



THE  
**Water  
Research**  
FOUNDATION

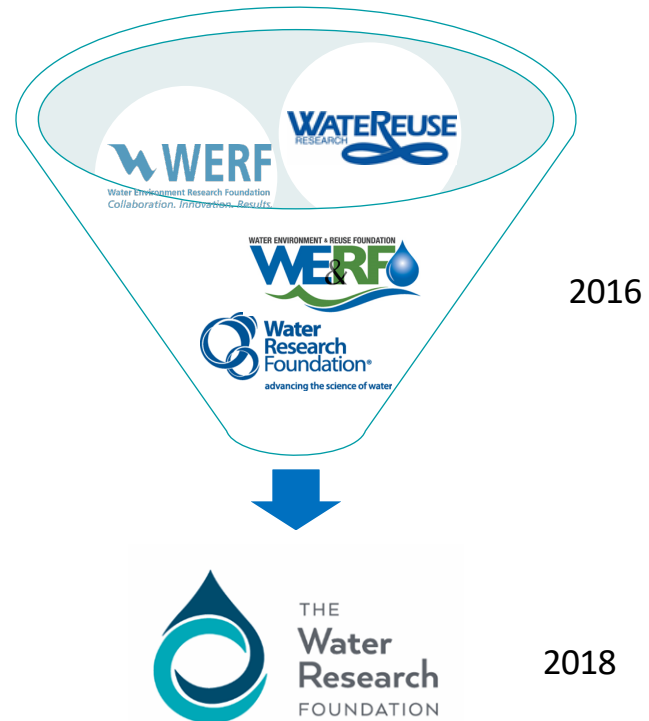
# Promoting Beneficial Reuse of Produced Water through Research

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# Evolution of The Research Foundation



# ABOUT



## MISSION

Advancing the science of water to improve the quality of life

## VISION

To create the definitive research organization to advance the science of all things water to better meet the evolving needs of subscribers and the water sector

## VALUES

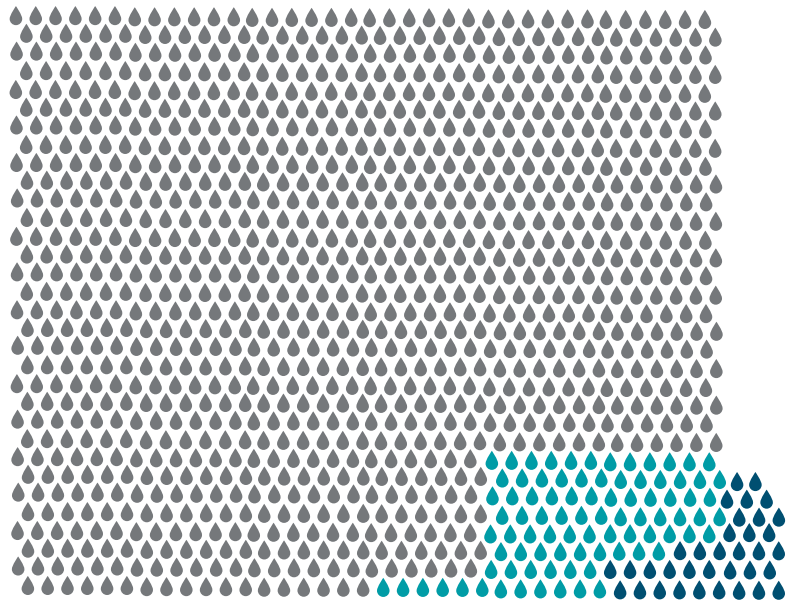
Integrity • Leadership • Respect  
Innovation • Collaboration

# One Water

WRFs research benefits all areas of the water sector, as well as agriculture, energy, watershed management, and other commercial industries.



