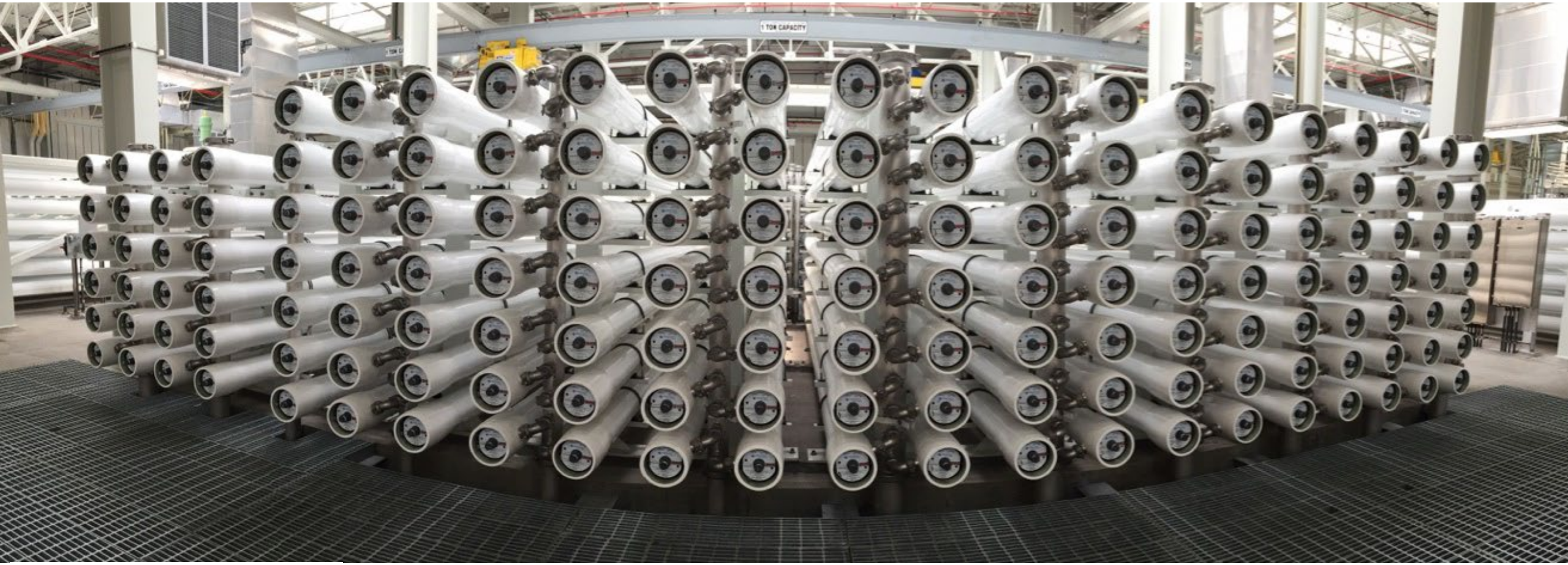
Potable Reuse in California: Past, Present and Future



R. Shane Trussell, Ph.D., P.E., BCEE

June 13, 2023

asersa
Asociación Española de Reutilización Sostenible del Agua

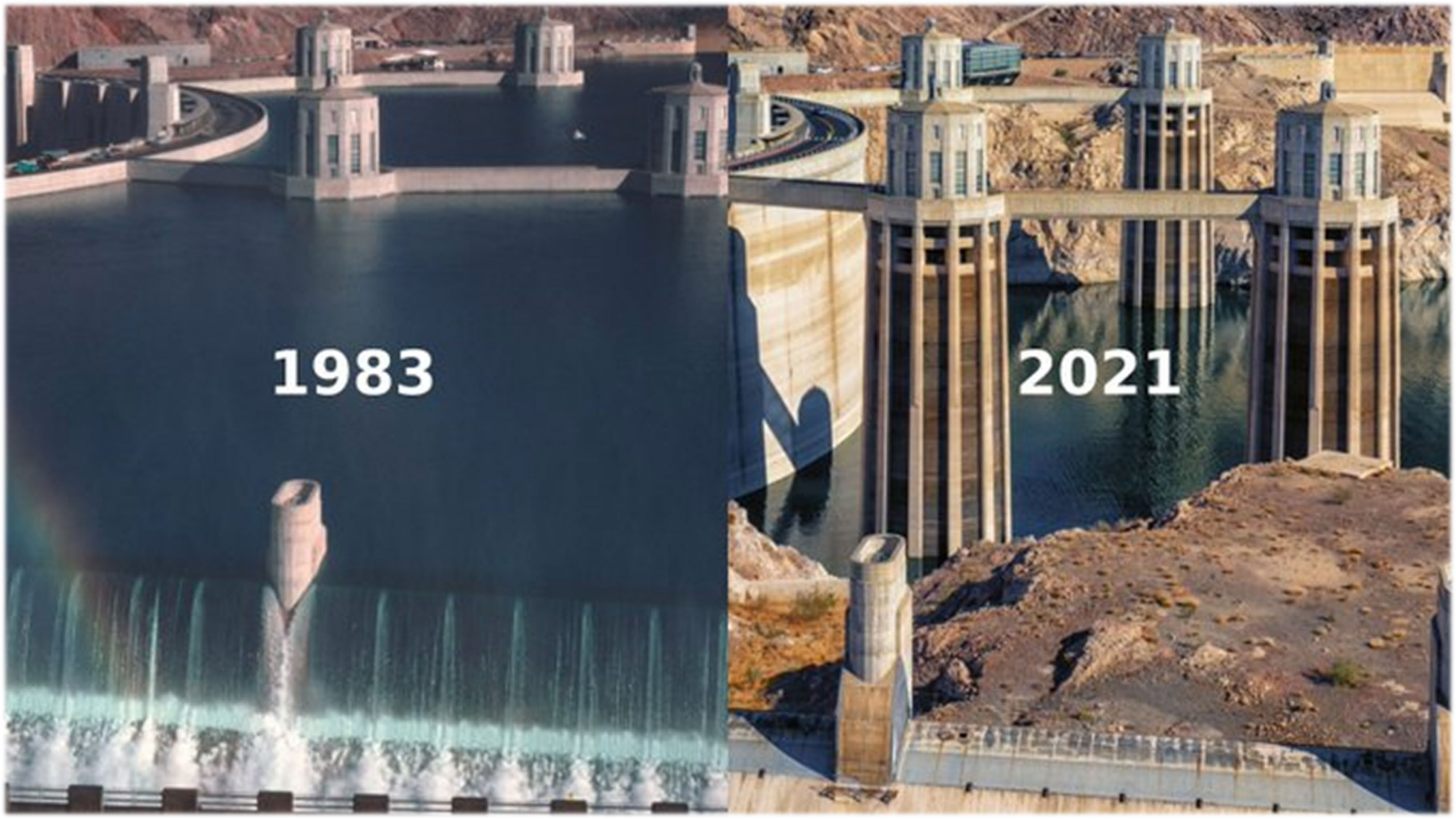
Trussell


HYDROGRAPHY
OF THE
CALIFORNIA REGION
PACIFIC
OCEAN
Del Norte
Klamath R.
Clear Lake Reservoir
Goose Lake
Siskiyou
Modoc
Humboldt
Clair Engle Lake
Trinity R.
Pit R.
Shasta
Lassen
Shasta Lake
Eagle Lake
Trinity
Honey Lake
Sacramento R.
Lake Almanor
Tehama
Plumas
Eel R.
Lake Oroville
Butte
Glenn
Sierra
Mendocino
Feather R.
Nevada
Lake Tahoe
Russian R.
Colusa
Sutter
Placer
Lake
Clear Lake
El Dorado
Yuba
Sonoma
Yolo
Sacramento
Alpine
Napa
Amador
Mokelumne R.
Bodega Bay
Solano
Stanislaus R.
Mono Lake
Marin
San Joaquin
Calaveras
Tuolumne
Contra Costa
Mono
San Francisco
Alameda
Owens R.
San Mateo
San Joaquin R.
Merced R.
Merced
Mariposa
Madera
Santa Clara
Stanislaus
Santa Cruz
San Luis Reservoir
Kings R.
Monterey Bay
Fresno
Friant-Kern Canal
San Benito
Inyo
Owens Lake
Tulare
Monterey
Salinas R.
Kings
San Luis Obispo
Kern R.
Buena Vista Lake
Kern
Santa Barbara
San Bernardino
Lake Havasu
Ventura
Los Angeles
Santa Barbara Channel
Riverside
Orange
Coachella Canal
Salton Sea
Colorado R.
San Pedro Channel
San Diego
Imperial
0
100 KM
100 Miles
© geology.com


