



Innovative Research at the Advanced Purification Center

Engineering and Operations Committee

Item 6a

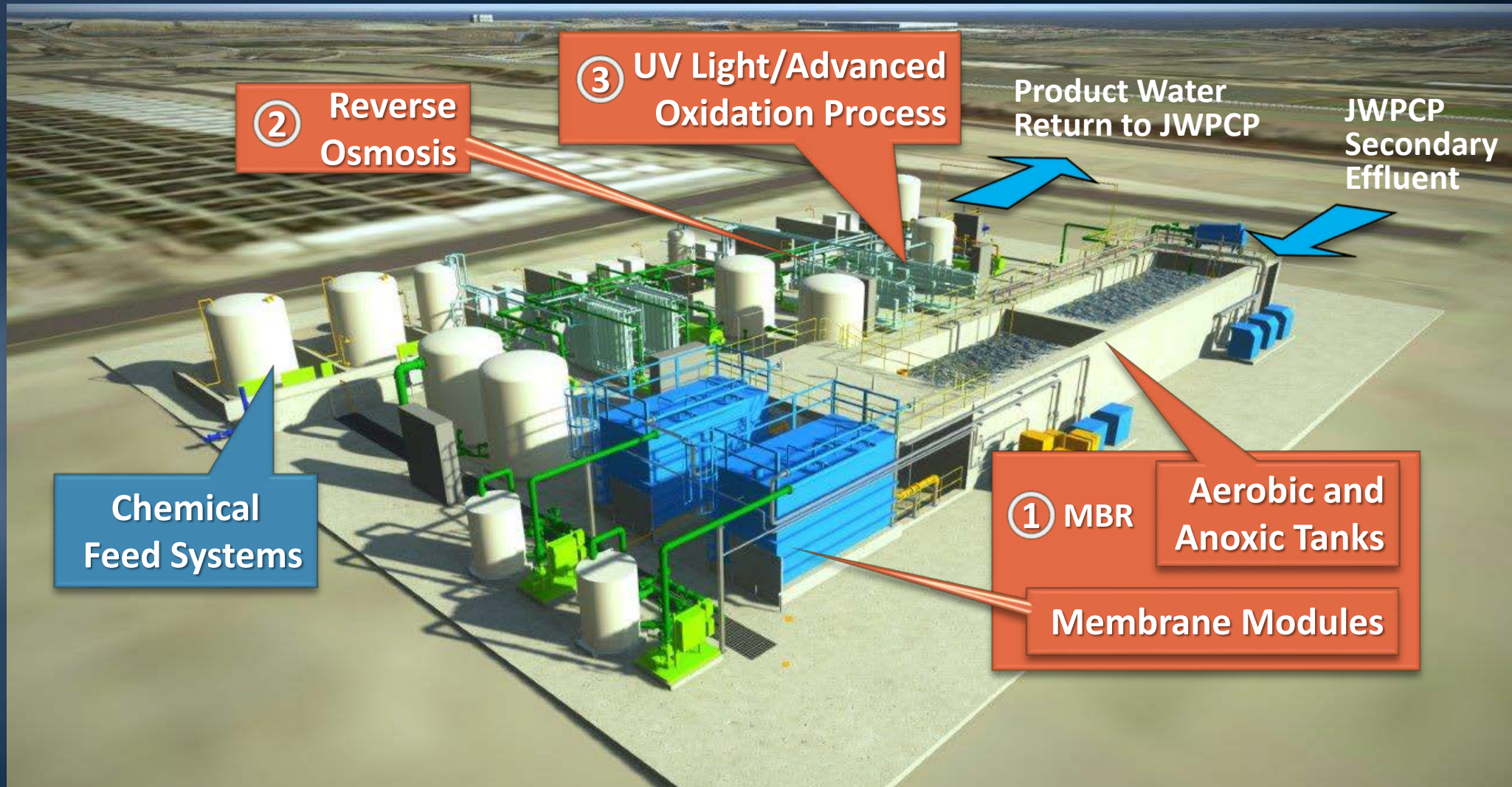
May 10, 2021

Outline

- Demonstration Project Overview
- Advanced Water Treatment
- Microbial Testing
- Industry Benefits and Collaboration
- Current Testing and Next Steps



Demonstration Facility Processes



Demonstration Project Objectives

- Provide data for regulatory acceptance
- Confirm viability of membrane bioreactor (MBR) process

ONGOING

- Confirm operational dependencies/interfaces with LACSD
- Provide vehicle for public outreach and acceptance

ONGOING

- Optimize treatment process, develop design criteria, and establish cost clarity
- Develop Raw Water Augmentation approach

