Engineering, Operations, & Technology Committee

Nitrification Management

Item 6d

January 8, 2024

Item 6d

Nitrification Management

Subject

Update on nitrification in the treated water distribution system

Purpose

Provide background information on causes of nitrification, details of the 2023 nitrification event, and actions to minimize nitrification

Next Steps

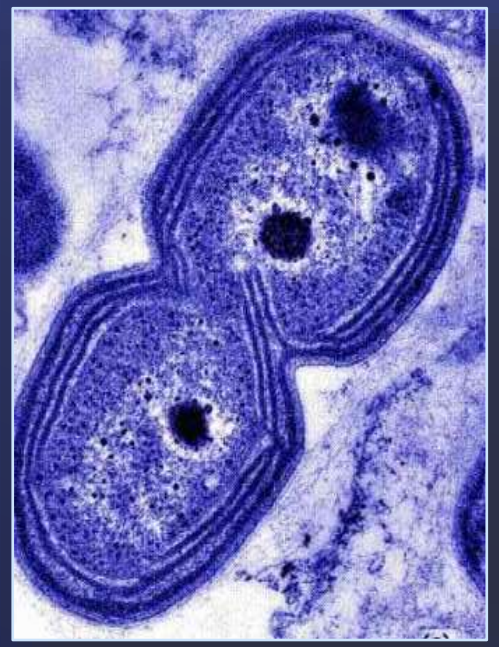
Assess actions and opportunities for improved nitrification management and control in the future

Nitrification Introduction

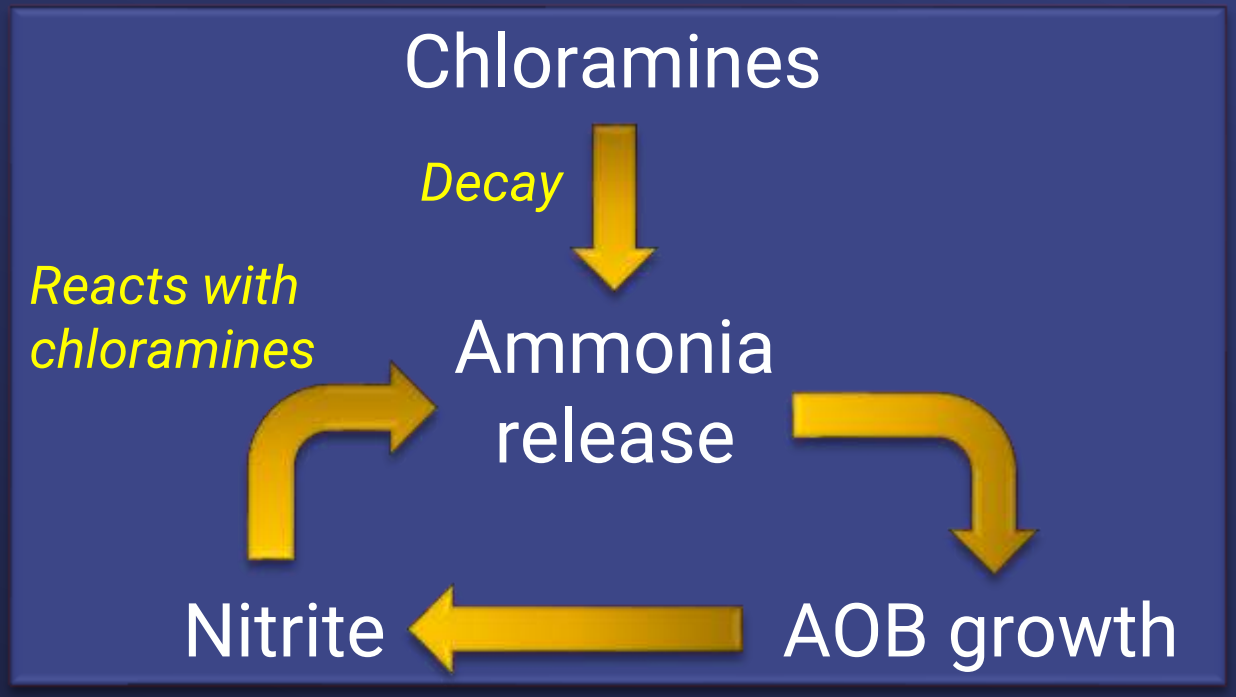
- *Naturally occurring bacteria*
- *Not contaminants, not pathogens*
- *Normally present in aquatic systems*

