

Colorado River Hydropower

Status and Trends

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WECC Joint Technical Committees

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Glen Canyon Dam

Capacity: 1,320 MW
Generation: 5,000 GWh



Flaming Gorge Dam

Capacity: 152 MW
Generation: 781 GWh



Aspinall Dams

Capacity: 280 MW
Generation: 1,269 GWh

Blue Mesa



Morrow Point



Chrystal



Hoover Dam & Powerplant

Capacity: 2,074 MW

Average electrical production: 4,500 GWhs

Electrical service provided to: nearly 8 million people in Arizona, California, Nevada



Parker & Davis Dams

PARKER DAM

Capacity: 120 MW

Average electrical production: 457 GWhs

Electrical service provided to: $\frac{1}{2}$ of the electricity produced is used to pump water along the Colorado River Aqueduct. The rest; CA, AZ, NV

DAVIS DAM

Capacity: 251 MW

Average electrical production: 1,148 GWhs

Electrical service provided to: CA, AZ, NV



In the Colorado River; Water Equals Power

- The highs and lows of electrical power production follow paths of water
- Reclamation & the States are now engaged in extraordinary actions to maintain reservoir storage—in doing so, they are saving power production.
- So ... in this presentation, I will talk about both Colorado River power and water



MEGA-Drought

2000–2022

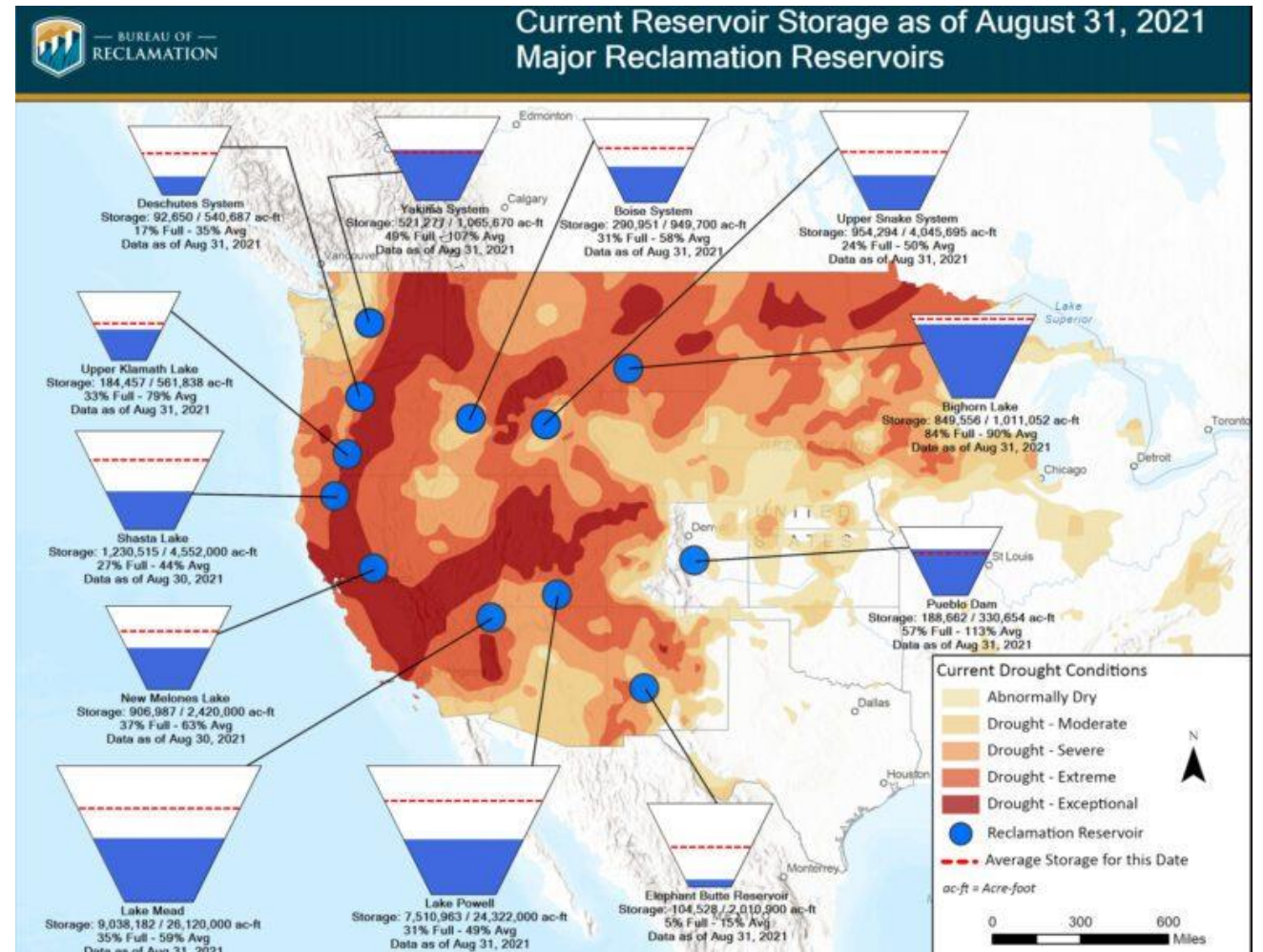
Impact on Colorado River hydropower



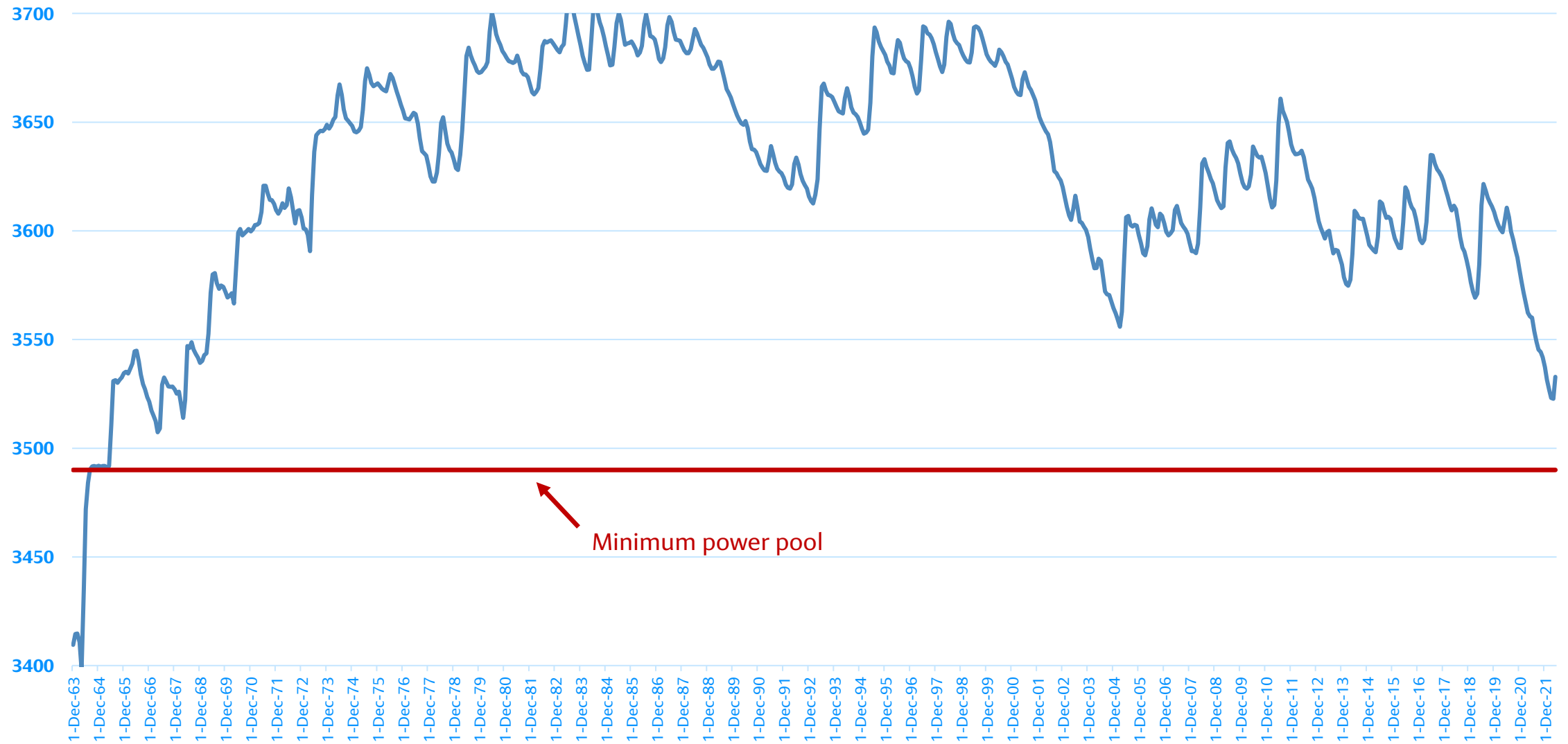
Drought is Affecting the Entire West

Reservoirs from the Missouri River to the Pacific Coast have lost considerable water storage

- Hydropower production has been significantly reduced



Lake Powell Elevation 1963 - 2022



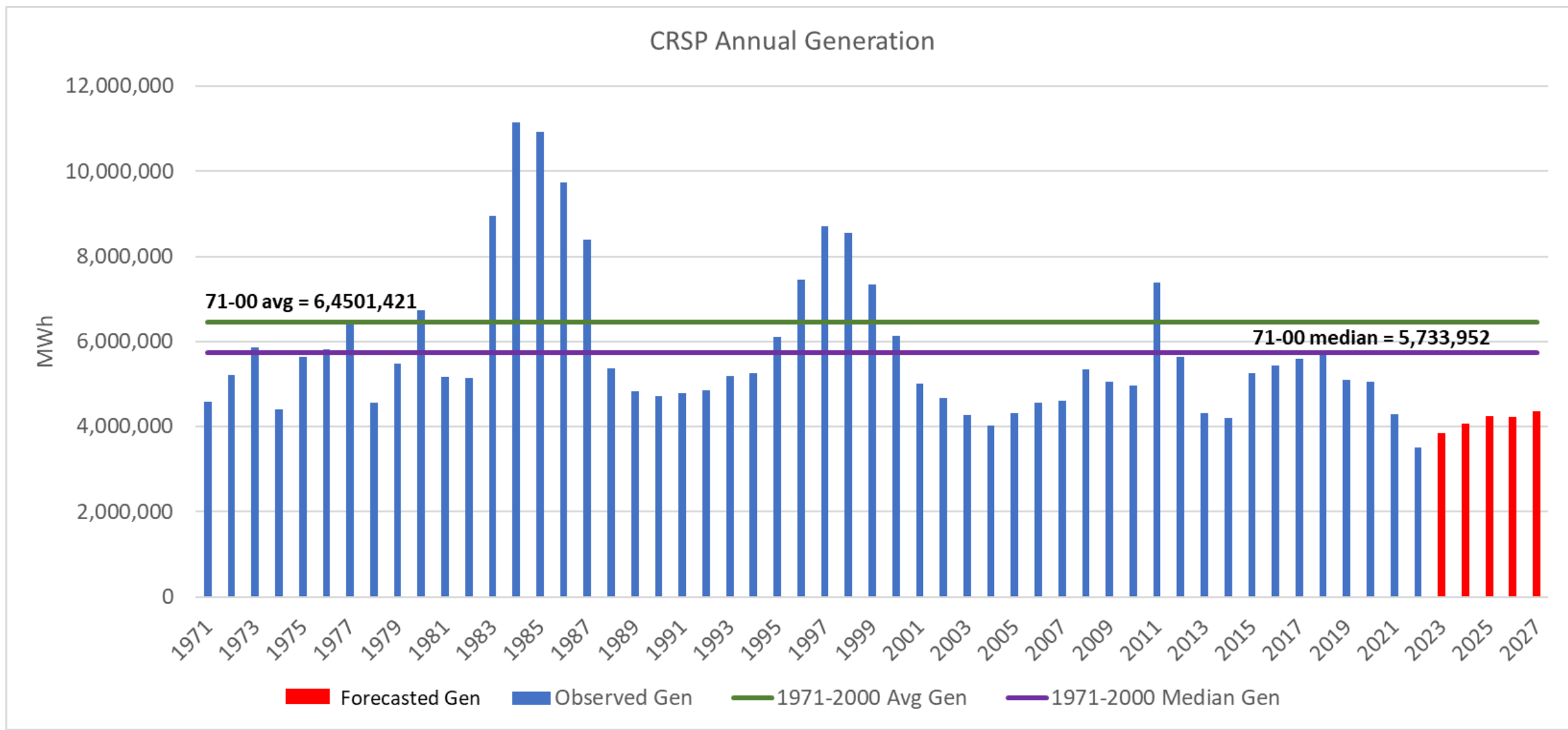
Changes in Hydropower Head Affects the Efficiency of Electrical Production

Hydropower head = elevation of Lake Powell – elevation of GCD tailrace

- Example:
- At full pool, it takes 1.9 acre feet to produce 1 MWh
- At elevation 3,522.16 (Jan 23), it takes 2.75 acre feet to produce 1 MWh



CRSP Annual Generation



Glen Canyon Electrical Production

Year	Release Volume (maf)	Electrical Production (GWhs)
2022	7.0	3,443
2021	8.23	4,258
1992-2022 Average	9.11	5,400

Power production in 2022 was 19% less than 2021 and 36% less than the 30-year average



CRSP Hydropower Drought Analysis

- From WY 2000–2022 the cumulative reduction in total generation compared to the pre-drought period is 32,624 GWh
- \$1.5 B in economic value
- GCD 19% capacity reduction
- The CRSP rate is almost 50% higher



What is WAPA Doing?

