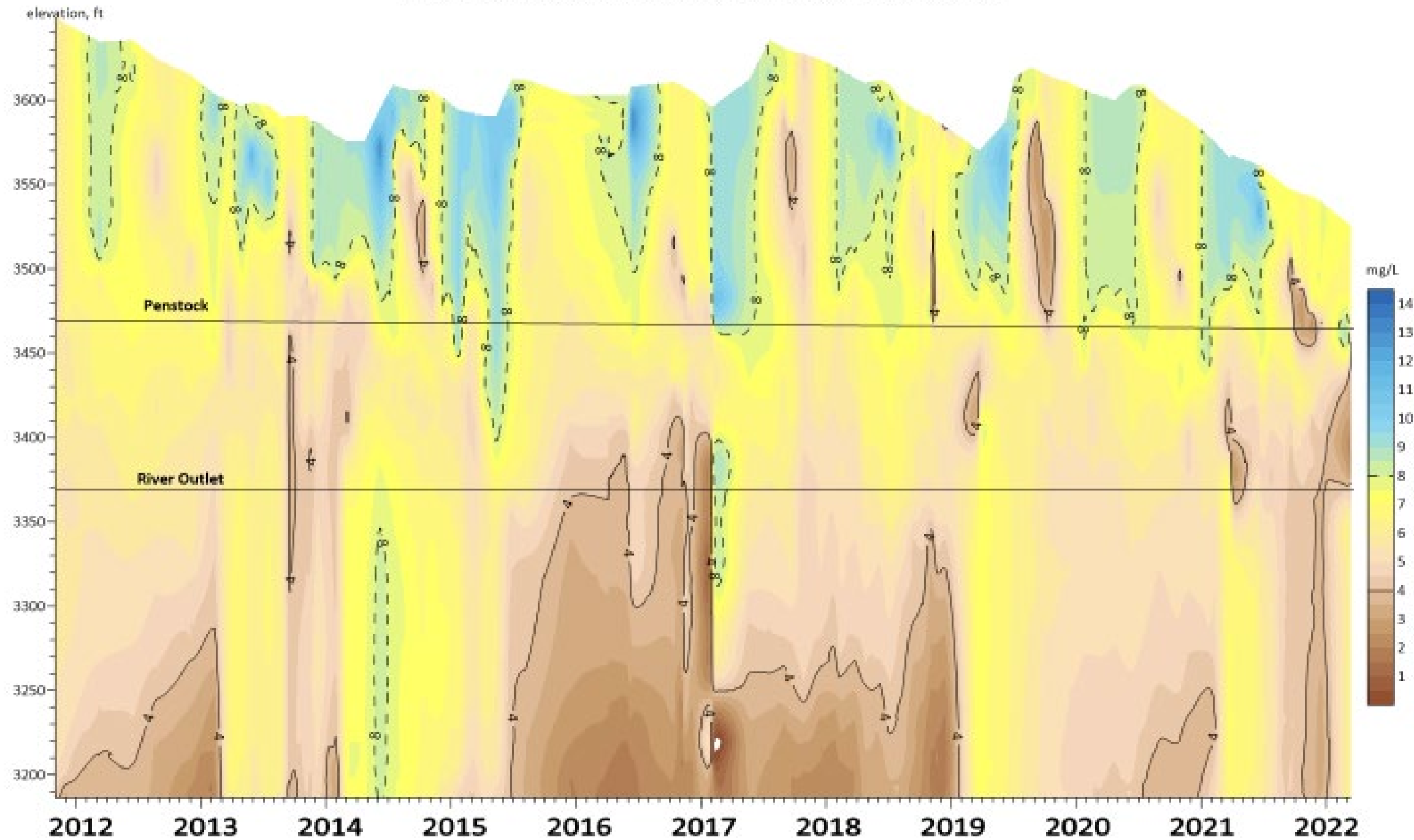
Lake Powell Dissolved Oxygen March 2022



