



— BUREAU OF —  
RECLAMATION

# Glen Canyon Monthly Operations Call

## Basin Hydrology and Operations

April 17, 2024

# 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.”

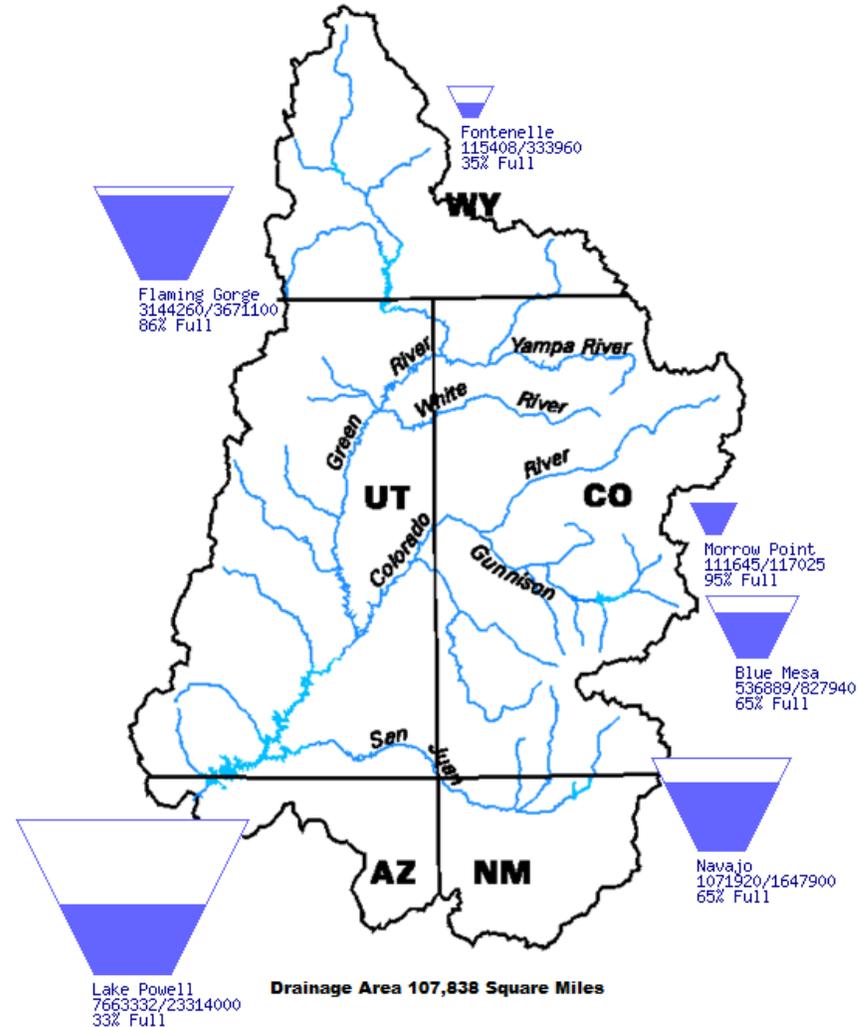


# Upper Basin Storage (as of April 14, 2023)

Data Current as of:  
04/14/2024

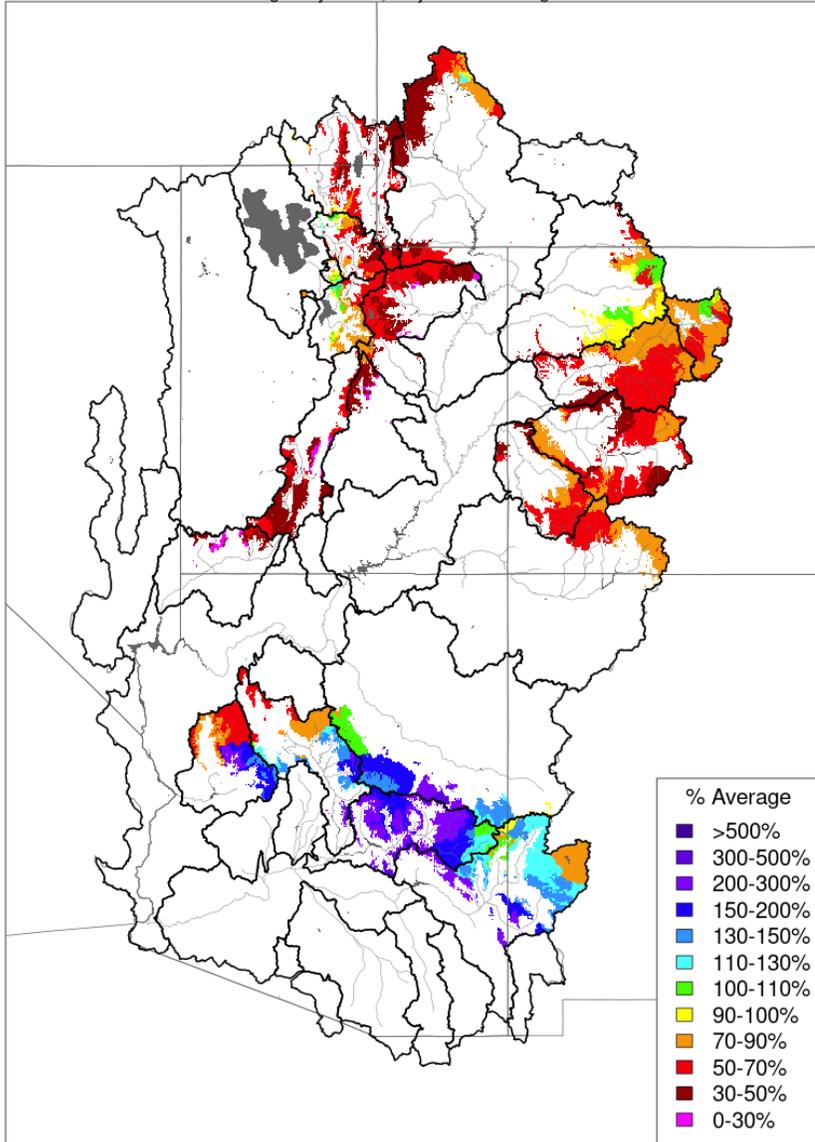
## Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	33	0.12	0.33	6,470.71
Flaming Gorge	86	3.14	3.67	6,026.73
Blue Mesa	65	0.54	0.83	7,484.69
Navajo	65	1.07	1.65	6,041.07
Lake Powell	33	7.66	23.31	3,558.25
UC System Storage	42	12.66	29.79	



### Month to Date Precipitation - April 16 2024

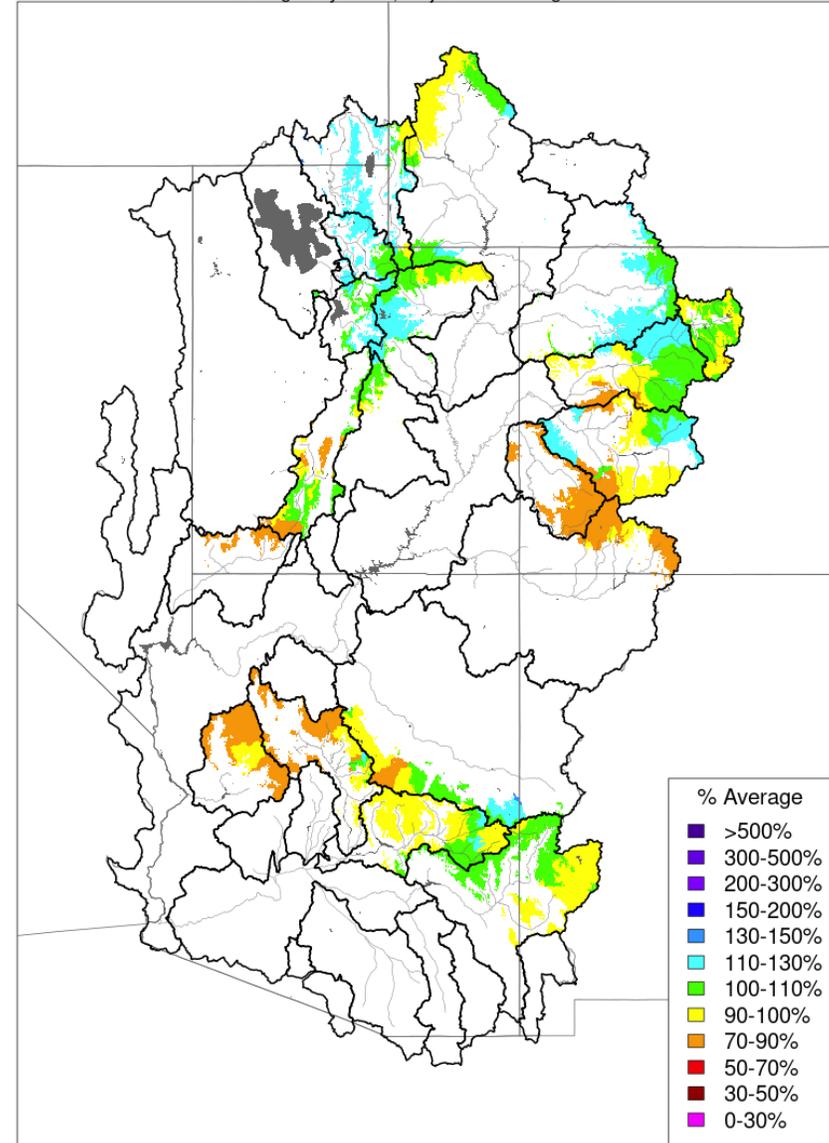
Averaged by Basin, Major Contributing Areas



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

### Water Year to Date Precipitation, October 01 - April 16 2024

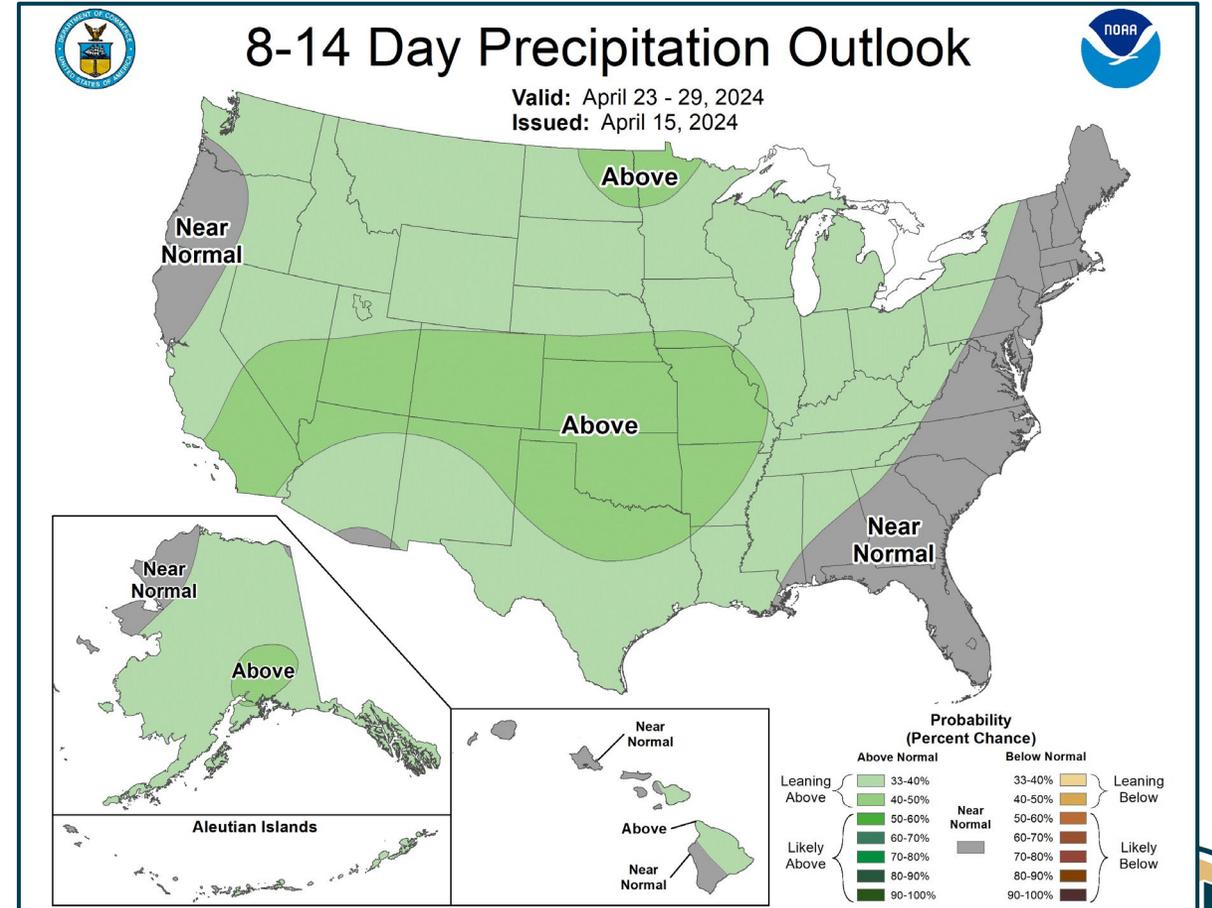
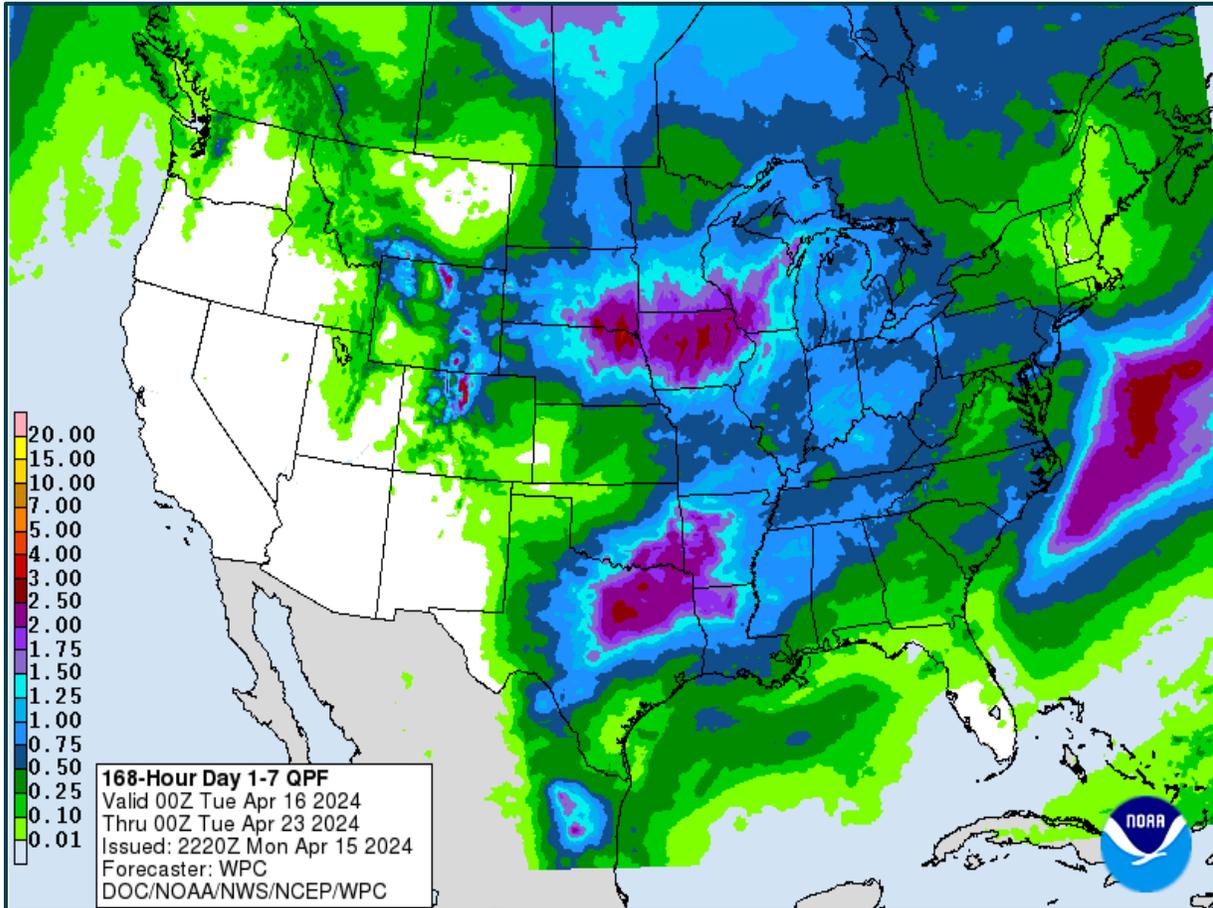
Averaged by Basin, Major Contributing Areas



