



Engineering, Operations & Technology Committee

# Celebrating the History of Water Quality at Metropolitan

Item 6b

June 10, 2024

## Item 6b

# History of Water Quality



## Subject

The History of the Water Quality Section

## Purpose

Celebrating 50 years since the formation of Metropolitan's Water Quality and Research Branch in response to passage of the Safe Drinking Water Act in 1974

## Next Steps

Another 50 years of Water Quality excellence, compliance, and innovation

## History of Water Quality



Softening and Filtration Plant,  
1940s (Weymouth Plant)

## Water Quality Before 1974

- 6,000 yrs. ago: Water treatment first referenced in ancient Greece to control bad tastes and odors
- 1700s: Filtration started in Europe
- 1854: John Snow - cholera outbreak
- 1908: Chlorine disinfection - New Jersey
- 1914: First U.S. federal drinking water standards
- **1941: Metropolitan's Softening and Filtration Plant started operation**
- 1962: Expanded federal standards - 28 substances
- 1970: U.S. Environmental Protection Agency

# Water Quality Testing at Metropolitan, 1941 & 1942



## Fourth Annual Report, 1942

As a precautionary measure under war conditions, the water is sampled throughout the distribution system to be examined especially for poison and bacterial contamination

Table 19 shows that the water received and delivered by the District at all times was decidedly better in bacterial quality than required by the U.S. Public Health Service

60 METROPOLITAN WATER DISTRICT

Table 19  
SUMMARY OF SOFTENING PLANT OPERATION  
BACTERIOLOGICAL EXAMINATION OF COLORADO RIVER AQUEDUCT WATER  
Year Ending June 30, 1942

MONTH	NUMBER OF SAMPLES TESTED	1.0 ML. TUBES		10.0 ML. TUBES		COLIFORM GROUP COMPLETENESS TEST		COMPLETENESS TESTS IN 10 ML. TUBES	
		NUMBER PLANTED	NUMBER POSITIVE	NUMBER PLANTED	NUMBER POSITIVE	NO. POSITIVE 1.0 ML. 10.0 ML.	% OF TOTAL		
NATURAL WATER									
31	31	0	0	155	0	13	0	7	4.5
31	31	0	1	155	0	5	0	2	1.3
30	30	0	0	150	0	6	0	0	0.0
31	31	0	0	155	0	9	0	0	0.0
30	30	0	0	150	0	0	0	0	0.0
31	31	0	0	155	0	1	0	0	0.0
31	31	0	0	155	0	6	0	1	0.6
28	28	0	0	140	0	3	0	0	0.0
31	31	0	0	155	0	3	0	0	0.0
30	30	0	0	150	0	2	0	0	0.0
31	31	0	0	155	0	4	0	0	0.0
30	30	0	0	150	0	4	0	0	0.0
365	365	0	1	1825	0	56	0	10	0.9
SOFTENED WATER									
31	31	0	0	155	0	1	0	0	0.0
31	31	0	0	155	0	0	0	0	0.0
30	30	0	0	150	0	1	0	1	0.7
31	31	0	0	155	0	2	0	1	0.6
30	30	0	0	150	0	0	0	0	0.0
31	31	0	0	155	0	1	0	0	0.0
31	31	0	0	155	0	0	0	0	0.0
28	28	0	0	140	0	0	0	0	0.0
31	31	0	0	155	0	3	0	0	0.0
30	30	0	0	150	0	0	0	0	0.0
31	31	0	0	155	0	1	0	0	0.0
30	30	0	0	150	0	3	0	2	1.3
365	365	0	0	1825	0	12	0	4	0.4
DISTRIBUTION SYSTEM SAMPLES									
221	221	0	3	1105	1	55	3	52	5.0
228	228	0	1	1140	0	6	1	0	0.1
168	168	0	0	840	0	22	0	9	1.1
130	130	0	0	650	0	6	0	0	0.0
125	125	0	0	625	0	0	0	0	0.0
141	141	0	0	705	0	23	0	1	0.1
162	162	0	0	810	0	6	0	0	0.0
133	133	0	1	665	0	6	1	4	0.8
154	154	0	0	770	0	5	0	0	0.0
142	142	0	0	710	0	4	0	1	0.1
225	225	0	0	1125	0	19	0	9	0.8
202	202	0	0	1010	0	3	0	1	0.1
2031	2031	0	5	10,155	1	155	5	77	0.8

Water Analyses

No. 1 From Copper Basin Reservoir near outlet gates.  
Sampled 4-23-41 (8:40 A.M.) by Fox  
Analyzed 5-4-41 by L. Streicher  
Alkalinity: P=8 M=117