***FUTURE
TESTING
PERIODS***

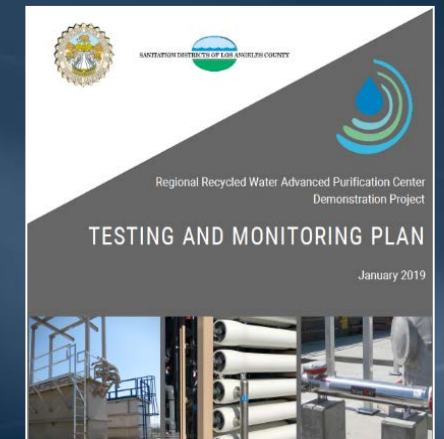
Demonstration Facility Testing Schedule



◆ Completion

↓ Current Status

- The MBR currently treats JWPCP secondary effluent, operating in a tertiary mode (or **tMBR**)
- In the next phase of testing, the MBR will treat primary effluent in a secondary mode (or **sMBR**)

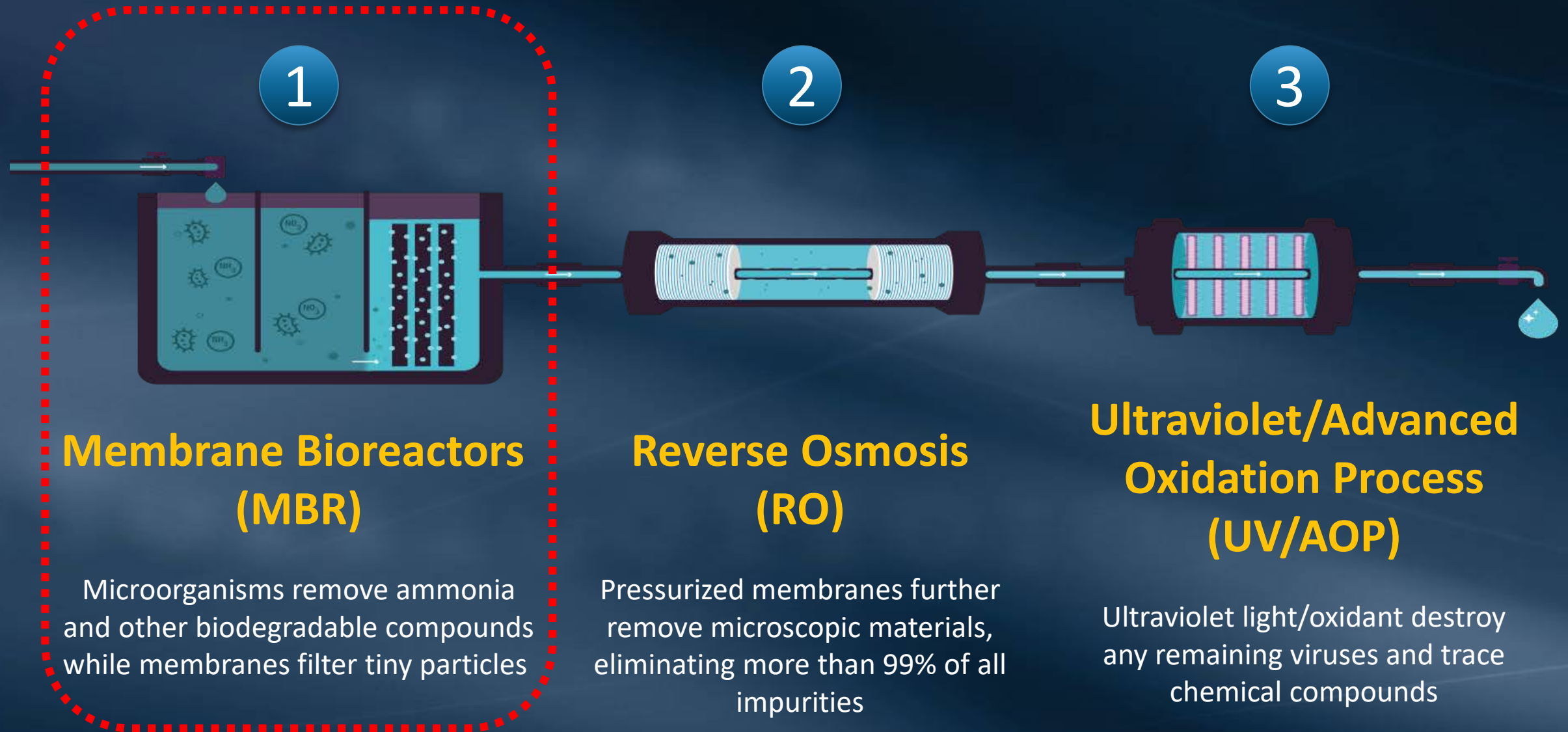


Tertiary MBR (tMBR) Testing Status

- Preliminary results show that the demonstration train meets water quality targets for chemical constituents in the groundwater recharge regulations
- Additional evaluations are ongoing to confirm results and refine operational conditions