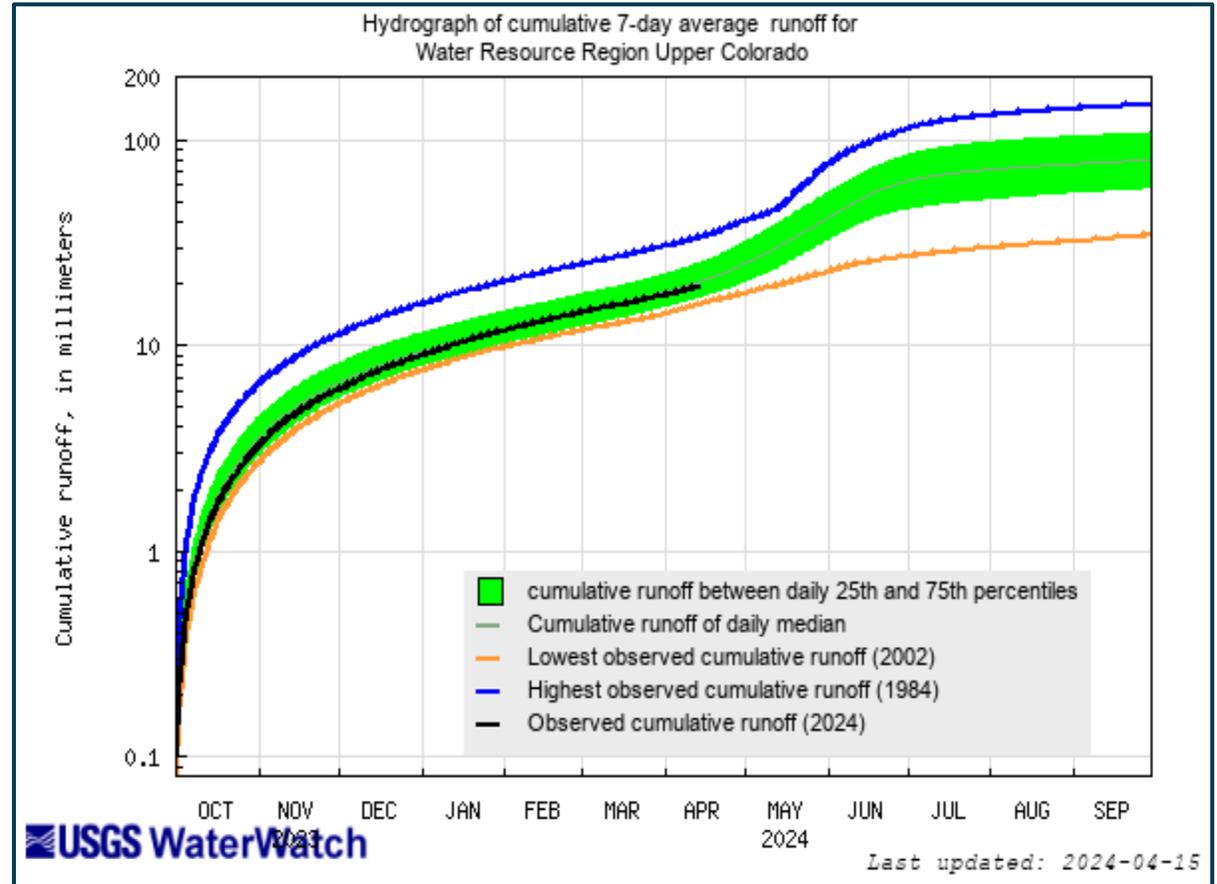
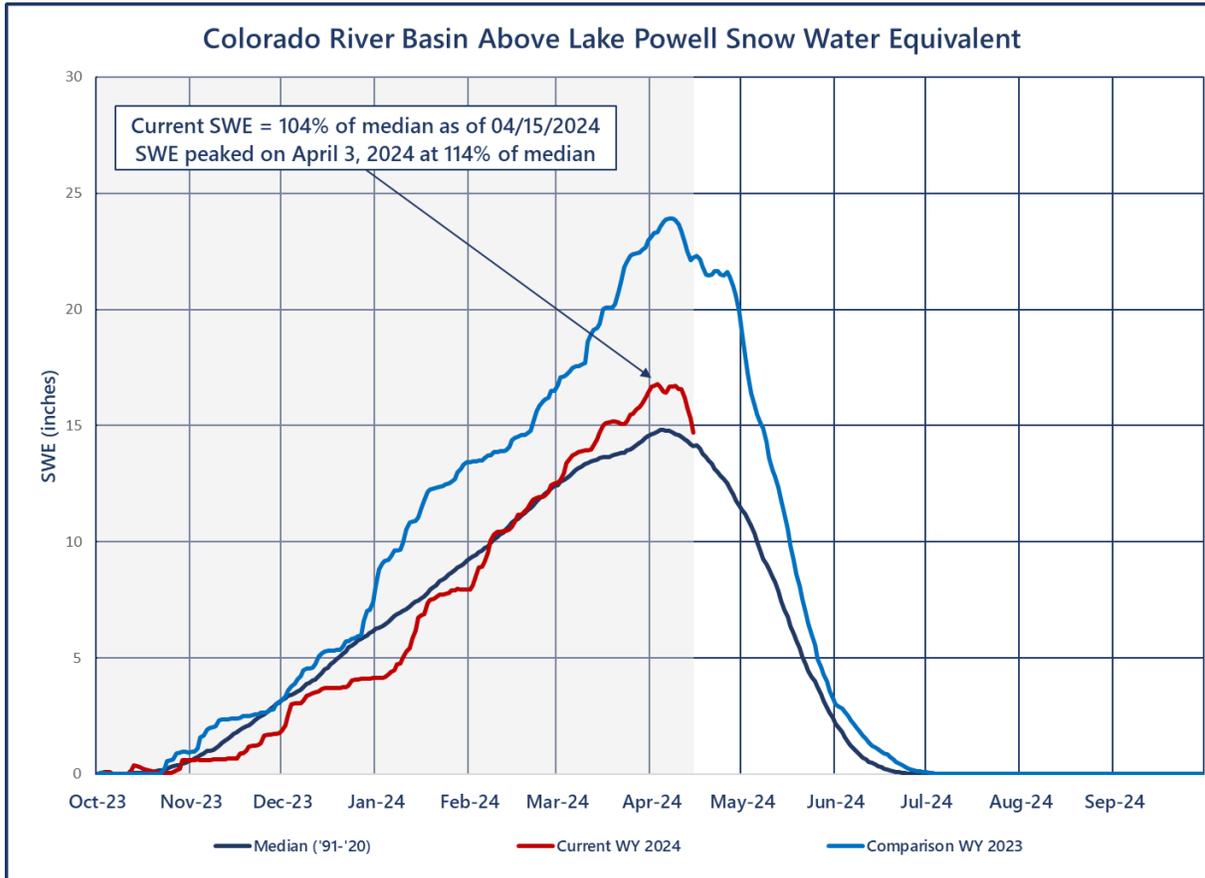
Prepared by NOAA, Colorado Basin River Forecast Center  
Salt Lake City, Utah, [www.cbrfc.noaa.gov](http://www.cbrfc.noaa.gov)



# Weather Prediction Center and Climate Prediction Center Precipitation Forecasts



# Upper Colorado SWE and Observed Inflows



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



# Most Probable April Forecast Water Year 2024

April – July 2024  
Forecasted Unregulated Inflow  
as of April 3, 2024

Reservoir	Inflow (kaf)	Change from Mar	Percent of Avg <sup>1</sup>
Fontenelle	710	+125	97
Flaming Gorge	960	+180	99
Blue Mesa	600	+40	97
Navajo	420	+30	67
Powell	5,700	+700	89

April Midmonth = 5,400 kaf **-300** (84%)

Water Year 2024  
Unregulated Inflow Forecast  
as of April 3, 2024

Reservoir	Inflow (kaf)	Change from Mar	Percent of Avg <sup>1</sup>
Fontenelle	1,056	+137	98
Flaming Gorge	1,444	+181	102
Blue Mesa	842	+41	93
Navajo	564	+16	62
Powell	8,391	+735	87

April Midmonth = 8,091 kaf **-300** (84%)

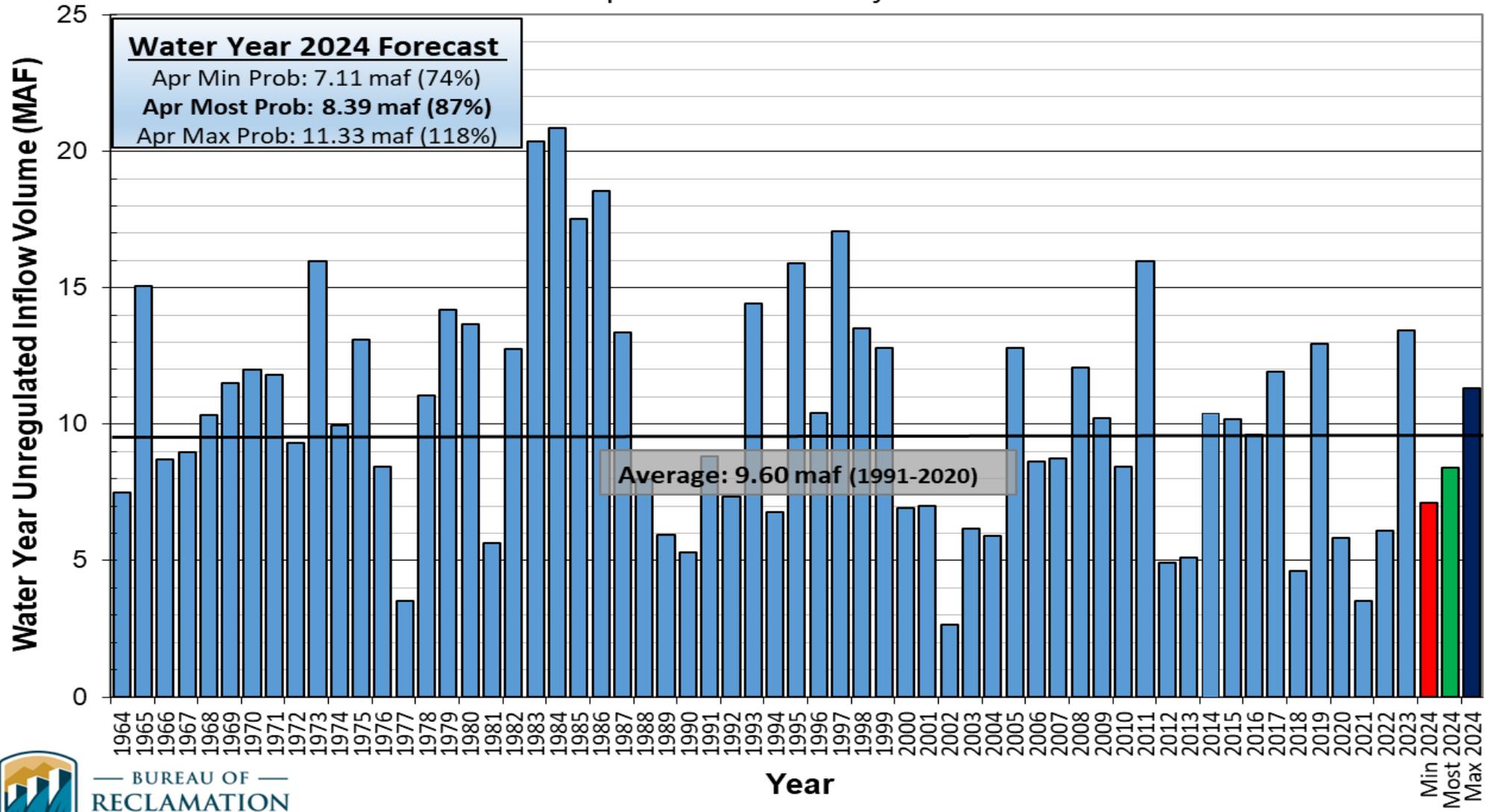
<sup>1</sup>Averages are based on the 1991 through 2020 period of record.