Background

- Nitrifying bacteria are always present in chloraminated systems
  - Sequentially convert ammonia to nitrite and nitrate
- Conditions that influence nitrification
  - Long detention times
  - Warm water
  - Excess free ammonia
  - Low or no disinfectant
  - Dead-end configurations
  - Poor circulation in reservoirs
  - Biofilm and sediment in pipes



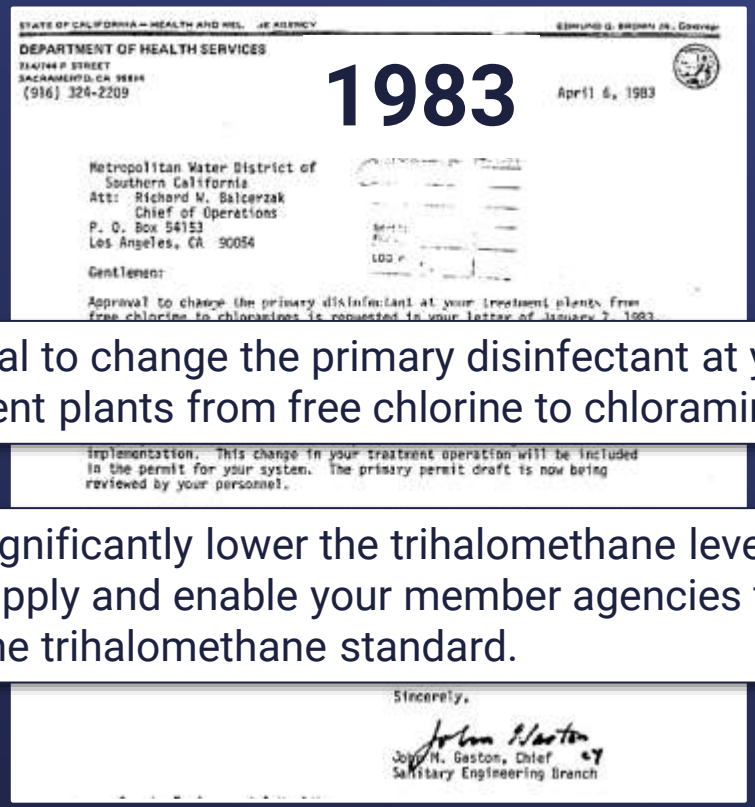
Potential Impacts of Nitrification on Water Quality



- Nitrite accumulation in the distribution system
- Chloramine decay
- Increase in bacterial growth (potentially coliforms)

AOB = Ammonia oxidizing bacteria

Introduction of Chloramines at Metropolitan



1983

DEPARTMENT OF HEALTH SERVICES
(916) 324-2209

April 6, 1983

Metropolitan Water District of
Southern California
Att: Richard N. Balcerzak
Chief of Operations
P. O. Box 54153
Los Angeles, CA 90054

Gentlemen:

Approval to change the primary disinfectant at your treatment plants from free chlorine to chloramines is requested in your letter of January 7, 1983

implementation. This change in your treatment operation will be included in the permit for your system. The primary permit draft is now being reviewed by your personnel.

Sincerely,

John M. Gaston, Chief
Sanitary Engineering Branch

Approval to change the primary disinfectant at your treatment plants from free chlorine to chloramines