HYDROGRAPHY
OF THE
CALIFORNIA REGION
PACIFIC
OCEAN
Shasta
Lake
Red Bluff
Diversion Dam
Sacramento River
Lake
Oroville
Folsom
Lake
Sierra Nevada Range
Delta
Pumps
Mokelumne
Aqueduct
Contra Costa
Canal
New Melones
Lake
Los Vaqueros
Reservoir
Hetch Hetchy
Aqueduct
San Joaquin River
Millerton
Lake
San Luis
Reservoir
Delta-Mendota
Canal
San Luis
Canal
Los Angeles
Aqueduct
California
Aqueduct
Bay-Delta Watershed
Delta
Tulare Sub-Basin
This basin flows into the San Joaquin
River only in wet years.
Engineering Projects
Federal
State
State & Federal
Local
Colorado River
Aqueduct
Coachella
Canal
San Diego
Aqueducts
All American

CAPITAL WEATHER GANG

California declares historic water emergency measures amid drought


1983
2021

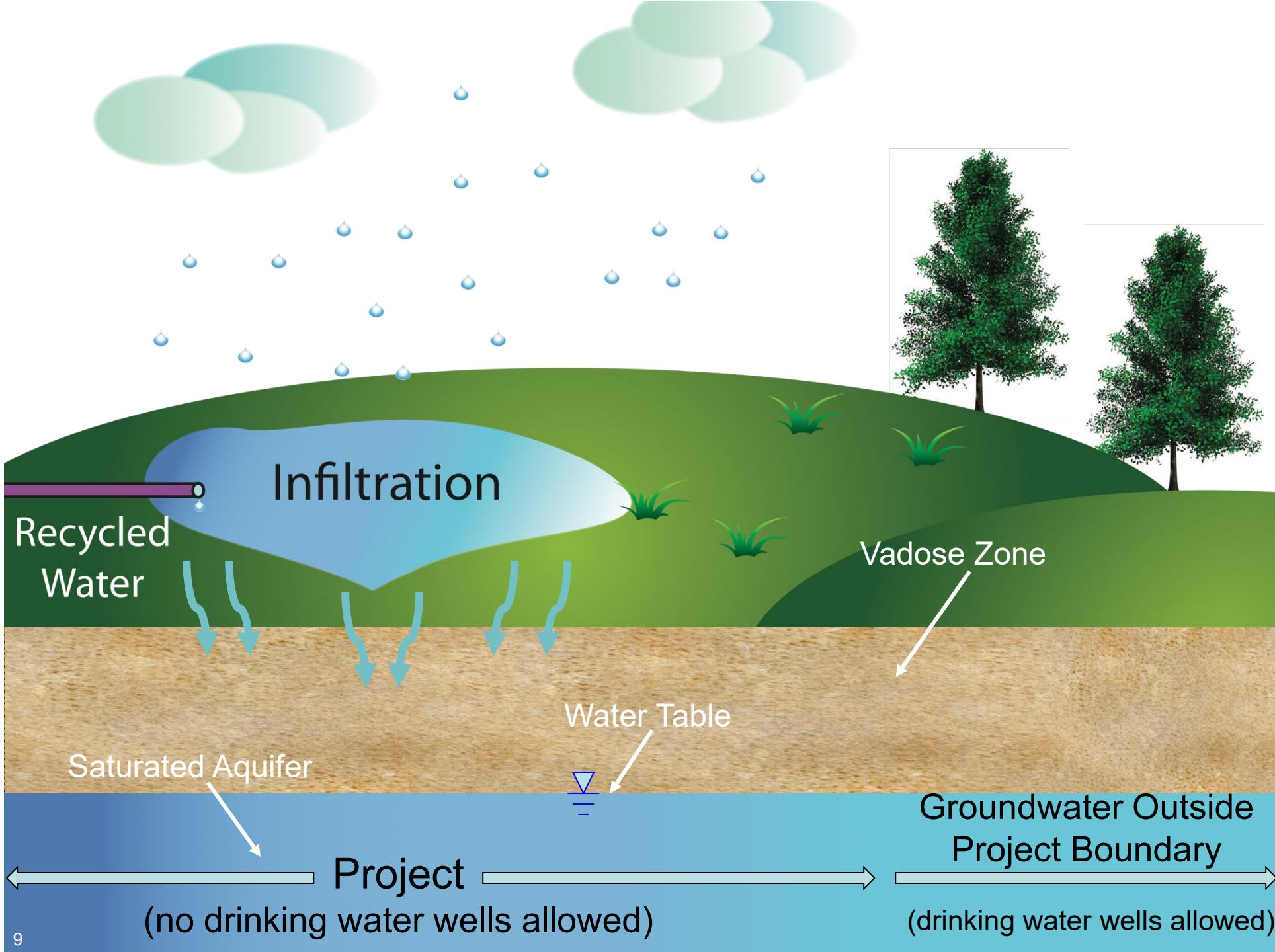
California Needs to Develop More Local Water Supplies

- Climate Change Adaptation
- Local Sustainability
- Water Supply Certainty
- Ecosystem Pressure
- Cost Control

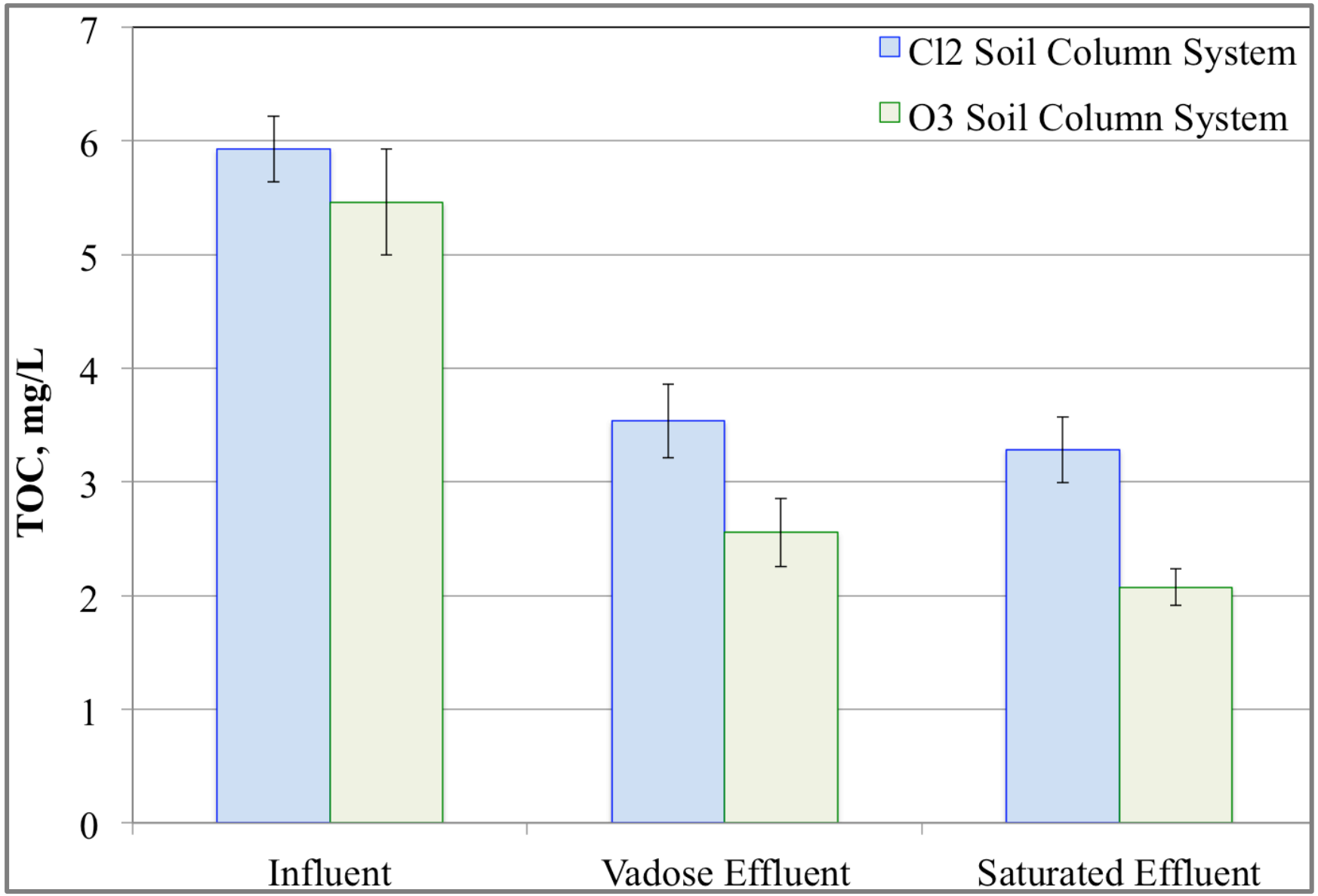
California Has Deep Roots in Potable Reuse