# WRF AT A GLANCE – 03/31/20



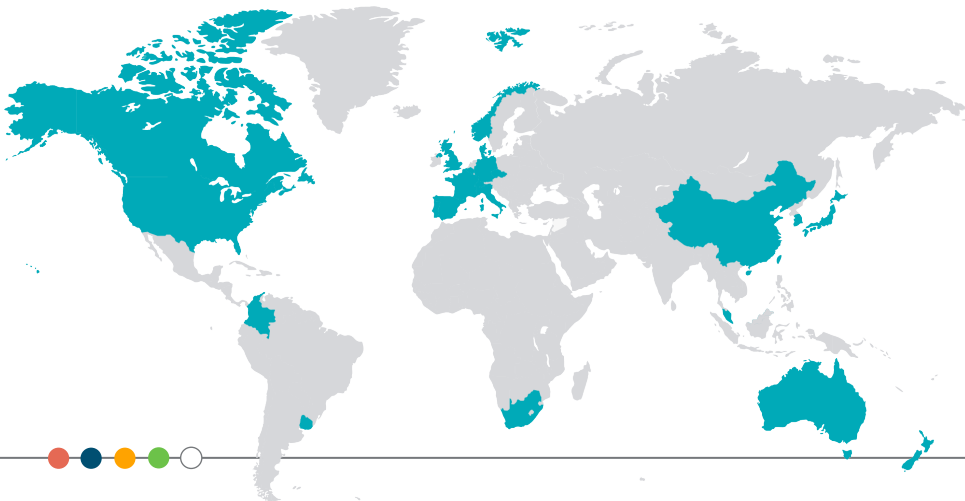
SUBSCRIBERS

1034 UTILITIES

39 MANUFACTURERS

89 CONSULTANTS

The Water Research Foundation operates and affects change on **6 continents**



## PROGRAMS

- Research Priority
- Tailored Collaboration
- Emerging Opportunities
- Unsolicited Research
- Grants/Awards
- Facilitated Research
- Paul L. Busch Award

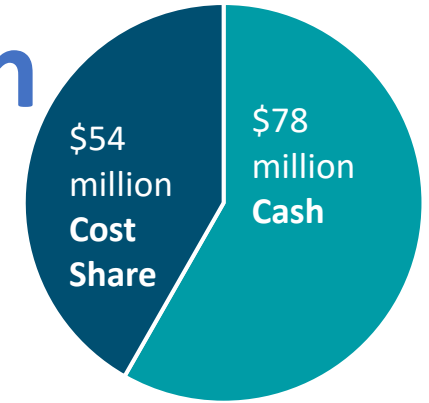
## RESEARCH PRIORITIES

- PFAS & Constituents of Emerging Concern
- Lead & Copper
- Harmful Algal Blooms (HABs)
- Resiliency
- Infrastructure
- Integrated Water Management
- Microplastics
- Nutrients

## FUNDED RESEARCH

# \$132 Million

Contractually Funded Research



## RESEARCH PORTFOLIO

1 Federal Contracts

4 Federal/State Grants



172 Co-funders IN 291 Co-funded projects



# WRF Research Programs

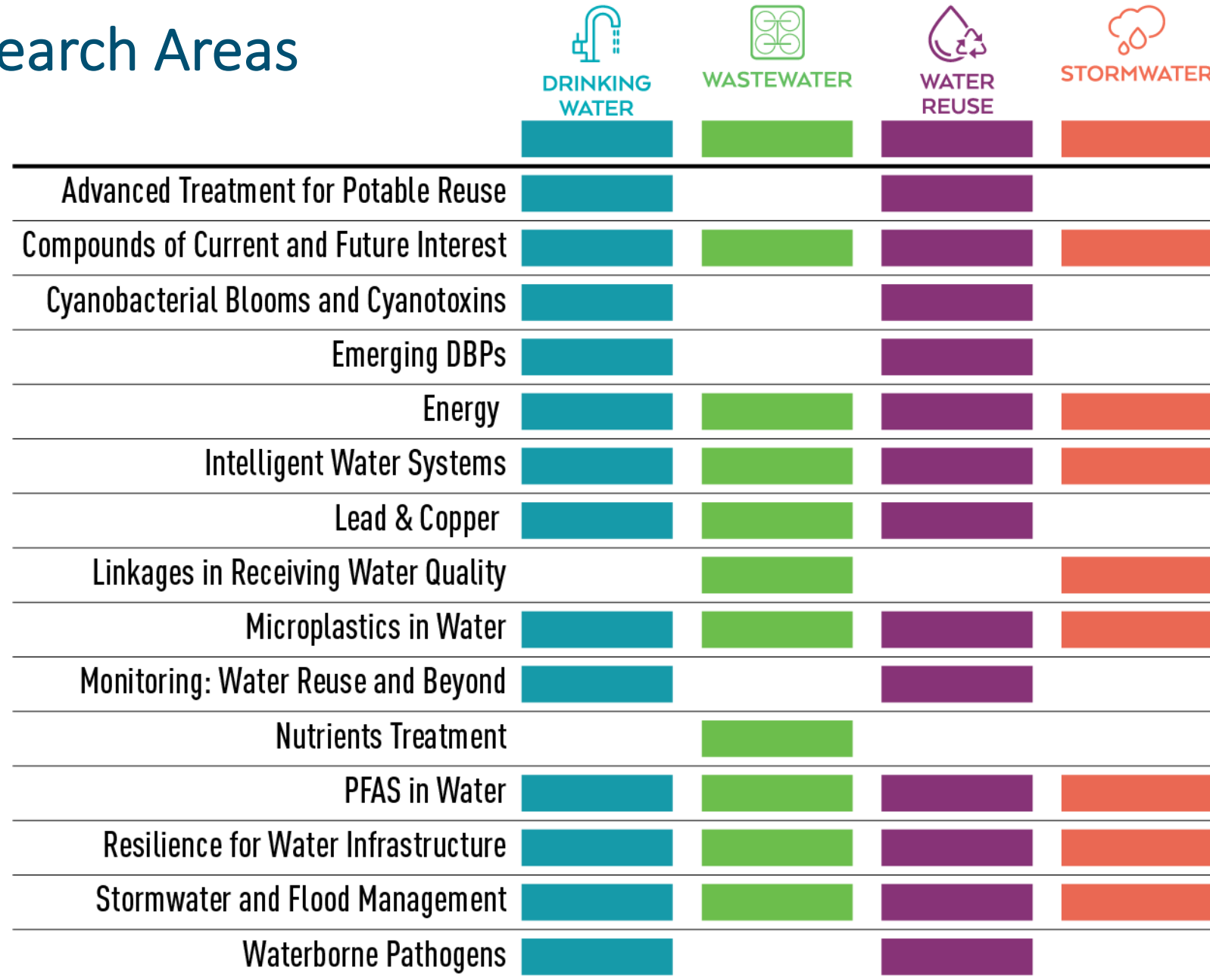
## At-a-Glance: Distinguishing Features of WRF Research Programs