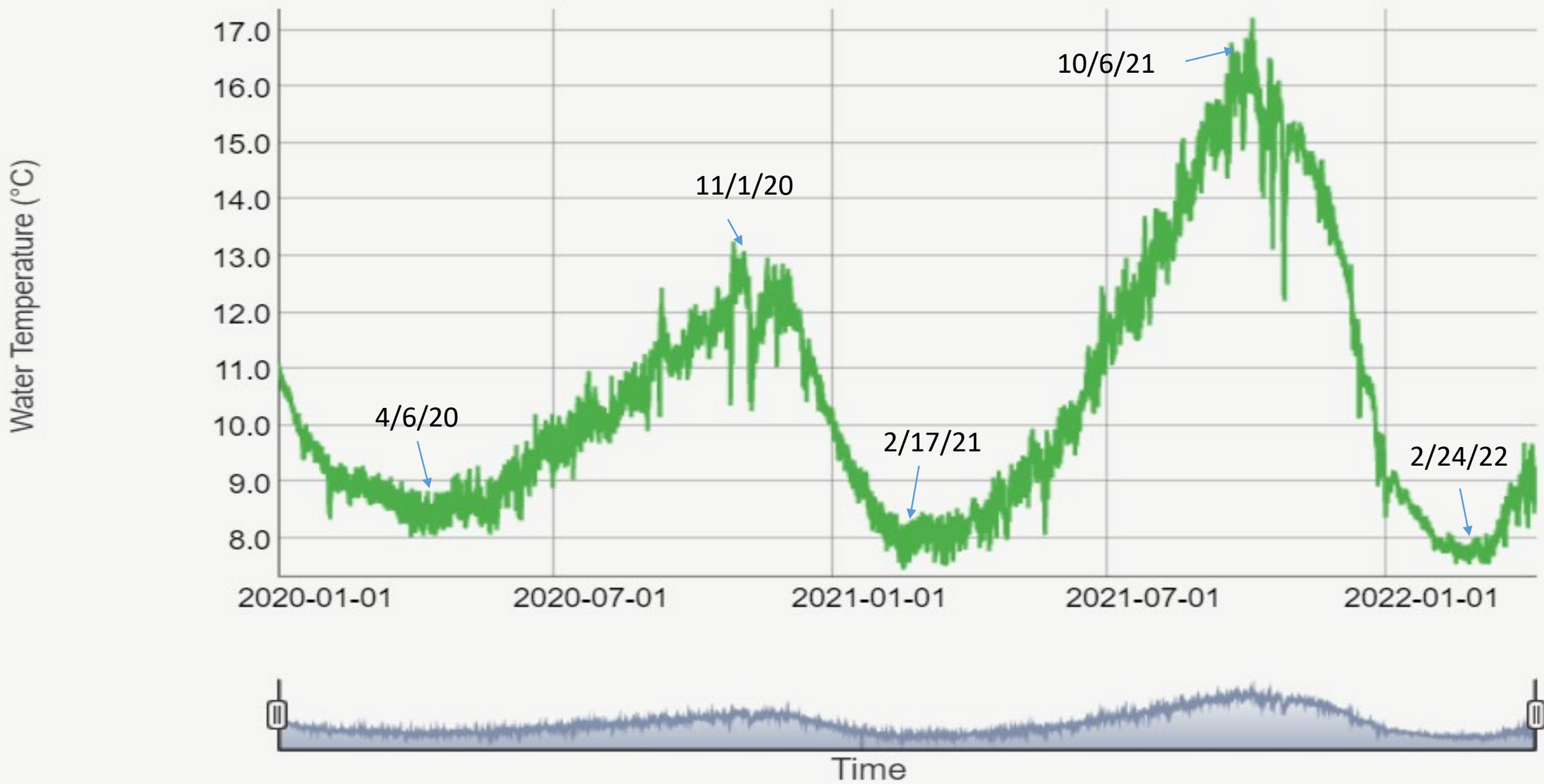
Wahweap Temperature Oct 2011 to March 2022



