



— BUREAU OF —  
RECLAMATION

# Adaptive Management Work Group

## Glen Canyon Dam Operations and Upper Basin Hydrology and Water Quality

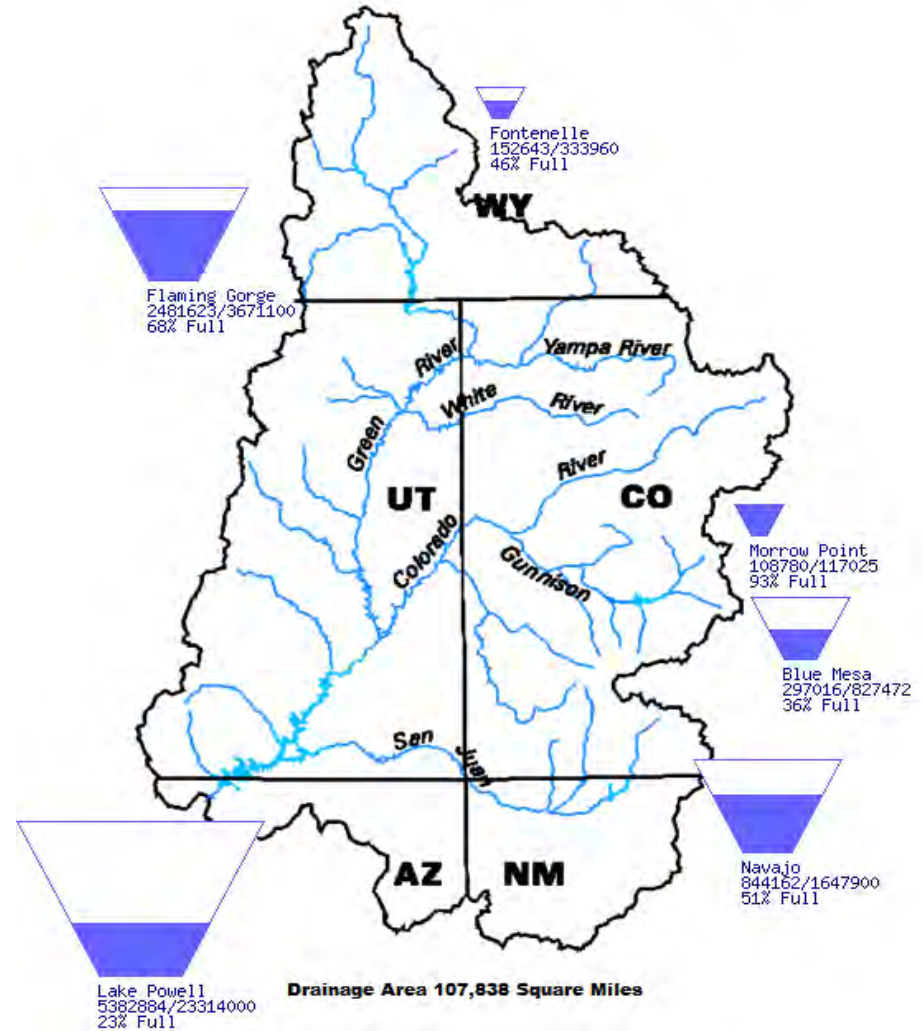
February 15, 2023

# Upper Basin Storage (as of February 13, 2023)

Data Current as of:  
02/13/2023

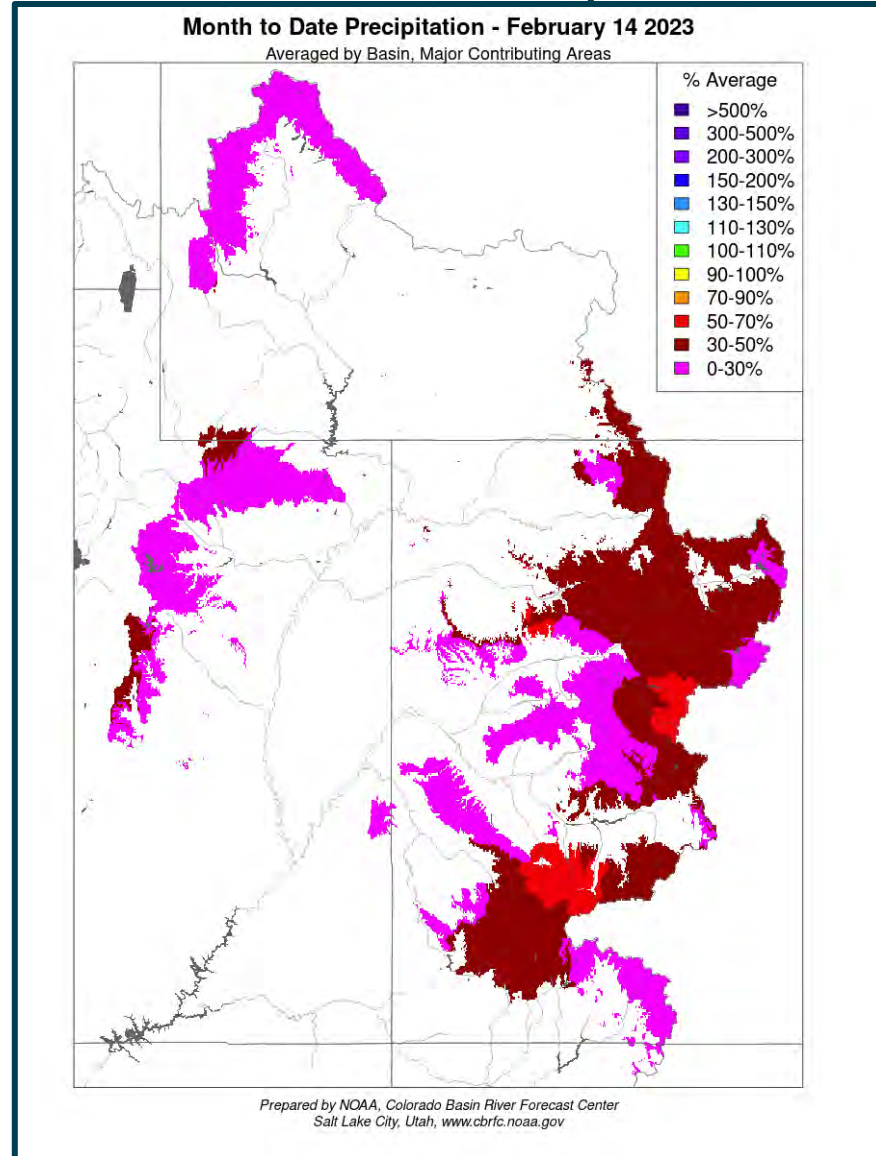
## Upper Colorado River Drainage Basin

Reservoir	Percent Current Live Storage	Current Live Storage (maf)	Live Storage Capacity (maf)	Elevation (feet)
Fontenelle	46	0.15	0.33	6,478.87
Flaming Gorge	68	2.48	3.67	6,006.69
Blue Mesa	36	0.30	0.83	7,447.73
Navajo	51	0.84	1.65	6,017.51
Lake Powell	23	5.38	23.31	3,522.16
UC System Storage	31	9.28	29.79	
Total System Storage	33	19.09	58.48	