WAPA's Colorado River Storage
Project Office has had to reduce
energy deliveries



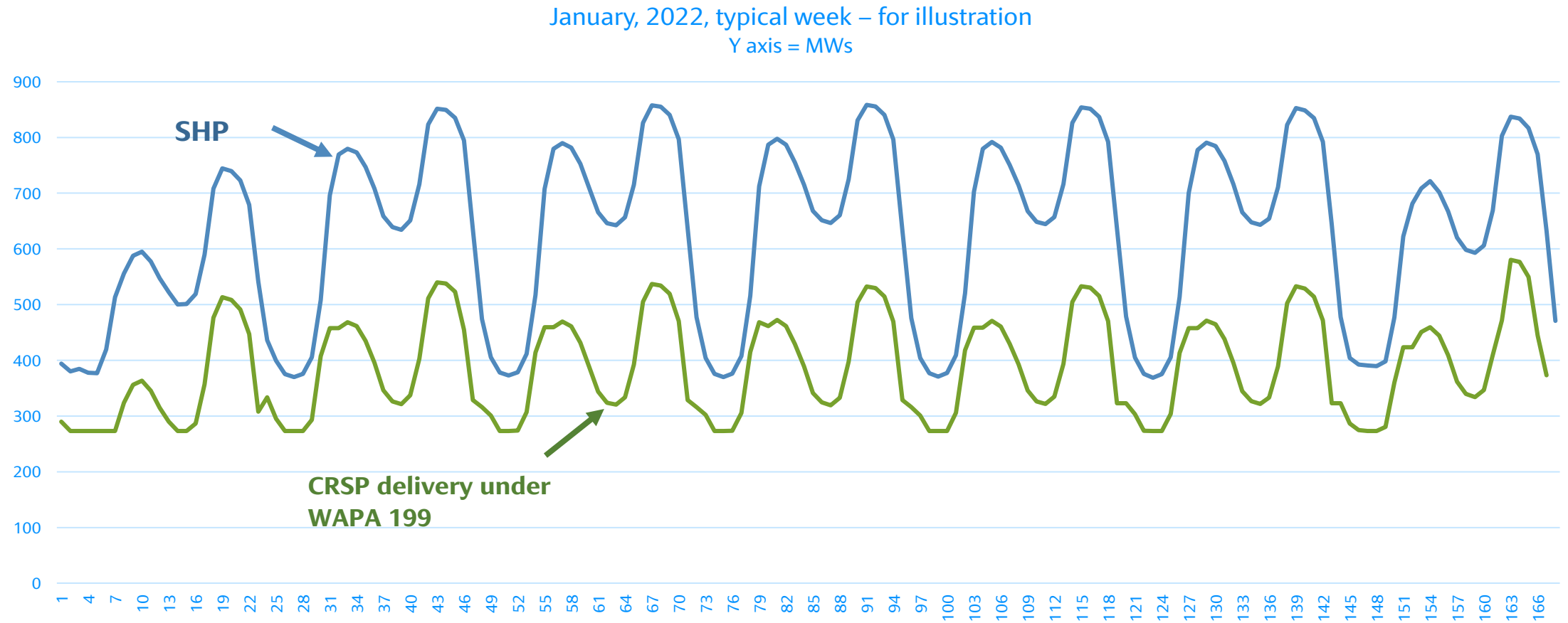
WAPA-199: Description & Consequences

- WAPA-199 is a new SLCA/IP rate - implemented December 2021
- Customers are charged a SLCA/IP rate for the electric power that is actual generation. Firming energy purchases, beyond what is actually generated, are charged to customers at the end of the month
- Customers can avoid these charges by taking only their share of what is generated
- SLCA/IP customers must either generate more of their own power or buy more power on the market
- Customers are now MUCH more interested in more water release from the CRSP units in peak electrical months
- Customers are lobbying Congress for relief



WAPA-199

Comparison of SHP versus WAPA-199 Energy



Aridification – Not Drought

- Snowpack does not translate to runoff
- Because:
 - Higher Temperatures
 - Drying Soil
 - Thirsty Atmosphere
- Moving storm tracks
- Shorter Winter/Longer Fall