11.6 x 20 = 232 ppm total hardness  
Noncarbonate hardness = 272 - 117 = 155 ppm  
Magnesium (Calc. method) 7.95 = 7.1  
Blank = 10.4 ml. 400 mg.  
Sample = 10.5 "  
2.9 x 9.6 = 27.8 ppm, say 28 ppm Mg.  
Half bound. Calc. = 11.7 x 14 = 164 ppm

No. 14 Plant Effluent  
Sampled 6-10-41 by Pieper 8:00 A.M.  
Analyzed 6-11-41 by Pieper  
Grav. Volum.  
Ca 18 17

Total dissolved solids 196

Water quality samples No. 1 and No. 14

# Water Quality Testing at Metropolitan up to 1974

## 1950s Research

Laboratory investigations have been continued to find the most satisfactory means for conditioning the water to reduce scaling and **minimize corrosion**.

Laboratory studies using artificially introduced fission products indicate that normal District softening plant operation procedures...can effectively **remove radioactive contamination** from the treated water.

LAB. NO. 12511  
 SOURCE F. E. WEYMOUTH MEMORIAL SOFTENING AND FILTRATION PLANT  
 ANALYZED 9/2/53  
 FILTERED WATER

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LAB. NO. 12511  
 SOURCE F. E. WEYMOUTH MEMORIAL SOFTENING AND FILTRATION PLANT  
 ANALYZED 9/2/53  
 FILTERED WATER

SI Oz	8.9	CO <sub>2</sub>	1	Alk	P 1
Fe	—	HCO <sub>3</sub>	127	PH	8.3
Ca	1	SO <sub>4</sub>	288	% Na	97
Mg	2	Cl	85	Sp. Cond.	110
Na	230	NO <sub>3</sub>	0.2	Hard	12

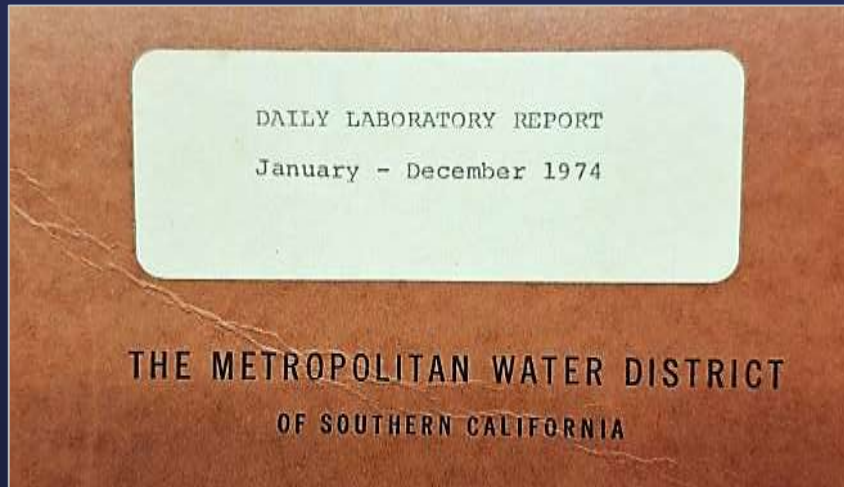
THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA  
 F. E. WEYMOUTH SOFTENING AND FILTRATION PLANT  
 DAILY LABORATORY RECORD

Shift 1	Shift 2	Shift 3	Date
2	4	6	7/6/54
118	119	117	
216	385	335	
83	31		

DISTRICT OF SOUTHERN CALIFORNIA  
 F. E. WEYMOUTH SOFTENING AND FILTRATION PLANT  
 DAILY LABORATORY RECORD

Shift 2	Shift 3	Date
A.M.		7/6/54

Shift	1	2	3	4	5	6	7	8	9	10	11	12
Turbidity, Comp.			1.2									
Turb. Basin a												
Total Alk.												
Phenol. Alk.												
Non-Carb. Hard.												
Total Hard.												
Res. Chlorine	32.30	30.27	27.27	25.27	23.22	21.17	19.21	17.13	15.21	13.17	11.24	9.28
Turbidity	0.23	0.25	0.23	0.23	0.20	0.27	0.26					
Odor			10.18									
pH			8.10									
Total Alk.												
Phenol. Alk.												
Total Hard.												
HARD - LAB.	14	26	9	14	14	16	39	46				
pH			8.25									
Total Alk.	124	123	124	123	122	122	122					
Phenol. Alk.	1	1	1	1	1	1	1					
RES. INFL. HARD	125	126	124	124	121	130	124					
RES. EFF. HARD	126	127	126	124	123	125	125					
RES. INFL. pH	8.34	8.34	8.45	8.25	8.28	8.3	8.3					
RES. INFL. RCI	12.12	12.12	12.12	12.12	12.12	12.12	12.12					
RES. EFF. RCI	11.11	11.11	11.11	11.11	11.11	11.11	11.11					
Turbidity	0.22	0.25	0.25	0.20	0.20	0.20	0.23					
Odor			10.18									
pH	8.34	8.3	8.45	8.25	8.25	8.29	8.29					