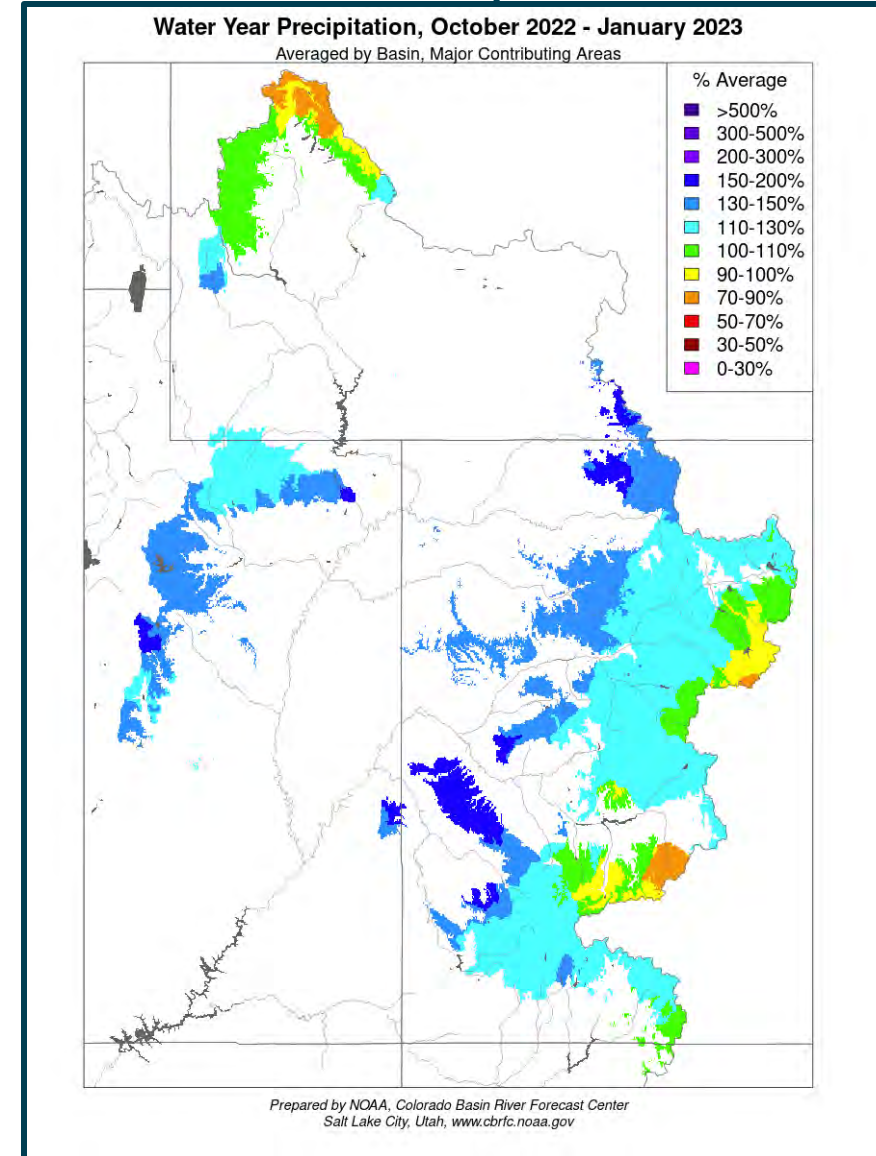


# February Month to Date and WY Precipitation

## Month to Date Precipitation

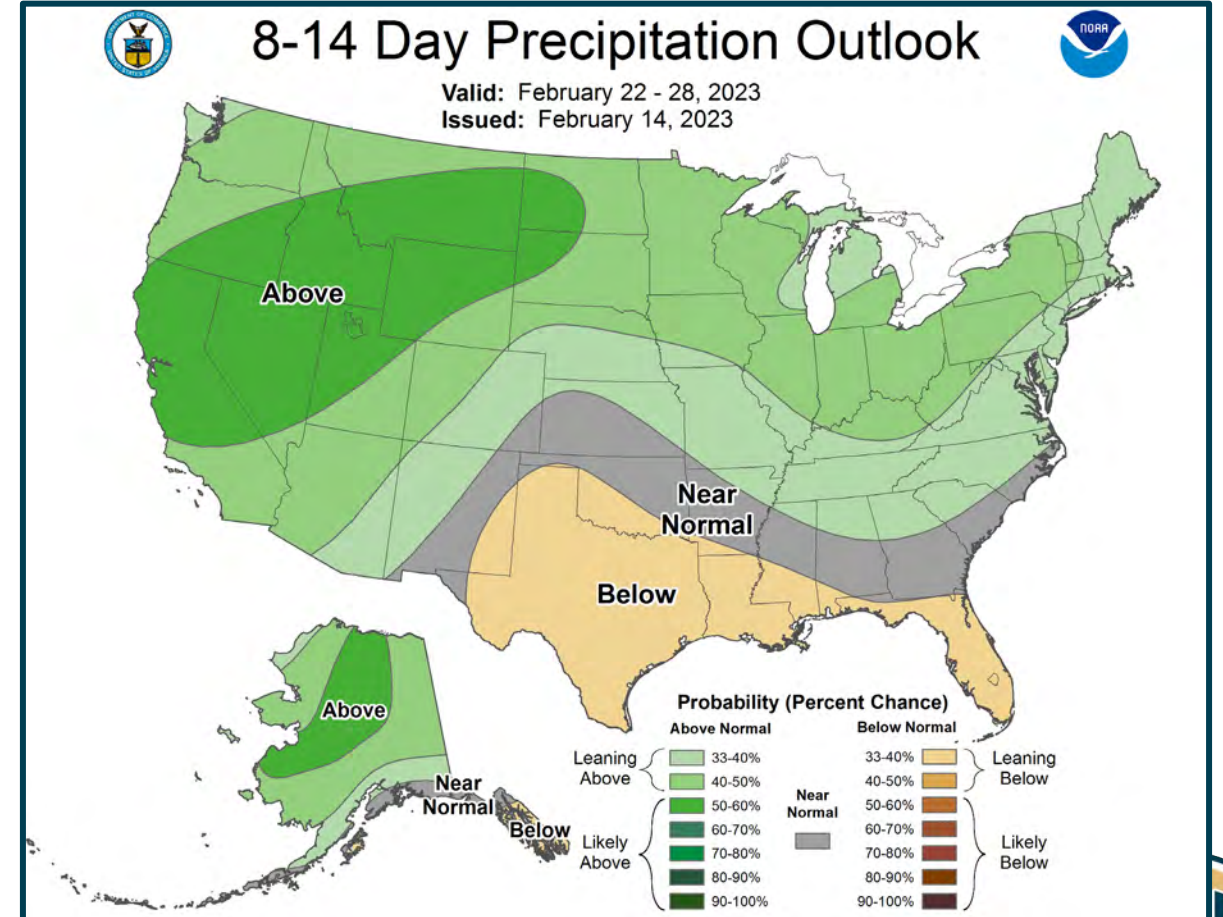
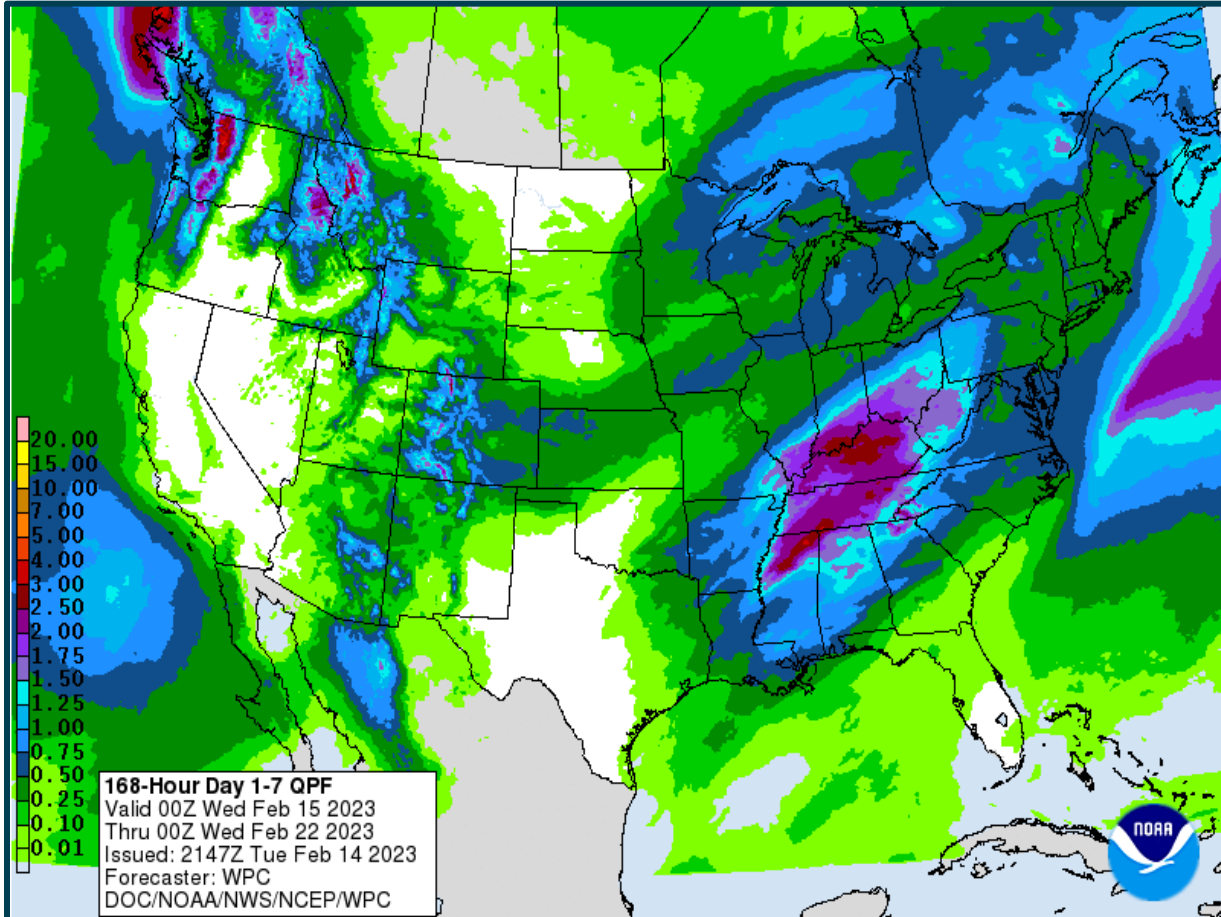


## WY Precipitation



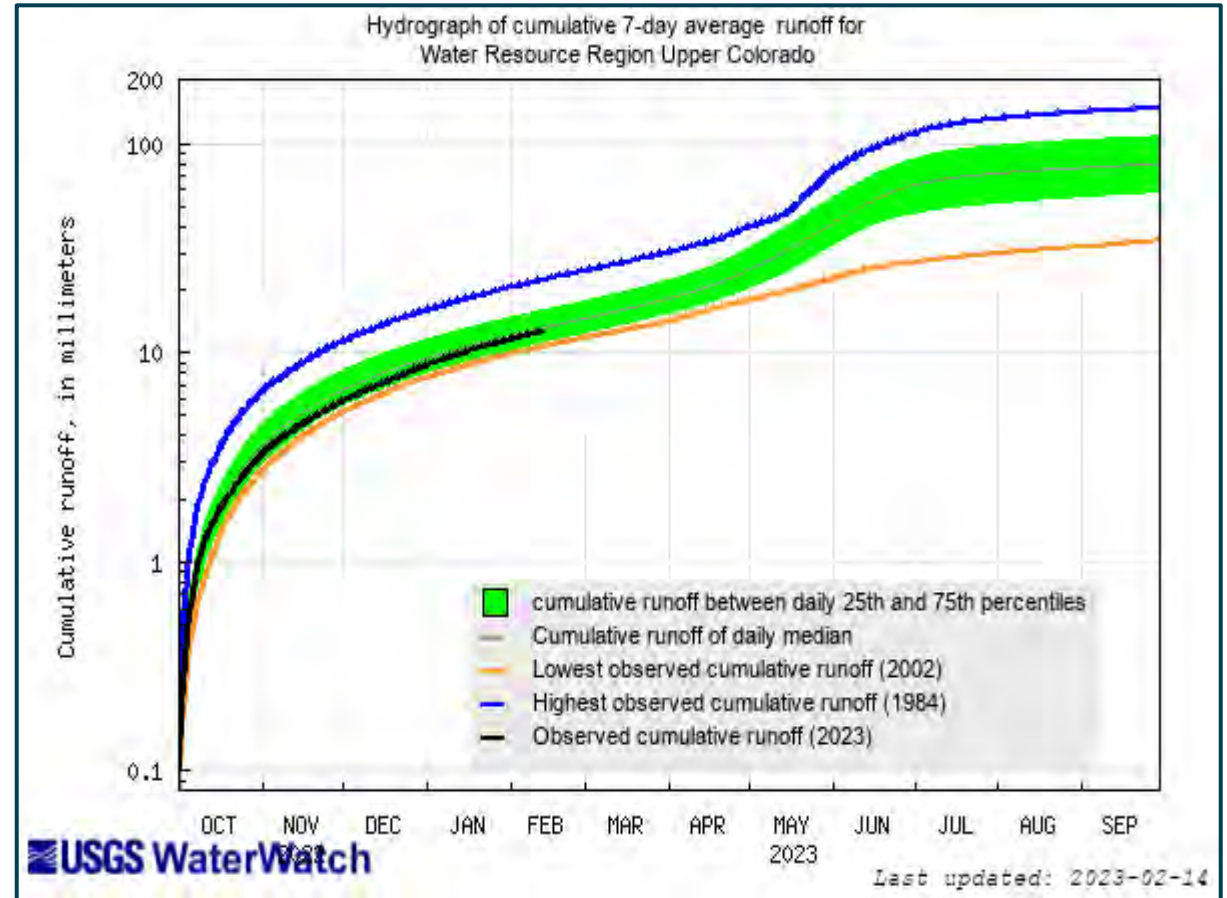
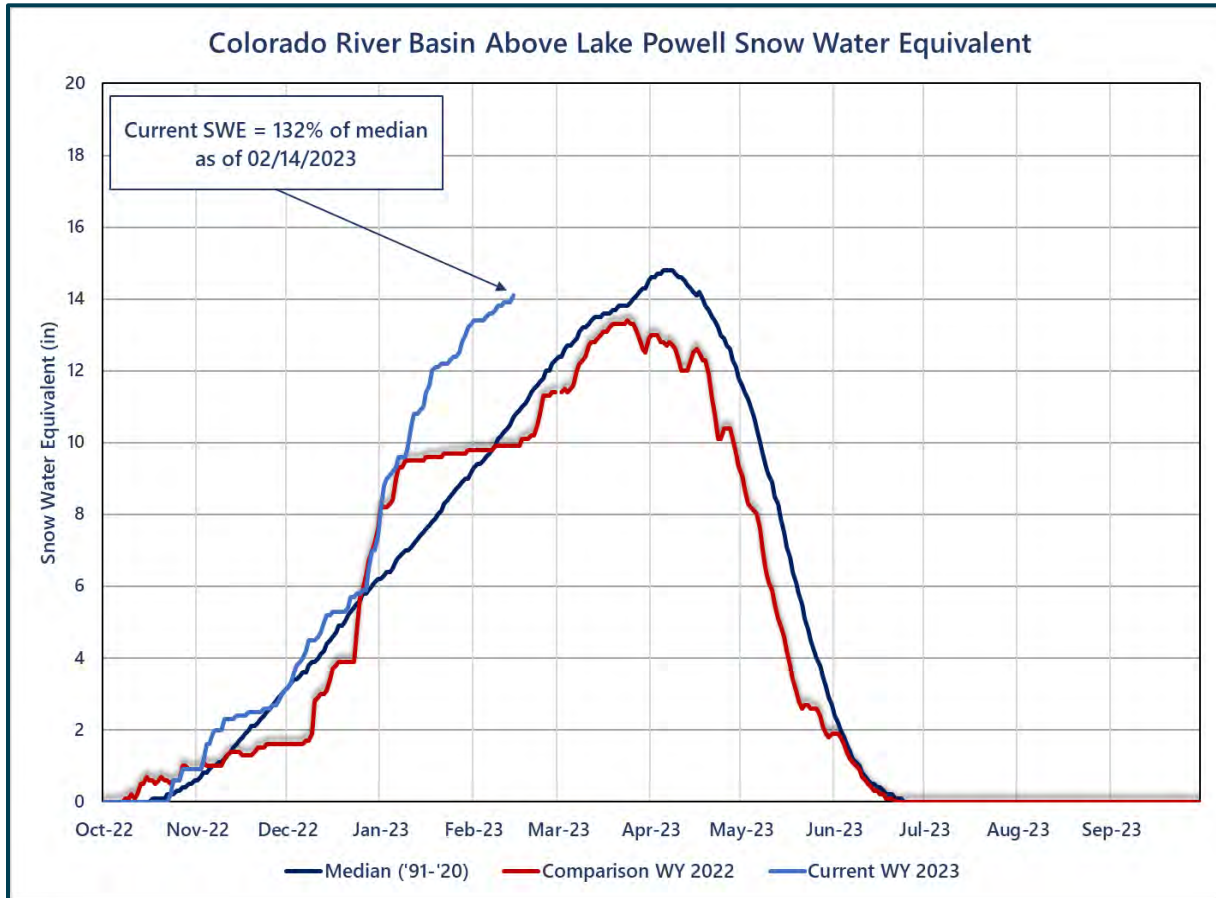


# Climate Prediction Center Short-Term Precipitation Forecast





# Upper Colorado SWE and Observed Inflows



Available online at: [https://waterwatch.usgs.gov/index.php?id=wwdur\\_cumrunoff](https://waterwatch.usgs.gov/index.php?id=wwdur_cumrunoff)