Research Program & Description	% Annual Research Budget	Project Approval	Anticipated Schedule
<b>Research Priority</b> A strategic research program broadly relevant to the water sector	60	WRF Board-appointed Research Advisory Council (RAC)	April/March
<b>Tailored Collaboration</b> A matching program designed to support utility-specific/regional issues	20	WRF Board-appointed Tailored Collaboration Review Committee	Pre-proposal & proposal period starts 2 QTR project selection 3 QTR
<b>Emerging Opportunities</b> A program to address emerging and time critical issues; additionally, supports partnering opportunities and add-ons to current projects	10	WRF Board Executive Committee	Rolling
<b>Unsolicited Research</b> A program that focuses on novel, transformative research	10 <sup>†</sup>	WRF Board-appointed RAC	Opening in 2020
<b>Facilitated Research</b> A program that is fully funded by the project team	0	WRF CEO and leadership team	Rolling

<sup>†</sup>While research budget is allocated to this program annually, research-project funds are released every other year, starting in 2020.



# Current Research Areas



# What constitutes Produced Water Management?

- Freshwater Management
  - Sourcing, Contracting, Delivery
- Produced Water Management
  - Analysis, Treatment, Customized Oilfield Application, Delivery
- Disposal / Treatment Water Handling
  - Analysis, Treatment, Disposal
- Water Remediation – Reuse for Beneficial Uses
  - Analysis, Treatment, Market Analysis, Customized Market Applications, Delivery
    - Drilling and Completions
    - Irrigation
    - Industrial needs
    - Municipal uses
    - Regulatory Water Rights Replacement (Augmentation)