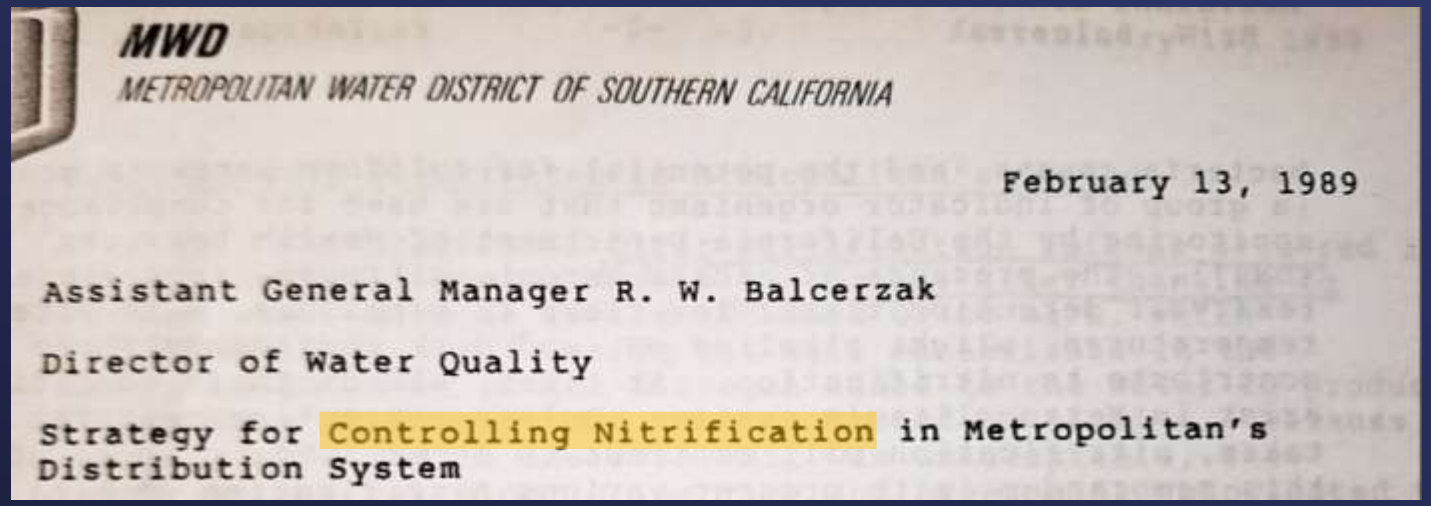
…will significantly lower the trihalomethane levels in your supply and enable your member agencies to meet the trihalomethane standard.

Metropolitan switched from free chlorine to chloramines as the primary disinfectant in June 1985

Nitrification is Not a New Phenomenon at Metropolitan

GM Report, January 1989

Nitrification. Staff will initiate a detailed investigation into the occurrence of nitrification in member agencies'/subagencies' systems. It is estimated that two to three months will be required to complete this investigation.



MWD
METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

February 13, 1989

Assistant General Manager R. W. Balcerzak

Director of Water Quality

Strategy for Controlling Nitrification in Metropolitan's Distribution System

Periodic nitrification episodes led to optimizing chloramine dosing over 13 years

	Chlorine residual	Cl_2 to NH_3 ratio
1985	1.5 mg/L	3:1
1989	1.5 mg/L	5:1
1994	1.7 mg/L	5:1
1998	2.5 mg/L	5:1

Early Research on Chloramines and Nitrification

RESEARCH ARTICLE | NOVEMBER 1988

Nitrifying Bacteria in a Chloraminated Drinking Water System

N. R. Ike; R. L. Wolfe; E. G. Means

Water Sci Technol (1988) 20 (11-12): 441-444.

Optimizing Chloramine Disinfection for the Control of Nitrification

N. I. Lieu, R. L. Wolfe, E. Means • Published 1 February 1993 • Chemistry • Journal American Water Works Association

Previous studies have shown that nitrification of chloraminated drinking water can have deleterious effects on water quality. These studies also showed that the cause of nitrification is the oxidation of ammonia (used to form

Ammonia-Oxidizing Bacteria in a Chloraminated Distribution System: Seasonal Occurrence, Distribution, and Disinfection Resistance

ROY L. WOLFE,* NANCY I. LIEU, GEORGE IZAGUIRRE, AND EDWARD G. MEANS

Metropolitan Water District of Southern California, 700 Moreno Avenue, La Verne, California 91750