# Lake Powell Unregulated Inflow

## Water Year 2024 Forecast (issued April 3)

### Comparison with History





# Upper Colorado Basin

Hydrology and Operations  
Projections Based on April  
2024 24-Month Study



# Upper Basin Reservoir Operations

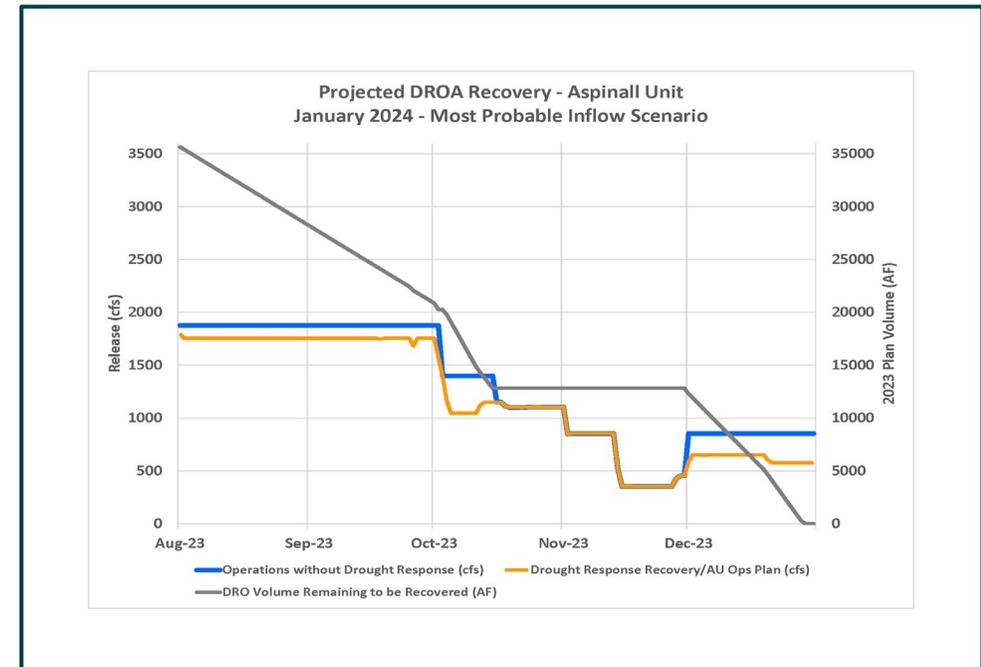
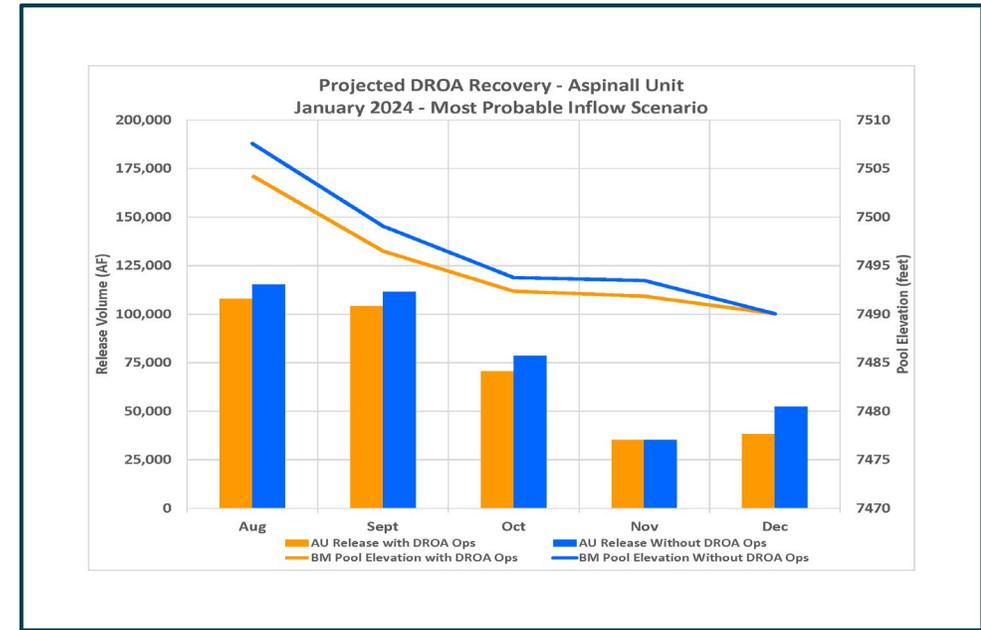
## Water Years 2024 and 2025

- Lake Powell will be operated consistent with the 2007 Interim Guidelines, the Upper Basin Drought Response Operations Agreement and Upper Basin Records of Decision
- Lake Powell WY 2024 will operate in the Mid-Elevation Release Tier where Lake Powell will release 7.48 maf
- Reclamation will also ensure all appropriate consultation with Basin Tribes, the Republic of Mexico, other federal agencies, water users and non-governmental organizations with respect to implementation of these monthly and annual operations.



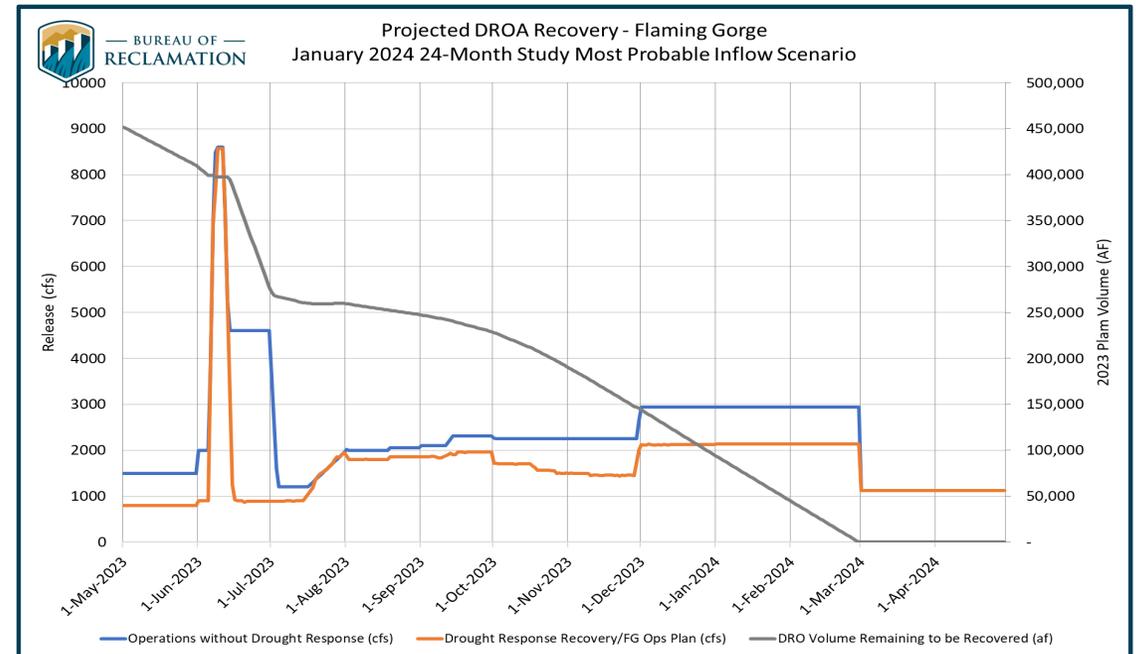
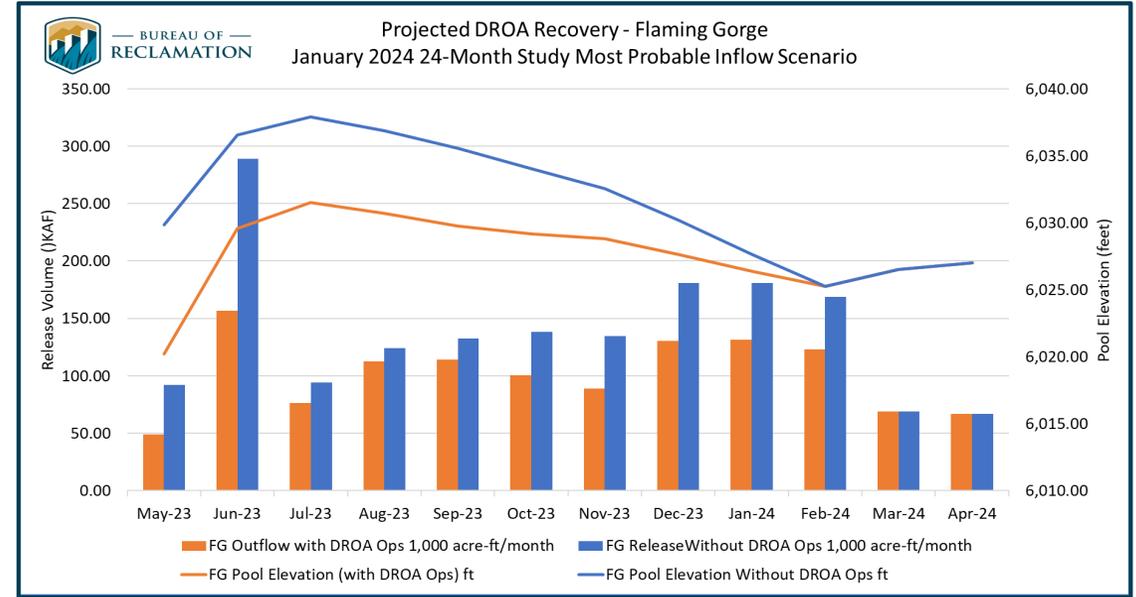
# DROA Recovery - BM

- Total DROA release - 36 kaf
- Incremental recovery achieved end of day 12/29/23.
- Icing target achieved at 7490.05' on midnight 12/31/23.



# DROA Recovery - FG

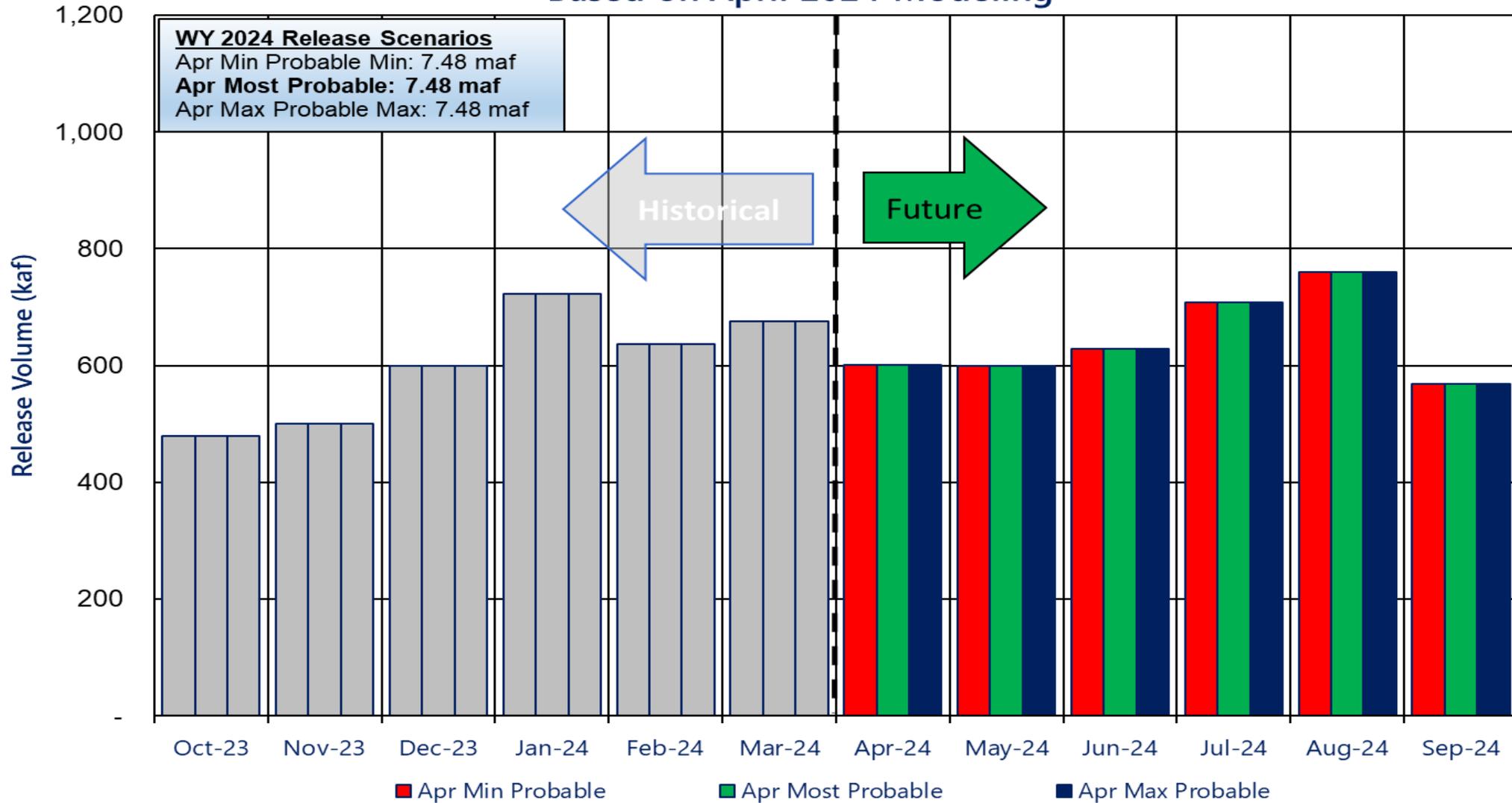
- Total DROA release - 588 kaf
- Incremental recovery achieved end of day 2/28/24
- Per ROD, Reclamation's goal is to achieve the May 1 Drawdown Target of 6,027 feet (mod-dry target)