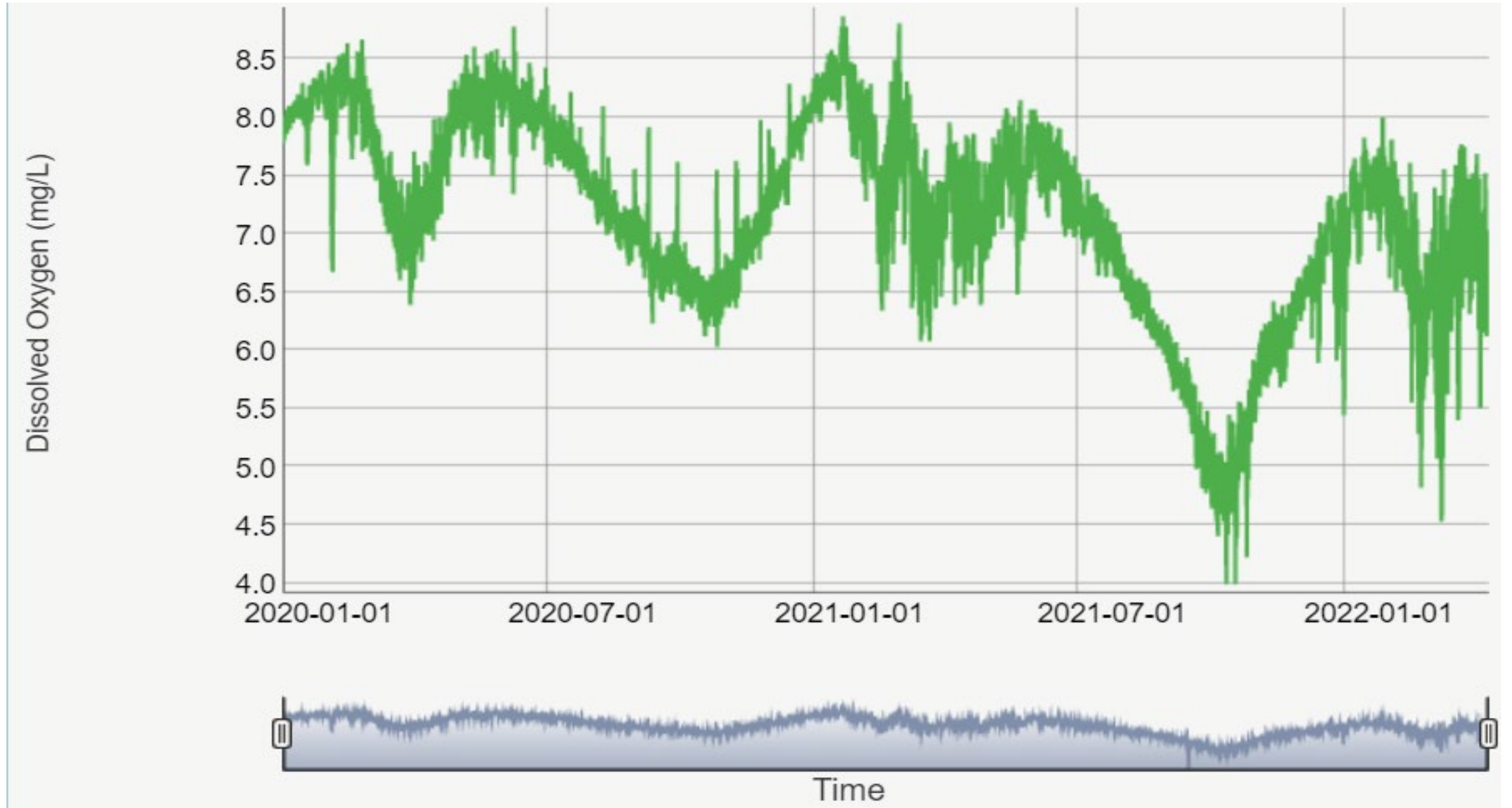
Lake Powell Forebay, Dissolved Oxygen Oct 2011 - March 2022