Nitrification Control Strategies

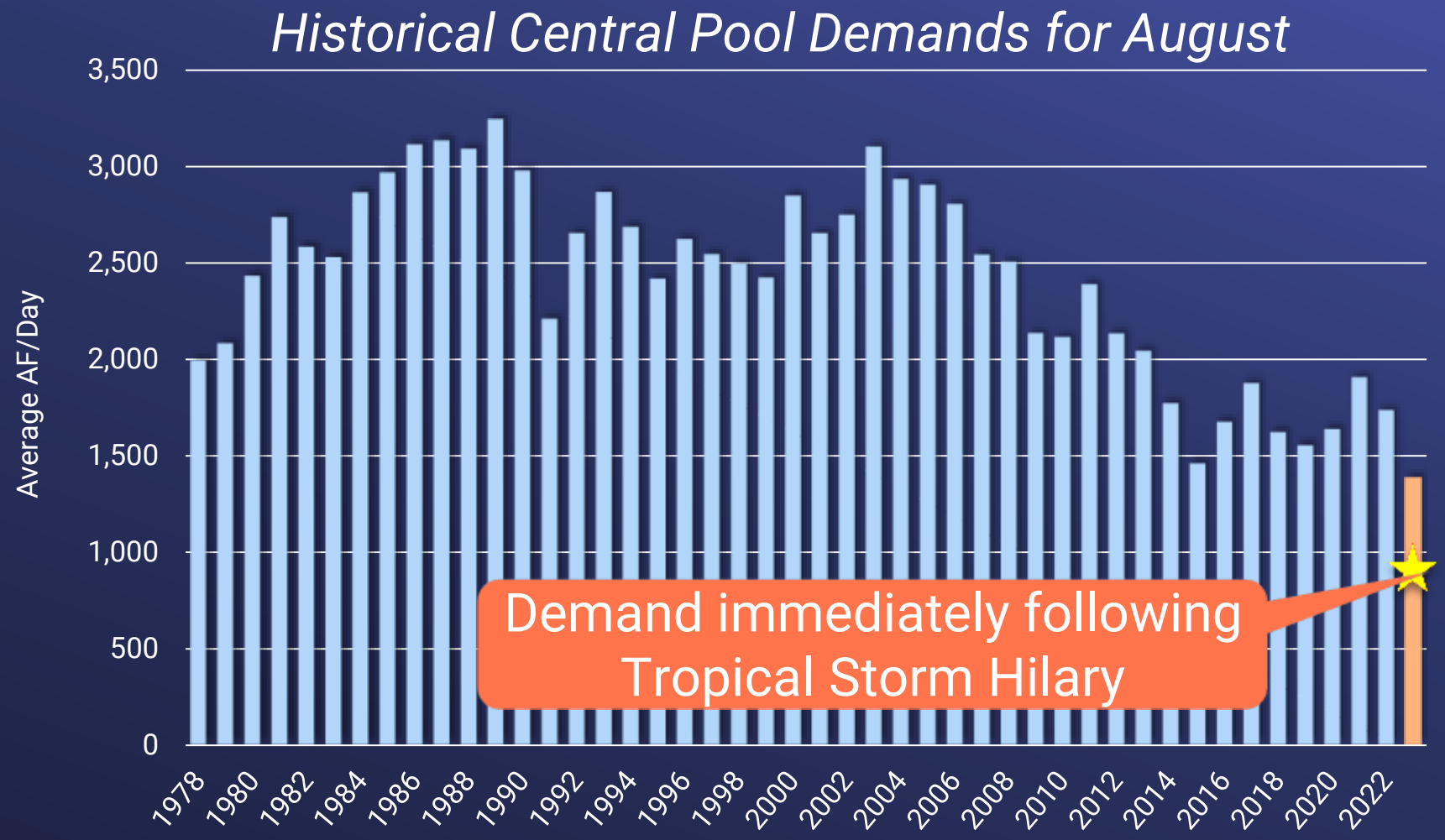
Preventing and Managing Nitrification

- Minimize free ammonia in the distribution system
- Maintain disinfectant residual throughout the distribution system
- Decrease water detention time
- Minimize stagnant or low-flowing water
- Flush impacted areas of the distribution system
- Shut down and disinfect impacted areas of distribution system
- Temporarily convert system to free chlorine