## SDWA 1974



Senator Warren Magnuson  
Washington State, 1944-1981

# The Safe Drinking Water Act

- 1973: Senator Warren Magnuson proposed the Safe Drinking Water Act

*...to address the lack of decisive federal regulations of contaminants in water supplies*

- Signed by President Ford on December 16, 1974
- Authorized EPA to establish minimum health related standards to protect tap water
  - 22 regulated contaminants - coliform bacteria, metals, organic pesticides, turbidity, and radiological contamination
- Compliance required by June 24, 1977

*...establish standards and treatment requirements for public water supplies, finance drinking water infrastructure projects, promote water system compliance...*

# The Water Quality & Research Branch, 1974

- Formed by action of Metropolitan's Board of Directors in July 1974  
*"To implement the system-wide surveillance program, a Water Quality and Research Branch was created with responsibility for coordinating water quality monitoring throughout the aqueduct and distribution system"*
- Ten staff who were previously assigned to the Water Purification Branch of the Operations Division

*Harold Pearson, WQ Engineer*

*Harold Sundberg, Sr. Res. Chemist*

*Janice Risner, Secretary*

*Bob Cohen, Research Chemist*

*Bill Mathews, Maintenance Man*

*Bob Jones, Sr. Chemist*

*Marshall Davis, Junior Chemist*

*Paul Evans, Sr. Chemist*

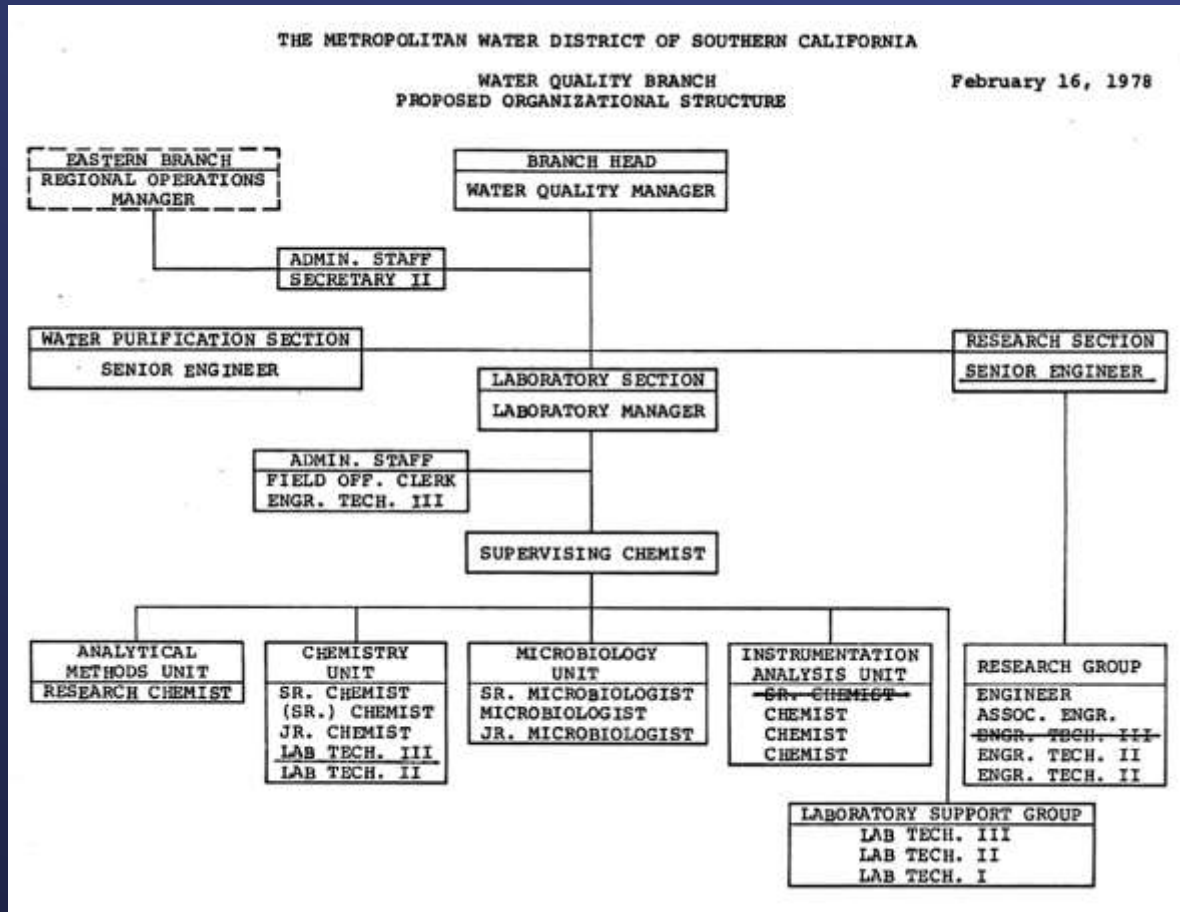
*Dan Bowers, Chemist*

*Dean Rauscher, Engineering Tech*



Constant testing  
assures water quality  
(Annual Report for 1974)