# Potential Lake Powell Monthly Release Volume Distribution

## Release Scenarios for Water Year 2024

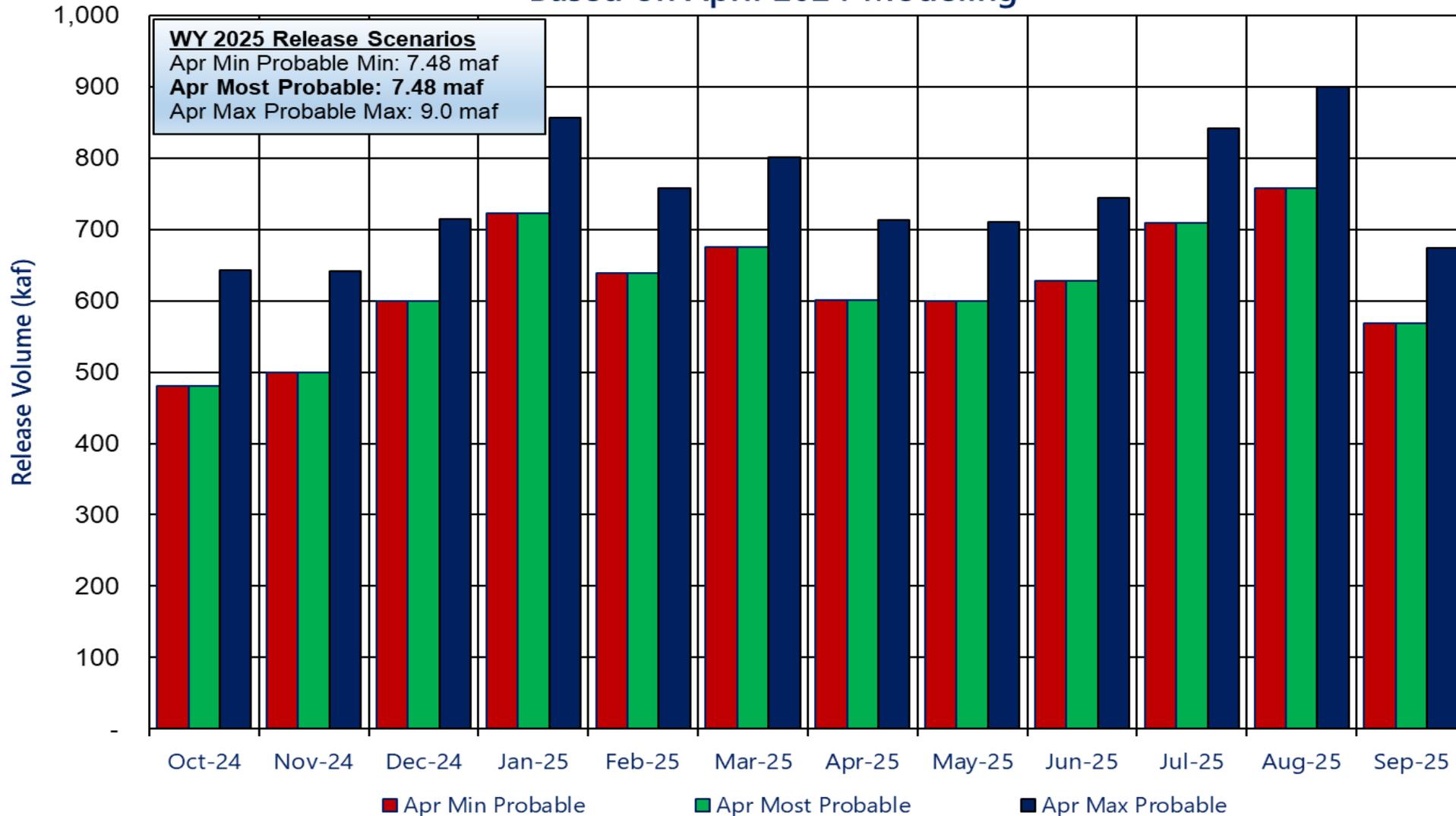
### Based on April 2024 Modeling



# Potential Lake Powell Monthly Release Volume Distribution

## Release Scenarios for Water Year 2025

### Based on April 2024 Modeling

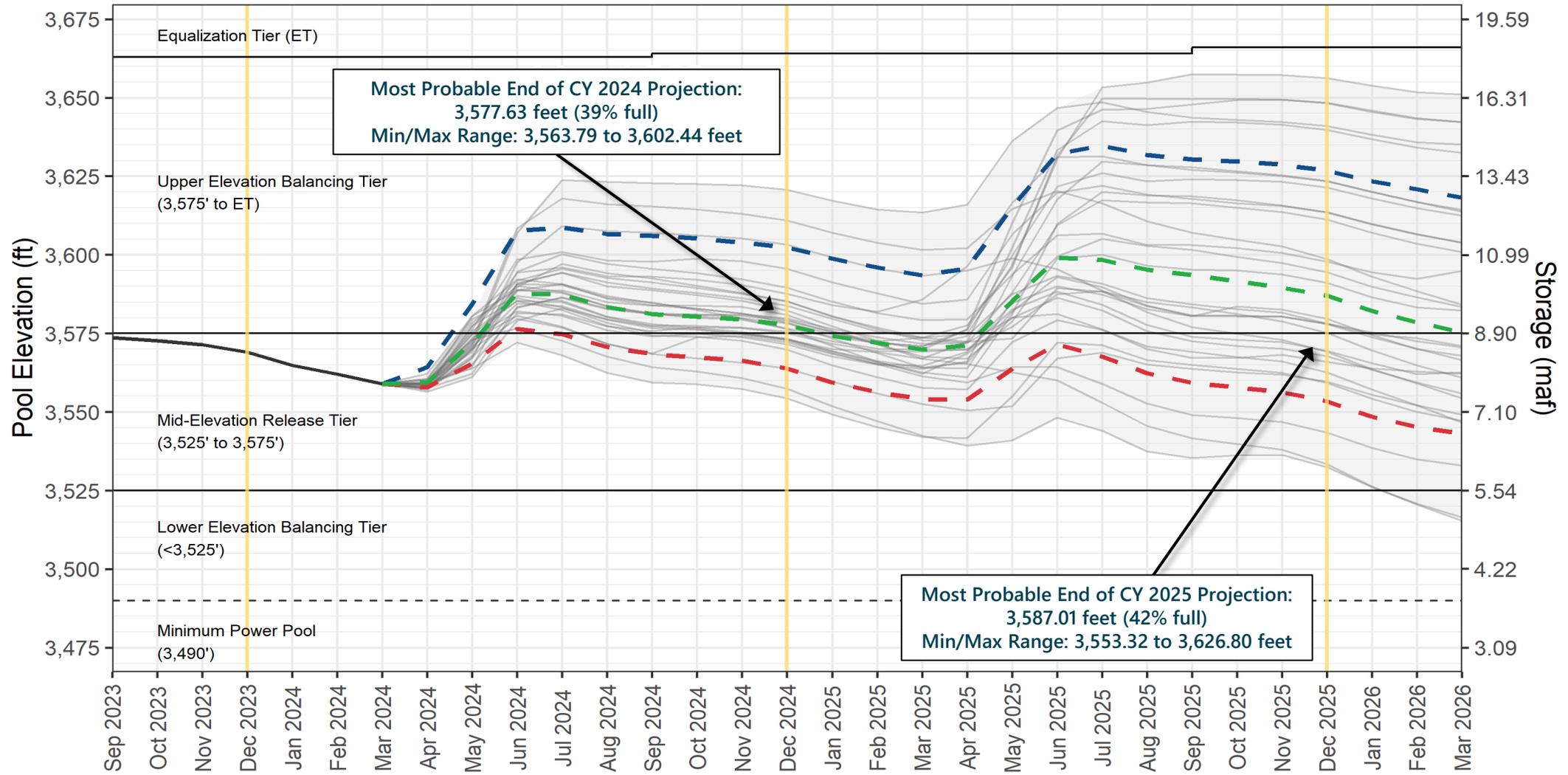


# Reclamation Operational Modeling Model Comparison

	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



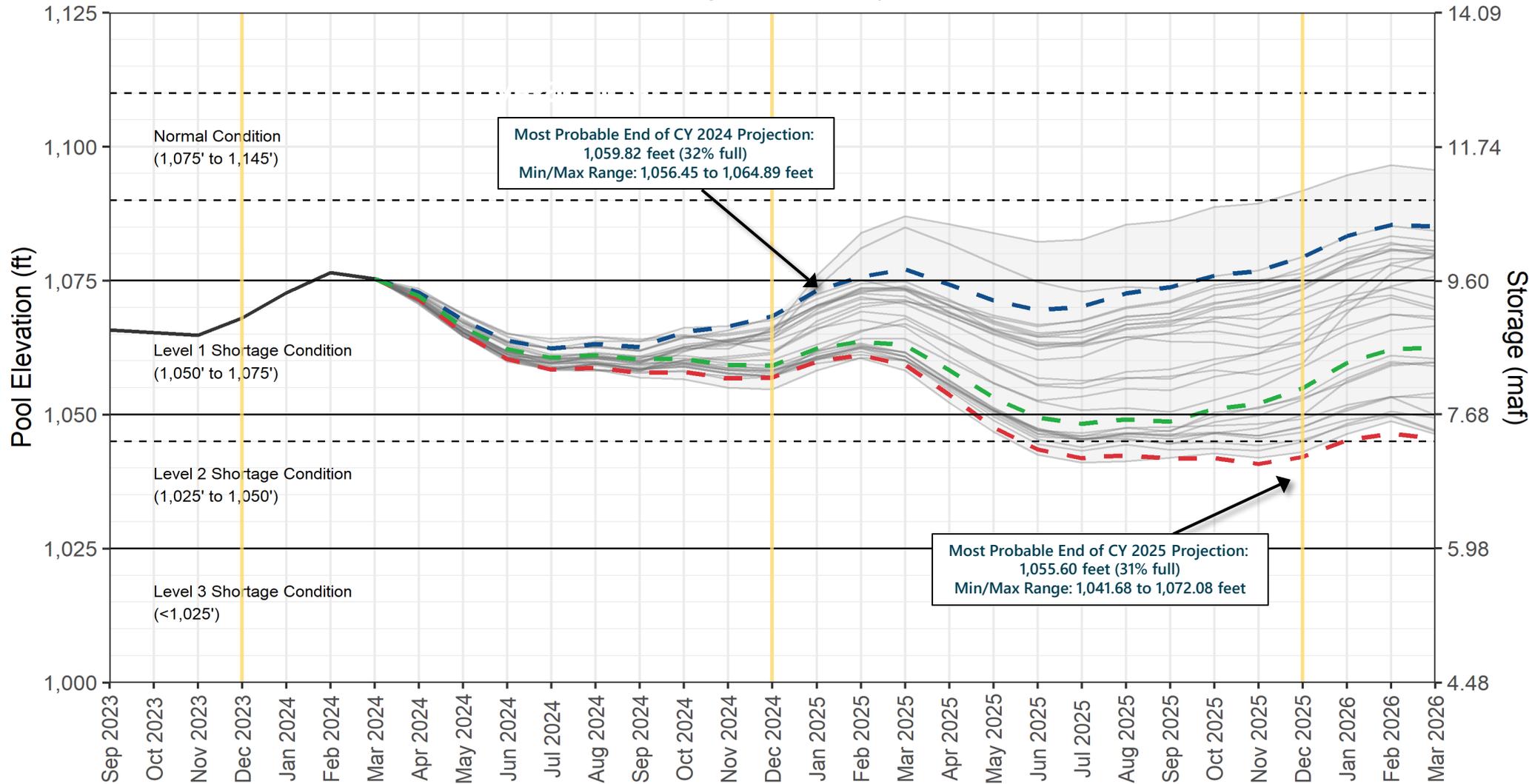
# Lake Powell End-of-Month Elevations CRMMS Projections from April 2024



- April 2024 Probable Maximum 24-Month Study
- April 2024 Most Probable 24-Month Study
- April 2024 Probable Minimum 24-Month Study
- Historical
- CRMMS-ESP Projection (30 traces)
- CRMMS-ESP Projections Range



# Lake Mead End-of-Month Elevations CRMMS Projections from April 2024



- April 2024 Probable Maximum 24-Month Study
- April 2024 Most Probable 24-Month Study
- April 2024 Probable Minimum 24-Month Study
- Historical
- CRMMS-ESP Projection (30 traces)
- CRMMS-ESP Projections Range





# Upper Colorado Basin

## Hydropower Maintenance



# Glen Canyon Dam Power Plant Unit Outage Schedule for 2024

Unit Number	Oct 2023	Nov 2023	Dec 2023	Jan 2024	Feb 2024	Mar 2024	Apr 2024	May 2024	Jun 2024	Jul 2024	Aug 2024	Sep 2024
1	█							█				█
2	█											█
3	█											
4	█											
5								█			█	
6								█			█	
7						█					█	
8						█					█	
Units Available	4	4	6	6	6	6	6	5	6	8	7	6
Capacity (cfs)	12,400	19,450	19,400	19,300	19,200	19,100	19,100	15,900	29,900	27,200	23,400 <sup>3</sup>	19,700
Capacity (kaf/month)	770	1,030	1,190	1,190	1,100	1,220	1,280	1,100	1,520	1,670	1,580	1,200
Max (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	567
Most (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	567
Min (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	567
											(updated 04-16-2024)	

APR MOST<sup>2</sup>  
 APR MOST  
 7.48 maf  
 7.48 maf  
 7.48 maf

1 Projected release, based on April 2024 24MS for the minimum, most probable and the maximum probable 24-Month Study model runs.  
 2 Dependent upon availability to shift contingency regulation, which will increase capacity by 30-40MW (3%) at current efficiency.  
 3 NERC testing with occasional removal of penstock generating capacity.



# Glen Canyon Dam Power Plant Unit Outage Schedule for 2025

Unit Number	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025	May 2025	Jun 2025	Jul 2025	Aug 2025	Sep 2025	
1	■											■	
2	■						■					■	
3	■												
4	■												
5						■							
6						■							
7				■									
8				■									
Units Available	5	6	8	6	6	6	7	8	8	8	8	6	
Capacity (cfs)	16,100/ 4,000 <sup>3</sup>	19,700	27,000	19,700	19,700	19,700	23,350	27,000	27,000	27,000	26,700	19,700	APR MOST <sup>2</sup>
Capacity (kaf/month)	1,210	1,500	1,660	1,590	1,110	1,240	1,390	1,600	1,660	1,660	1,640	1,190	APR MOST
Max (kaf) <sup>1</sup>	643	642	715	857	758	801	713	710	745	842	900	674	9.00 maf
Most (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
Min (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568	7.48 maf
													(updated 04-16-2024)