Record Low August Demands

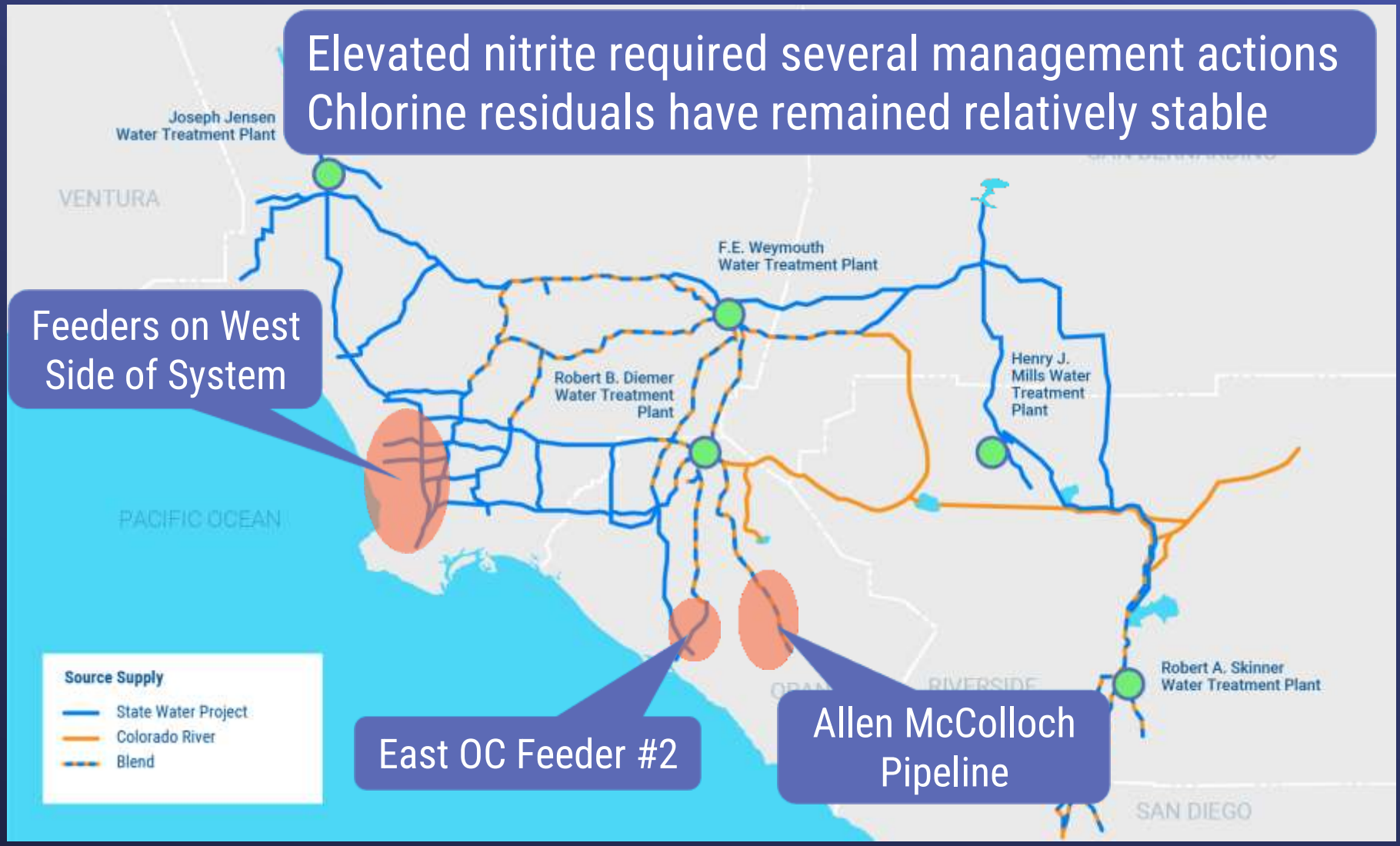
System Demand

2023 August summer demand was lower than average February winter demands prior to 2014



Affected Areas in LA and Orange Counties

Nitrification
Summer/Fall 2023



Extensive Routine Monitoring

- Plant effluent and distribution system sites
  - Chlorine, Ammonia, Nitrite

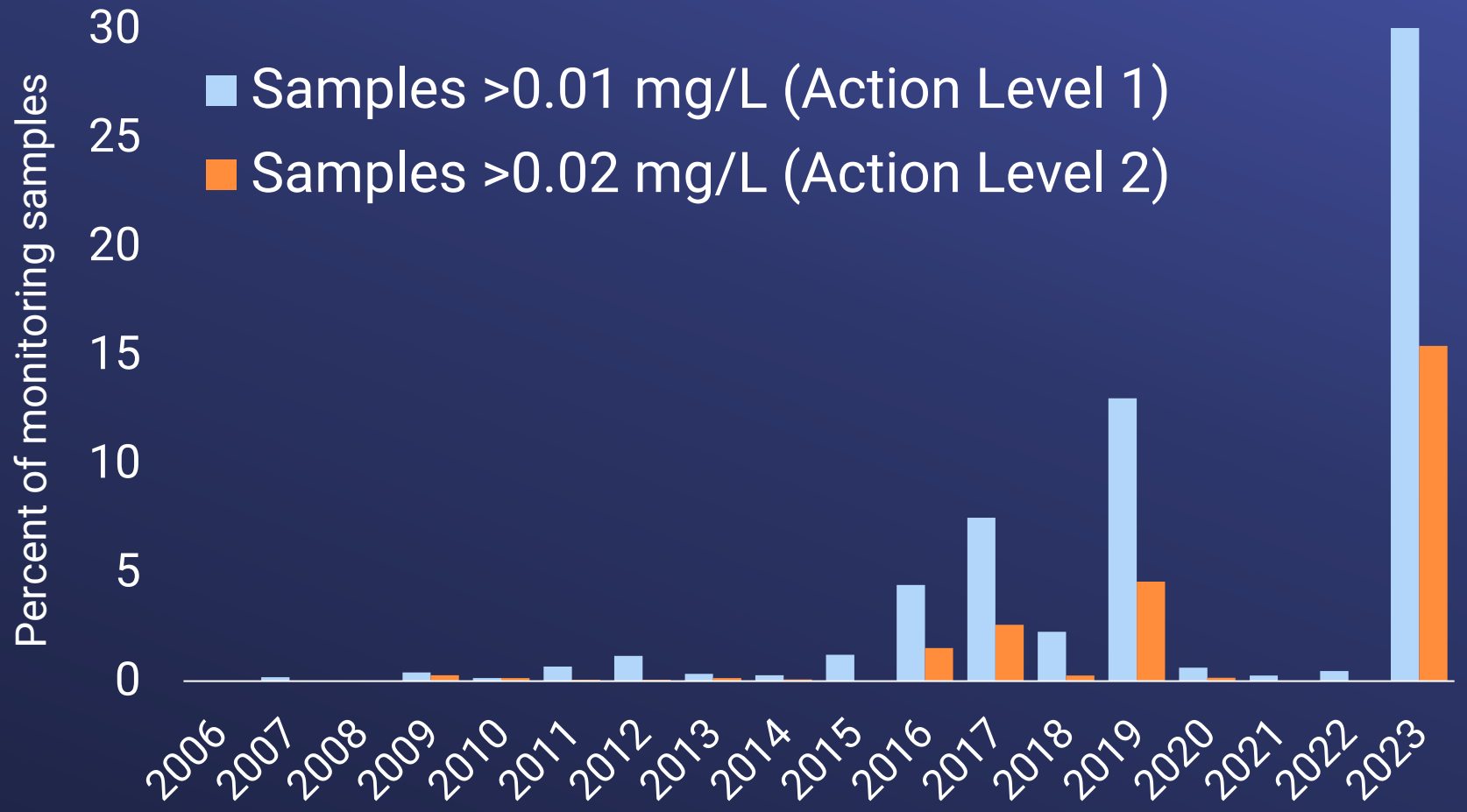
Nitrite Action Level 1*	Nitrite Action Level 2*
0.01 mg/L	0.02 mg/L

** Internal operational action levels, not regulatory limits*

- Low demand and higher temperatures during summer months led to elevated nitrite at various locations
- Tropical Storm Hilary on August 20 exacerbated nitrification event

Nitrite Monitoring

Historical Nitrification Events



Multiple Nitrification Management and Control Actions

50 sample locations
>1,700 samples

~100 staff
>21,000 hours

24 flushing locations
~14,000 AF

- Daily meetings of multiple teams to coordinate response and monitoring operations
- Operational changes to increase flow in affected areas
- Daily monitoring of water quality throughout the system
- Flushing pipelines started in late August in Orange County and west LA County

Nitrification Response

Multiple Nitrification Management and Control Actions

- Minimized free ammonia leaving treatment plants
- Increased pH at treatment plant effluents
- Reduced State Water Project blend from 80 percent to 25 percent at the Diemer plant
- Turned off ozone at Diemer Plant

THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA

Infrastructure Maintenance Activities in Your Community

ABOUT THE PROJECT

The Metropolitan Water District of Southern California is performing maintenance and flushing on one of our regional drinking water delivery pipelines in your community. This work will continue for the next few days to ensure we're providing high-quality, reliable water supplies.

SCHEDULE

Work is expected to continue through Friday, September 1.

Thank you for your patience.

PROJECT LOCATION

Work is occurring on Manhattan Beach Blvd. between Aviation Blvd and Redondo Ave.