# Water Quality Branch Organizational Changes



1978 – 28 staff



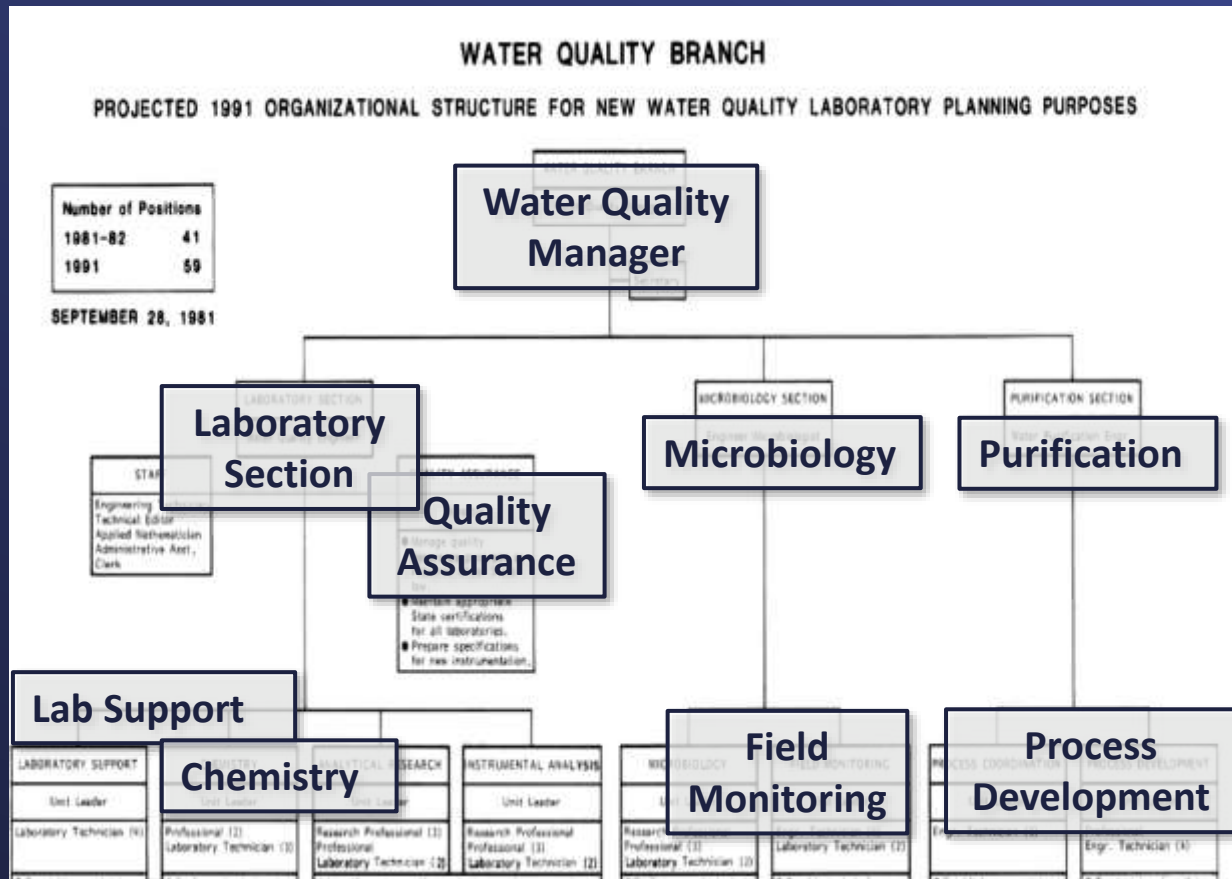
Water Quality Staff, 1976 and 1980



Water Quality Staff, 1982



# Water Quality Branch Organizational Changes



Water Quality Staff, 1983

1981 – 41 staff but projecting 59 by 1991

# Home of the Water Quality Laboratory

1974  
Water Quality &  
Research Branch  
Weymouth Bldg.  
10 staff  
22 regulated  
contaminants



1976  
Water Quality &  
Research Branch  