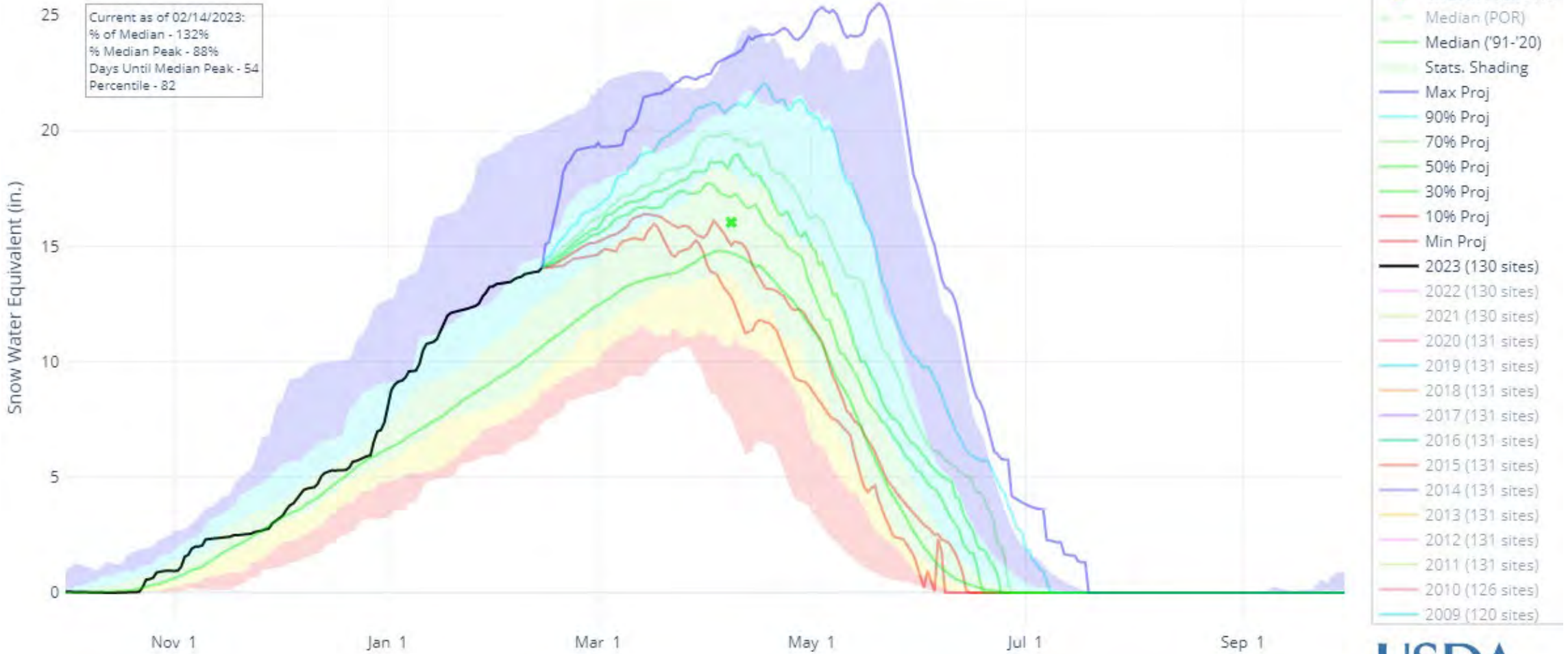


# SNOW WATER EQUIVALENT PROJECTIONS IN UPPER COLORADO REGION

Reset Range

[Link to data: CSV / JSON](#)

Station List



# Most Probable February Forecast Water Year 2023

April – July 2023  
Forecasted Unregulated Inflow  
as of February 3, 2023

Reservoir	Inflow (kaf)	Percent of Avg <sup>1</sup>
Fontenelle	650	88
Flaming Gorge	880	91
Blue Mesa	680	107
Navajo	620	99
Powell	7,500	117

Water Year 2023  
Unregulated Inflow Forecast  
as of February 3, 2023

Reservoir	Inflow (kaf)	Percent of Avg <sup>1</sup>
Fontenelle	944	88
Flaming Gorge	1,263	90
Blue Mesa	921	102
Navajo	841	92
Powell	10,439	109

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

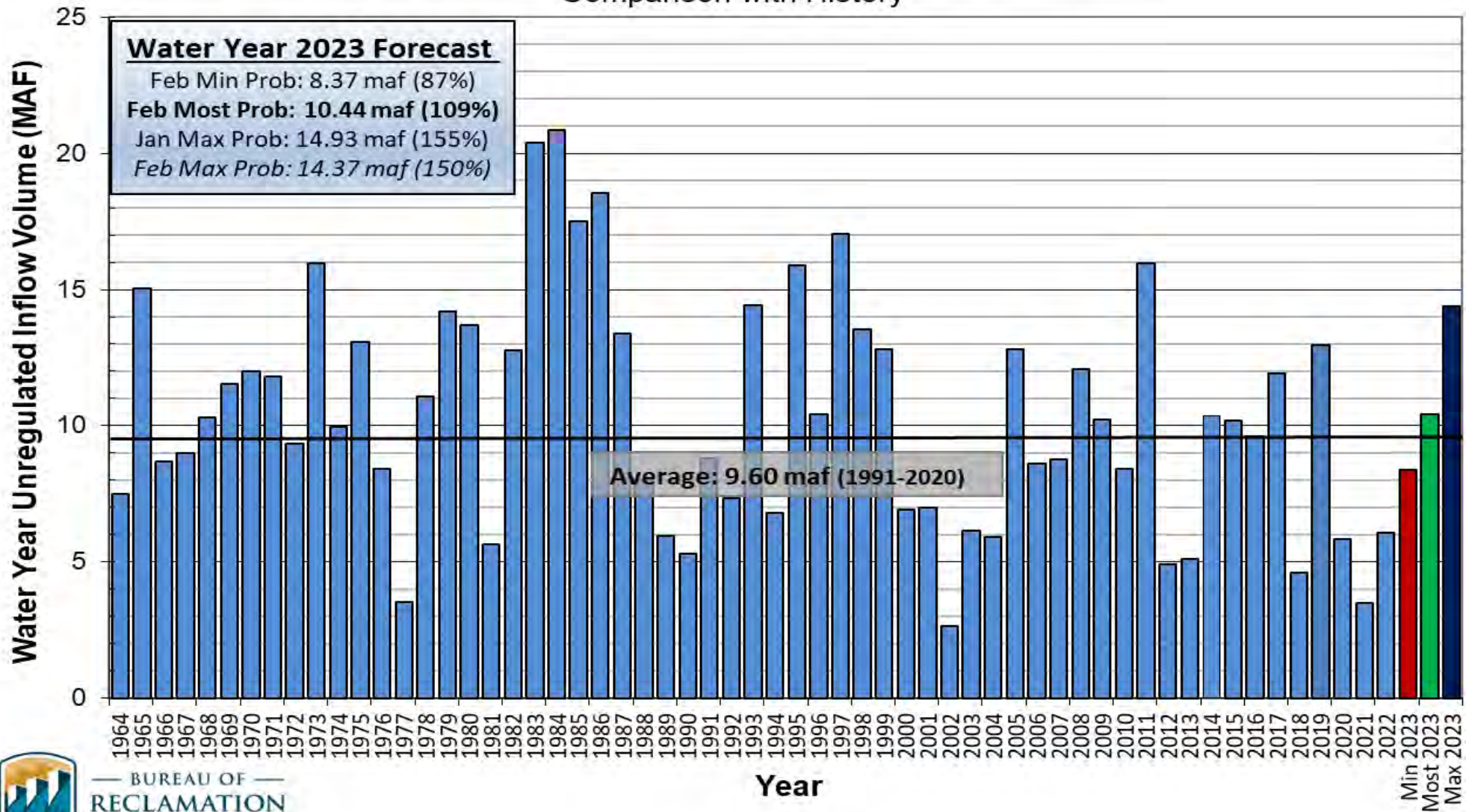




# Lake Powell Unregulated Inflow

## Water Year 2023 Forecast (issued February 3)

### Comparison with History



BUREAU OF RECLAMATION





# Upper Colorado Basin

Hydrology and Operations  
Projections Based on January  
and February 2023 24-  
Month Study



# 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>
  - Glen Canyon Dam will hold back a total of 523 kaf during the months of December 2022 through April 2023. There are continued discussions when and how that water will be released later in the year.





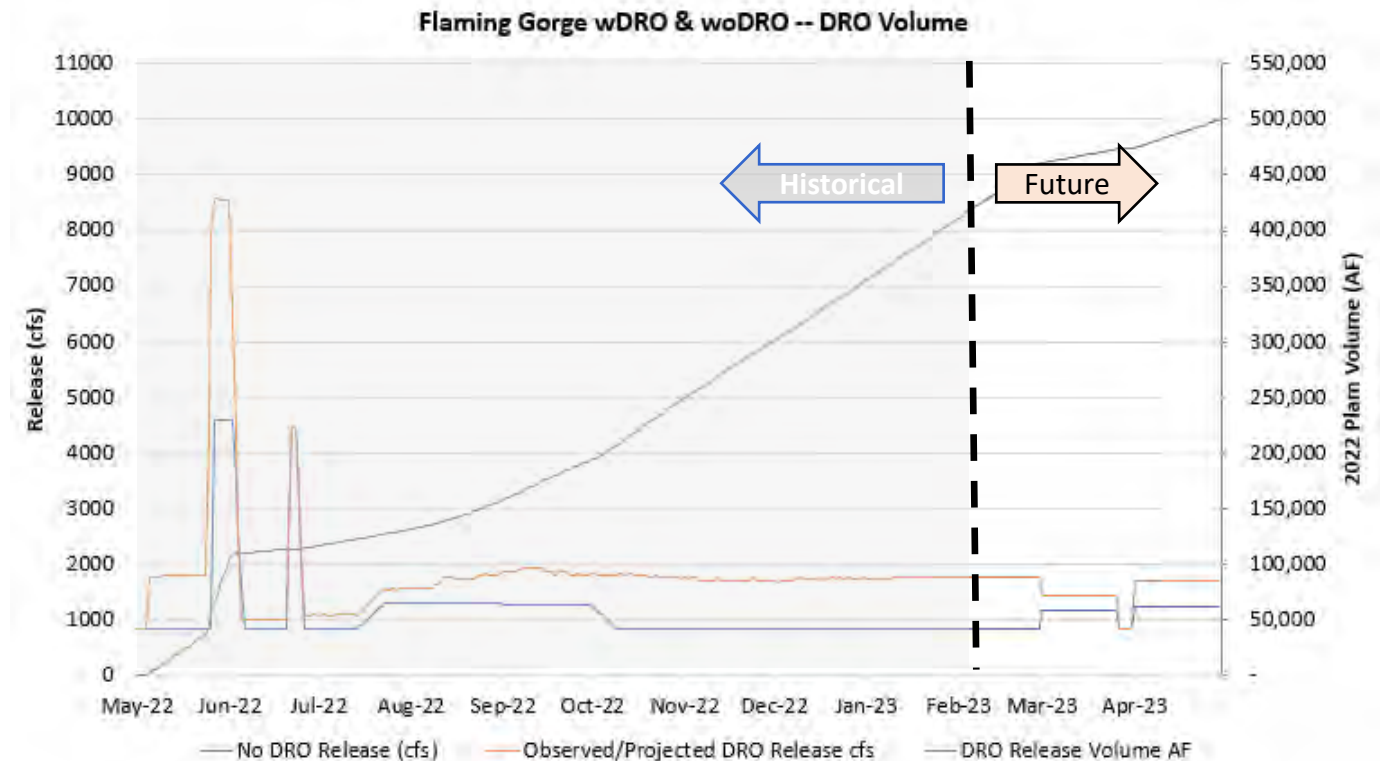
# Drought Response Operations Agreement (DROA)

## DROA Volumes Released<sup>1</sup>

Reservoir	2021 DROA Volume (kaf)	2022 DROA Volume (kaf)	Total DROA Volume (kaf)
Flaming Gorge	125	500	625
Blue Mesa	36	0	36
Navajo	0	0	0
Volume in Powell	161	500	661

<sup>1</sup>DROA operational year is from May through April.

## Flaming Gorge 2022 Plan Daily Releases



Flaming Gorge DROA release as of February 12 = 431 kaf



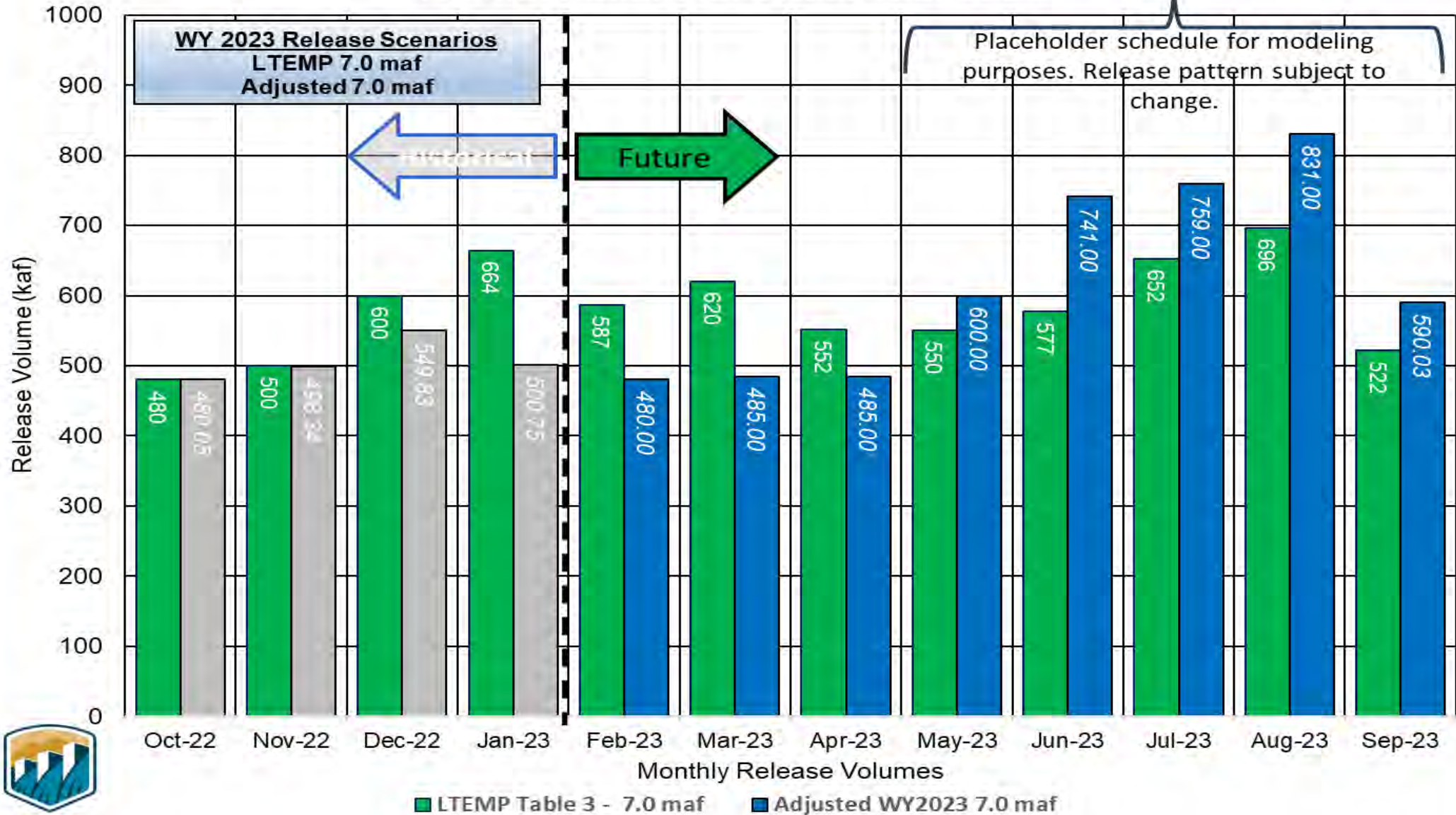
# Upper Basin Reservoir Operations in Water Year 2023