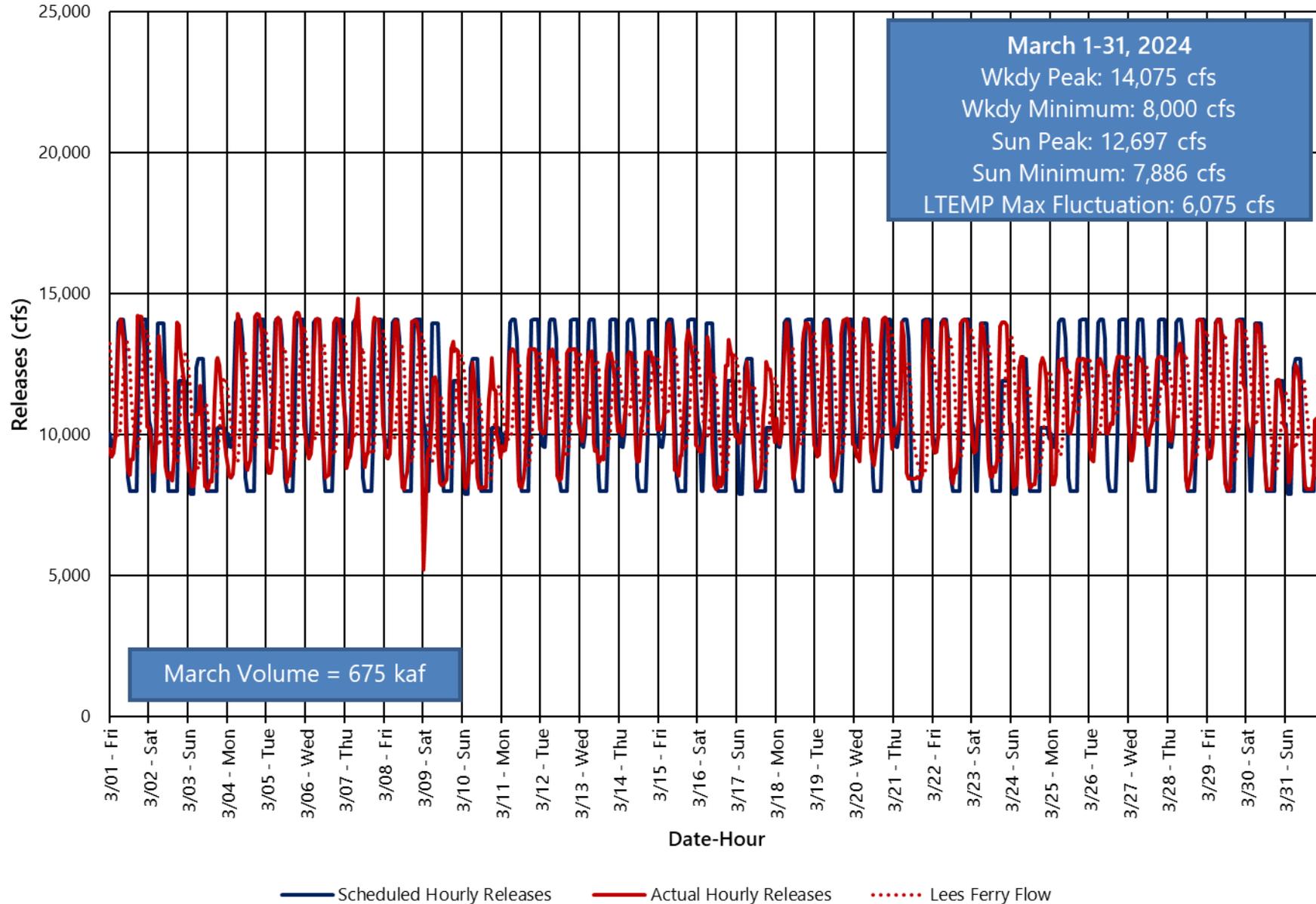
1 Projected release, based on April 2024 24MS for the minimum, most probable and the maximum probable 24-Month Study model runs.

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

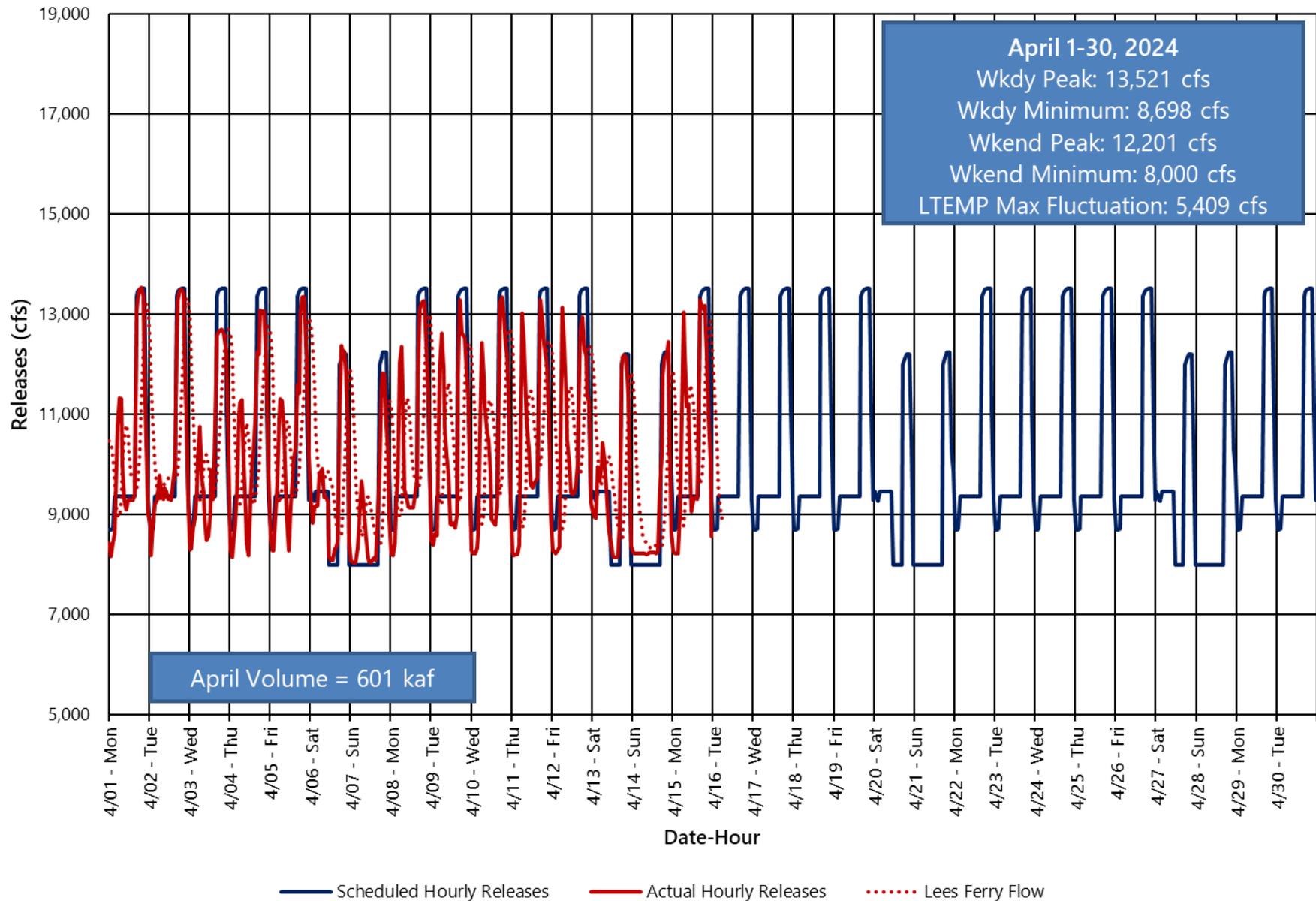
3 Tailwater/Forebay inspection will require one day at 4,000 cfs and possibly two if necessary.



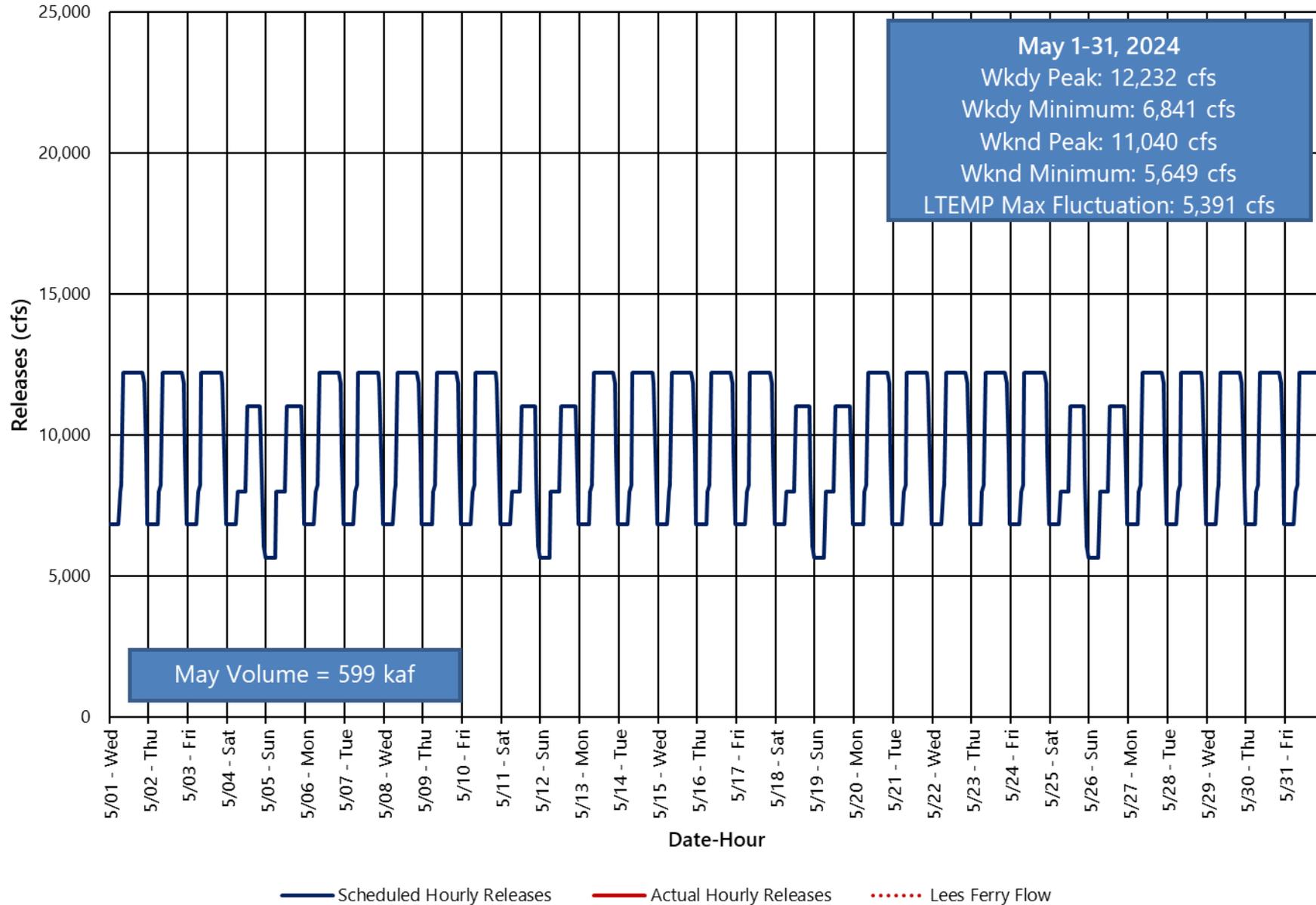
### Glen Canyon Dam Hourly Release Pattern - March 2024



### Glen Canyon Dam Hourly Release Pattern - April 2024



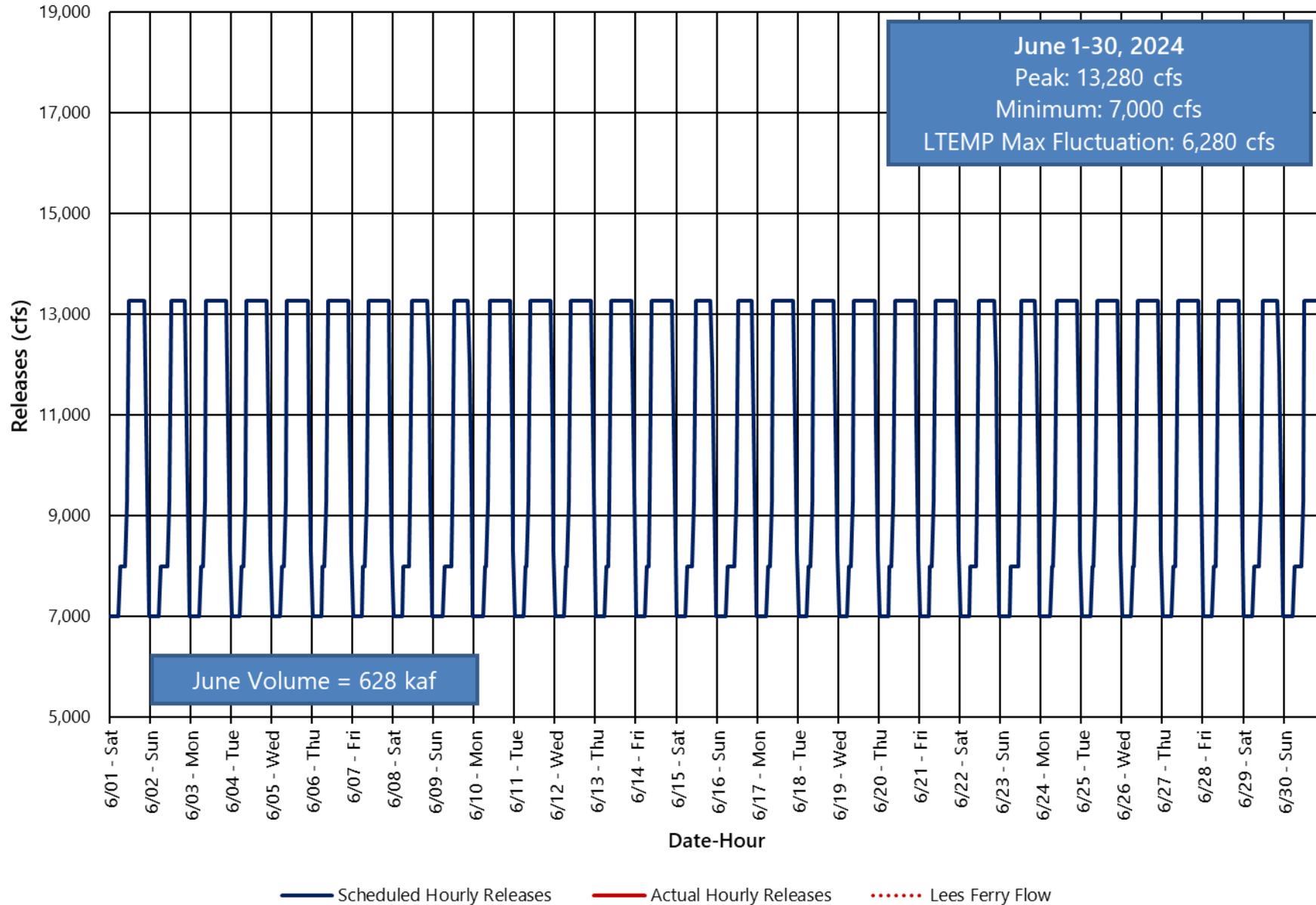
### Glen Canyon Dam Hourly Release Pattern - May 2024