Water Year	Snowpack: % of Average	Runoff: % of Average
2021	88	33
2022	100	63

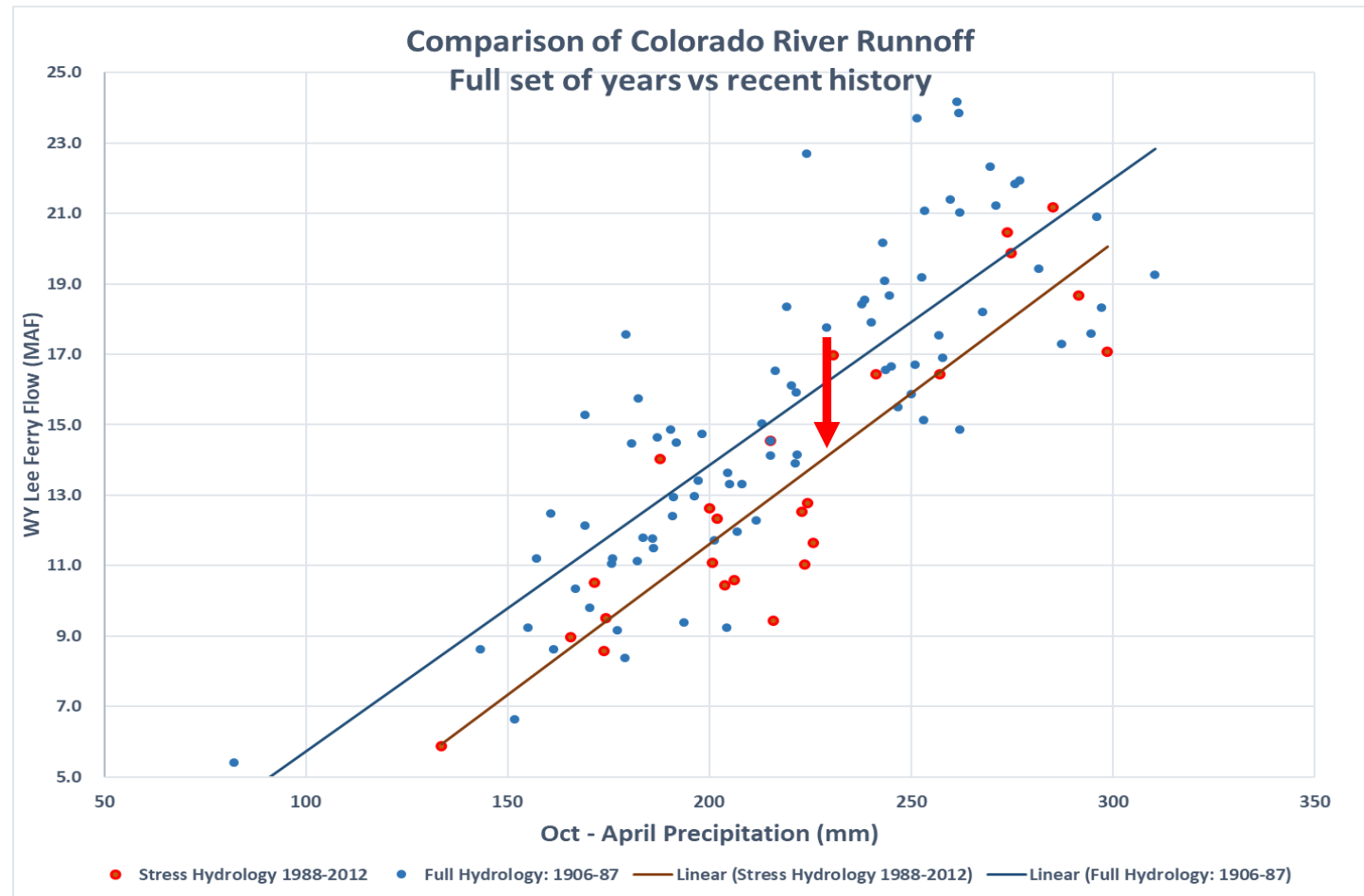


How much of the snow becomes water in the reservoirs?

Measuring the “efficiency” of the runoff

- Upper Colorado River Basin: precipitation vs runoff
- X-axis is precipitation
- Y-axis is runoff at Lees Ferry
- Each dot measures one year
 - Blue dots: 1906 – 1987
 - Red dots: 1987 - 2012

Since 1988; for every mm of water that falls as snow, less water gets into the reservoirs



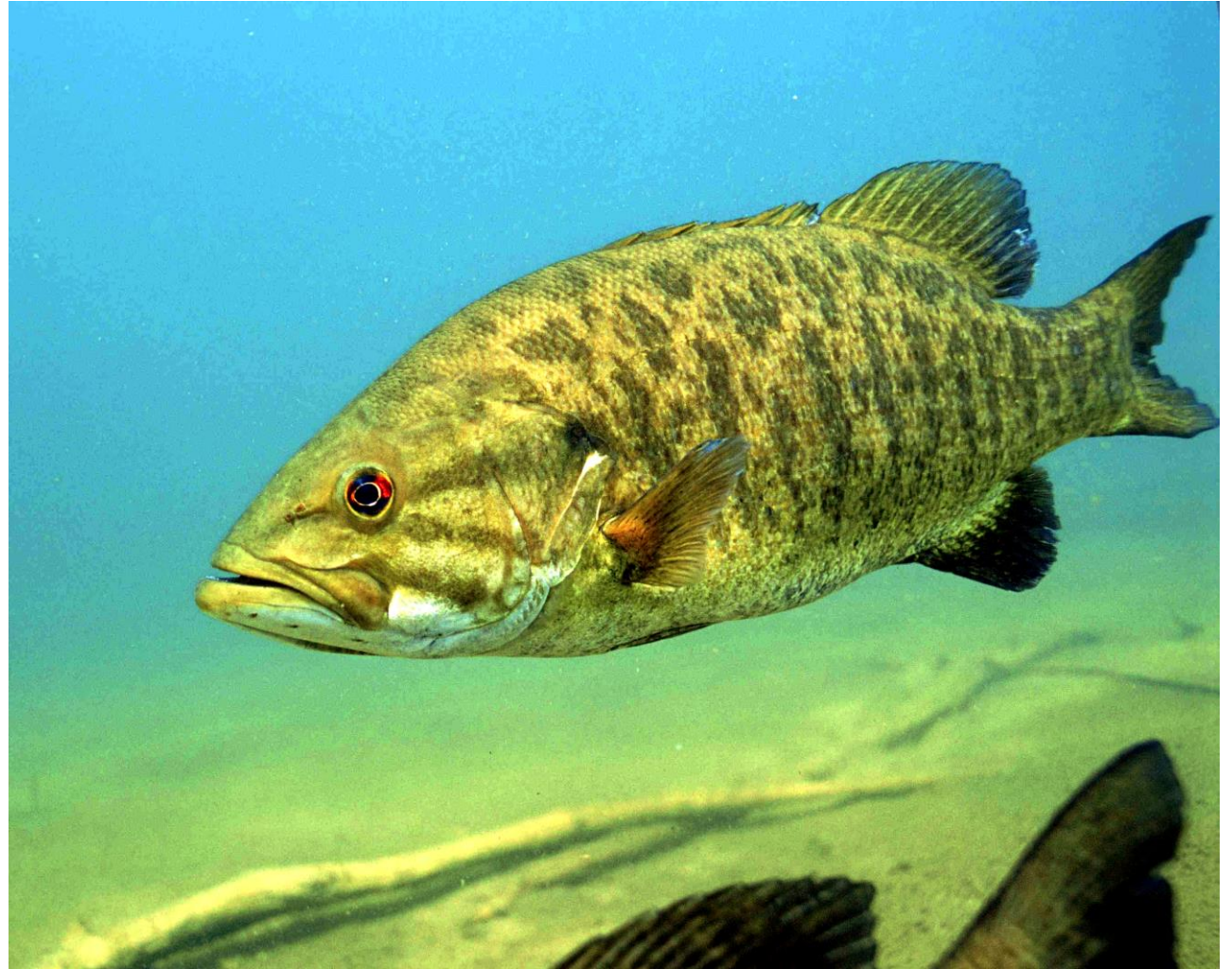
The drought is largely caused by an increase in temperature