Spreading Projects Play an Important Role and Offer a Non-RO Solution

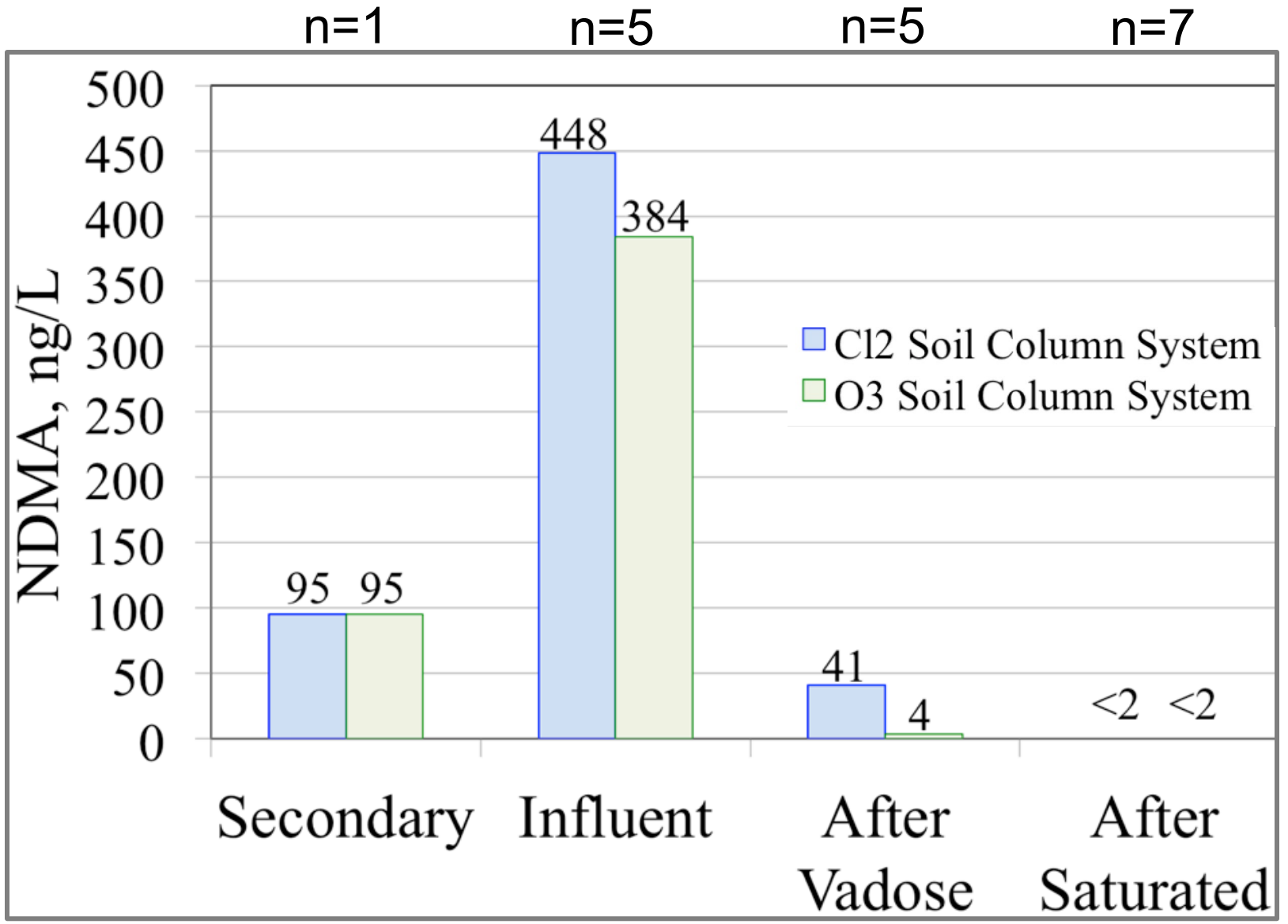
Average recharge of 215 ML/day



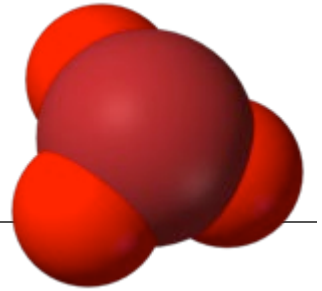
Total Organic Carbon Removal



NDMA

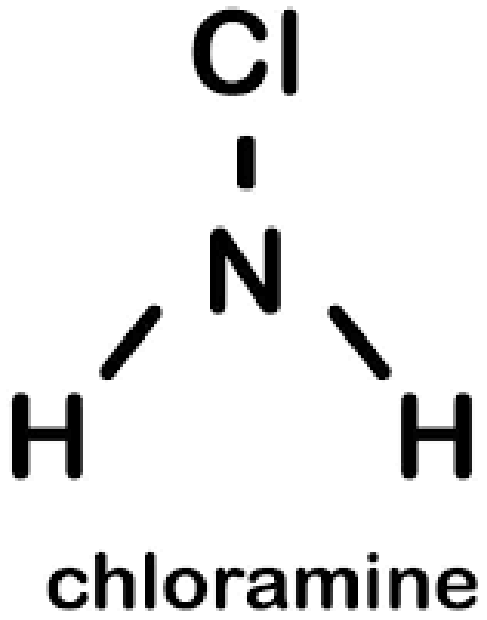

n=1
n=5
n=5
n=7
NDMA, ng/L
500
450
400
350
300
250
200
150
100
50
0
448
384
95
95
41
4
<2
<2
Cl2 Soil Column System
O3 Soil Column System
Secondary
Influent
After Vadose
After Saturated

DBP Attenuation



			Event 3	Event 4	Event 5	Average
Cl_2 Soil Column System	HHAs	Influent	30	36	15	**27**
		Saturated	<1.0	<1.0	<1.0	**<1.0**
	TTHMs	Influent	34.7	24.3	15.1	**24.7**
		Saturated	<0.50	<0.50	<0.50	**<0.50**
O_3 Soil Column System	Bromate	Influent	5.5	<0.50	1.4	**2.5**
		Saturated	<0.50	<0.50	<0.50	**<0.50**