Colorado River below Glen Canyon Dam, Temperature Jan 2020 – April 4 2022

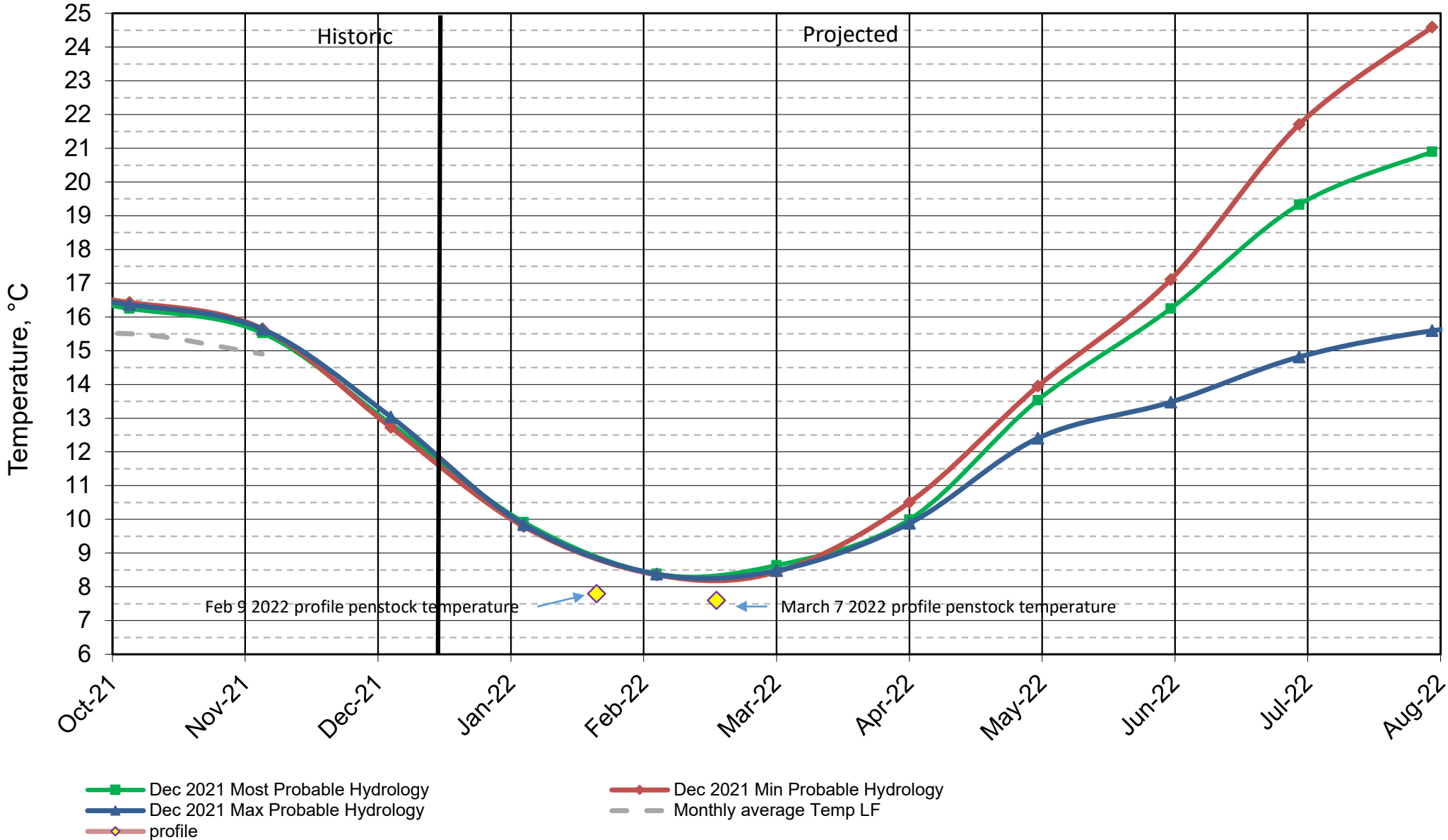


Colorado River below Glen Canyon Dam, Dissolved Oxygen Jan 2020 – April 4 2022



Lake Powell Release Temperature

Projected Temperature based on Dec 2021 Forecast



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

Questions?



— BUREAU OF —
RECLAMATION