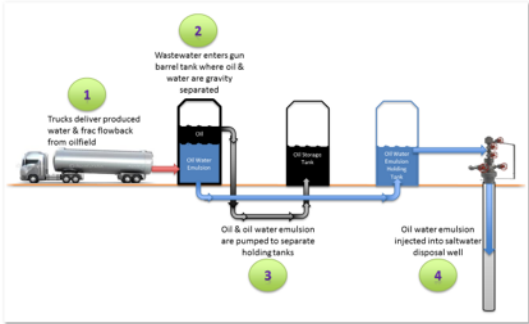
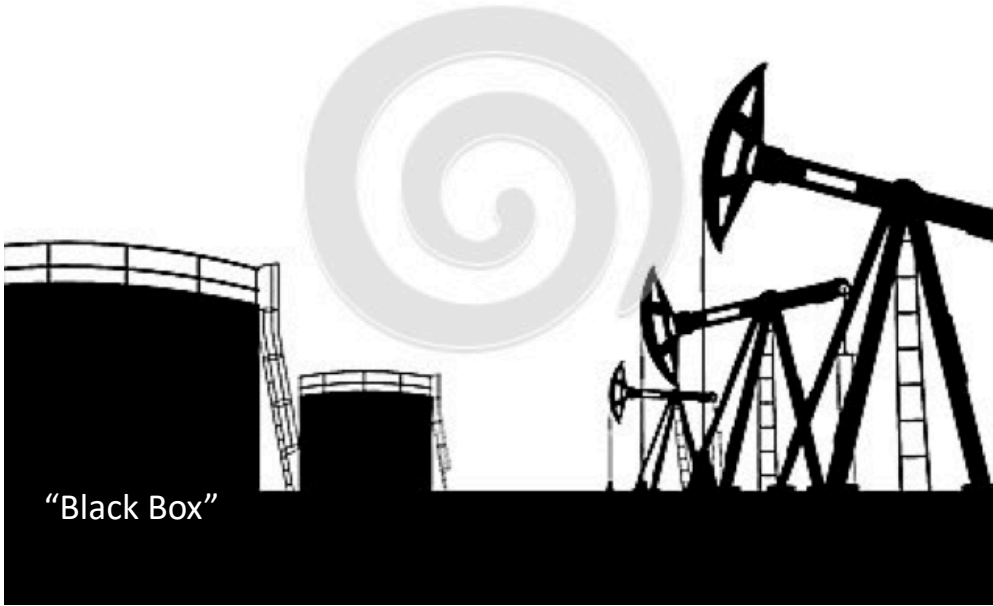


# Water Treatment has become a Commodity for oilfield uses

Treatment philosophy is  
“Fit for Purpose”