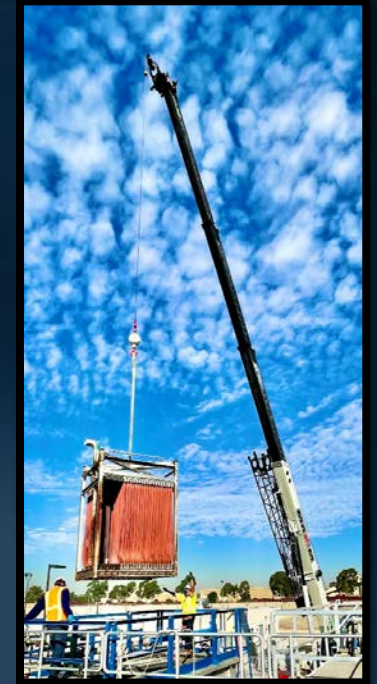


Advanced Water Treatment Process

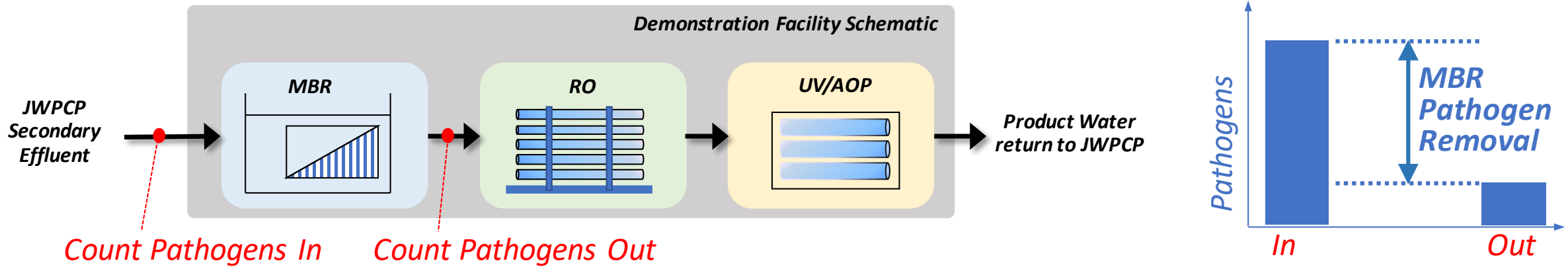


Membrane Process Selection

- Membrane filtration (MF) is commonly used globally in potable reuse without a biological process
- An MWD/LACSD pilot study in 2010-2012 showed performance advantages of MBR over MF
 - MBRs provide biological treatment upstream of the MBR membrane
- No MBR systems are currently permitted in CA for potable reuse
- Two MBR systems available for testing at the demonstration facility



Demonstrating ≥ 2.5 Pathogen LRV through MBR

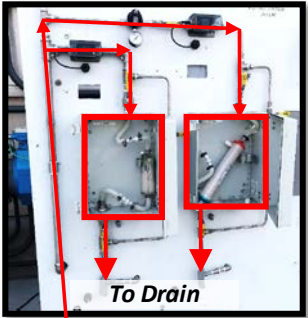


Example Log Removal Value (LRV) Calculations

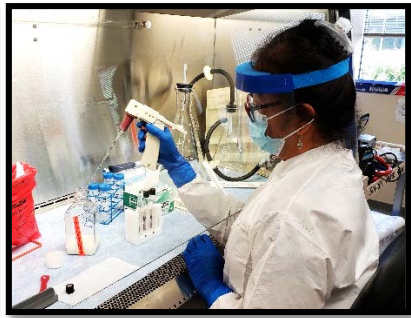
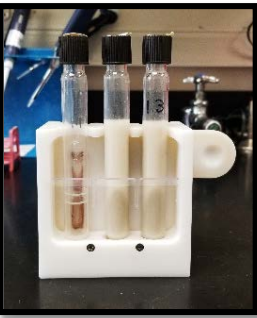
Pathogens In (organisms/L)	Pathogens Out (organisms/L)	Percent Removal	LRV
100	10	90%	1.0
100	1	99%	2.0
100	0.3	99.7%	2.5
100	0.1	99.9%	3.0
100	0.01	99.99%	4.0