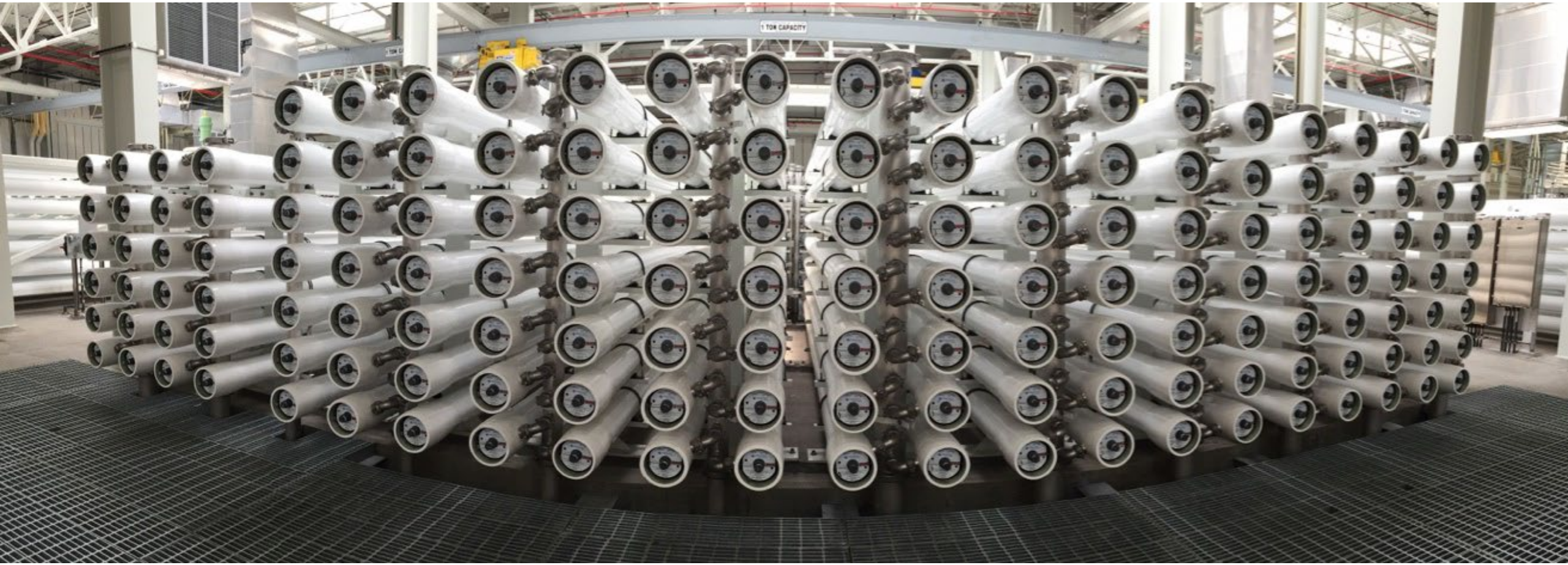
Advent of Integrated Membrane Systems in the Late 90s



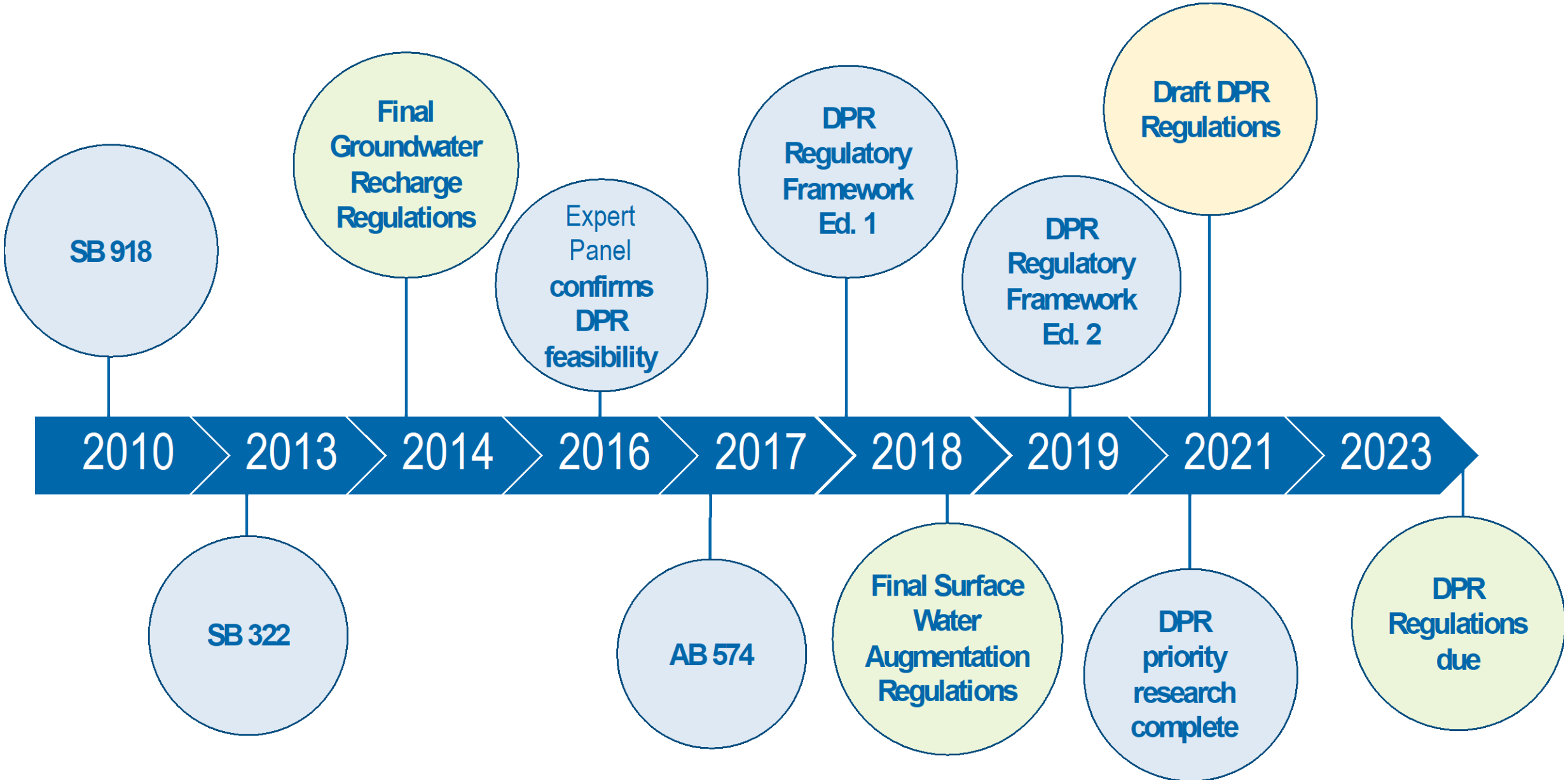
West Basin Municipal Water District Commissions First Full-Scale Microfiltration Reverse Osmosis Facility in 1999

Terminal Island Begins Full-Scale Operation of MF/RO in 2003

Orange County Water District Commissions the Groundwater Replenishment System in 2008

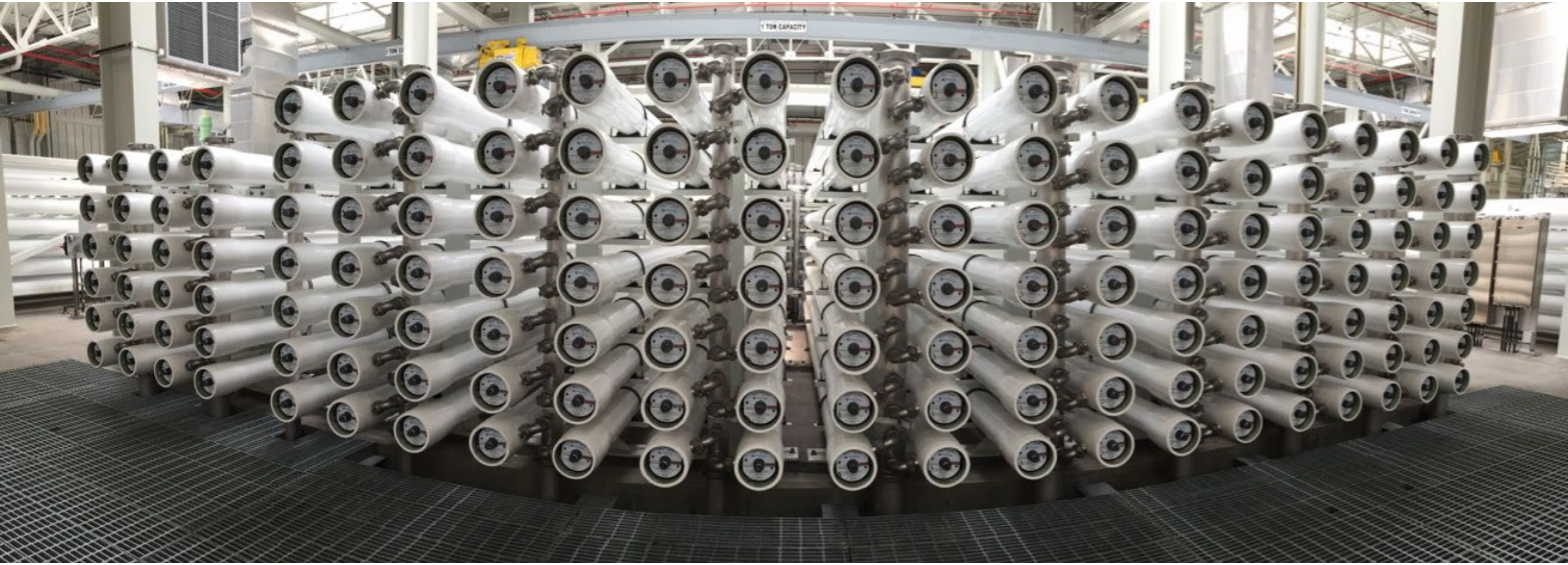


Rapid Development of Potable Reuse Regulations



Terminal Island Expansion (12 MGD) and UV-HOCl

Groundwater Replenishment System (130 MGD)