Materials Testing Lab  
19 staff  
22 regulated  
contaminants



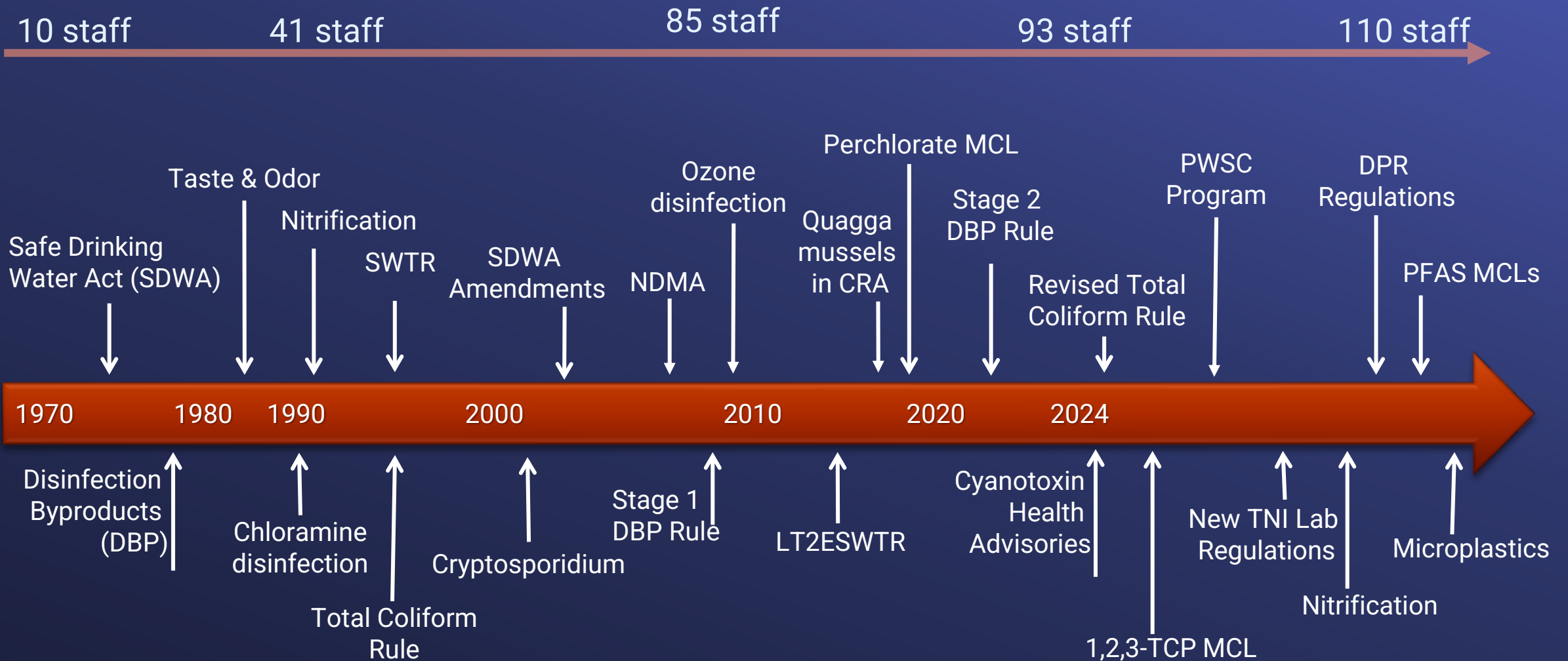
1985  
Water Quality Branch  
New Water Quality Lab  
47 staff  
23 regulated  
contaminants



1998  
Water Quality Division  
Expanded WQ Lab  
87 staff  
102 regulated  
contaminants



# Water Quality's Expanded Functions



# Home of the Water Quality Laboratory – Another 50 Years



Engineering, Operations, & Technology Committee – 2023 Water Quality Lab Inspection Trip