- The Colorado River Basin has increased in average temperature by 2 degrees F
- Higher average temperatures cause snowmelt to be absorbed in the soils, greater evaporation and higher water absorption by plants
- Unusually dry soils are absorbing a lot of the water that melts from the snowpack
- In WY2021, 19% of the reduction from average runoff was caused by temperature alone



Glen Canyon Dam flow experiment: Smallmouth bass

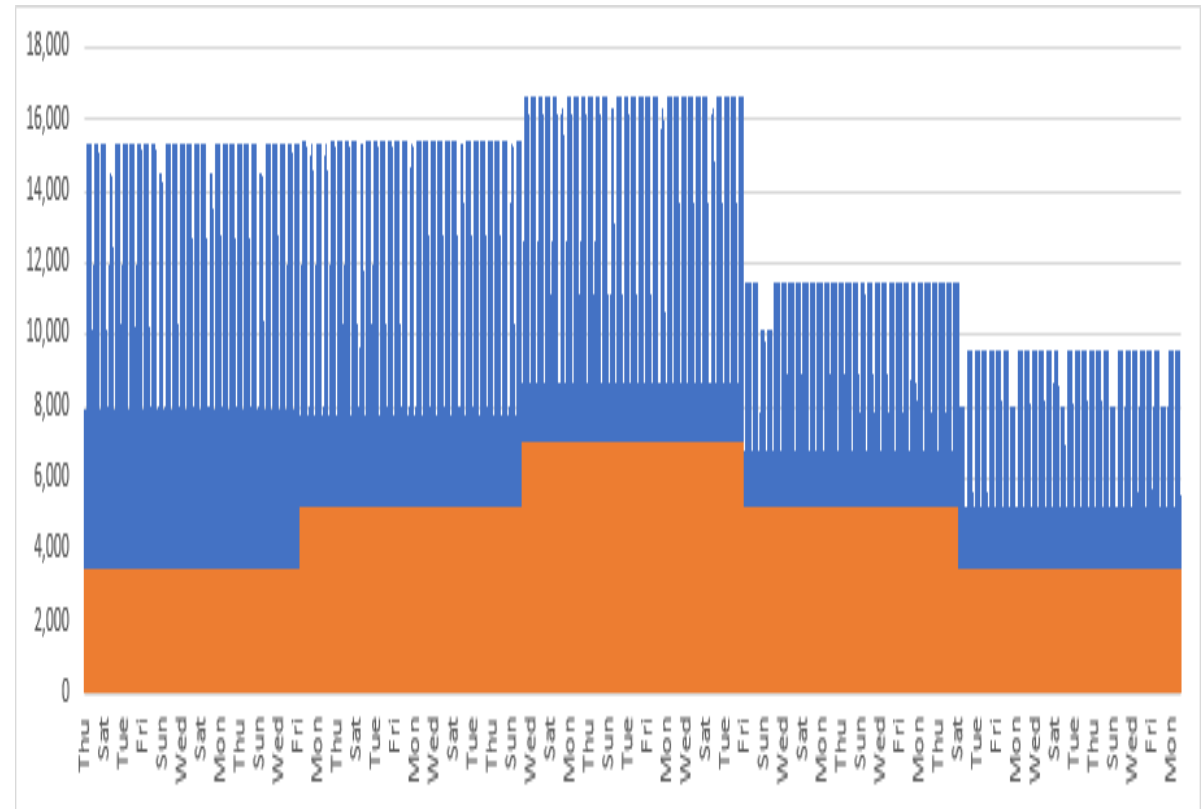
The goal is to prevent
this invasive species
from getting a
“foothold” in the
Grand Canyon



Flow Option A

Reductions in GCD Power Production & Firming Expense

- Releases 65% of GCD water through the bypass tubes – rather than penstocks
- This is done in order to release colder water



Smallmouth Bass Experiments

Electrical Power Impacts (continued)

Research Questions (analysis is in progress)

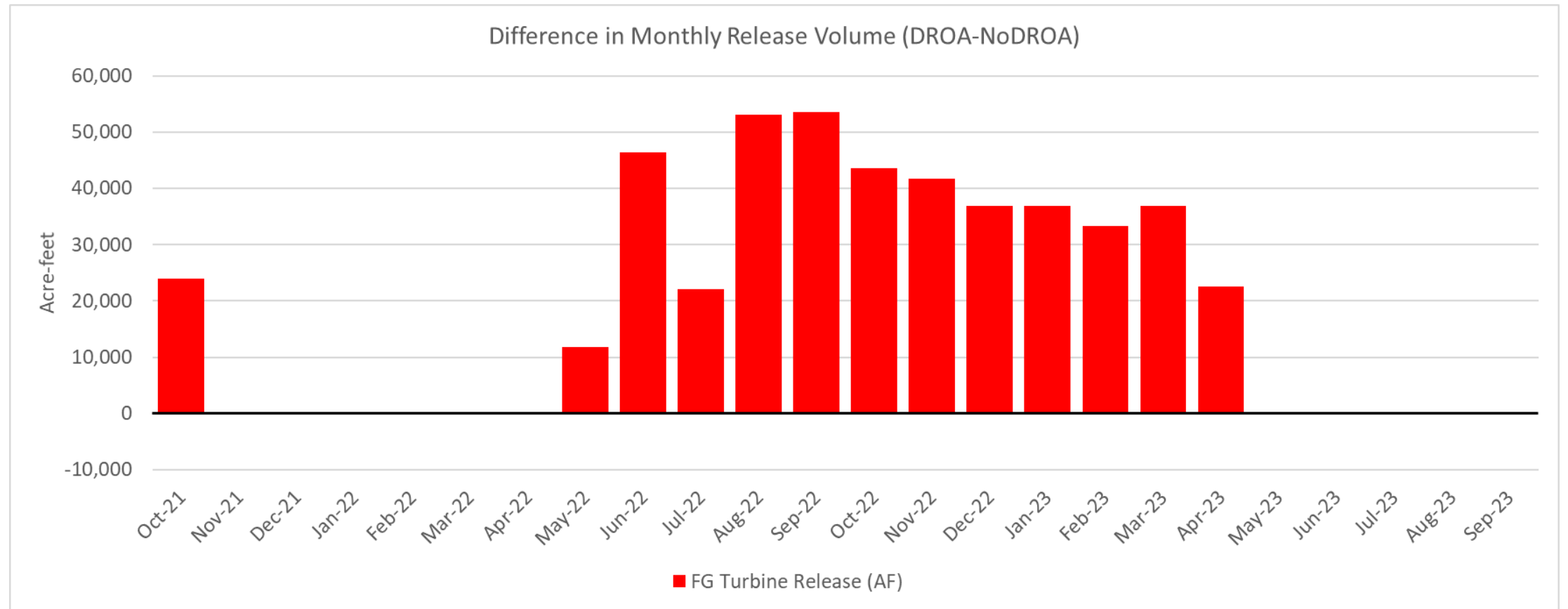
- Is replacement energy available?
- Since the CRSP transmission grid was built to distribute GCD power to federal points of delivery, if replacement energy is available, can it be transmitted from new generation sites to retail load?
- Will reductions in GCD power production decrease the reliability or stability of the electrical system?
- How will flow options impact exchange prices?
- How much will firming expenses be and how will these expenses impact the CRSP Basin Fund?