WHAT TO EXPECT

You may notice the following:

- Water flowing on streets and localized floodin
- Metropolitan crews, vehicles, and equipment

WATER SUPPLY TO RESIDENCES AND BUSINESSES WILL NOT BE IMPACTED.

FOR MORE INFORMATION

CommunityRelations@mwdh2o.com

Rupam Soni: (213) 217-7262
Community Relations Team Manager

www.mwdh2o.com

nextdoor

Metropolitan Water District of Southern California
Community Relations Team Manager Rupam Soni • 25 Aug

Hi Neighbors,
You may have noticed flooding at the intersection of El Segundo Blvd. and Isis Ave. This is because The Metropolitan Water District of Southern California is flushing one of our large regional drinking water delivery pipes in this area. This flushing will continue for the next few days to ensure we're providing high-quality reliable water supplies. Our crews are onsite to monitor this work. Please note that water supply to residences and businesses will not be impacted as we complete this work. If you have any questions, please feel free to e-mail communityrelations@mwdh2o.com or call 213-217-7262.
Thank you for your patience!

Frequent Communications

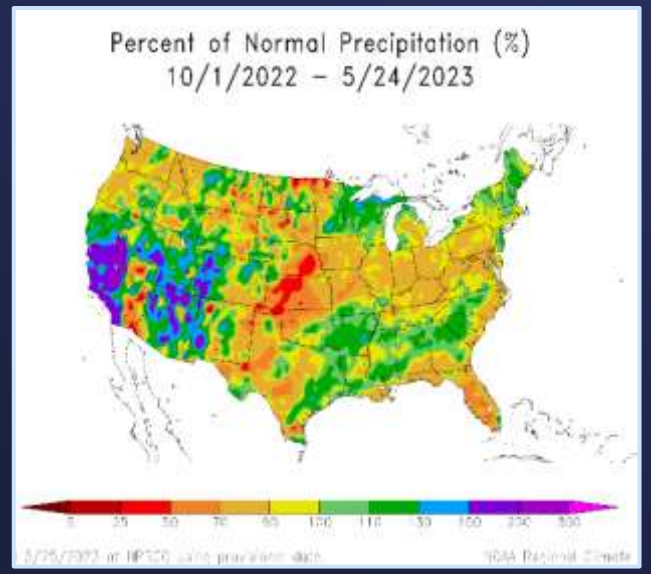
- Member Agency Managers Meeting
- General Manager update to Board
- Regular updates to affected Member Agencies
- Periodic updates to the SWRCB Division of Drinking Water
- Targeted outreach in impacted communities

Nitrification Update

January 2024

- Nitrite below action levels in majority of samples
  - Monitoring frequency reduced
- Chlorine residuals remained relatively stable throughout the event
- Pipeline flushing stopped
  - Mid-October in Orange County
  - Late November in west LA County
- SWP blend increased to 45 percent at Diemer plant (mid-December)
- Continuing to modify flow in affected areas
- Continued updates to impacted Member Agencies

Long-Term Nitrification Outlook



New Challenges May Lead to More Frequent Nitrification Events

- More frequent swings between wet and drought
  - More variable demand
  - Changes in source water quality
- Nitrification promoted by
  - Longer detention times due to lower system demand
  - Extended periods of warmer weather
- Metropolitan's facilities and pipelines designed for large volume, high flow conditions

Long-Term Nitrification Management & Control

Future Actions and Considerations

- Nitrification Taskforce
  - Develop a more proactive approach to nitrification control
  - Improved monitoring tools (e.g., online WQ monitoring, distribution system hydraulic modeling)
- Potential infrastructure improvements
  - Assess options and locations for chlorine booster stations in distribution system
  - Assess feasibility of reducing dead legs in system and opportunities for treated water recirculation
- Improved flushing operations
  - Assess opportunities for alternative uses of flushed water

Summary

Over 100 staff from 20 teams worked throughout the event to ensure reliable water supplies

- Managed 2023 nitrification event using a toolbox of actions and operational changes
- Staff working to develop long-term approaches to control and minimize nitrification
- Nitrification may become a more frequent issue when low demand coincides with warm weather
- Continued coordination with Member Agencies
  - Annual nitrification workshop in late Spring 2024


THE METROPOLITAN WATER DISTRICT OF
SOUTHERN CALIFORNIA
1928