Measuring Pathogens in MBR Filtrate Water

Filtration of 10,000+ L



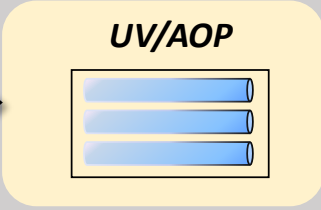
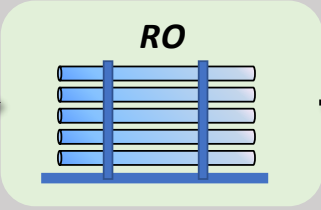
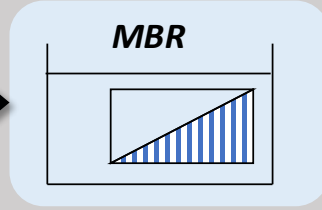
Elution, Concentration, and Purification



Microscopy



JWPCP Secondary Effluent



Product Water return to JWPCP

Demonstration Facility Schematic

Pathogen Method Improvements

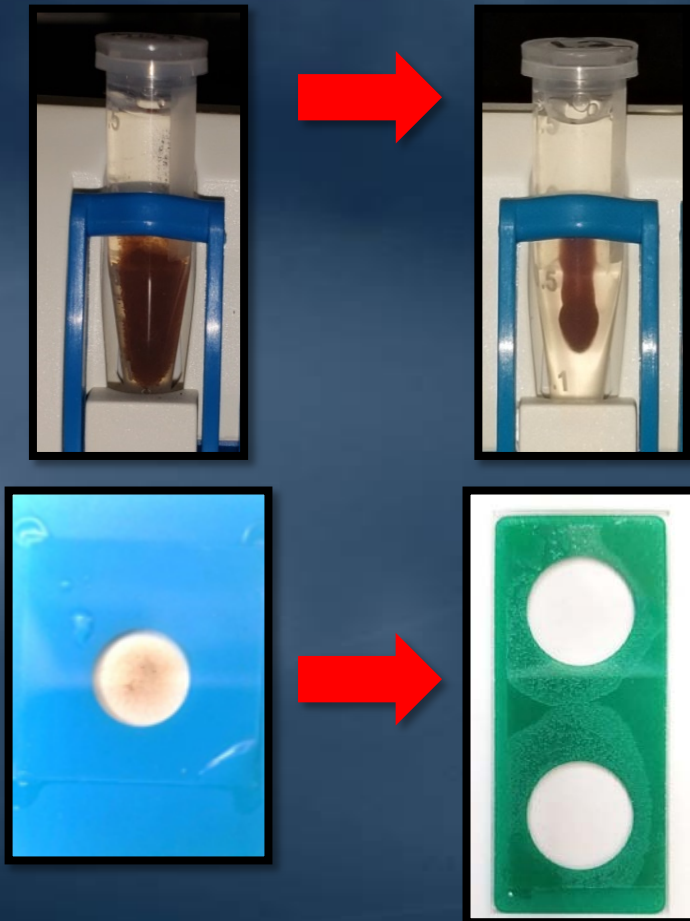
- Much larger sample volumes than previous industry studies
- Pathogen detection methods modified to improve recovery efficiency and detection limits
- Unlike most reuse studies, recovery efficiency for each sample is being determined
- Higher method sensitivity, quality control, and better data integrity



Large volume
sample collection

Pathogen Method Improvements (cont.)

Less Interfering Debris



Cryptosporidium and *Giardia* Analysis Method

	Previous Reuse Projects	Advanced Purification Center
MBR Filtrate Sample Volume	≤250 L	>10,000 L
Sampling Duration	<1 hr	~16 hrs
Recovery	<10%	45-55%

Lab Work During the Pandemic

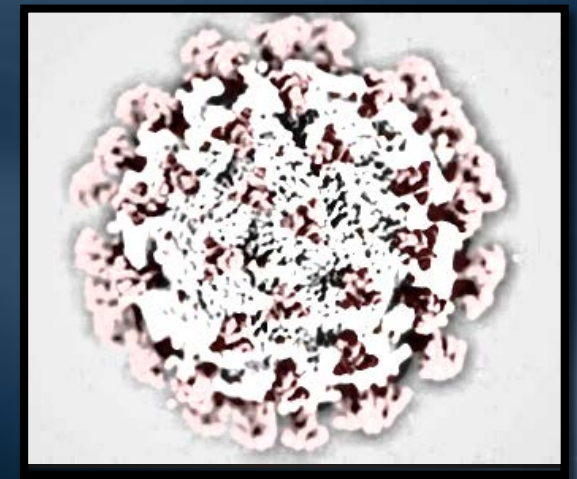
- Concentrating samples that probably contain SARS-CoV-2, the cause of the COVID-19 pandemic, is unprecedented
- With LACSD, developed a novel SARS-CoV-2 inactivation method (cholate from bile) that allows staff to work safely while analyzing target organisms