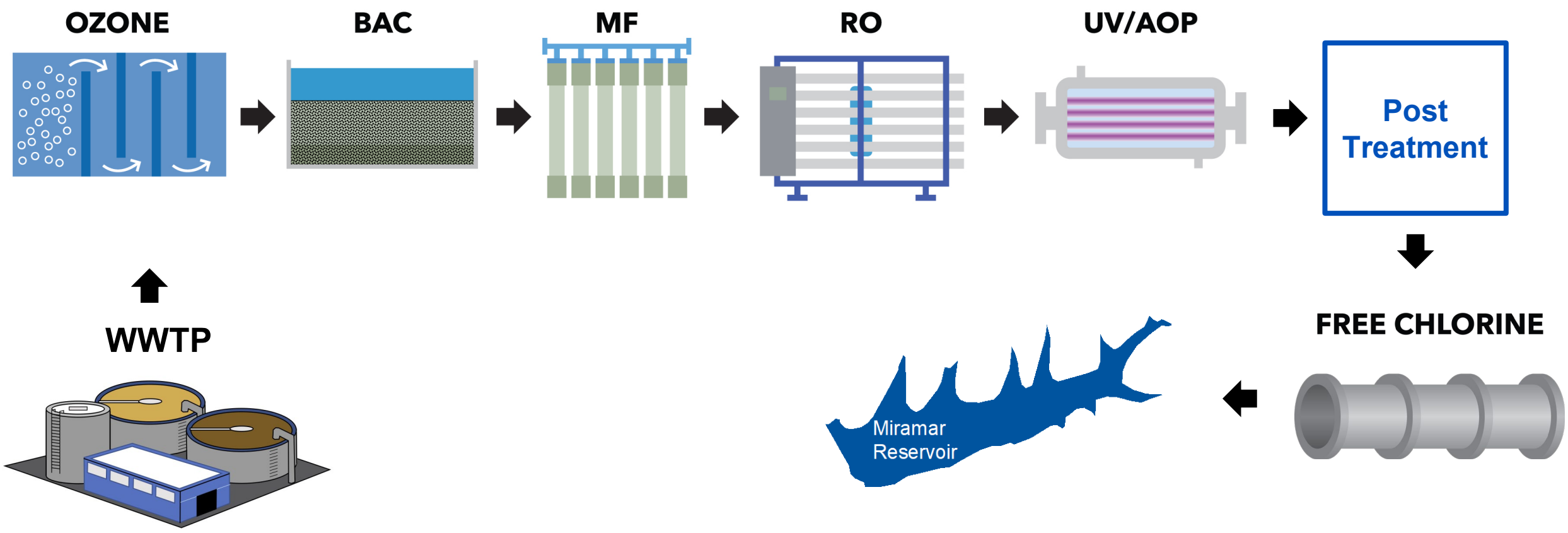
Albert Robles Center (14 MGD)

Pure Water Monterey (5.5 MGD)

Pure Water Oceanside (4.5 MGD)

The Next Frontier for Potable Reuse in California

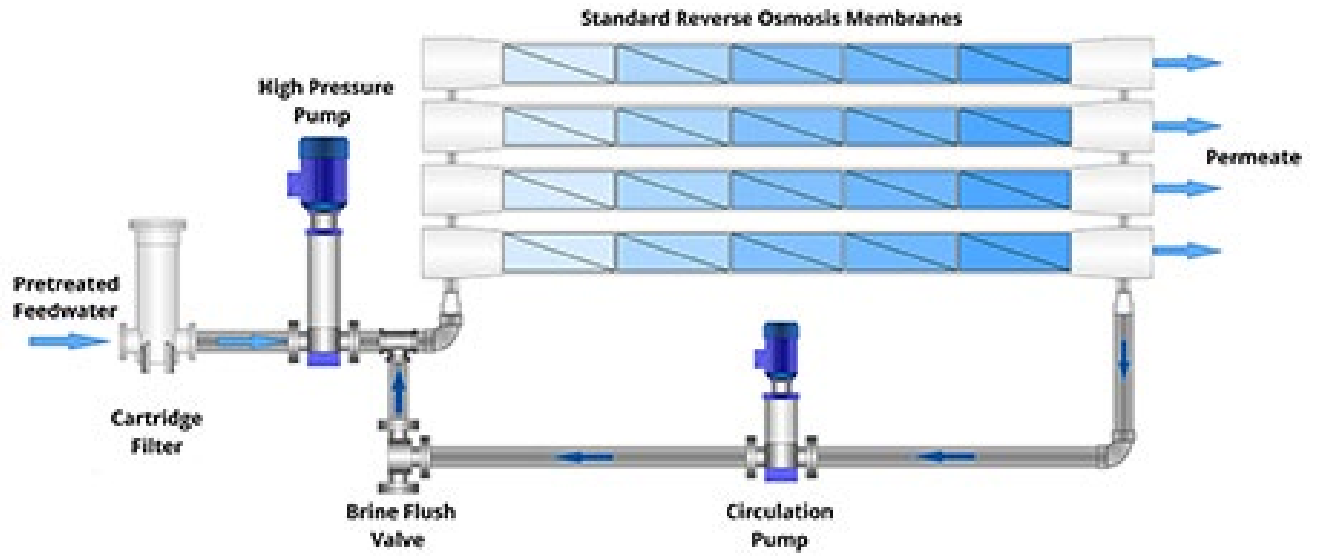
San Diego North City Pure Water Treatment Train (34 MGD)



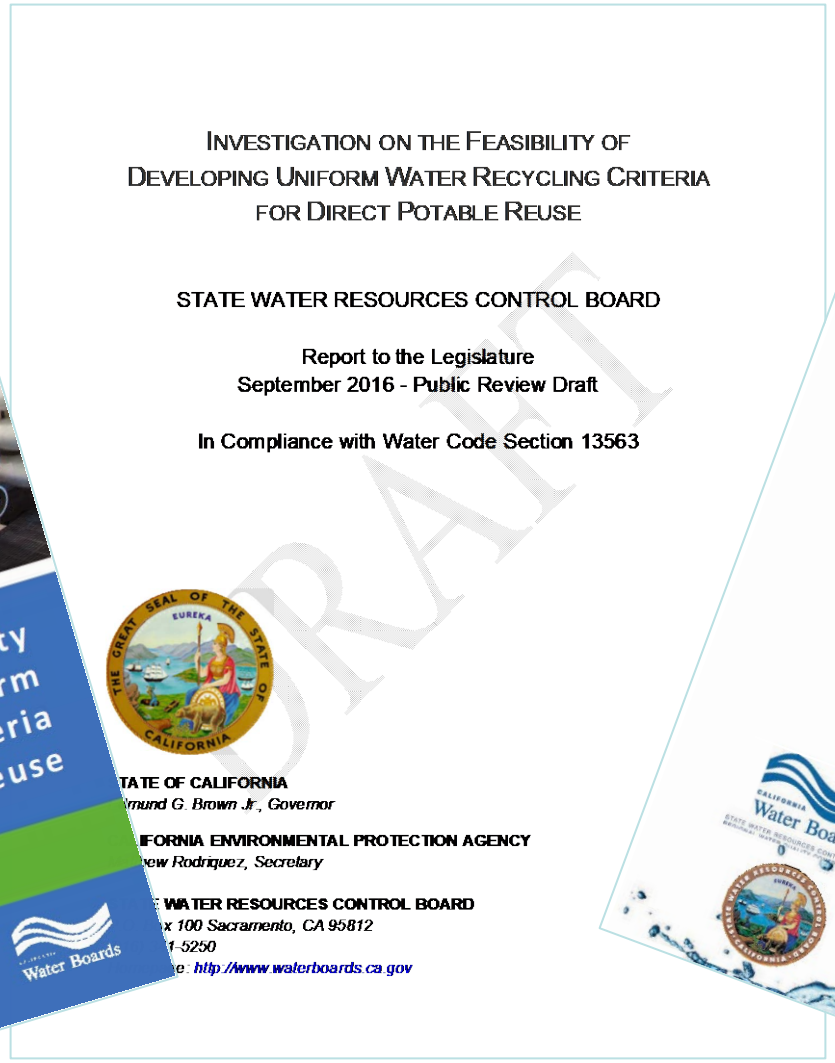
Phase 1 Pure Water San Diego (34 MGD)

