



Engineering & Operations Committee

# Reservoir Management Update

Item 6b

August 15, 2022

# Large Regional Source Water Reservoirs

Metropolitan  
Reservoirs

Dept. Water  
Resources

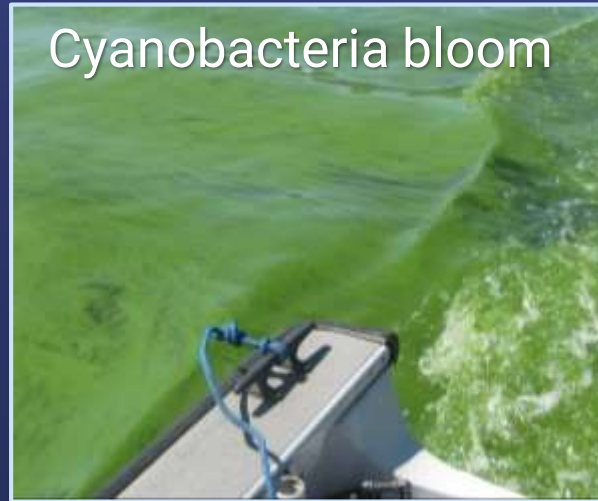
Bureau of  
Reclamation



# Reservoir Challenges

Water quality issues  
can reduce operational  
flexibility

Cyanobacteria bloom



Mussel infestation



## Water Quality Issues

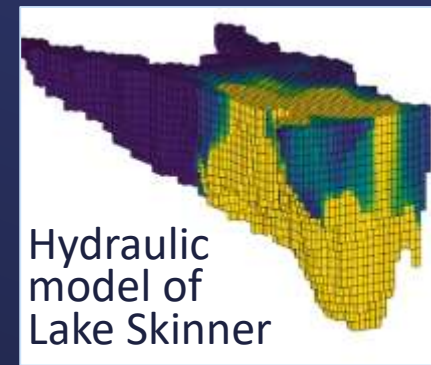
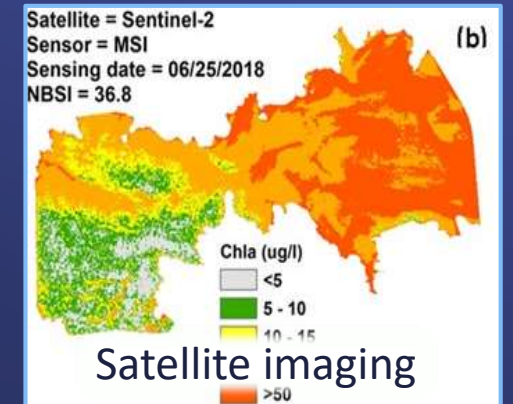
- **Cyanobacteria** “blooms”
  - Taste & odor (T&O) production
  - Toxin production
- **Anoxia** (low dissolved oxygen)
  - Elevated manganese
  - Hydrogen sulfide production
- **Invasive quagga mussels**
  - Restricts delivery options for infested CRW



# Reservoir Monitoring Tools

## Above the Lake, In the Lake, and In the Lab

- Satellite monitoring of lake conditions
- Remote water quality sensors/probes
- Sampling and laboratory analyses
- Remotely operated vehicles (ROV)
- SCUBA diving
- Water quality models



# Reservoir Management Toolbox

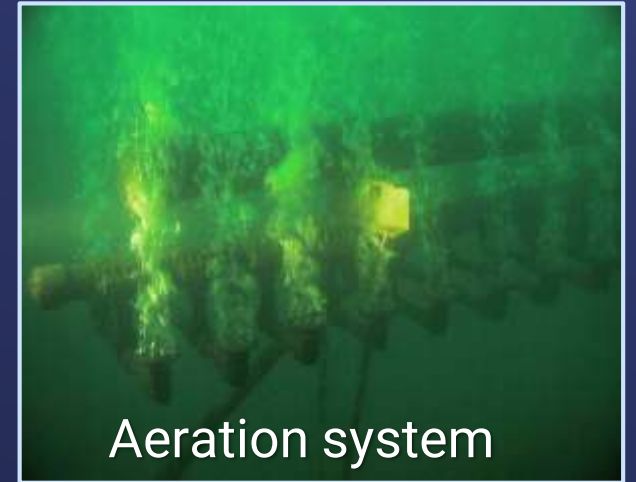
Managing lakes to  
ensure continued  
reliable water supply

## Lake Management Actions

- Cyanobacteria “blooms”
  - Tier change to **avoid** problem
  - Ozone at plants to **reduce** problem
  - Copper sulfate to **eliminate** problem
- Low dissolved oxygen (anoxia)
  - Aeration to **mix** water column
  - Deep water **oxygenation** (future)
- Quagga mussels (CRW)
  - **Control** through chlorination, cleaning, and controlled discharges