Training staff

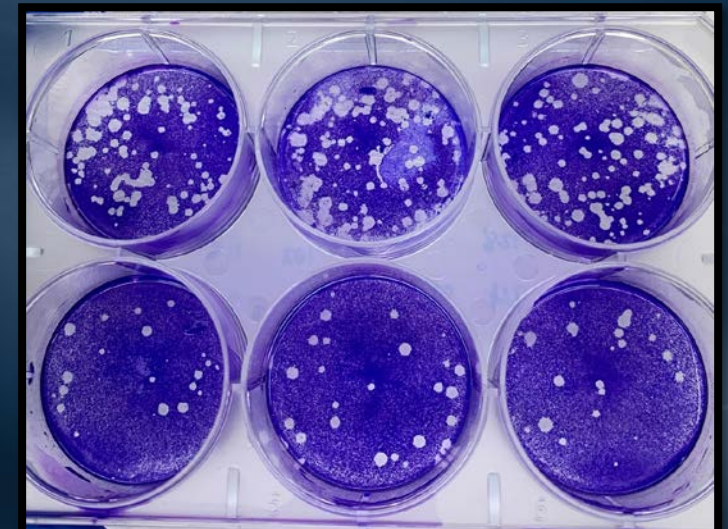


Cholate treatment and sample elution



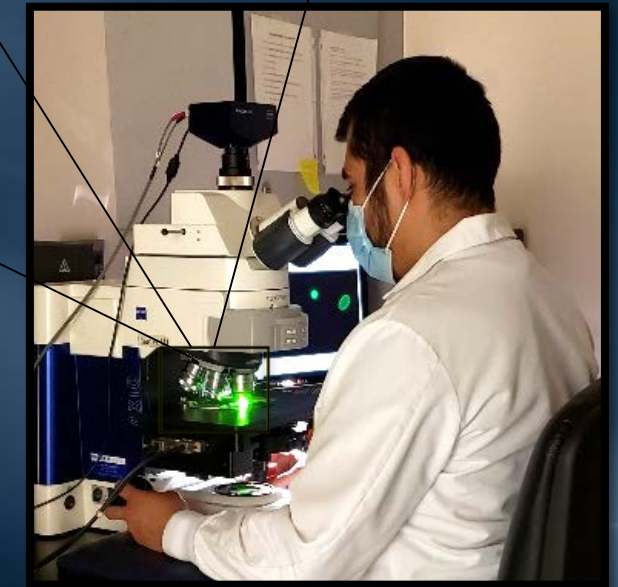
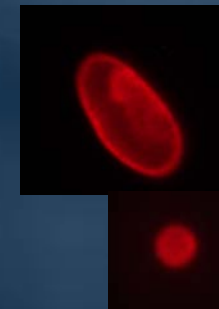
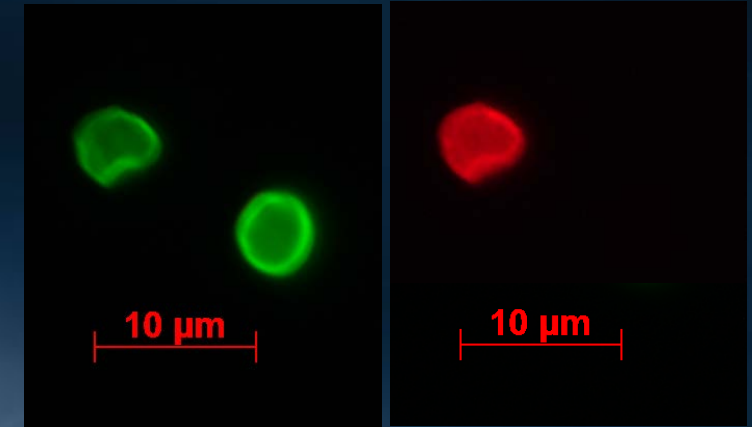
Inactivating Coronaviruses

Virus Analysis in the Lab



Benefits of Using Indicators Instead of Pathogens

- Pathogens are difficult to analyze
 - Resource and time intensive processes
 - Highly trained staff and specialized facilities
- Appropriate indicators (or surrogates) that conservatively represent pathogens
 - Safer to work with
 - Easily measurable
 - Results obtained with faster turnaround
 - Higher frequency monitoring