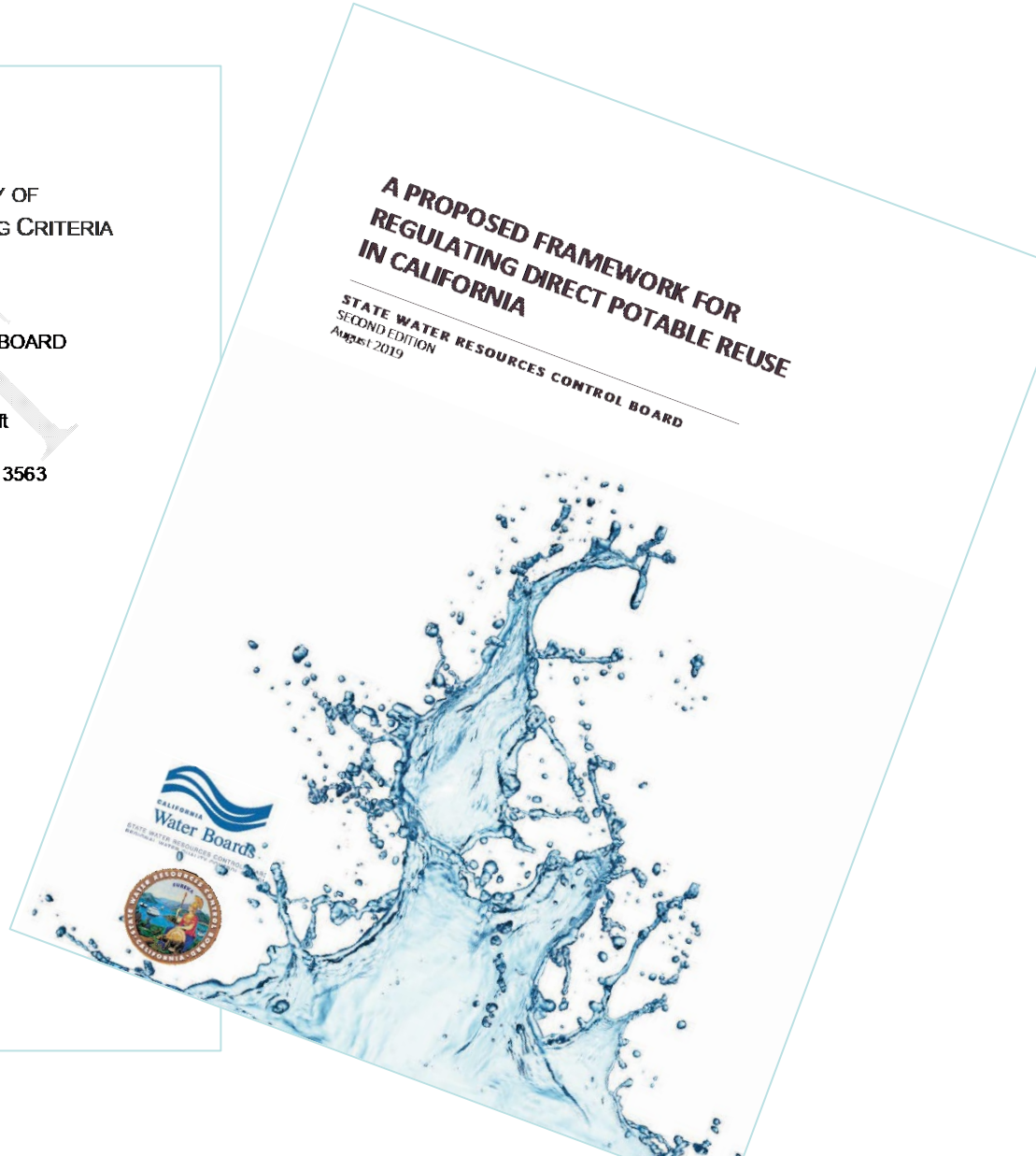
East County AWPF (12.5 MGD)