**PROVISIONAL – PATTERN WILL LIKELY CHANGE AFTER PUBLICATION OF APRIL 24MS**



### Glen Canyon Dam Hourly Release Pattern - June 2024



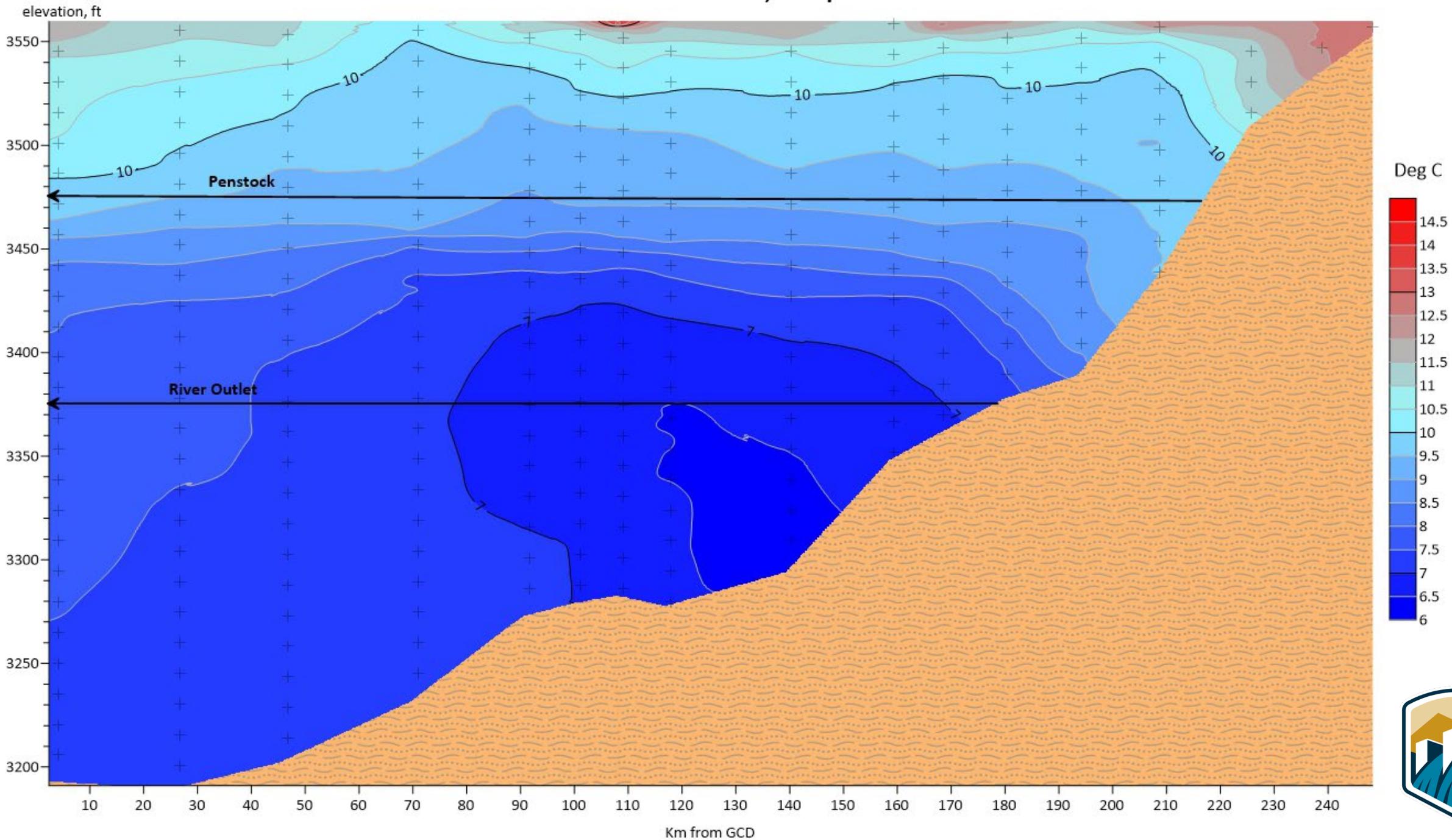
**PROVISIONAL – PATTERN WILL LIKELY CHANGE AFTER PUBLICATION OF APRIL 24MS**



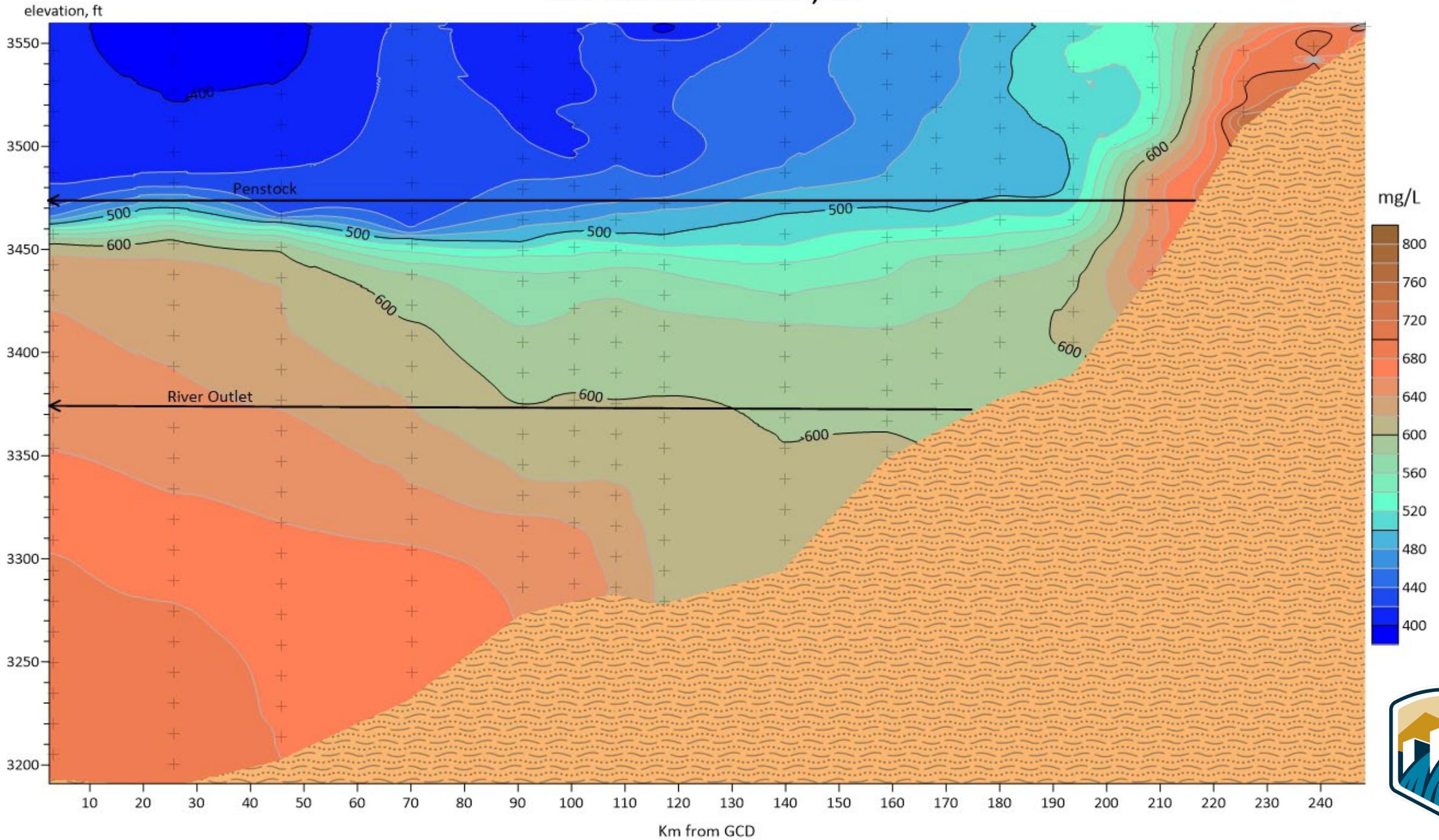
# Water Quality



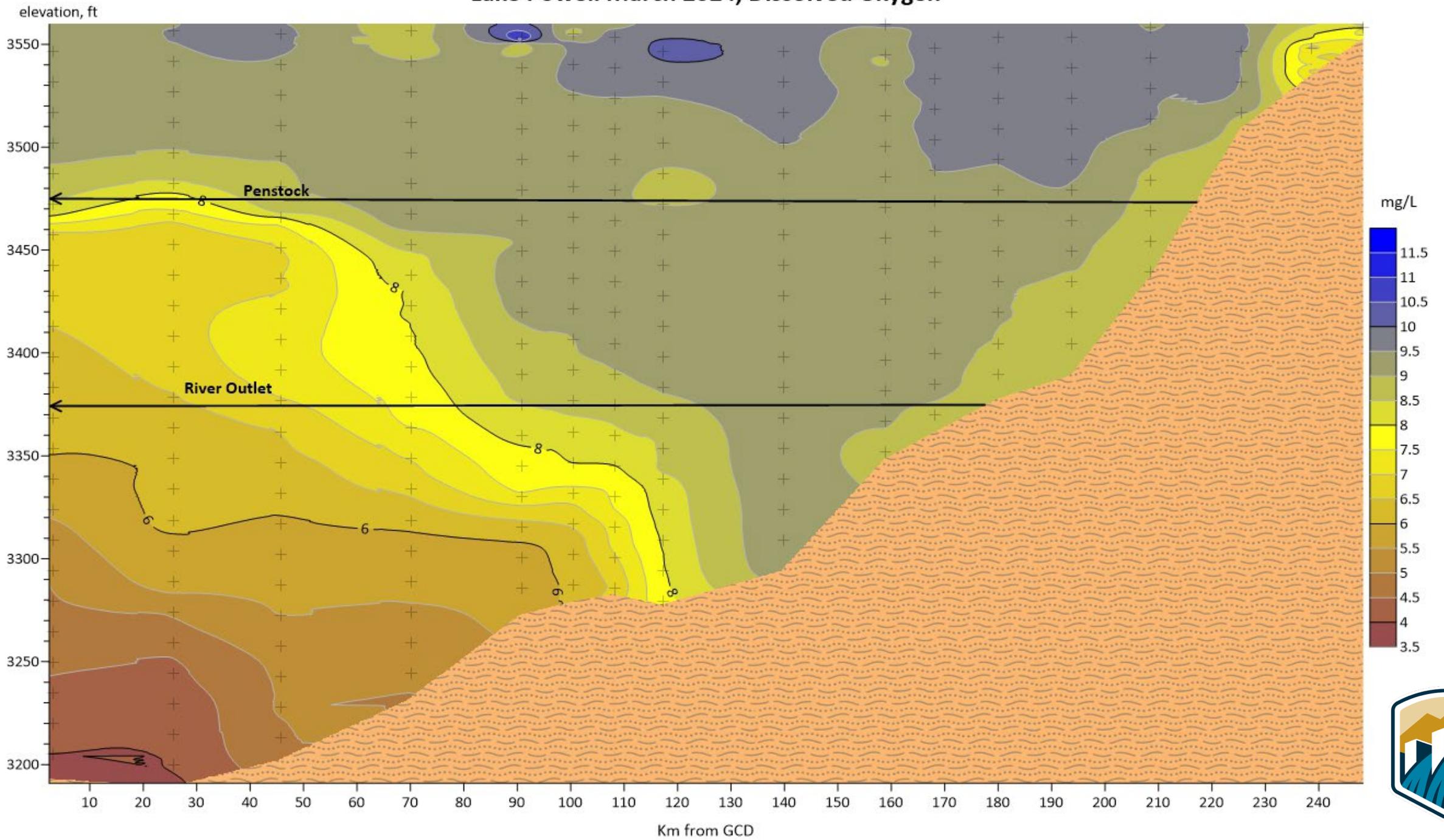
# Lake Powell March 2024, Temperature



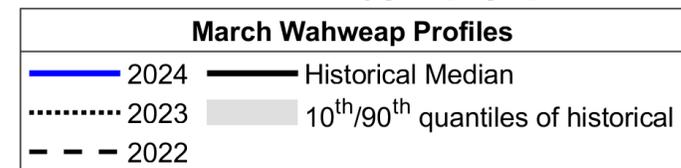
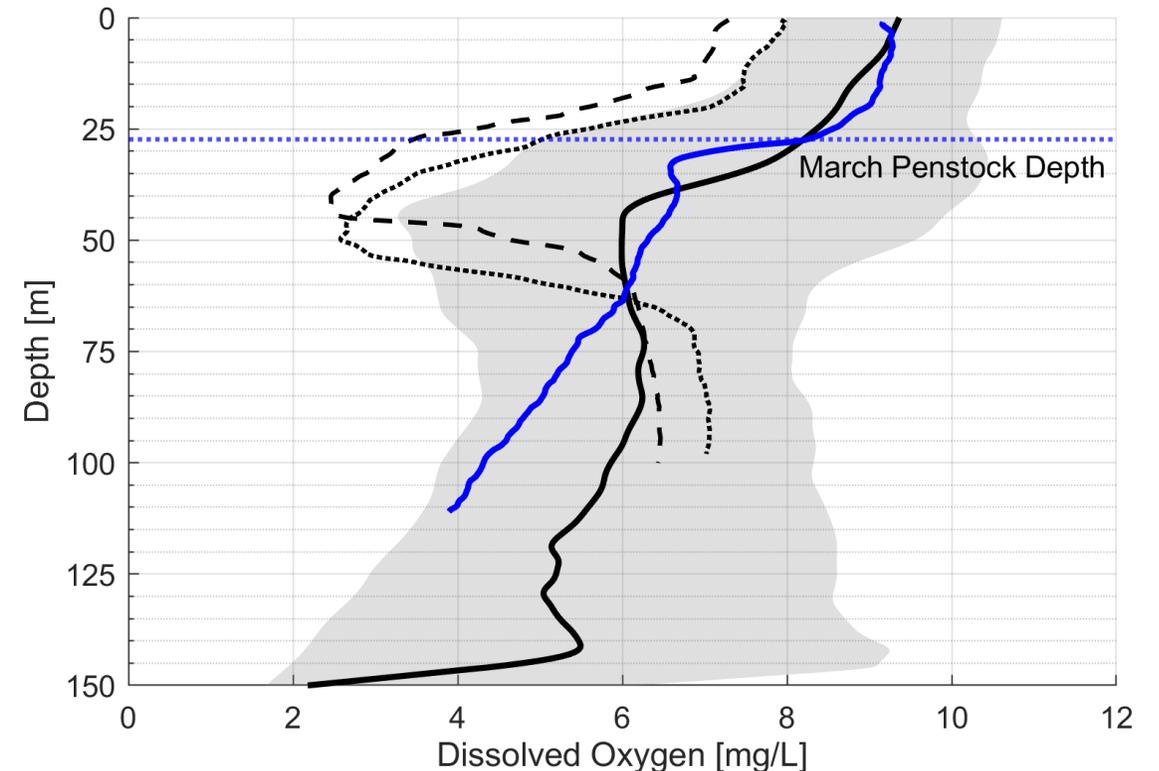
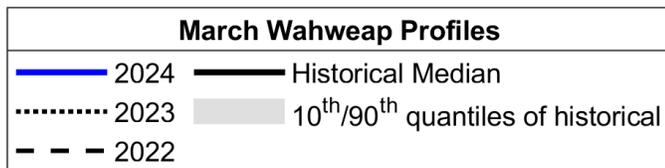
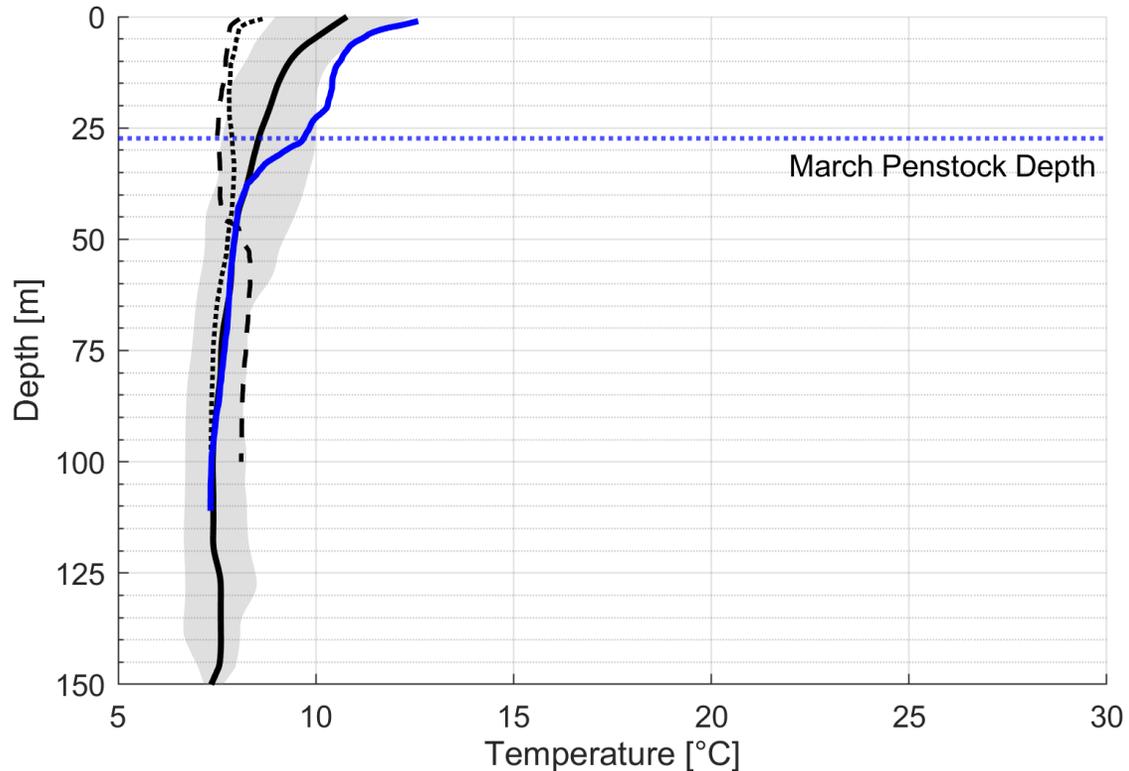
# Lake Powell March 2024, TDS