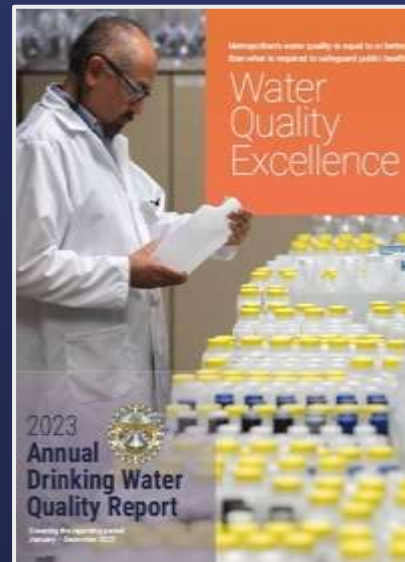
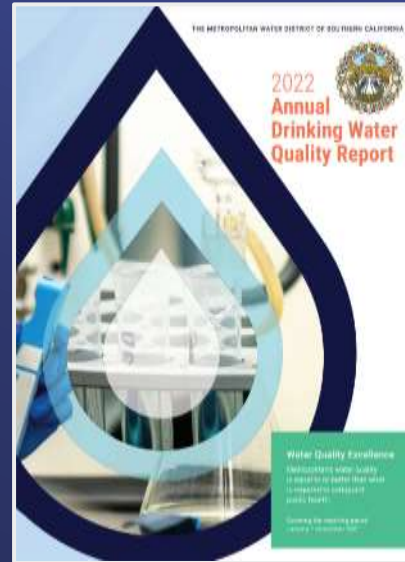
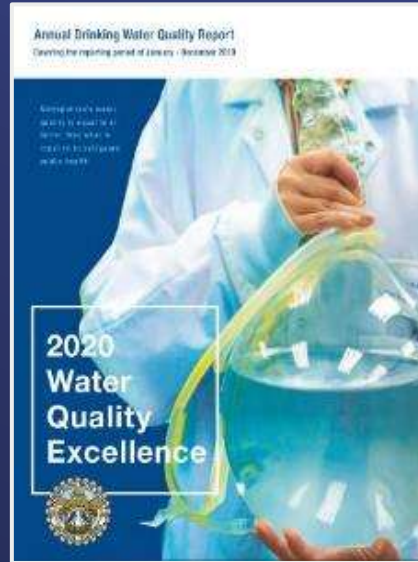
Artist Conceptual Renderings of Upgraded WQ Lab Front Entrance and Lobby

2024  
Water Quality Section  
110 staff  
122 regulated contaminants  
Lab upgrade preliminary design

# 100% Compliance With Drinking Water Regulations

## Water Quality's Mission

To safeguard the public's drinking water



- About 70,000 samples per year
- More than 400 constituents monitored
- Over 200,000 test results per year

Metropolitan's water quality meets or surpasses the standards required to safeguard public health

# Research and Innovation



DBPs  
Chloramine  
disinfection  
Taste & Odor  
Nitrification

1980s

Ozone  
disinfection  
*Cryptosporidium*

1990s

Water security  
Desalination  
Quagga  
mussels

2000s

Cyanotoxins  
Nitrosamines

2010s

PWSC  
Emerging  
contaminants

2020s

# Published Research (>400 technical publications)



Available at [www.sciencedirect.com](http://www.sciencedirect.com)  
ScienceDirect  
journal homepage: [www.elsevier.com/locate/watres](http://www.elsevier.com/locate/watres)

### Benthic cyanobacteria (Oscillatoriaceae) that produce microcystin-LR, isolated from four reservoirs in southern California

George Izaguirre<sup>a,\*</sup>, Anne-Dorothee Jungblut<sup>b</sup>, Brett A. Neilan<sup>b</sup>

<sup>a</sup>Water Quality Laboratory, 700 Miramar Avenue, Metropolitan Water District of Southern California, La Verne, CA 91750, USA  
<sup>b</sup>School of Biotechnology and Biomolecular Sciences, The University of New South Wales, Sydney, 2053 New South Wales, Australia

Peer Reviewed Expanded Summary

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

YIMBEE C. BUI, ANTHEA K. LEE, RICHARD S. YATES, SUN LIANG, AND PAUL A. ROCHELLE

<https://doi.org/10.1016/j.watres.2016.08.007>

### Impact of Combined Chlorination and Chloramination Conditions on N-Nitrosodimethylamine Formation

STUART W. KRASNER,<sup>1</sup> CHIH-FEN TSENG,<sup>1</sup> WILLIAM A. MITCHELL,<sup>2</sup> AND