Copper sulfate treatment  
of cyanobacteria bloom



Aeration system

# Historic Drought Operations

## Water supply challenges:

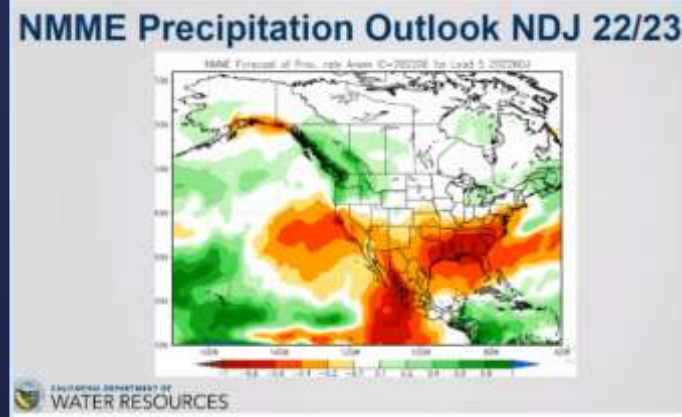
- Constrain operations
- Require operational flexibility
- Impact water quality

## California Precipitation (Water Year)

Period	Rainfall (inches)	Rank
1-year (2022)	16.65	13 <sup>th</sup> driest
2-year (2021–22)	28.48	2 <sup>nd</sup> driest
3-year (2020–22)	44.81	Driest by 4.45 inches



Lake Oroville



## Low SWP allocation

- Third year of drought
- Record 3-year low SWP deliveries
- DVL supplying Mills Plant
- Dry conditions forecast to continue

## Increased reliance on CRA

- Moving treated CRW farther into Metropolitan's system
- Operating the system in new and innovative ways



# Diamond Valley Lake

810,000 acre-feet capacity  
Only SWP supply since 2006



## Typical water quality issues

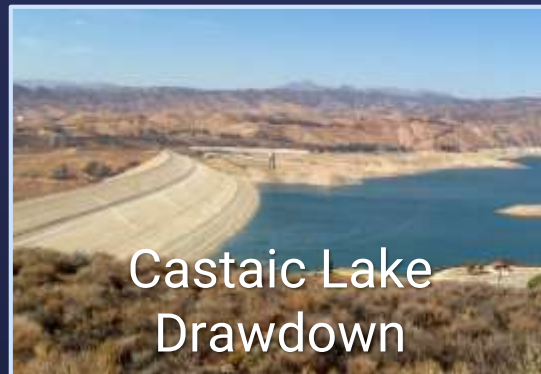
- Cyanobacteria blooms
  - T&O, cyanotoxins (e.g., 2018)
- Anoxia and manganese

## New Operation

- DVL supplying Mills Plant (2021-present)
- Over 75,000 AF delivered
- Tier changes when necessary to avoid water quality issues

# Water Quality Issues and Operations

- Cyanobacteria blooms
- Low oxygen (anoxia)
- Manganese & sulfide



- **Lake Skinner**
  - Tier changes to avoid deep-water manganese
- **Lake Mathews**
  - Outlet tower change for maintenance and cleaning
- **Silverwood Lake**
  - Supplies SWP water to member agencies on the Rialto Pipeline
  - Taste-and-odor issues
- **Castaic Lake**
  - Significant drawdown to support outlet tower seismic work



# Quagga Mussel Discoveries in the State Water Project

- A few invasive quagga mussels discovered in SWP
  - **Pyramid Lake**- December 2016
  - **Castaic Lake**- August 2021
  - No veligers (larval stages) detected in routine monitoring of SWP- no evidence of widespread infestation
  - Currently no impact on water system operations
- Control measures still in place for all CRW sources
  - Chlorination, cleaning, controlled discharges



*Photos courtesy of DWR*

# Lake Perris



## Water Quality Challenges

- Taste and odor
- Low oxygen (anoxia)

## Improving Water Quality

- Backup supply for Mills Plant when needed
- Current aeration system is inadequate
  - Does not prevent oxygen loss during summer and fall
- Engaging with DWR to design, construct and install new aeration system
  - Improve water quality
  - Increase operational flexibility



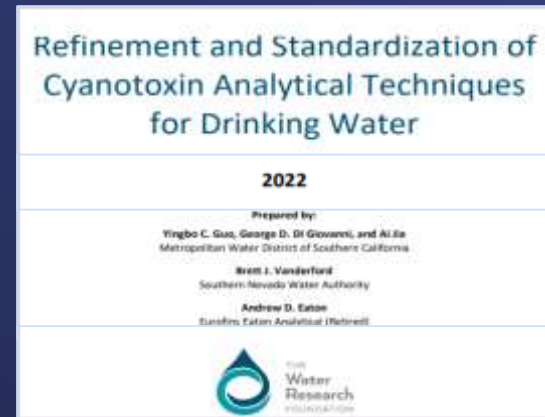
# Cyanotoxins

- Not regulated in drinking water
- EPA Health Advisories
- State recommendations for notification levels
- Voluntary guidelines for recreational waters