- 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's projected end of calendar year (CY) 2022 "tier determination" elevation in the August 2022 24-Month Study determines Lake Powell's operating tier in CY 2023
  - Lake Powell will operate in the Lower Elevation Balancing Tier where Lake Powell and Lake Mead will balance contents with Glen Canyon Dam release volumes no less than 7.0 maf and no more than 9.5 maf
- Consistent with the provisions of the 2007 Interim Guidelines, and to preserve the benefits to Glen Canyon Dam facilities from 2022 Operations into 2023 and 2024, Reclamation will consult with the Basin States on monthly and annual operations. 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.
  - The Glen Canyon Dam annual release has initially been set to 7.00 maf, and in April 2023 Reclamation will evaluate hydrologic conditions to determine if balancing releases may be appropriate under the conditions established in the 2007 Interim Guidelines;
  - Balancing releases will be limited (with a minimum of 7.00 maf) to protect Lake Powell from declining below elevation 3,525 feet at the end of December 2023;
  - Balancing releases will take into account operational neutrality of the 0.480 maf that was retained in Lake Powell under the May 2022 action<sup>1</sup>. Any Lake Powell balancing release volume will be calculated as if the 0.480 maf had been delivered to Lake Mead in WY 2022; and
  - The modeling approach for WY 2023 will apply to 2024.



# Lake Powell Monthly Release Volume Distribution

## 7.0 maf Pattern for Water Year 2023

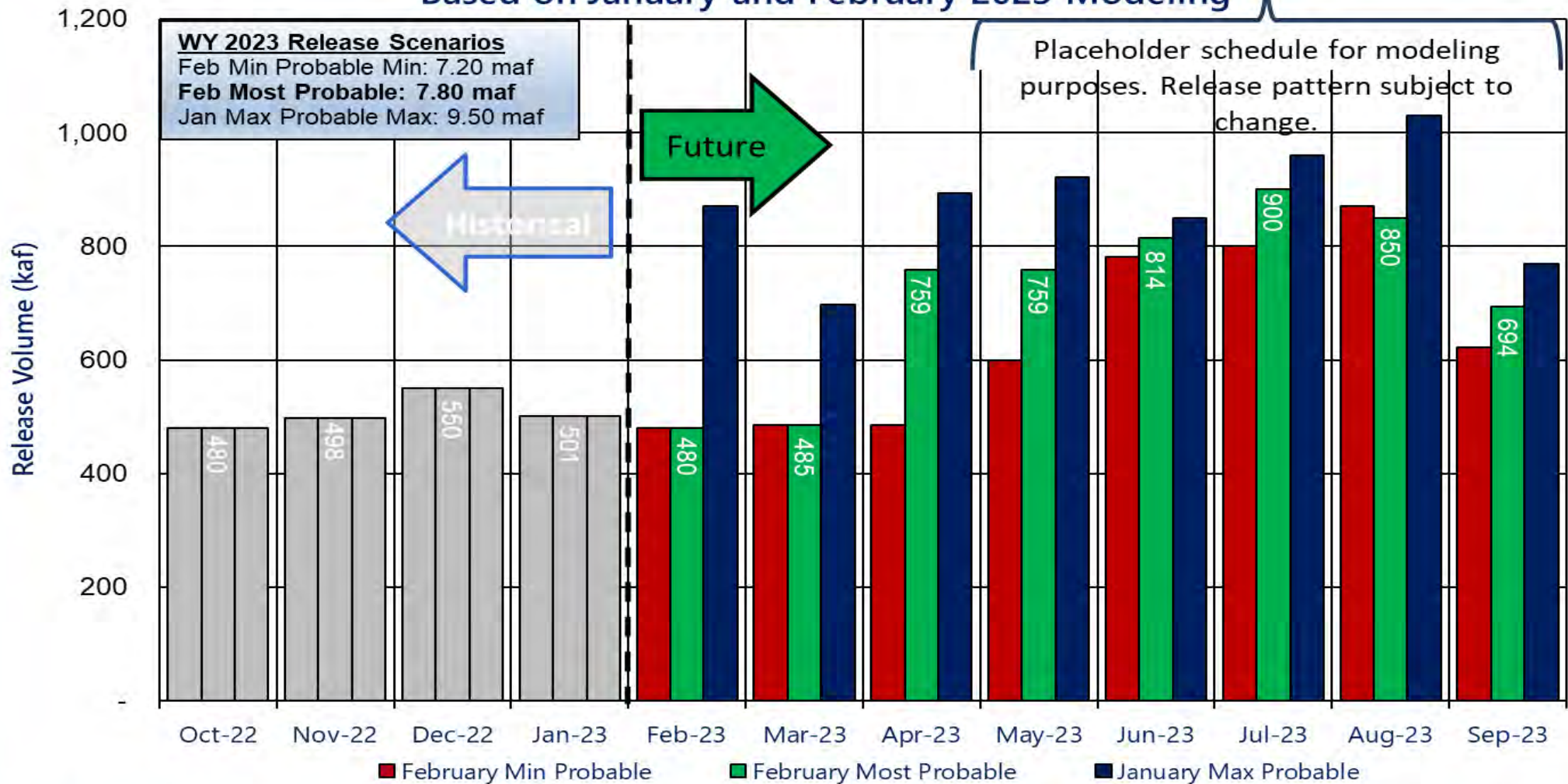




# Potential Lake Powell Monthly Release Volume Distribution

## Release Scenarios for Water Year 2023

### Based on January and February 2023 Modeling



Consistent with the provisions of the 2007 Interim Guidelines, and to preserve the benefits to Glen Canyon Dam facilities from 2022 Operations into 2023 and 2024, Reclamation will consult with the Basin States on monthly and annual operations. 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.



# Reclamation Operational Modeling Model Comparison

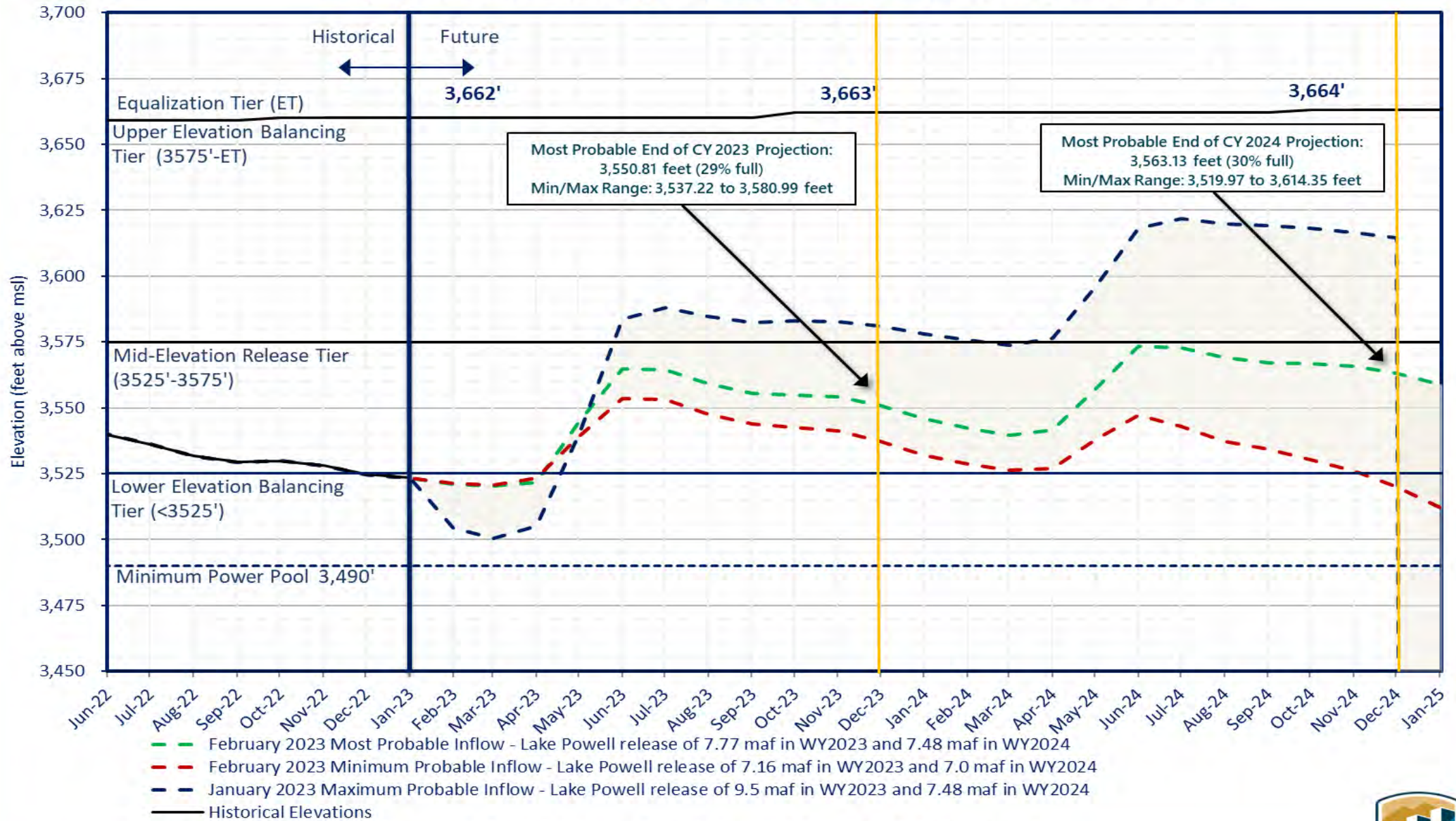
	Colorado River Mid-term Modeling System (CRMMS)		CRSS
	24-Month Study Mode (Manual Mode)	Ensemble Mode (Rule-based Mode)	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir 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<sup>1</sup>