Evaluate Correlation Between Pathogen LRVs and Indicators

Microorganisms

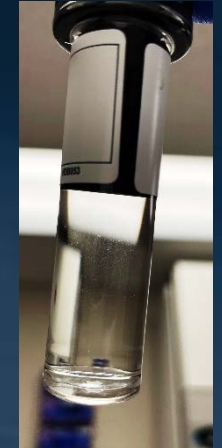
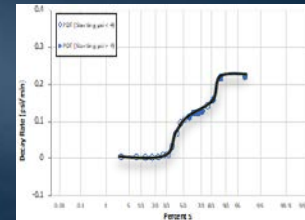
Type of Microbe	Microorganism	LRVs* (%)
Pathogens	<i>Cryptosporidium</i>	4.4 (>99.99%) ^
	<i>Giardia</i>	5.8 (>99.999%) ^
Indicators	Total Coliforms	6.3
	<i>Escherichia coli</i>	7.0
	Aerobic Bacterial Spores	3.7
	<i>Clostridium perfringens</i> Spores	4.8

*Results during Baseline Testing

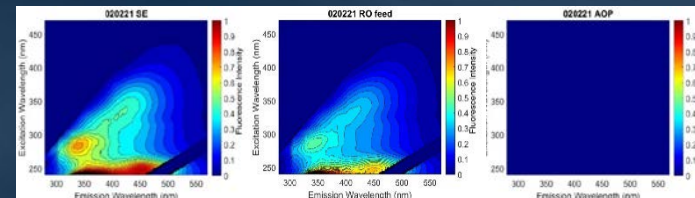
^LRV using daily matrix spike corrections, lowest 5% pathogen removal

Non-microbial surrogates

Pressure Decay *Suspended Solids* *Turbidity*



Electrical Excitation Matrices



Other surrogates with continuous monitoring:

- *Adenosine triphosphate*
- *Particle Counts*

Industry Benefits

- High quality pathogen and indicator organism data sets
- Demonstrated baseline MBR removal of *Cryptosporidium* and *Giardia* much higher than minimum 2.5 LRV needed for regulatory compliance



Industry Outreach and Collaboration


WaterReuse SYMPOSIUM 2021

In Collaboration with The Water Research Foundation

Water Environment Federation
the water quality people®
VOLUME 32, NUMBER 11
▶ NOVEMBER 2020

WATER ENVIRONMENT & TECHNOLOGY
WET&
OPERATIONS & ENGINEERING

FEATURE ▶ Reuse



An Indirect Route with Direct Results

Forging a path to reuse for Southern California pushes through a pandemic

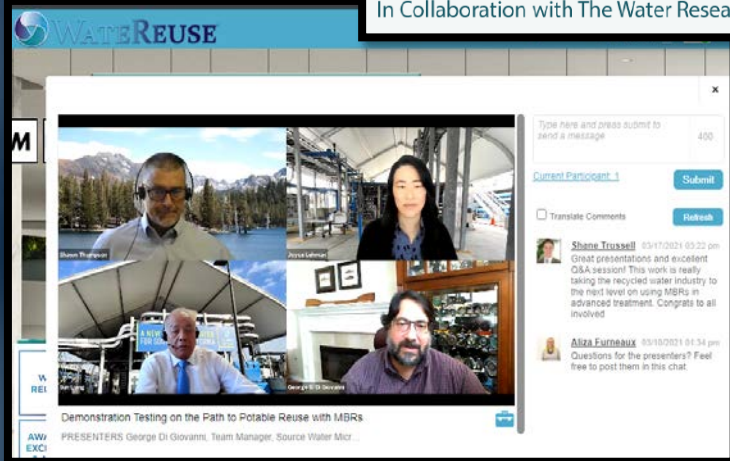
Sun Liang, Joyce Lehman, Heather Collins, Mckley Chaudhuri, Gloria Lal-Bium, Bruce Chalmers, and John Bednarz

The Metropolitan Water District of Southern California (Metropolitan) and the Los Angeles County Sanitation Districts (Sanitation Districts) are partnering on a regional recycled water program to develop a drought-resilient new water source for Metropolitan's member agencies. For Metropolitan and all Southern California, the program offers potentially significant regional benefits. The production of up to 544 million LdF (150 mgd) of purified water for indirect potable reuse (IPRU) can help to maintain groundwater production in Los Angeles and Orange counties.

This new supply has the potential to complement other Metropolitan water supply initiatives by providing reliable replenishment, forcing up impaired water to be placed in storage as a drought buffer. The program also prepares Southern California for a catastrophic earthquake by developing a new reliable water supply wholly within the region. Furthermore, the program can be integrated into the existing regional system and become part of Metropolitan's network of facilities.