Recreational advisories typically do not impact drinking water

## Metropolitan's Monitoring and Research

- Year-round monitoring in source water reservoirs
- Event-specific monitoring when blooms develop
- Developing and improving detection methods





**U.S. Drought Monitor**

June 28, 2022  
(Most recent Thursday, July 28, 2022)  
Valid 6 a.m. EDT

**Drought Legend:**  
 P = Irrigated areas are exempt  
 S = Short Term, Moderate to Dry  
 M = Moderate, Moderate to Dry  
 S = Severe Drought  
 L = Long Term, Moderate to Dry  
 E = Extreme Drought

**Legend:**  
 Green: No Drought  
 Yellow: Moderate to Dry  
 Orange: Moderate to Dry  
 Red: Severe Drought  
 Dark Red: Extreme Drought  
 Blue: Irrigated Areas

U.S. Drought Monitor  
 USDA  
 NCEP  
 NOAA

droughtmonitor.unl.edu

- Recent climate volatility could continue
  - A warmer, drier climate; reduced snowpack/runoff
  - Extended droughts on the SWP and Colorado River
  - Increased extreme weather events
- Potential for increased water quality issues
  - Increased turbidity from wildfires and storm erosion
  - More frequent cyanobacteria blooms
  - Increased spread of invasive species

# At the Forefront of Reservoir Management Science

Sci Total Environ. 2021 Aug 15;782:146755. doi: 10.1016/j.scitotenv.2021.146755. Epub 2021 Mar 30.

## Evidence of a rapid phosphorus-induced regime shift in a large deep reservoir

Seyoum Yami Gebremariam<sup>1</sup>, Paul McCormick<sup>2</sup>, Paul Rochelle<sup>2</sup>

Affiliations + expand

PMID: 33839665 DOI: 10.1016/j.scitotenv.2021.146755

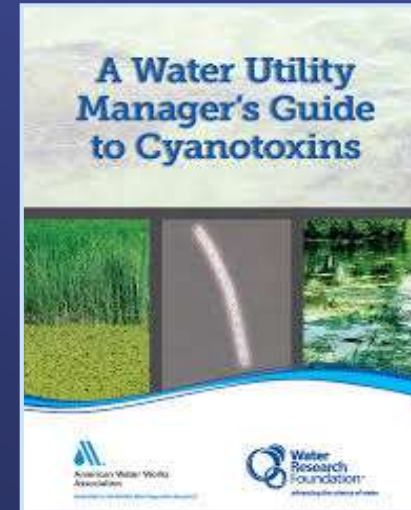
### Abstract

Ecological regime shift studies in freshwater systems are mainly limited to shallow lakes and reservoirs, while abrupt changes in deeper lakes are often attributed to climate change. Here, we demonstrate the application of regime shift theory to one of California's newest and deepest reservoirs, Diamond Valley Lake (DVL), which in recent years showed an unexpected rapid departure



## Early Warning and Management of Surface Water Taste-and-Odor Events

Subject Area  
Environmental Leadership



Peer Reviewed

Research Focus

## Analysis of Microcystins in Drinking Water by ELISA and LC/MS/MS

YINGBO C. GUO,<sup>1</sup> ANTHEA K. LEE,<sup>1</sup> RICHARD S. YATES,<sup>2</sup> SUN LIANG,<sup>1</sup> AND PAUL A. ROCHELLE<sup>1</sup>

<sup>1</sup>Metropolitan Water District of Southern California, La Verne, Calif.

<sup>2</sup>Retired, Metropolitan Water District of Southern California

California Lake Management Society. July 23, 2019

## Application of Satellite Remote Sensing for Routine Monitoring of Water Quality in Water-Utility Lakes and Reservoirs

Presenter: Seyoum Gebremariam, PhD, PE

An Assessment of the Impacts of Climate Change on the Quality of  
MWD Source Waters and Reservoirs  
Seyoum Gebremariam and Paul McCormick  
(in preparation)



## Looking into the Future



Drought conditions highlight the need for enhanced operational flexibility and require innovation in reservoir management

- Enhance monitoring of source water quality
- Improve and expand remote sensing
- Increase modeling and prediction capabilities
- Prepare for climate impacts on water quality
- Continue adapting lake operations to ensure reliable delivery and increase resiliency