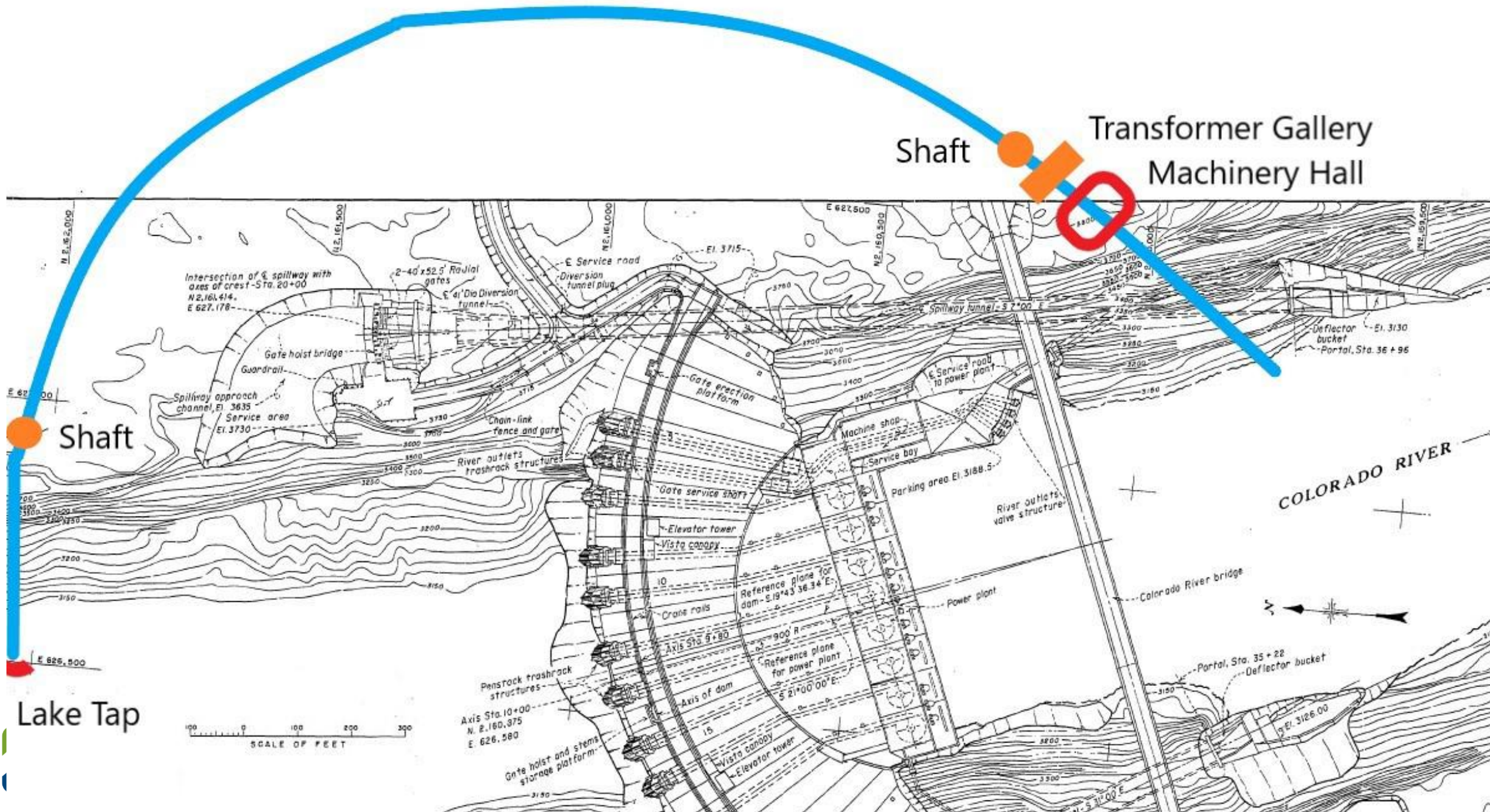


Saving the Colorado!