While originally conceived as an IPRU-only program, Metropolitan will continue to monitor and

WaterReuse

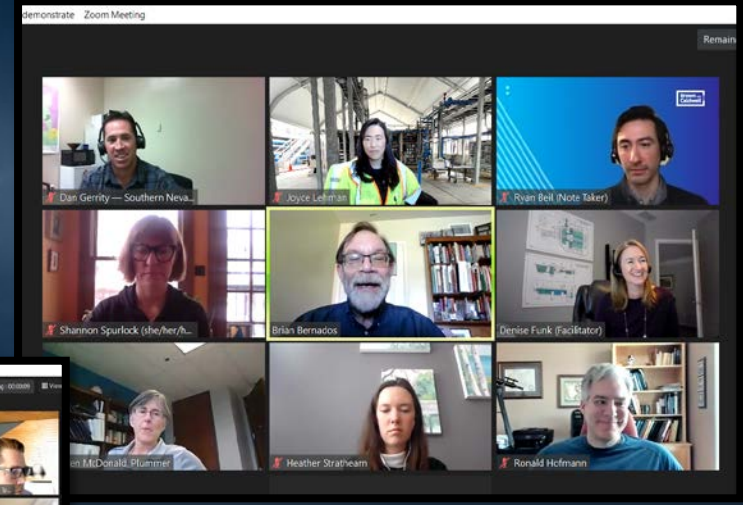


Demonstration Testing on the Path to Potable Reuse with MBRs

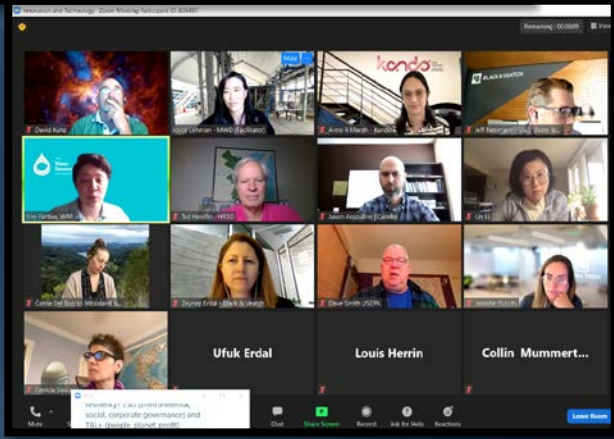
PRESENTERS: George Di Giovanni, Team Manager, Source Water Mgr...

Chat messages:
Shane Trussell: Great presentation and excellent Q&A session! This work is really taking the recycled water industry to the next level on using MBRs in advanced treatment. Congrats to all involved!
Aliza Furbush: Questions for the presenters? Feel free to post them in this chat.

Demonstrate - Zoom Meeting



Participants visible: Dan Gerrity, Joyce Lehman, Ryan Bell (Note Taker), Shannon Spurlock (she/her/A...), Brian Bernados, Denise Funk (Facilitator), Heather Strathearn, Ronald Hofmann.



Participants visible: Ufuk Erdal, Louis Herrin, Collin Mummert...