# Lake Powell March 2024, Dissolved Oxygen



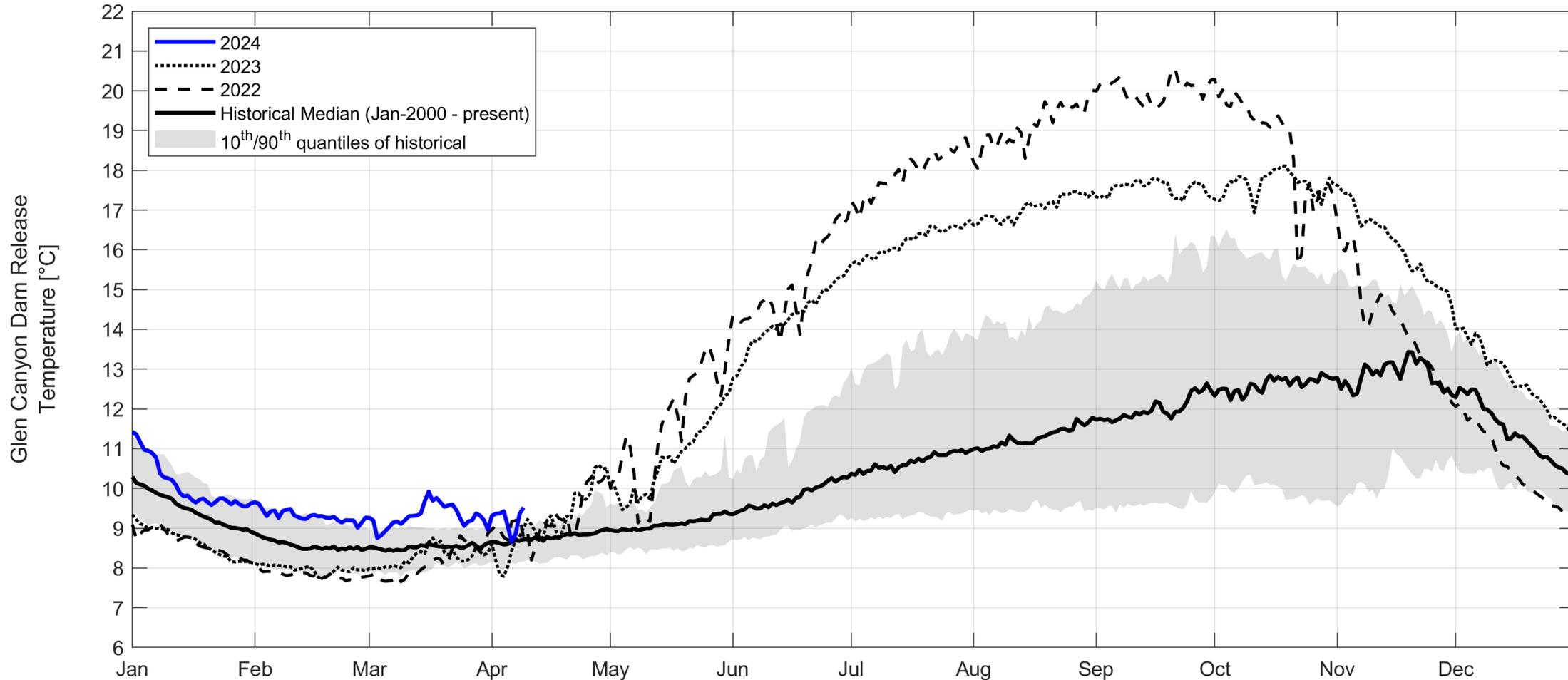
# Water Quality Observations in Forebay near GCD



- Reservoir is starting to stratify
- Surface temperatures are warm



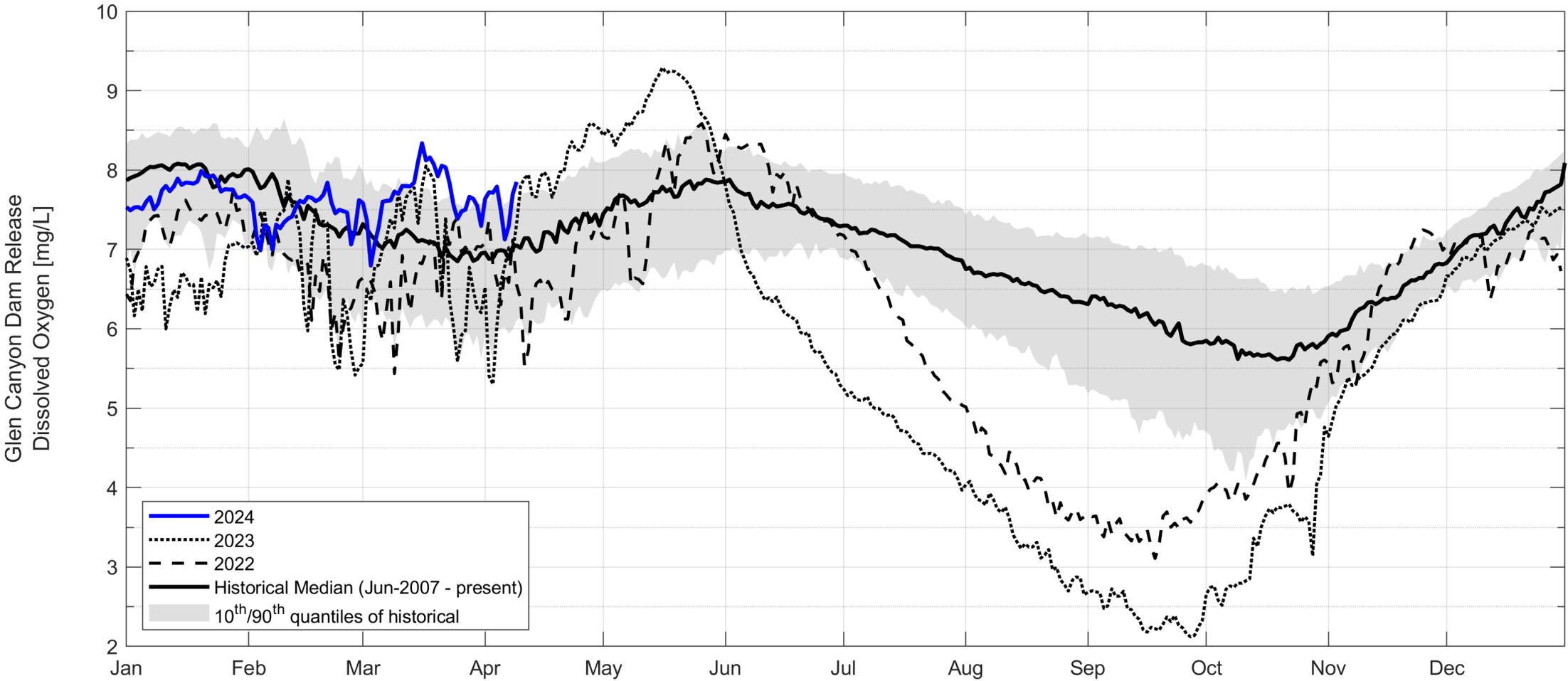
# Glen Canyon Dam Observations - Temperature



- Already starting to observe warmer than normal releases out of the dam



# Glen Canyon Dam Observations – Dissolved Oxygen



# On-Going Testing of the Lake Powell CE-QUAL-W2 Model

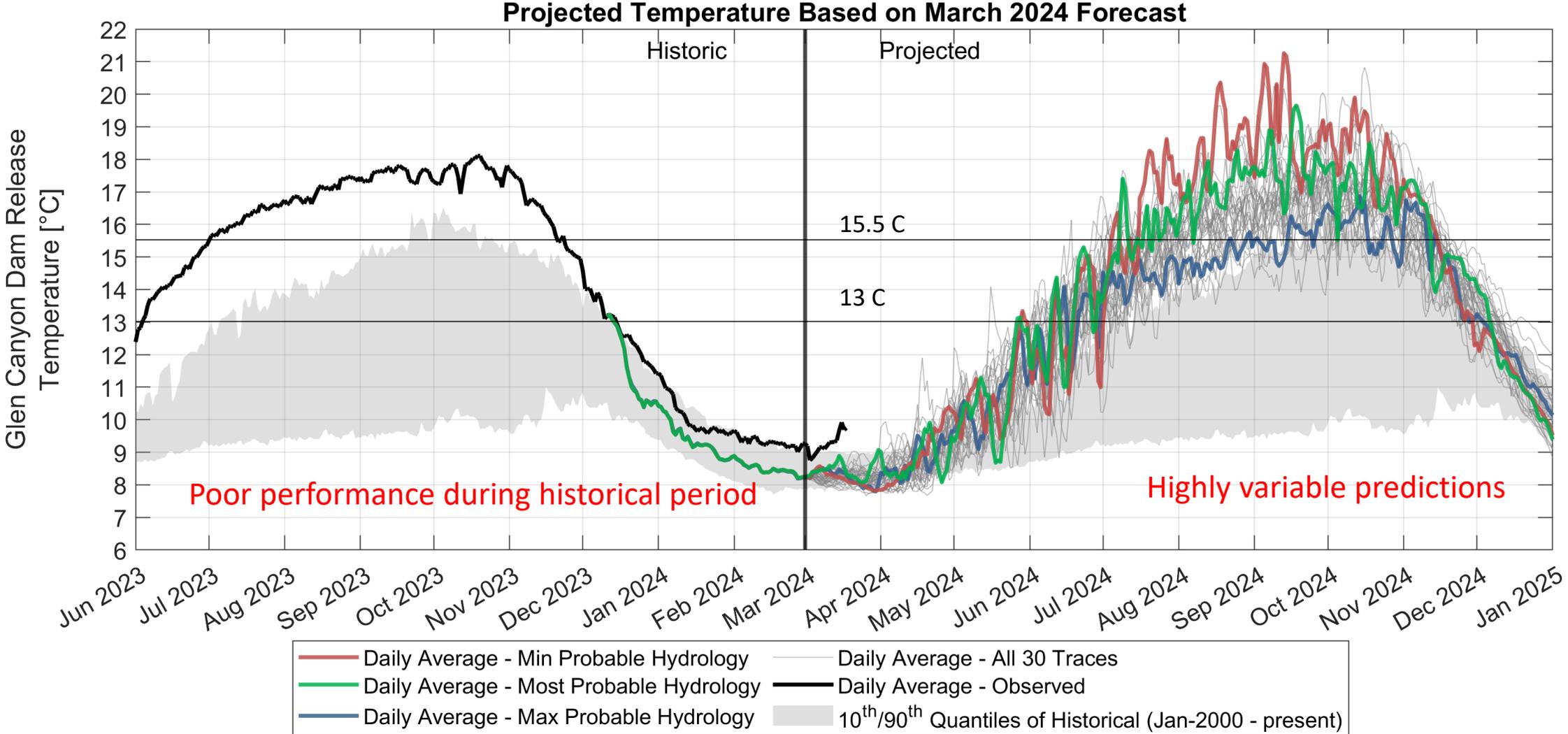
## Testing Different Model Grid Resolutions

- “1k” version
  - Segments are 1km in length
  - 894 cells and 54 branches
- “2k+” version
  - Segments are 2km or more in length
  - 225 cells and 16 branches
- Pros - Cons
  - more cells = better representation
  - less cells = faster runtime