Projections from the January and February 2023 24-Month Study Inflow Scenarios

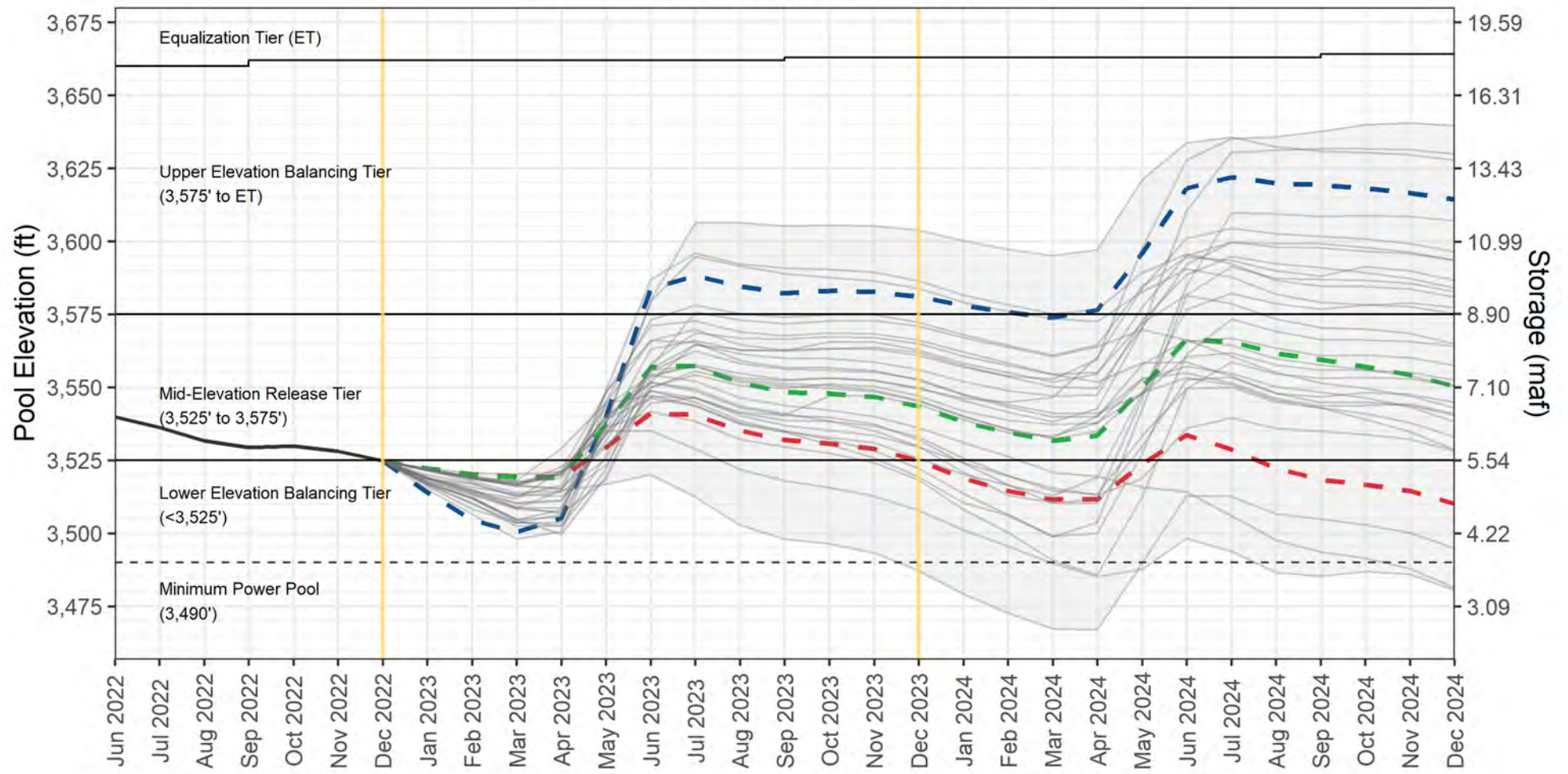


<sup>1</sup>Projected Lake Powell end-of-month physical elevations from the latest 24-Month Study inflow scenarios. Additional information can be found here: <https://www.usbr.gov/dcp/droa.html>





# Lake Powell End-of-Month Elevations<sup>1</sup> CRMMS Projections from January 2023



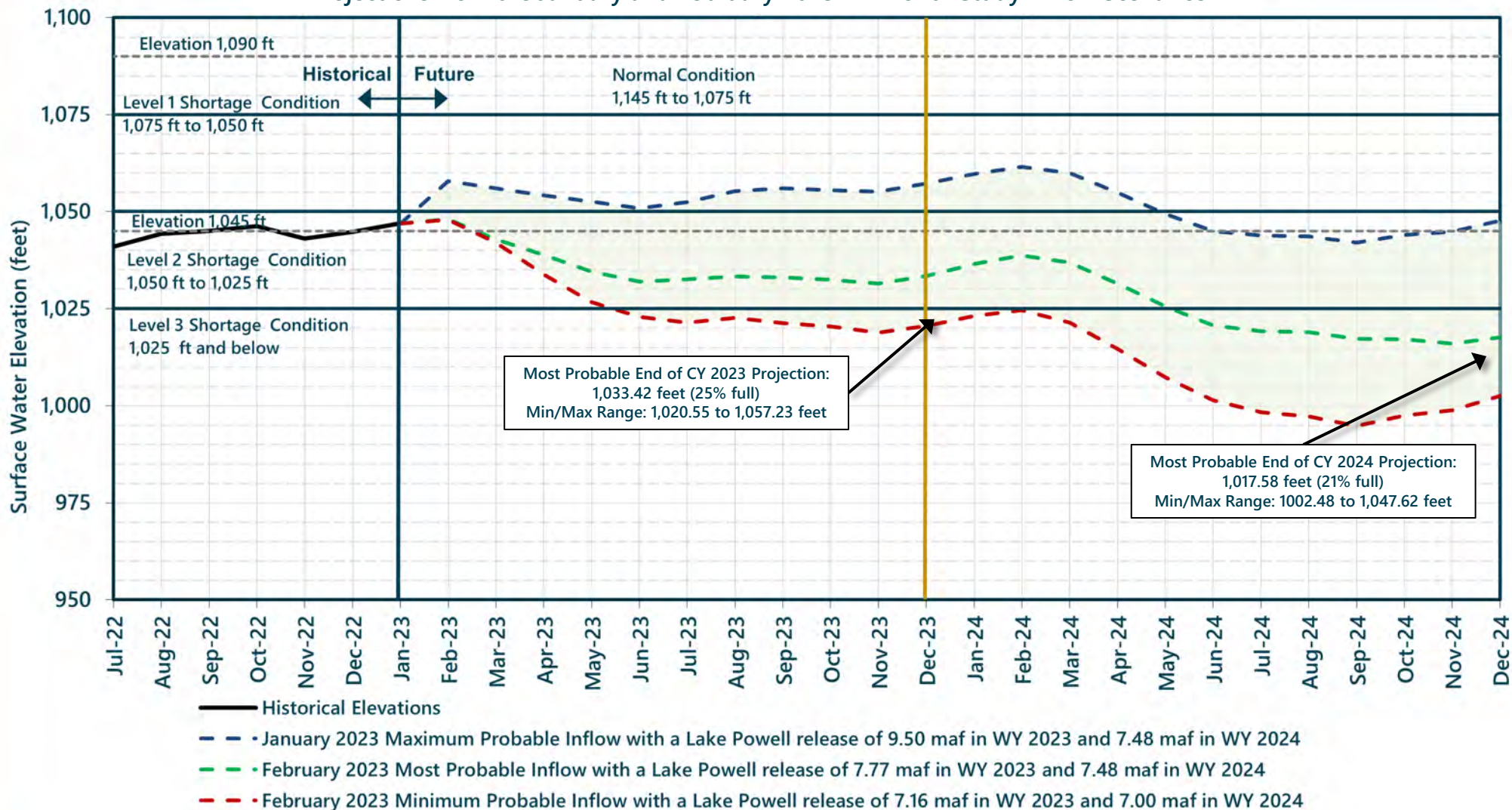
- - January 2023 Probable Minimum 24-Month Study
- - January 2023 Probable Maximum 24-Month Study
- - January 2023 Most Probable 24-Month Study
- Historical
- CRMMS-ESP Projections (30 projections)
- CRMMS-ESP Projections Range

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



# Lake Mead End of Month Elevations<sup>1</sup>

Projections from the January and February 2023 24-Month Study Inflow Scenarios



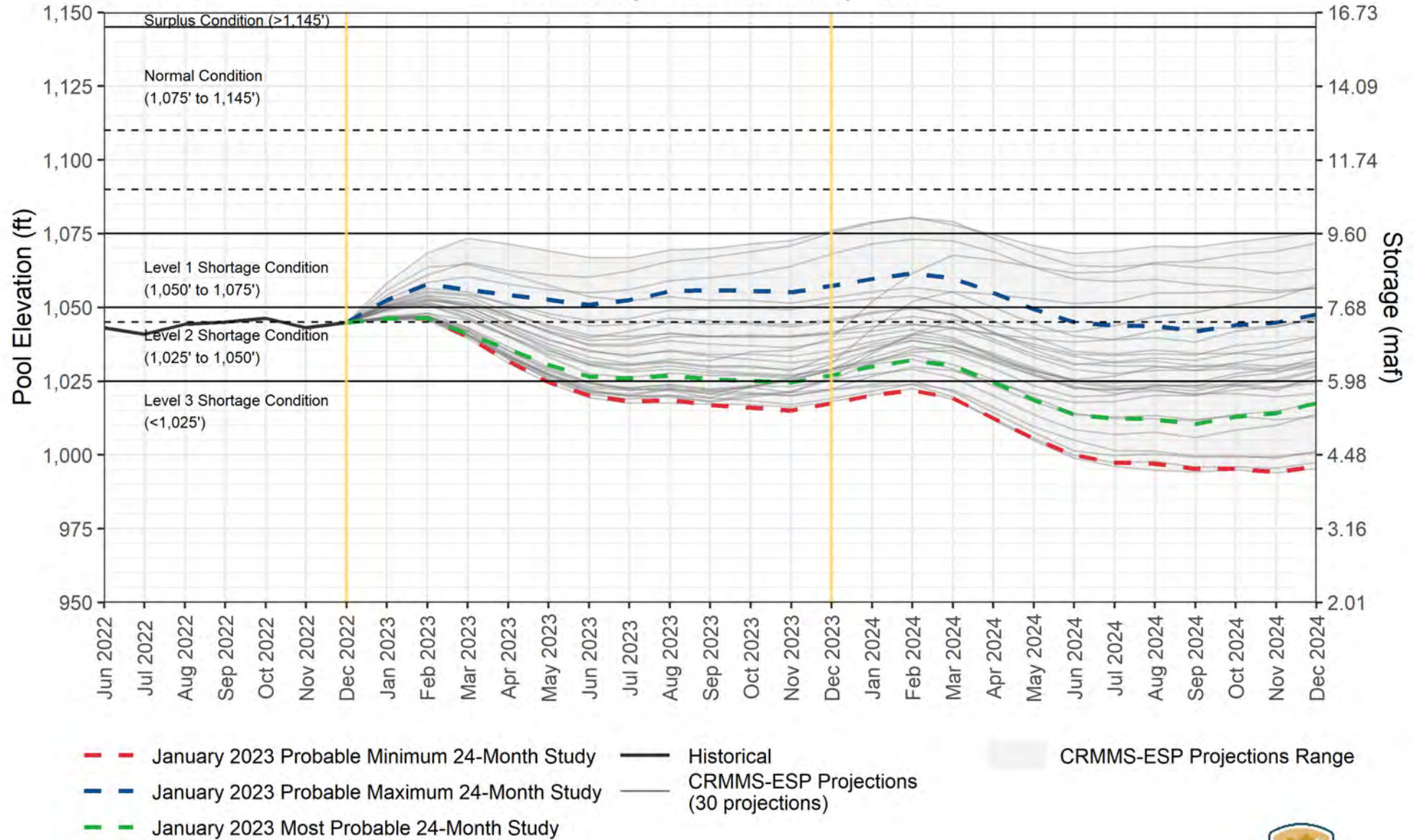
<sup>1</sup> Projected Lake Mead end of month physical elevations from the latest 24-Month Study inflow scenarios. The Drought Response Operations Agreement (DROA) is available online at: <https://www.usbr.gov/dcp/finaldocs.html>.

The chart above displays projected “physical” elevations for Lake Mead.





# Lake Mead End-of-Month Elevations<sup>1</sup> CRMMS Projections from January 2023



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







# Upper Colorado Basin

## Hydropower Maintenance







# Glen Canyon Dam Power Plant Unit Outage Schedule for WY2024

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	5	4	6	8	6	7	5	6	8	8	8	6
Capacity (cfs)	15,500	12,000	18,900	25,600	18,620	21,950	15,150	19,000	26,700	26,670	26,540	19,350
Capacity (kaf/month)	1,060	830	1,160	1,470	1,120	1,510	1,050	1,270	1,590	1,640	1,630	1,220
Max (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568
Most (kaf) <sup>1</sup>	480	500	600	723	639	675	601	599	628	709	758	568
Min (kaf) <sup>1</sup>	480	500	600	664	587	520	552	550	577	652	696	522