On Water & Works  
STUART W. KRASNER

### Controlling Nitrosamines: A Balancing Act

Over the last few decades, drinking water utilities have more effectively optimized their treatment and distribution processes to control a variety of microconstituents to meet state and federal regulations, operational requirements, and aesthetic issues. However, the discovery of new pollutants presents challenges to the drinking water industry. An emerging class of disinfection by-products (DBPs) of health and regulatory concern are nitrosamines (e.g., N-nitrosodimethylamine [NDMA]). NDMA is preferentially formed by chloramines, where chlorination have been increasingly used to control the formation of the regulated

JournalAWWA  
Research & Technology

### Comparing PEROXONE and Ozone for Controlling Taste and Odor Compounds, Disinfection By-products, and Microorganisms

David W. Ferguson, Michael J. McGuire, Bart Koch, Roy L. Wolfe, E. Marco Aseta

First published: 01 April 1990 | <https://doi.org/10.1002/j.1551-8833.1990.tb06950.x> | Citations: 53

### Bench-scale ozonation for removing constituents of emerging concern

SUN LIANG,<sup>1</sup> SHANNON M. MACERIO,<sup>1</sup> WADE A. TAKEGUCHI,<sup>1</sup> AND RICHARD S. YATES<sup>1</sup>

<sup>1</sup>Metropolitan Water District of Southern California

The study assessed the efficiency of removing constituents of emerging concern (CECs) with ozone and ozone in combination with hydrogen peroxide in a bench-scale flow-through system designed to predict full-scale results. For CECs were selected for evaluation: atrazine, caffeine, carbamazepine, promazine, and tri(2-chloroethyl) phosphate. Two emerging compounds, 2-ethylhexanoic acid and guaifenesin, were used to establish bench-scale operating conditions that anticipated process performance and disinfection side-effects. The study demonstrated that C removal efficiency in bench-scale systems was generally consistent with results in full-scale systems. Thus, the bench-scale system can be used to predict full-scale removal. Additionally, bench-scale results showed that UV mineral oxidizers were generally less than 100% effective (DPP) than a Colorado River water (CRW) or the SPARC RW line. These results were likely a consequence of the rapid formation of hydroxyl radicals in SPARC.

### Optimizing Chloramine Disinfection for the Control of Nitrification

Nancy I. Lieu, Roy L. Wolfe, and Edward G. Means III

Previous studies have shown that nitrification can have deleterious effects on water quality; the cause of nitrification is the oxidation of ammonia to nitrite by autotrophic nitrifying bacteria. Experimental studies conducted with fully defined media to determine the optimum chloramine application of

APPLIED AND ENVIRONMENTAL MICROBIOLOGY, May 1997, p. 2029-2037  
0099-2240/97/0502029-09  
Copyright © 1997, American Society for Microbiology

Vol. 63, No. 5

### An Assay Combining Cell Culture with Reverse Transcriptase PCR To Detect and Determine the Infectivity of Waterborne *Cryptosporidium parvum*

PAUL A. ROCHELLE,<sup>1</sup> DONNA M. FERGUSON,<sup>1</sup> TROY J. HANDOJO,<sup>1</sup> RICARDO DE LEON,<sup>1</sup> MIC H. STEW

<sup>1</sup>Water Quality Laboratory, Metropolitan Water District of Southern California

APPLIED AND ENVIRONMENTAL MICROBIOLOGY, May 2005, p. 2800-2802  
0099-2240/05/052800-03  
Copyright © 2005, American Society for Microbiology. All Rights Reserved.

### UV Inactivation of *Cryptosporidium hominis* as Measured in Cell Culture

Anne M. Johnson,<sup>1</sup> Karl Linden,<sup>2</sup> Kristina M. Ciociola,<sup>2</sup> Ricardo De Leon,<sup>1</sup> Giovanni Widmer,<sup>2</sup> and Paul A. Rochelle<sup>1\*</sup>

<sup>1</sup>Water Quality Laboratory, Metropolitan Water District of Southern California, La Verne, California; <sup>2</sup>Environmental Engineering, Duke University, Durham, North Carolina; <sup>3</sup>Disease, Tufts University School of Veterinary North Grafton, Massachusetts

Journal of Environmental Sciences  
Available online 19 April 2022  
In Press, Corrected Proof

### Relationships between regulated DBPs and emerging DBPs of health concern in U.S. drinking water

Stuart W. Krasner,<sup>1,\*</sup> A. B. Xu,<sup>1</sup> Chih-Fen Tse,<sup>1</sup> Babu Shankar,<sup>1</sup> Joshua R. Allen,<sup>2,3</sup> Susan D. Richardson,<sup>2</sup> Michael J. Plewa,<sup>3,4</sup>

<sup>1</sup>Metropolitan Water District of Southern California, Water Quality Laboratory, CA 91750;