First Potable Reuse Facility with 95% RO Recovery



Draft Direct Potable Reuse Criteria Released





>$10M in Research to Support DPR Regulations

PROJECTS TO INFORM THE DEVELOPMENT OF DPR REGULATIONS

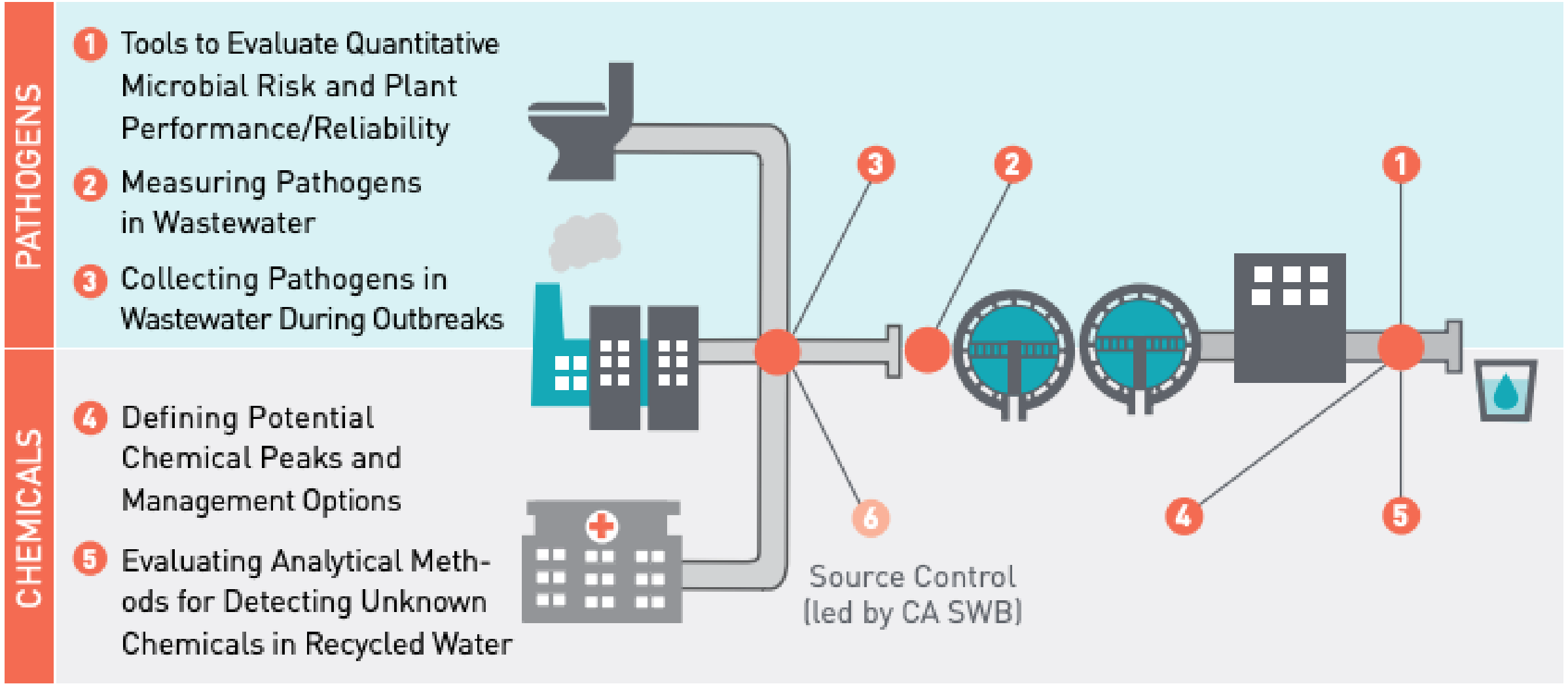
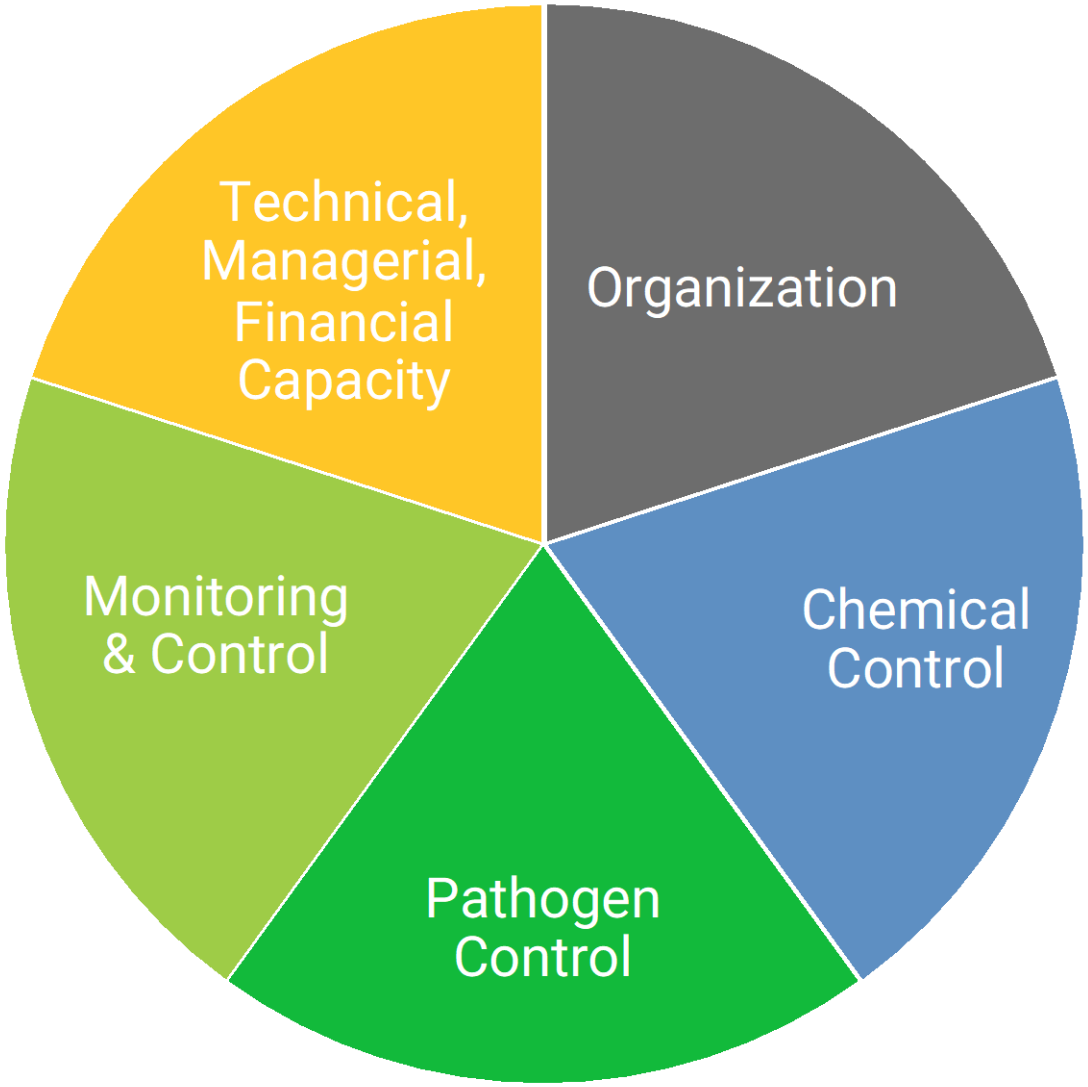


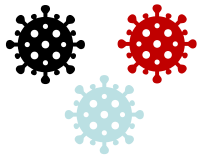
Figure credit: Water Research Foundation

Major Provisions



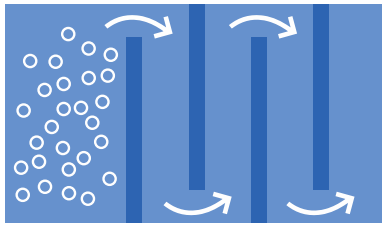
Pathogen Control

- 4 processes providing at least 1-log for *each* pathogen
  - GWR is 3 processes total
  - SWA is 2-3 processes total
- 3 *mechanisms* including:
  - UV disinfection
  - Physical separation
  - Chemical disinfection

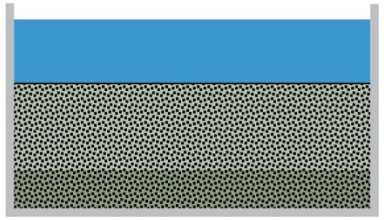
	Groundwater Recharge	Surface Water Augmentation	Direct Potable Reuse
Virus 	12	12 to 14	20
Giardia 	10	10 to 12	14
Cryptosporidium 	10	10 to 12	15

Chemical Control – Treatment Requirements

OZONE

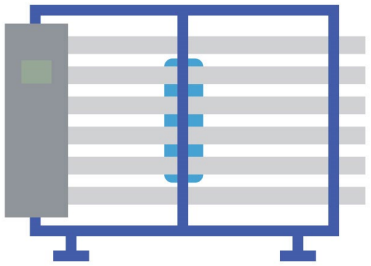


BAC

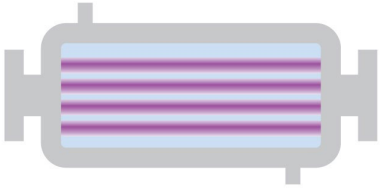


New requirement

RO



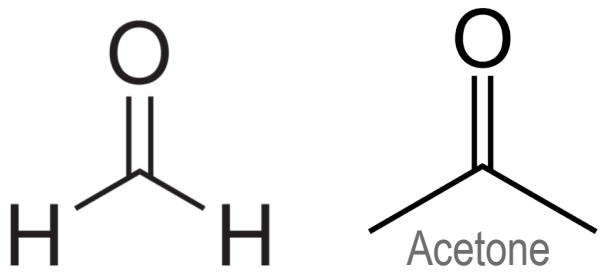
AOP



New operational triggers

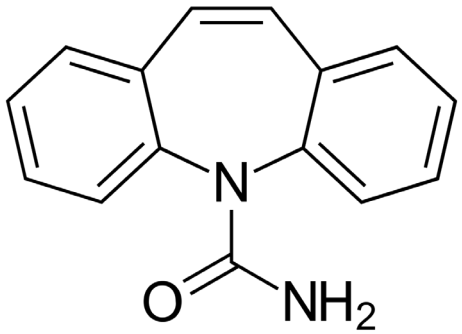
Treatment must be in this order

O3/BAC Requirements

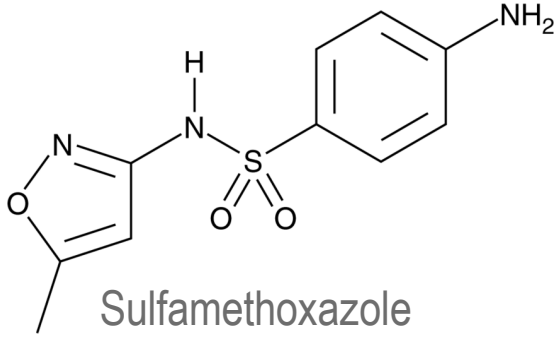


Formaldehyde

Acetone

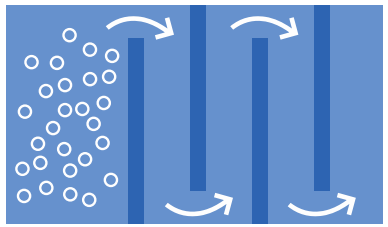


Carbamazepine



Sulfamethoxazole

OZONE

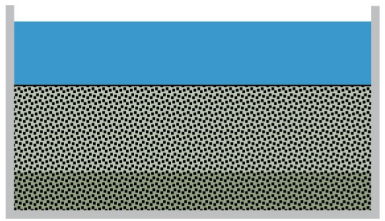


O_3:TOC > 1

1-log reduction:

- Sulfamethoxazole
- Carbamazepine

BAC



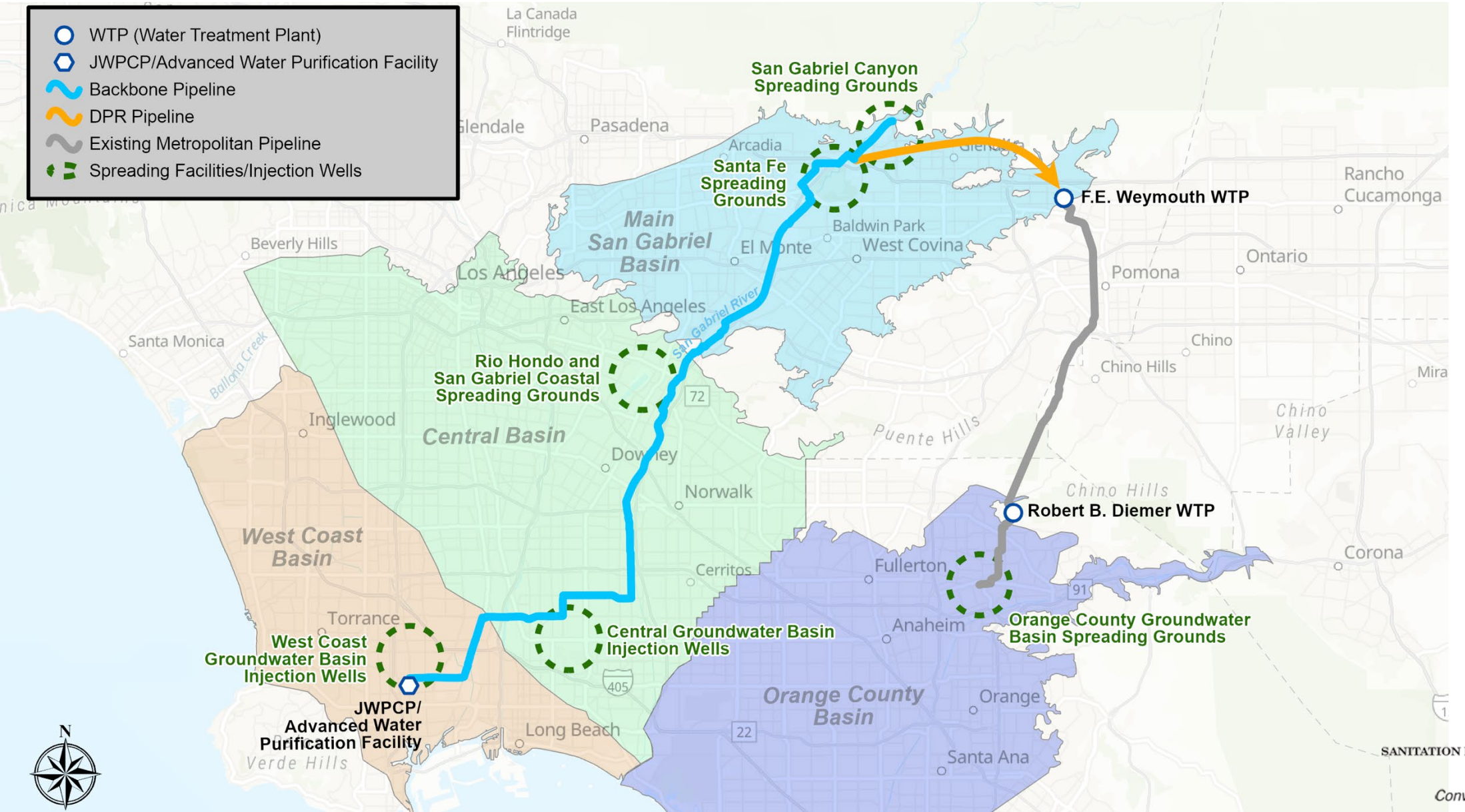
EBCT ≥ 15 min

1-log reduction:

- Formaldehyde
- Acetone

Central Area Project to Produce 53 MGD

Pure Water Southern California (150 MGD)



SANITATION DISTRICTS OF LOS ANGELES COUNTY

Converting Waste Into Resources

Advanced Purification Center (0.5 MGD)

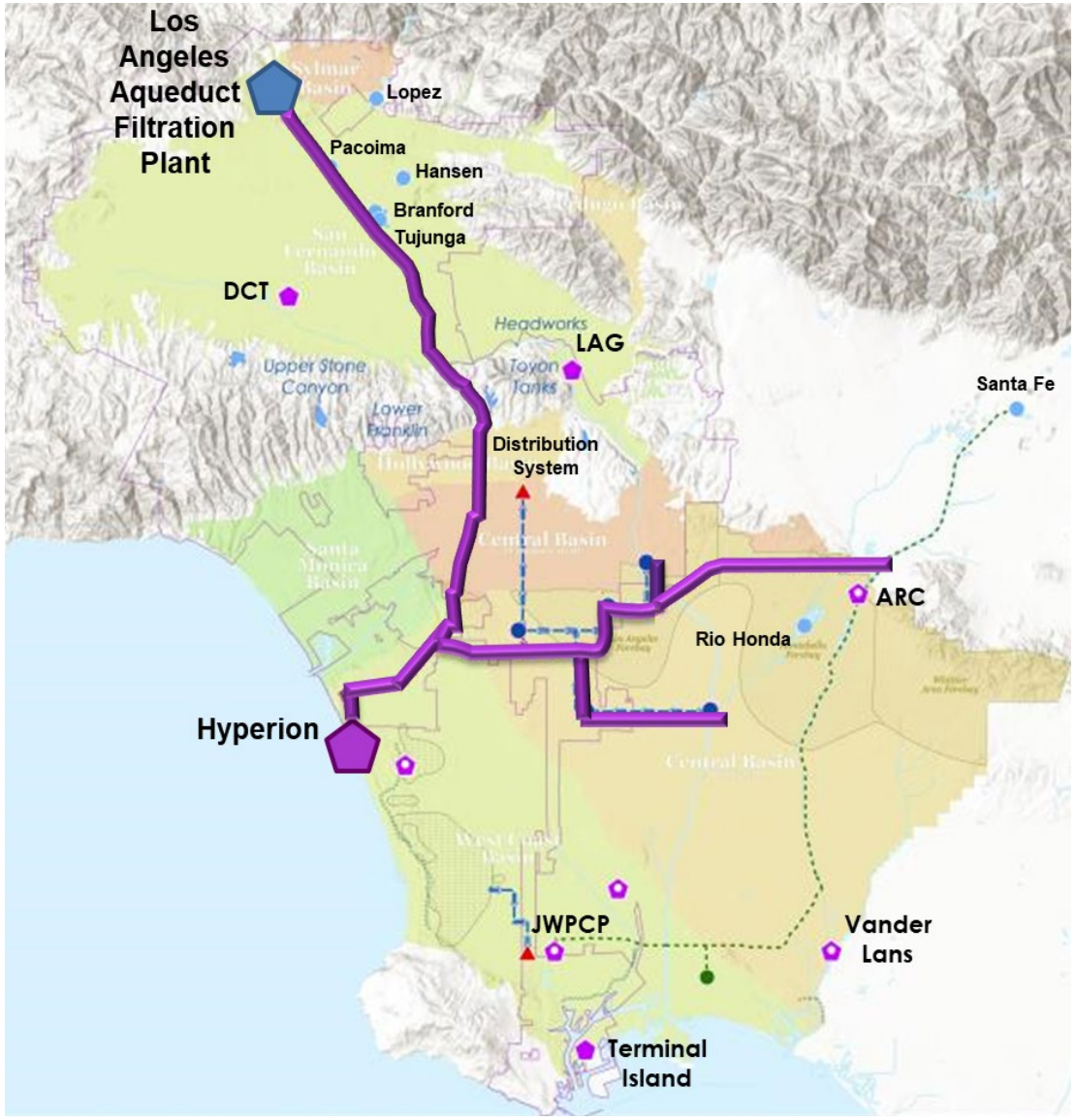
SANITATION DISTRICTS OF LOS ANGELES COUNTY

Converting Waste Into Resources

City of Los Angeles

Operation NEXT

- Largest Potable Reuse Project (200 MGD)
- 1/3 City's Water Demand
- $16 Billion



Potable Reuse Will Dramatically Change California

More Seawater Desalination Facilities in Our Future

Thank you for listening!

R. Shane Trussell

President

shanet@trusselltech.com

Trussell