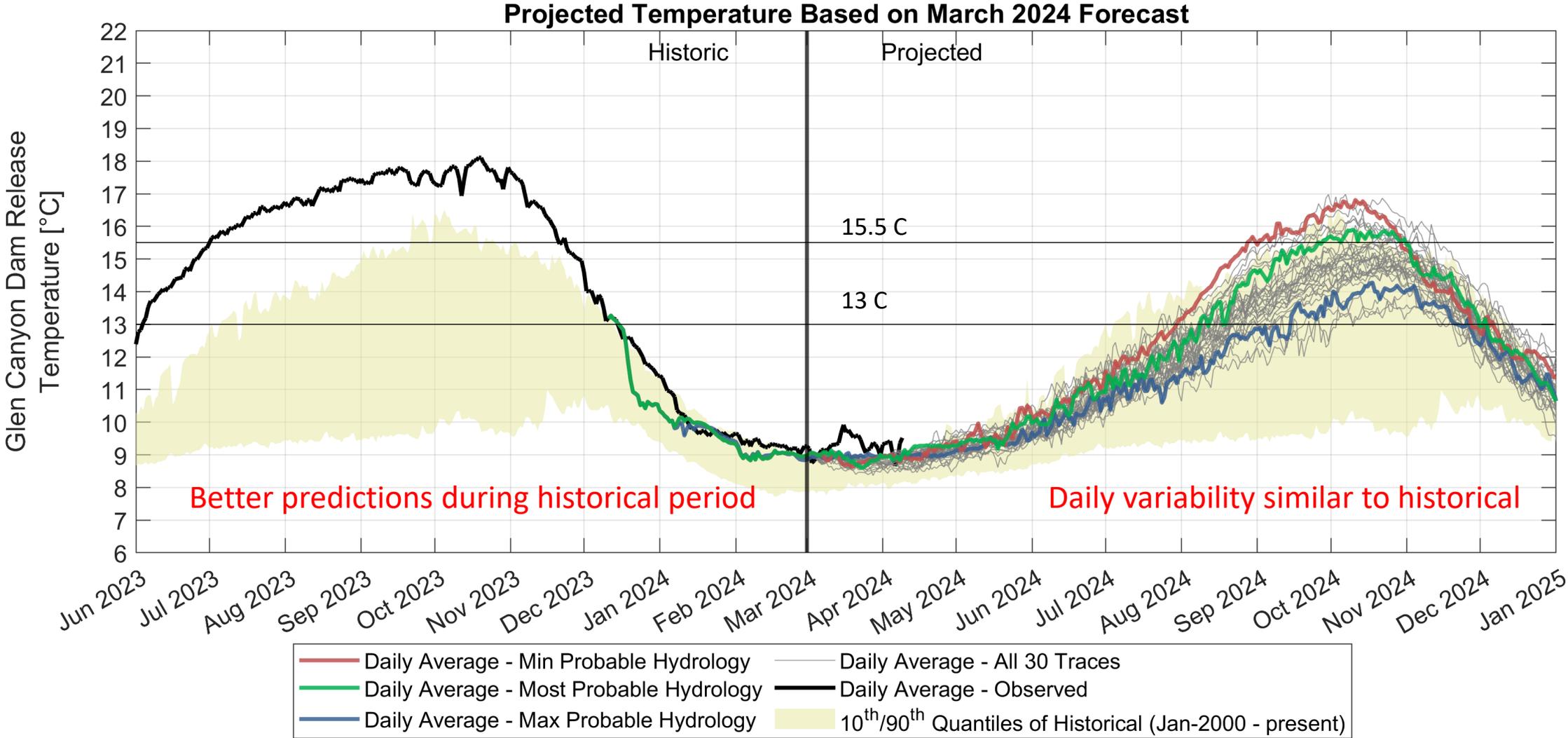
# CE-QUAL-W2 Modeled Temperature

2k+ Model



# CE-QUAL-W2 Modeled Temperature

1k Model

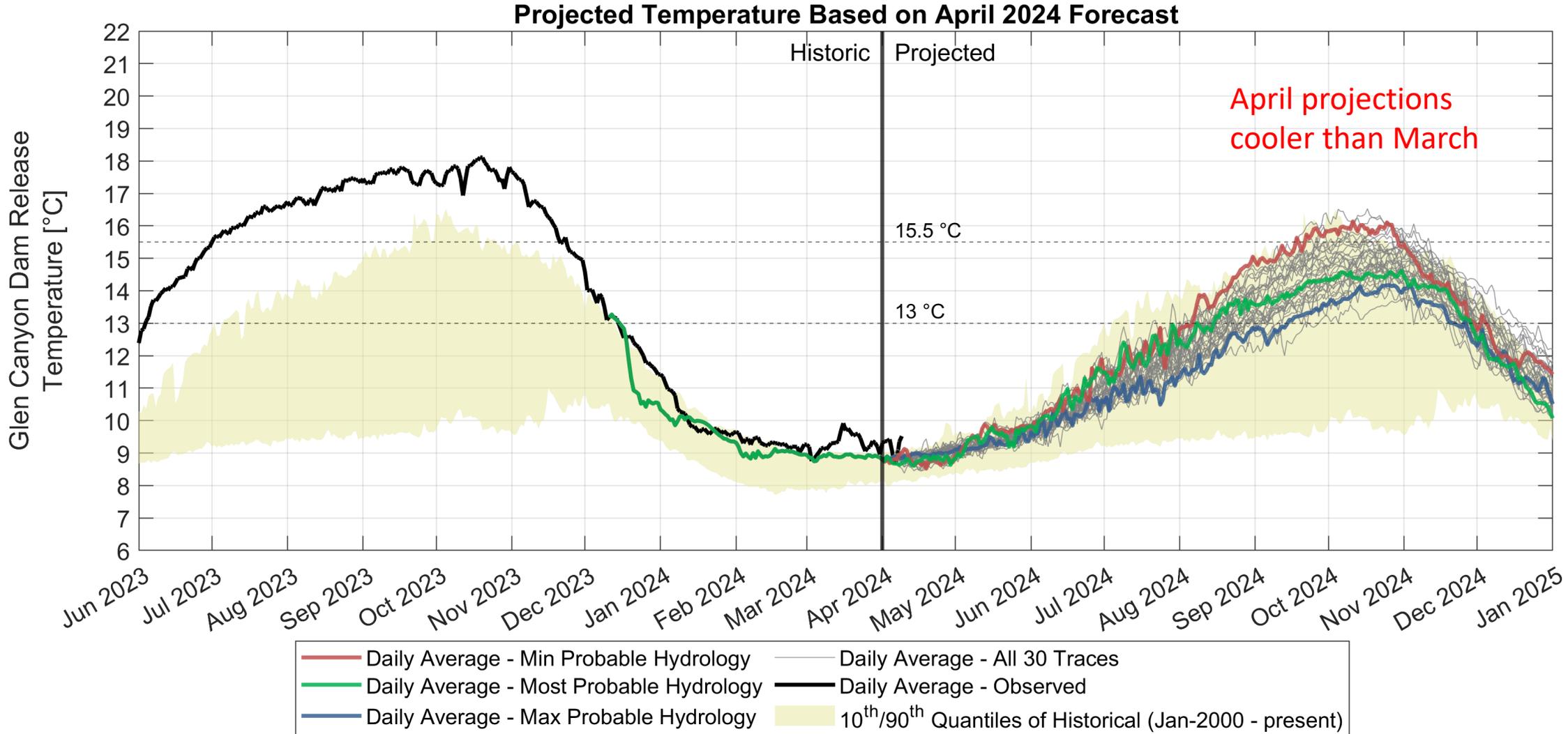


We will be using the 1k model grid going foreword

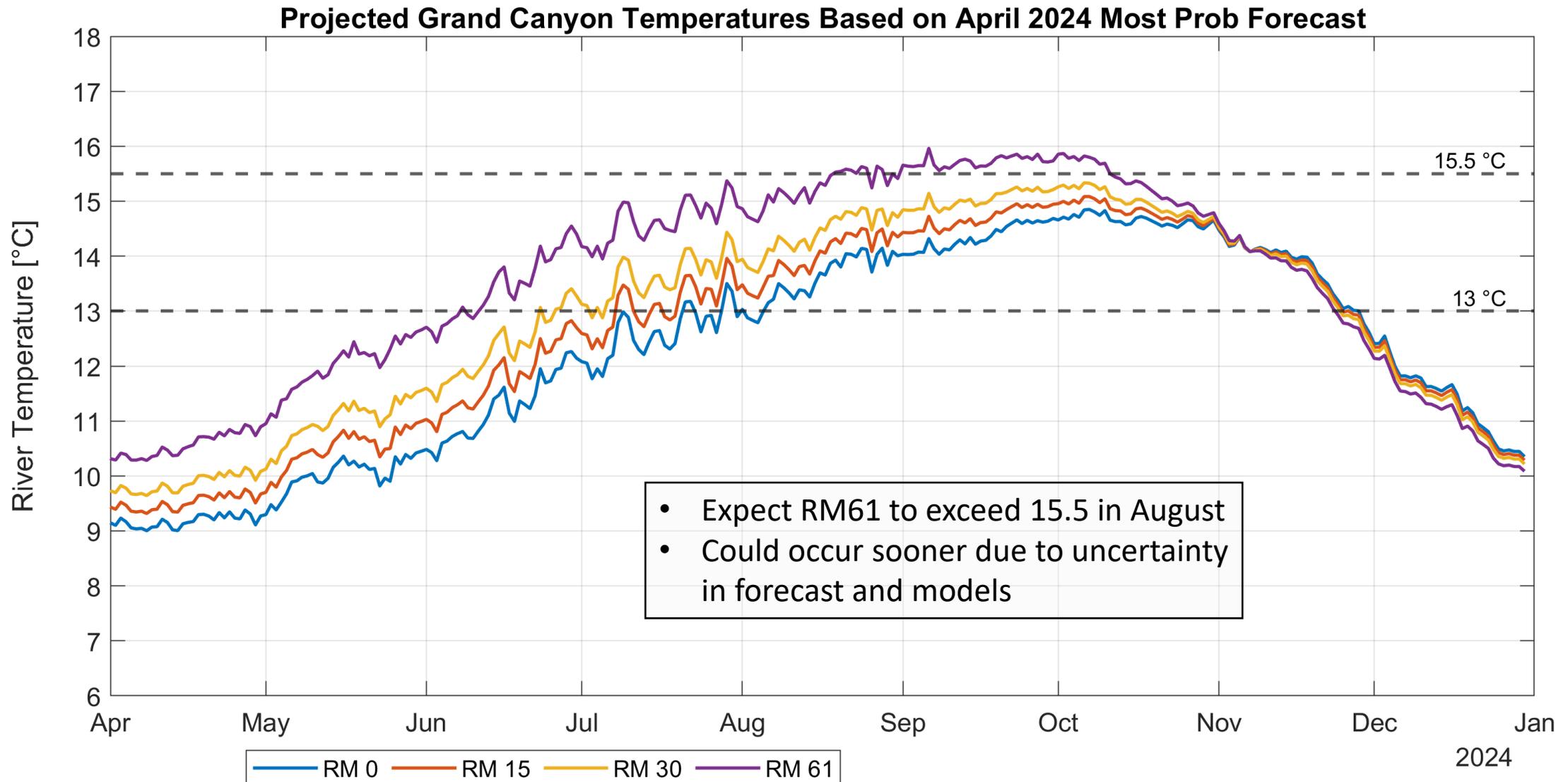


# CE-QUAL-W2 Modeled Temperature

1k Model

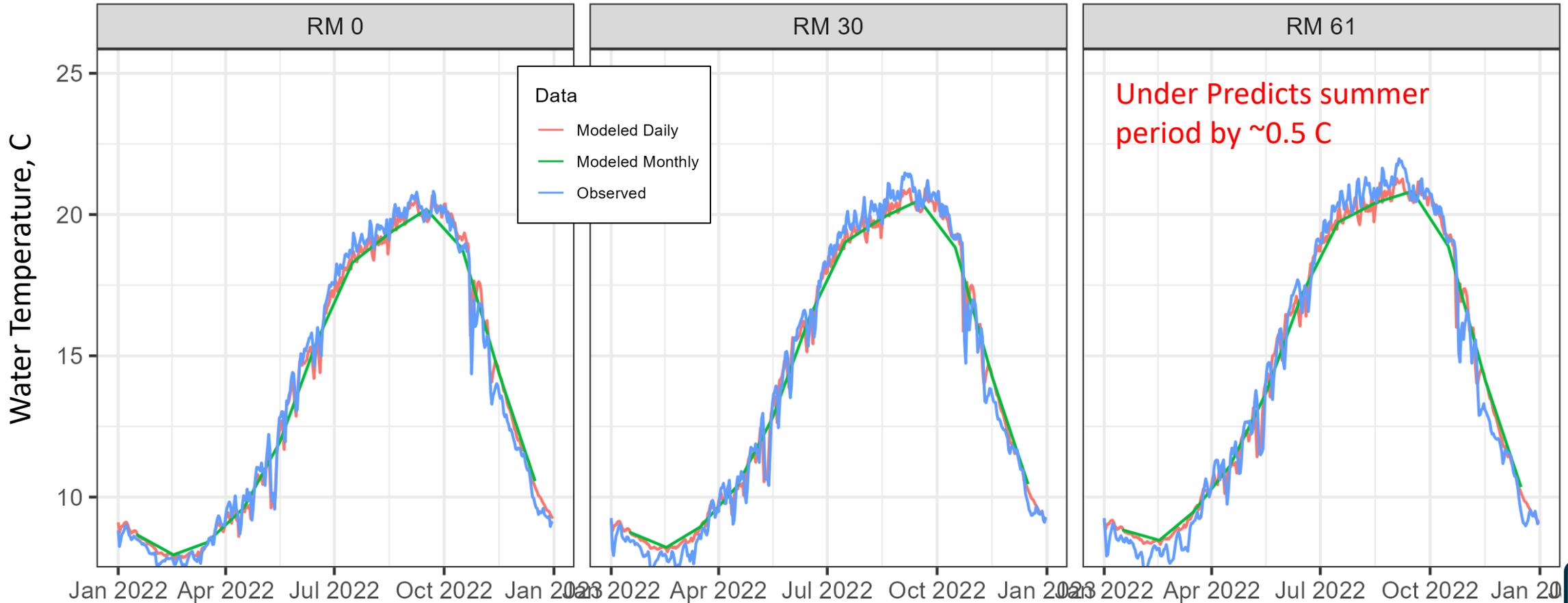


# Dibble et al. Grand Canyon Modeled Temperature



# Dibble et al. Grand Canyon Modeled Temperature

Colorado River in Grand Canyon Water Temperature Comparison  
Temperature model of Dibble et al. 2021



Evaluation of Dibble et al model for 2022



# Questions?



— BUREAU OF —  
RECLAMATION