### Estimation of NDMA Precursor Loading in Source Water via Artificial Sweetener Monitoring

MATTHEW FREDDOTT,<sup>1</sup> STUART W. KRASNER,<sup>1</sup> AND YIMBEE C. BUI<sup>1</sup>

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

### Assessing the risk of infectious *Cryptosporidium* in drinking water

PAUL A. ROCHELLE,<sup>1</sup> ANNE M. JOHNSON,<sup>1</sup> RICARDO DE LEON,<sup>1</sup> AND GEORGE D. DI GIOVANNI<sup>2</sup>

<sup>1</sup>Metropolitan Water District of Southern California, Water Quality Laboratory, La Verne, Calif.  
<sup>2</sup>University of Texas, School of Public Health, El Paso Regional Campus, El Paso, Texas

### Disinfection of *Cryptosporidium parvum* WITH polychromatic UV light

BENCH-SCALE EXPERIMENTS DETERMINED THE GERMINAL EFFECTS OF VARYING DOSES OF POLYCHROMATIC ULTRAVIOLET (UV) RADIATION ON CYSTS OF *Cryptosporidium parvum*. *C. parvum* oocysts suspended in treated surface water were irradiated with polychromatic light emitted by either a medium-pressure, continuous-wave UV lamp or a pulsed UV lamp then assayed with human cell culture techniques. Experiments conducted using pulsed UV doses of 18 mJ/cm<sup>2</sup> provided > 3-log inactivation of suspended oocysts of *C. parvum*. Experiments at least UV design established a dose-response relationship with both the medium-pressure and pulsed UV lamps. When disinfection results from both light sources were compared on an equivalent dosage basis, no statistical difference in disinfection power was found between the medium-pressure and pulsed UV lamps. Results from both

### Predicted Public Health Consequences of Body-contact Recreation ON A POTABLE WATER RESERVOIR

Advanced treatment systems such as ozonation, membrane, and biological treatment (BPT), settling, and flocculation to remove natural organic matter (NOM) and disinfection by-products (DBPs) are used in the primary process for drinking water. Consequently, the quality of drinking water varies. However, emerging regulatory requirements that place greater emphasis on water treatment, coupled with scientific interest in monitoring emerging contaminants in drinking water

# Water Quality Tools



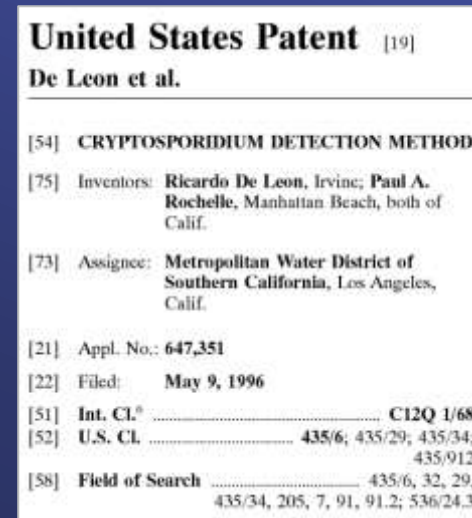
Closed Loop Stripping Analysis



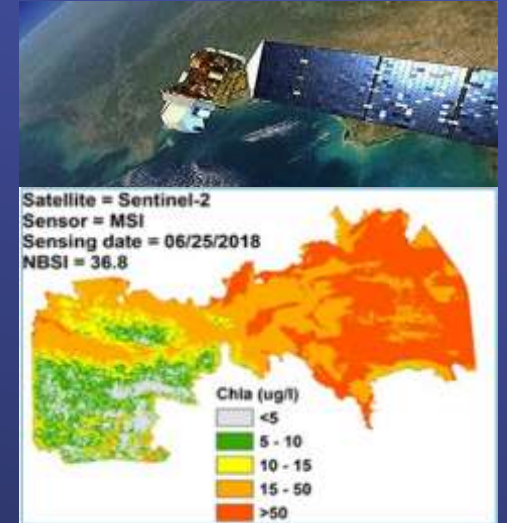
SCUBA Diving



Flavor Profile Analysis



Molecular Pathogen Detection



Lake Monitoring by Satellite

## Analytical methods development for:

- Disinfection byproducts
- Taste & odor compounds
- Cryptosporidium detection and infectivity
- Virus quantification
- Cyanotoxin detection and identification



# Water Quality 50 Year Anniversary



Redesigned Lobby at  
Water Quality Laboratory



Member Agency Water Quality  
Managers Meeting



Retiree Lunch

Additional events to commemorate 50-year anniversaries of  
Water Quality Section and SDWA planned for later in the year

# Continuing the Legacy of Water Quality