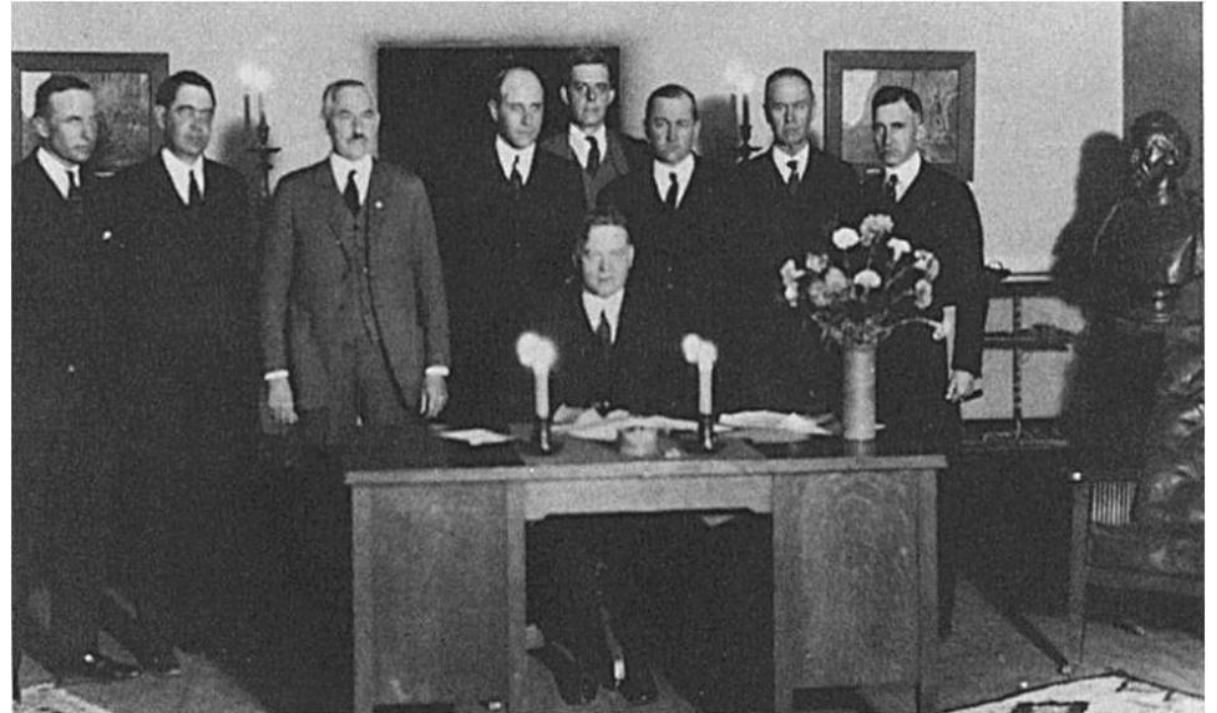
DROA: Higher Flaming Gorge Releases





Reconsidering How Powell & Mead are Operated: revising the 2007 Interim Guidelines

- In 1922, the Colorado River Basin States divided the waters
- Lake Powell purpose is to store water so the UB states can make obligated deliveries to the LB states. Lake Mead's purpose is to store water for use by the LB states
- The 2007 IG describes how the two reservoirs will be managed
- Combined, the states use 15 maf. The Colorado River NOW has an average flow of (approx) 12.5 maf

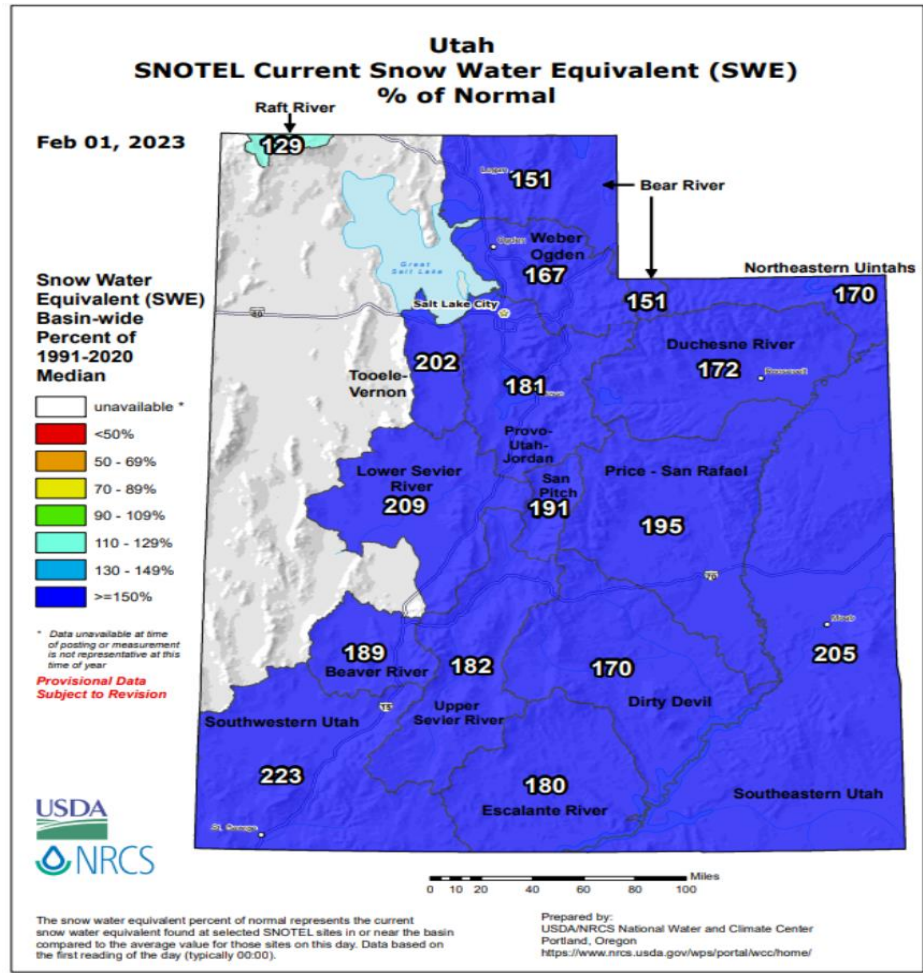


2007 IG Supplemental EIS

- Covers WY 2024 – 2026
- 3 Alternative actions have been prepared
 - Federal alternative
 - Six-states alternative
 - California alternative
- Six-states alternative
 - targets 3,500' as minimum value at Lake Powell
 - targets 1,000' at Mead
 - Attempts to keep these reservoir levels by water delivery shortages in the LB