AWWA Research Webinar:
Leading Research in the Field
of Potable Reuse
April 2021

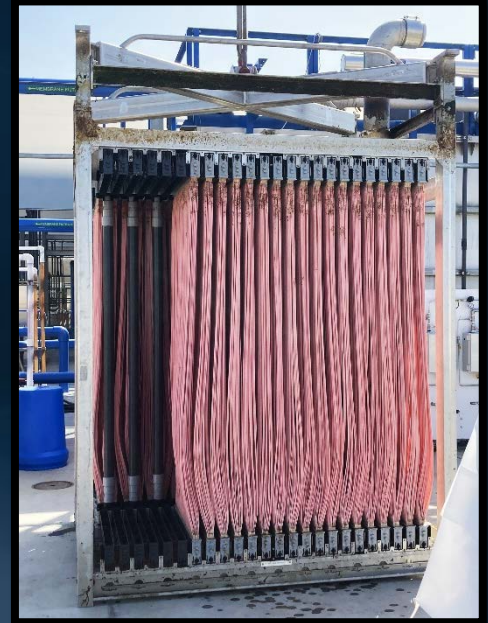
Current MBR Challenge Testing Phase

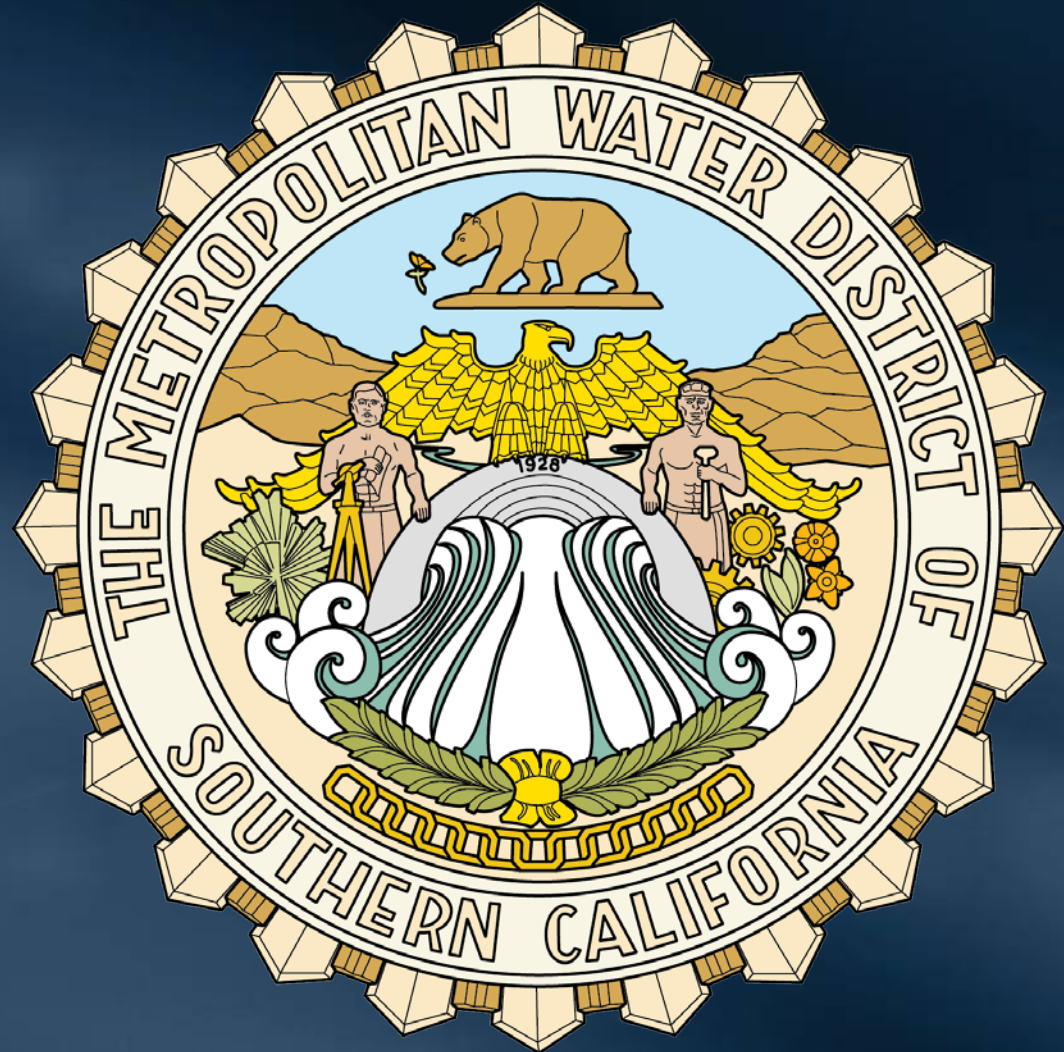
- Assessing performance under damaged conditions to evaluate robustness and integrity of the MBR
- Three challenge test conditions to evaluate pathogen removal through intentionally cut membranes and the reduction in LRVs
- LACSD is sampling RO concentrate to evaluate compliance with ocean discharge requirements



Next Steps

- Tertiary MBR testing anticipated to be completed in fall 2021
- Secondary MBR testing scheduled for late 2021
 - RFP has been issued for operational support
- Ongoing coordination with LACSD partners, regulators and the Independent Science Advisory Panel (ISAP)
- Sharing research and testing results through industry forums and publications





Targeting ≥ 2.5 LRV (99.7%) Removal of Pathogens through MBR

Unit Process		Typical Reuse Project LRVs			Metropolitan's Proposed LRVs		
		Virus	<i>Crypto.</i>	<i>Giardia</i>	Virus	<i>Crypto.</i>	<i>Giardia</i>
MBR		-	-	-	-	2.5	2.5
MF		-	4.0	4.0	-	-	-
RO		1.5	1.5	1.5	1.5	1.5	1.5
UV/AOP		6.0	6.0	6.0	6.0	6.0	6.0
Free Chlorine		6.0	-	-	6.0	-	-
Train Total LRVs	MF + RO + UV/AOP	13.5	11.5	11.5			
	MBR + RO + UV/AOP				13.5	10	10
	Minimum Required	12	10	10	12	10	10