FEB MOST<sup>2</sup>  
 FEB MOST  
 7.48 maf  
 7.48 maf  
 7.00 maf

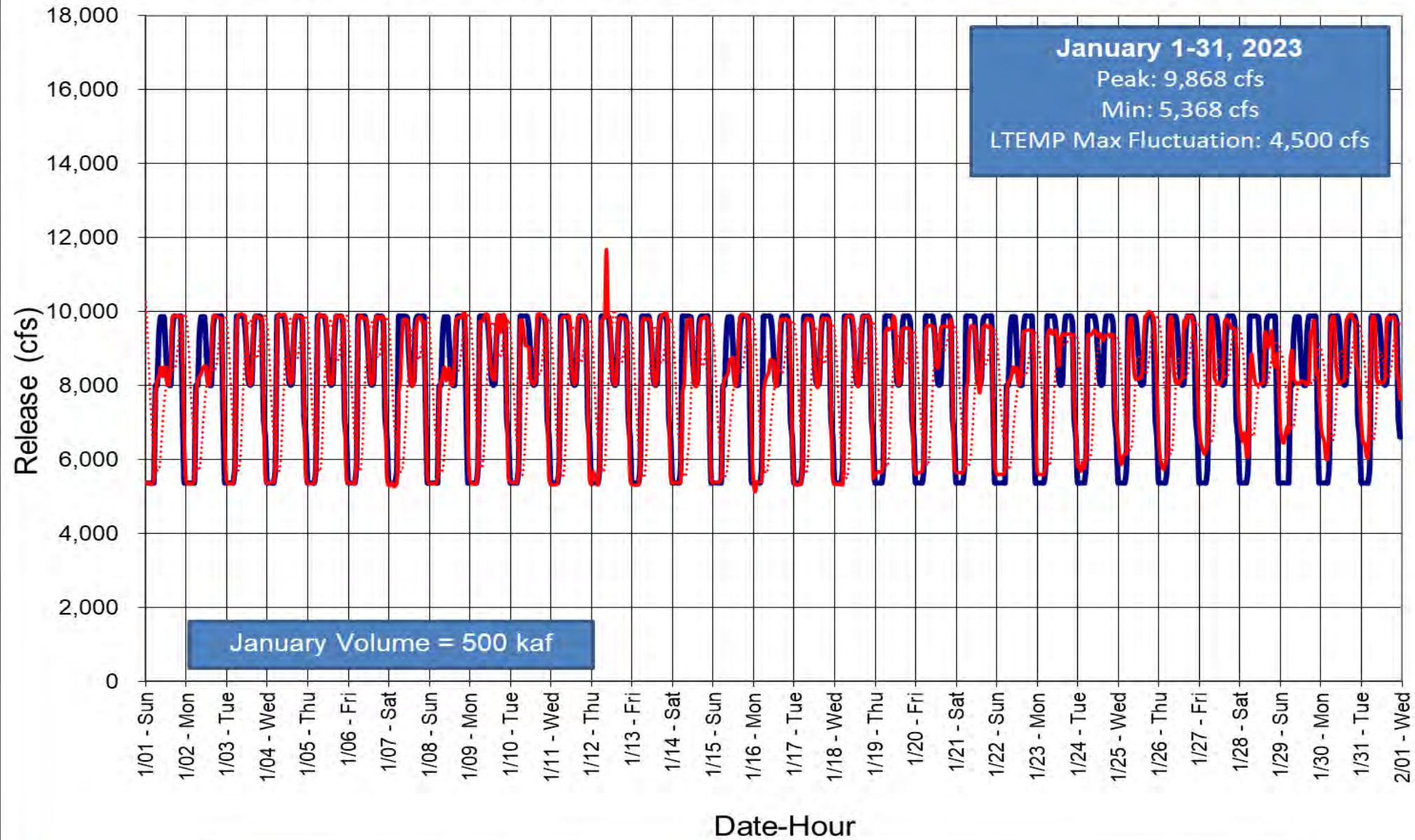
(updated 02-14-2023)

1 Projected release, based on February 2023 24MS for the minimum and most probable and January 2023 24MS for the 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.





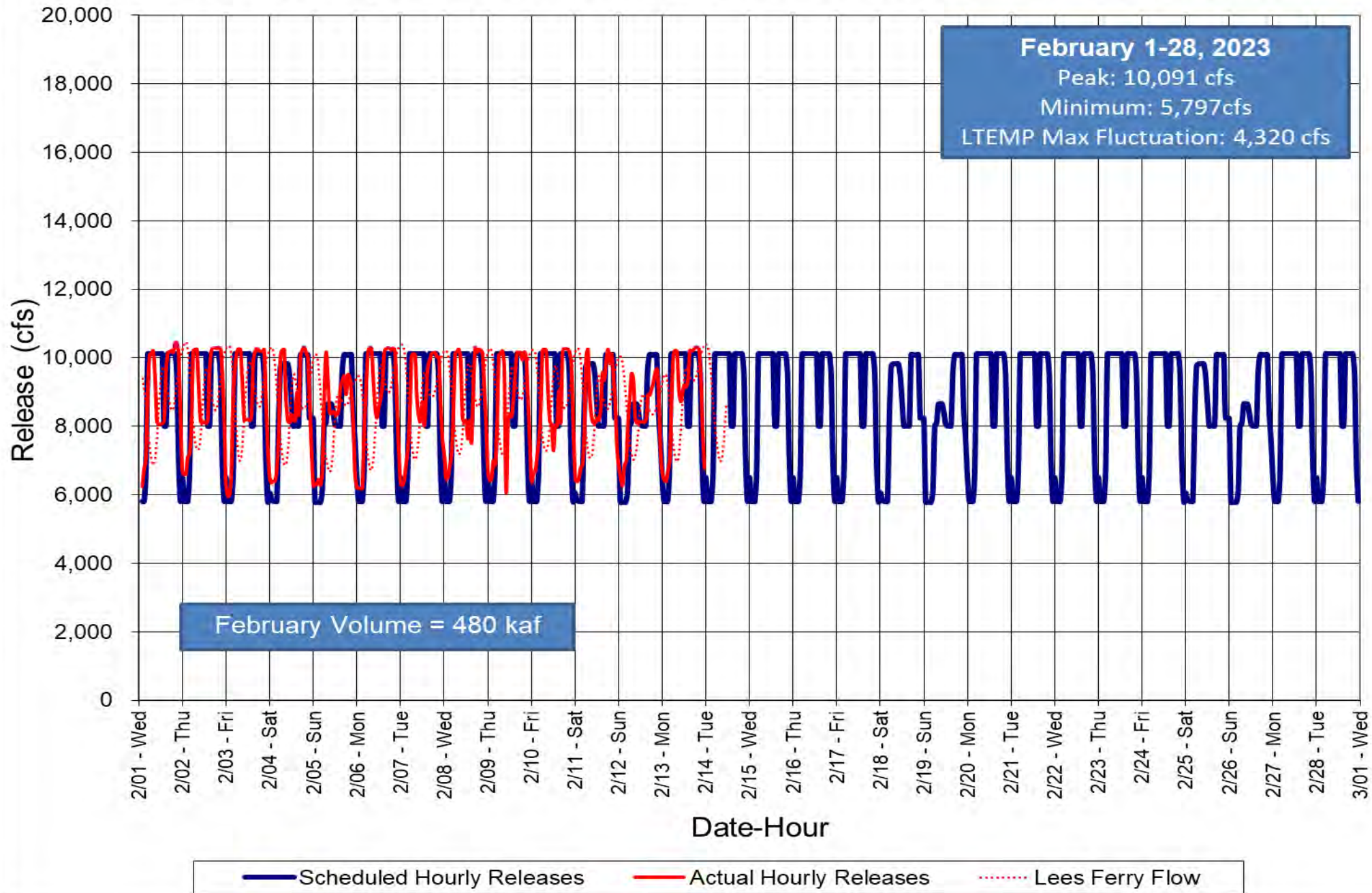
# Glen Canyon Dam Hourly Release Pattern January 2023