WY 2023

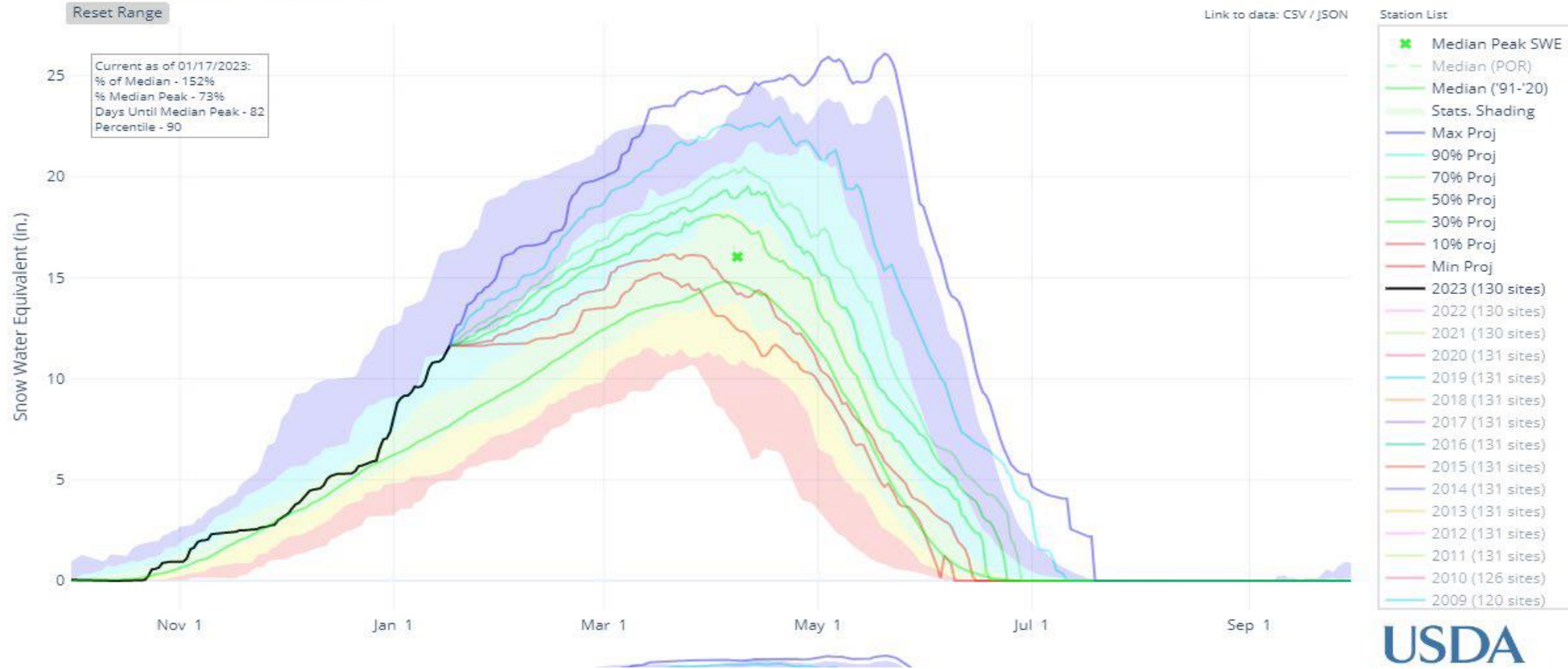


Reservoir	Inflow (kaf)	% of Average
Fontenelle	700	95
Flaming Gorge	950	98
Blue Mesa	605	95
Navajo	570	91
Powell	6,700	105



WY 2023

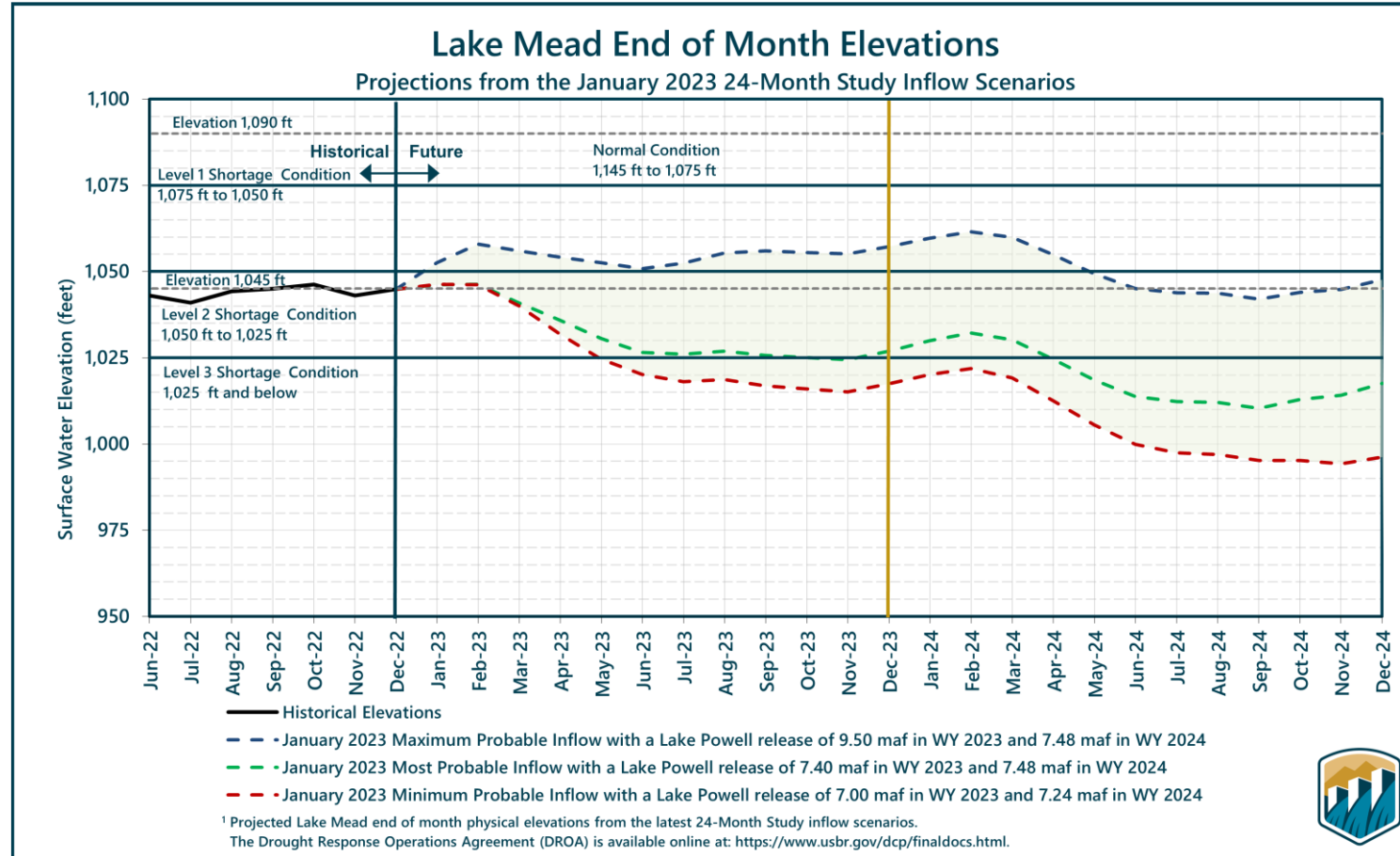
SNOW WATER EQUIVALENT PROJECTIONS IN UPPER COLORADO REGION



USDA



Water Year 2023: Hoover/Lake Mead



Questions?



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