— Scheduled Hourly Releases    — Actual Hourly Releases    ..... Lees Ferry Flow

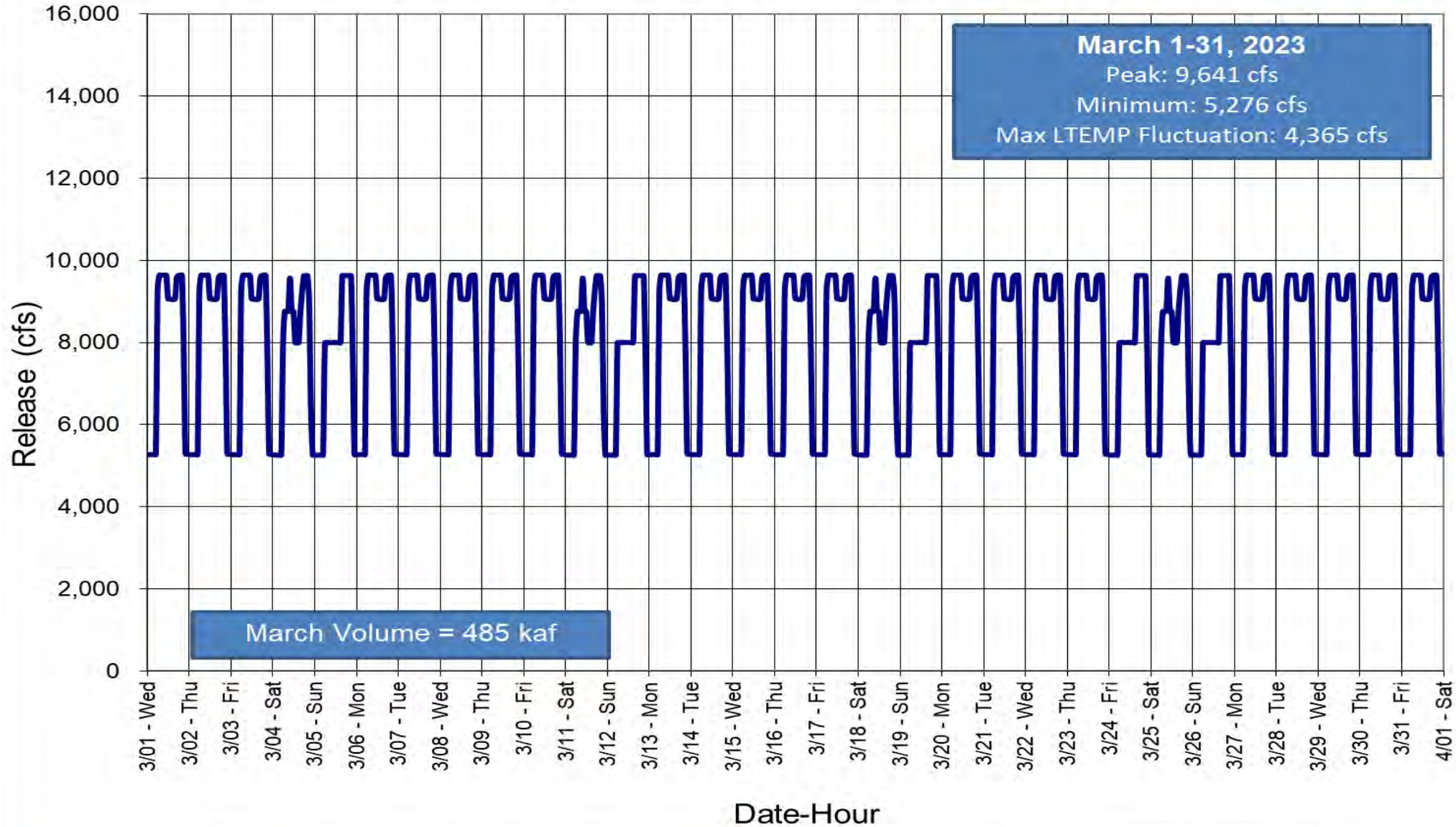


# Glen Canyon Dam Hourly Release Pattern February 2023





# Glen Canyon Dam Hourly Release Pattern March 2023



— Scheduled Hourly Releases   
 — Actual Hourly Releases   
 ⋯ Lees Ferry Flow



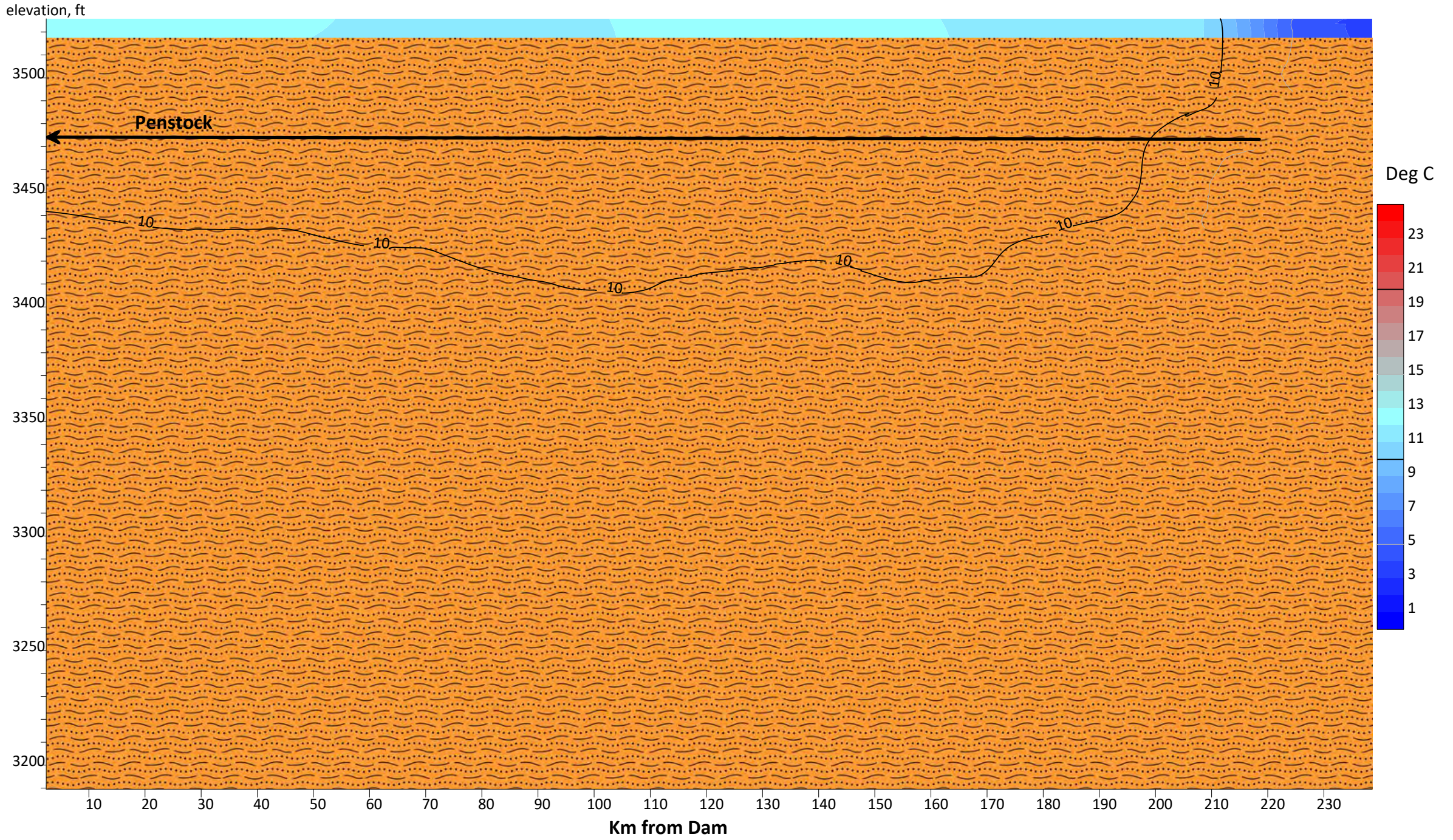


# Water Quality





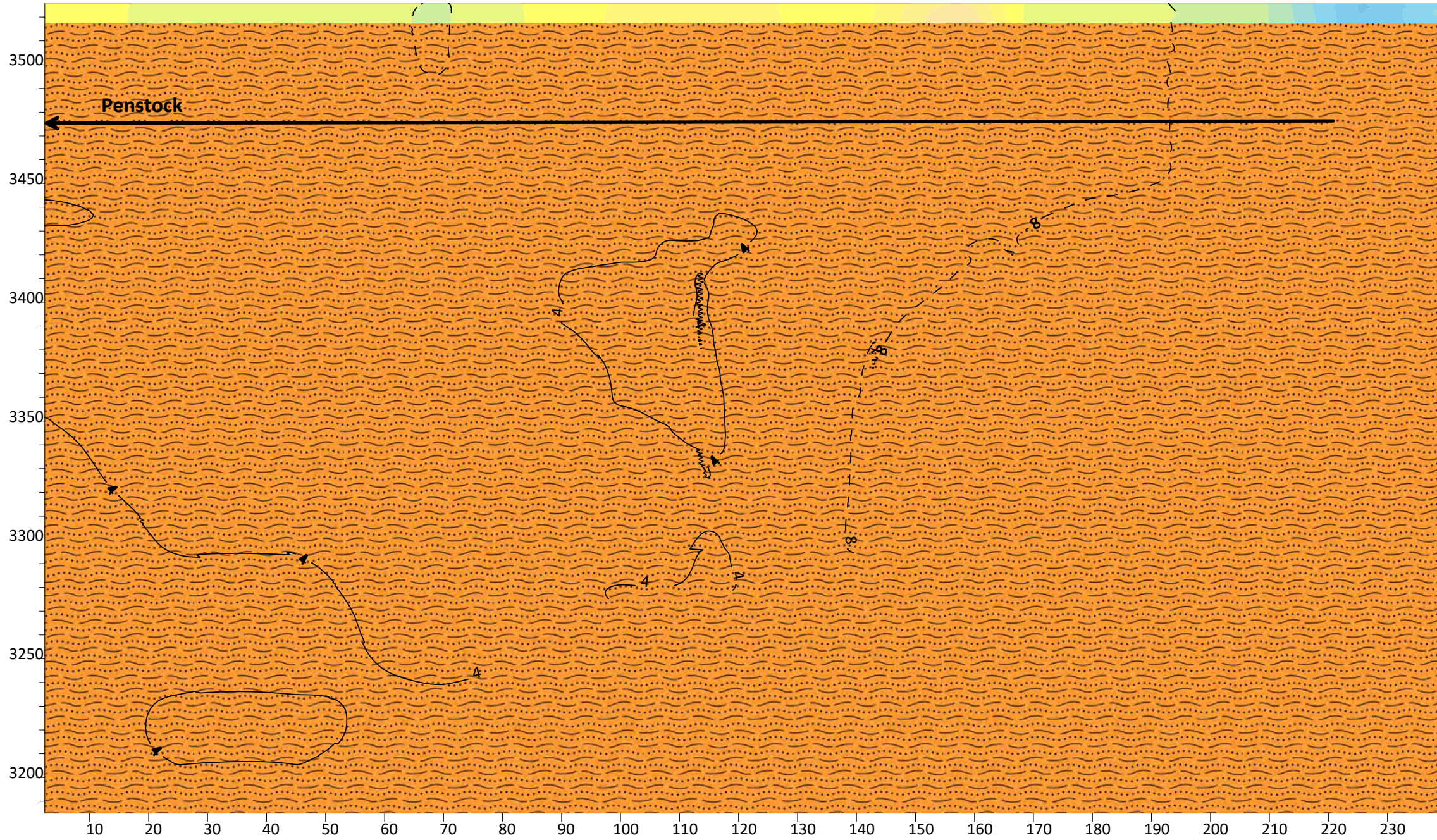
# Lake Powell Temperature Dec 2022



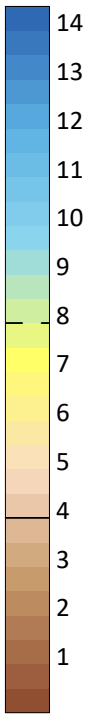


# Lake Powell December 2022 Dissolved Oxygen

elevation, ft



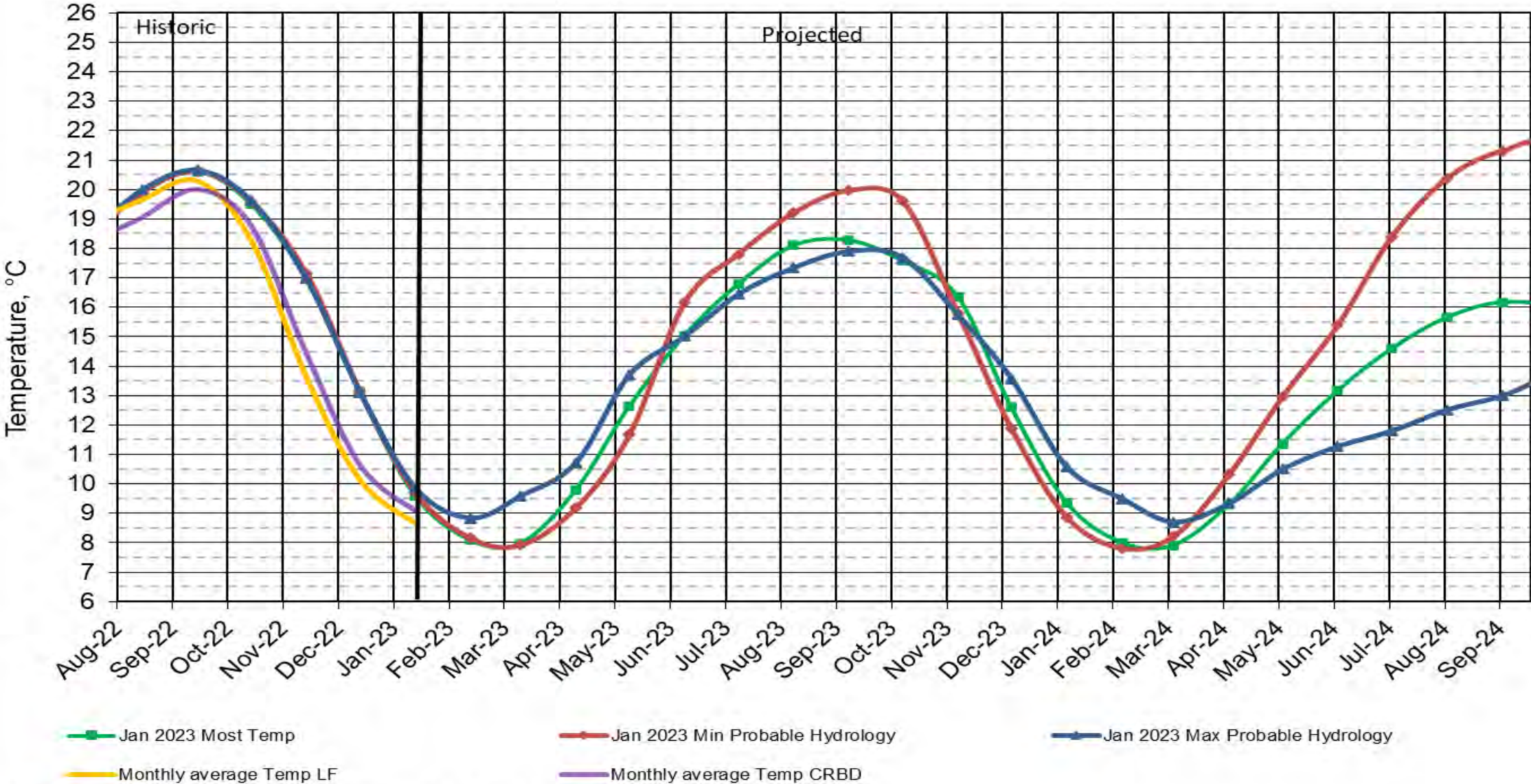
mg/L





# Lake Powell Release Temperature

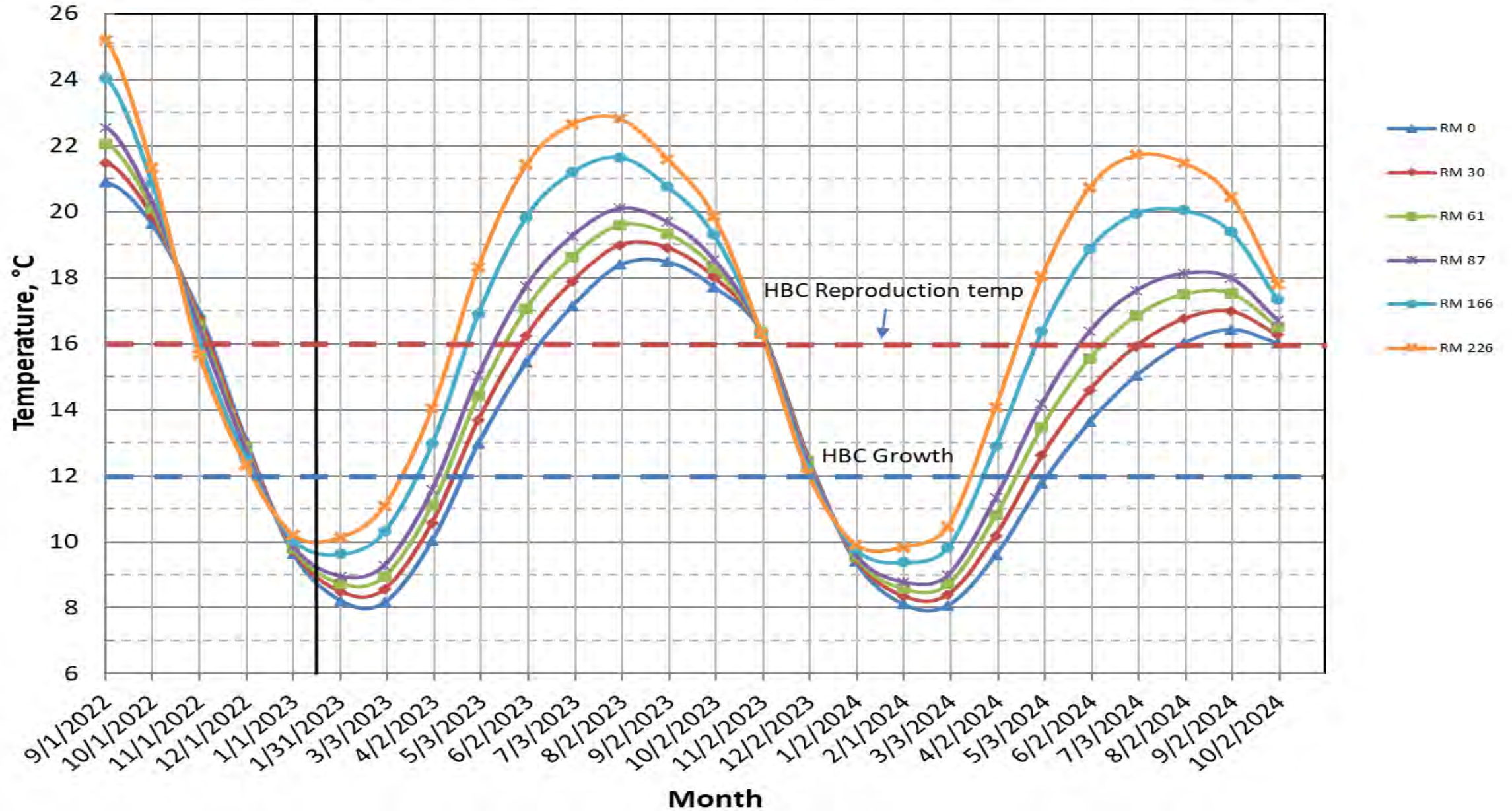
## Projected Temperature based on January 2023 Forecast



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

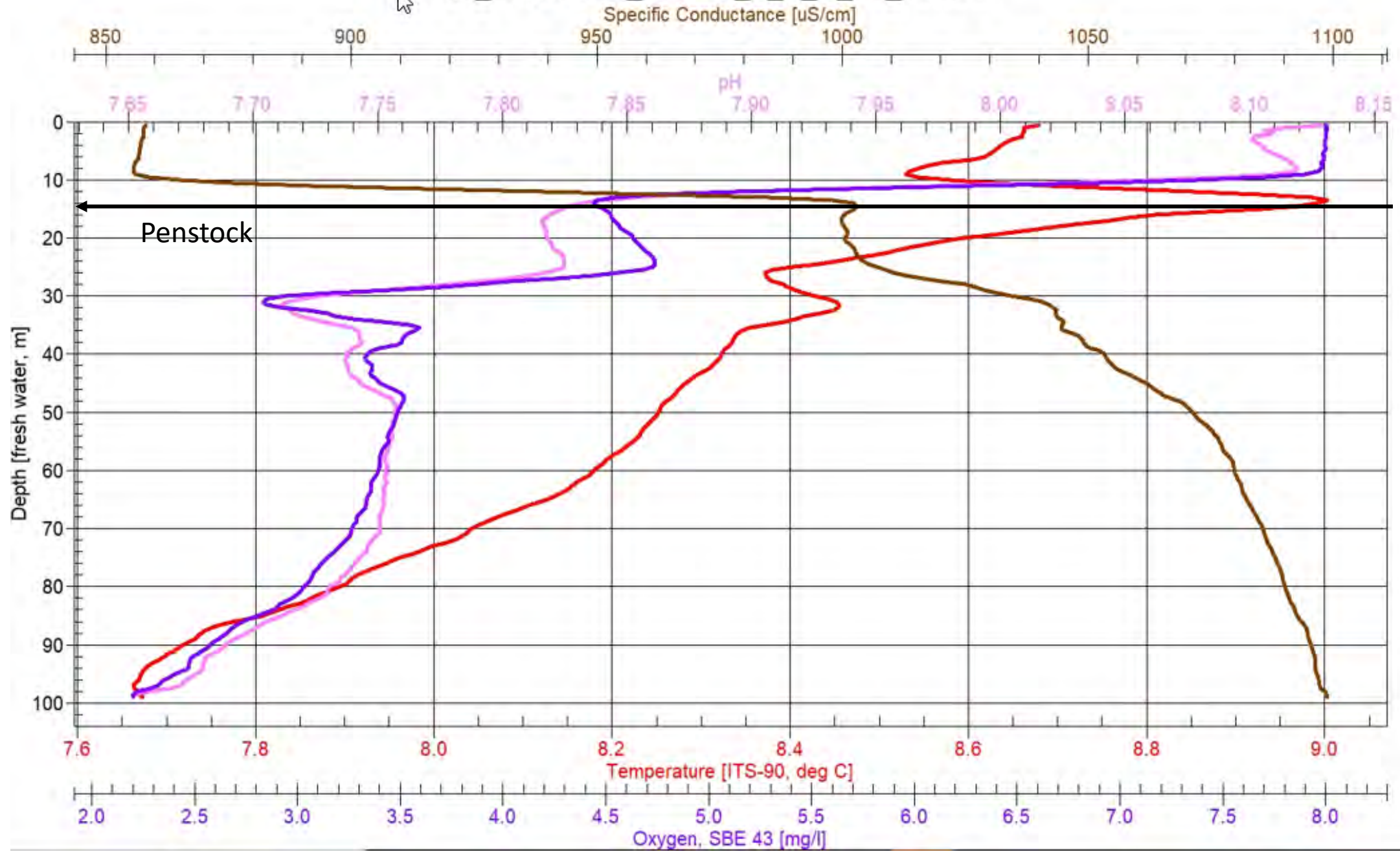
# Colorado River, Grand Canyon Water Temperatures

Projections based on January 2023, Most Probable Hydrology



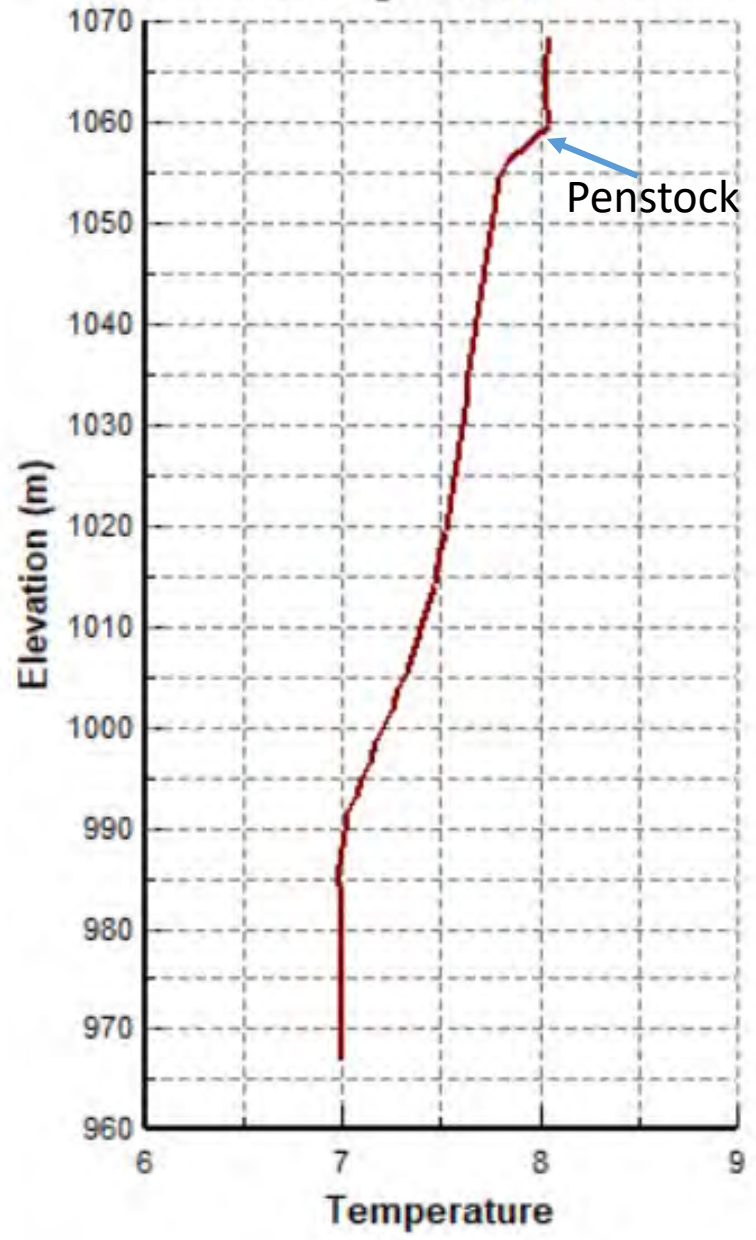


95\_LPCR0024\_230118\_F\_A\_D\_LE\_bin.cnv





Segment: 49

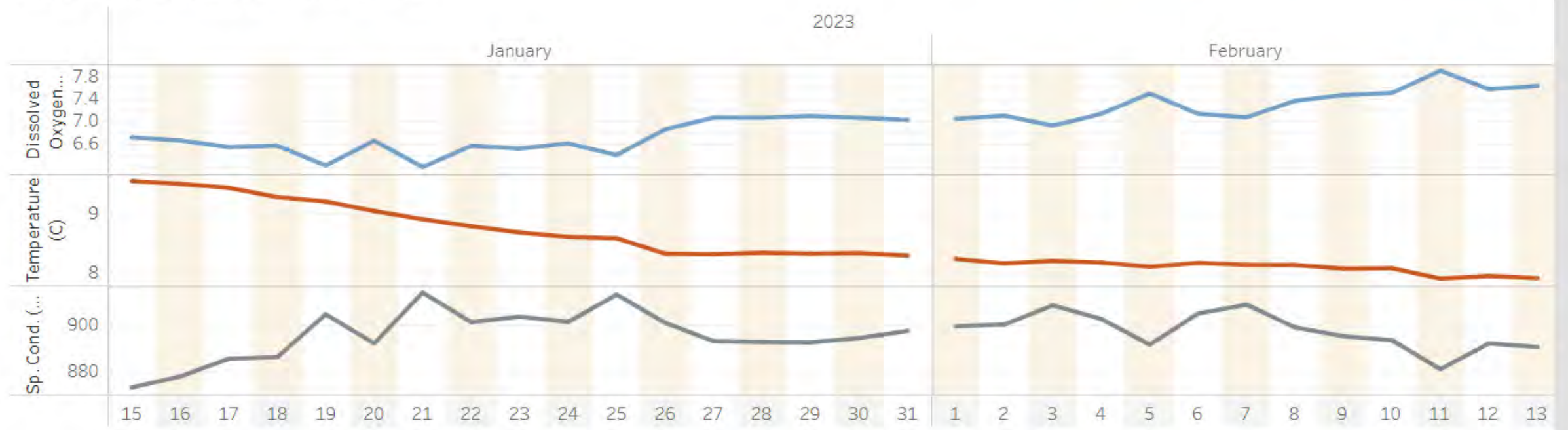


# Daily Water Quality Data at Glen Canyon Dam

[Download PDF](#)



Daily Dissolved Oxygen & Temperature Values

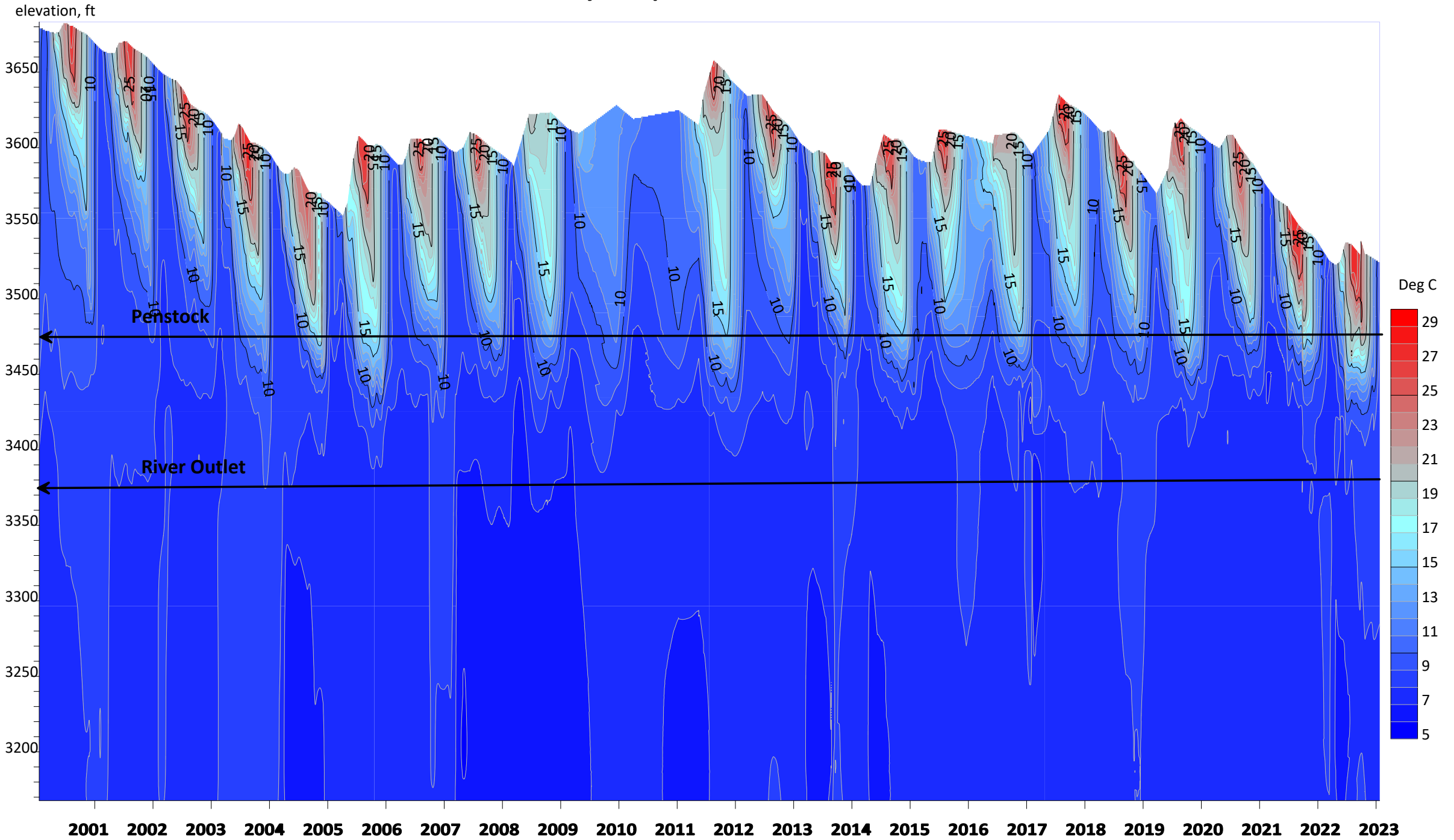


The trends of daily average Dissolved Oxygen, Temperature and Specific Conductance shown for the past 30 days.

Select Dat...

These data are preliminary or provisional and are subject to revision. They are being provided to meet the need for timely best science. The data have not received final approval by the U.S. Geological Survey (USGS) and are provided on the condition that neither the USGS nor the U.S. Government shall be held liable for any errors or omissions in this data.

# Lake Powell Forebay Temperature Jan 19, 2000 - Jan 18, 2023









# Questions?



— BUREAU OF —  
RECLAMATION