# The Ultimate Solution – Multiple Reuse options



## Current Scenario



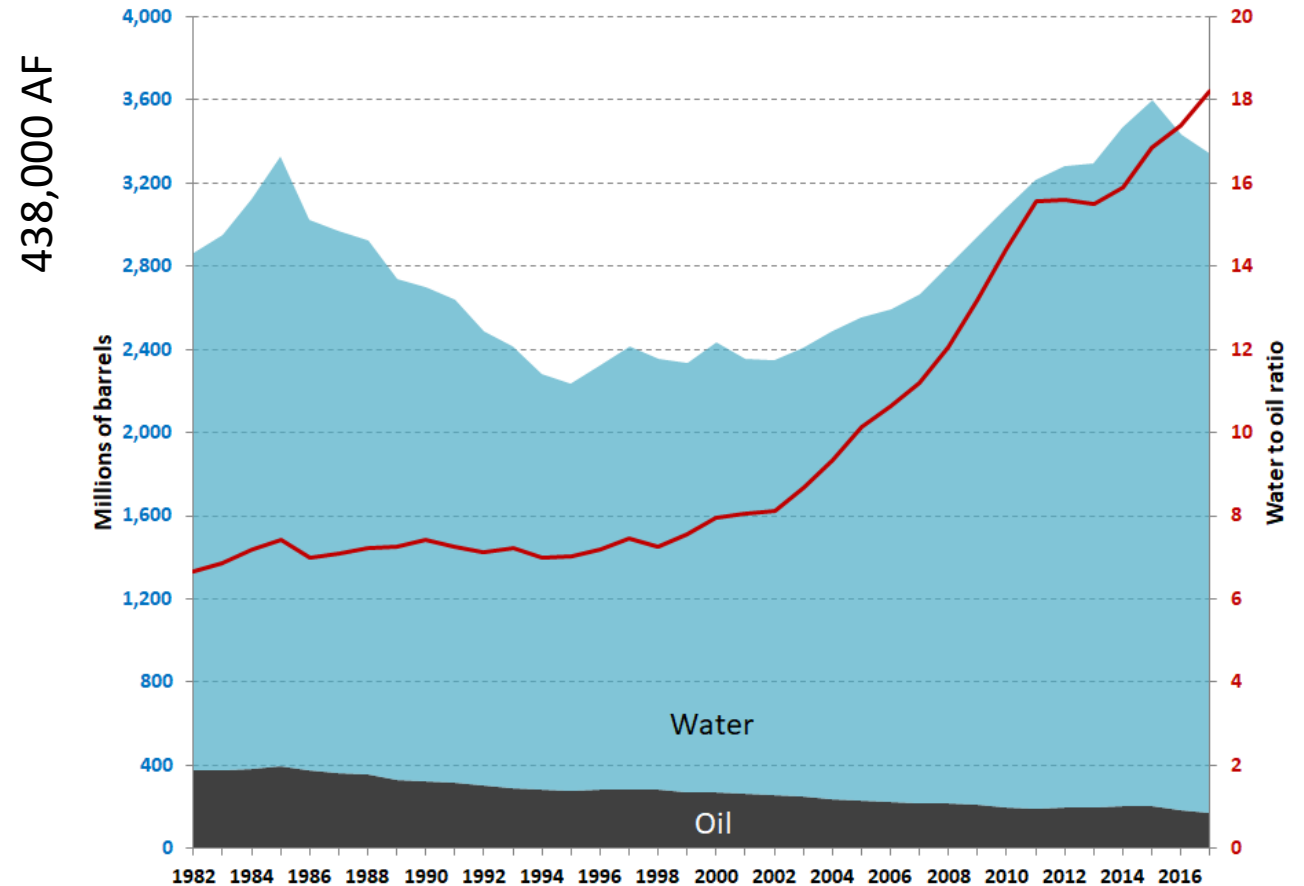
## Workable Solution for Surface Reuse

# Active Project

- **Potential of Oilfield Produced Water for Irrigation In California (WRF 4993)**

- Evaluate Title-22 Recycled Water Regulations as a Science and Policy Template for OPW
- Geospatial Model and Map Potential for OPW Reuse

## Produced Water to Oil Ratio in California is 18:1



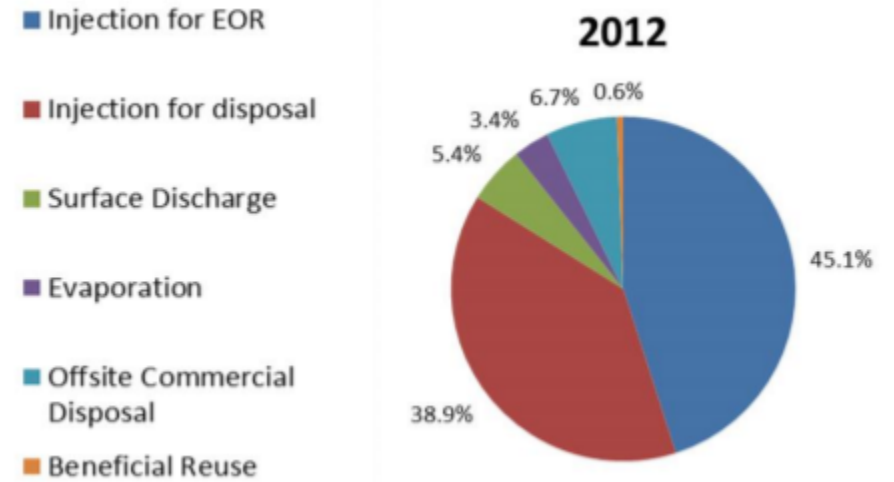
Source: Jordan, 2019

# Why?

## National Interest in Reuse of Produced Water

United States Environmental Protection Agency study: Management of Wastewater from Oil and Gas Extraction. Goal: evaluate surface disposal.

16,200 AF of produced water in U.S. are “beneficially reused.”



Source: Veil 2014



# Why?

## Volumes of Produced Water are a Small Percentage of Human Use

Produced water volume in major oil-producing counties in California compared to water use for other purposes. All values are in million gallons per day (mgd).

County	Public supply & domestic	Industrial (self-supplied)	Irrigation	Mining	Total water use in county	Produced water volume in 2013	Potential for produced water reuse as fraction of total water use
Kern	228	2	1,810	93	2,160	<b>210</b>	10%
Los Angeles	1,413	103	91	94	3,064	<b>98</b>	3%
Monterey	50	2	479	5	546	<b>13</b>	2%
Santa Barbara	74	6	177	6	264	<b>13</b>	5%
Orange	520	18	18	8	765	<b>10</b>	1%
Ventura	167	10	226	9	719	<b>8</b>	1%
Fresno	266	11	2,493	7	2,813	<b>7</b>	0.2%

Notes: Water use estimates are from the U.S. Geological Survey for the year 2010 ([Maupin et al. 2014](#)).

Source: Heberger and Donnelly, 2015

# Value of Municipal Recycled Water Criteria as a Model for Regulating Recycled Produced Water

- Science-based regulations
- Acknowledged scientific uncertainty
- Planned revisions as knowledge improved
- Uniform statewide criteria

# What are the motivations for greater reuse?

- Reliable water source during drought years;
- California's policy framework emphasizes water recycling and efficiency;
- Increasingly desirable water becomes more limited;
- Growing limitations in traditional avenues for produced water disposal.



# What are the barriers to greater reuse?

- Large number of geogenic compounds and anthropogenic chemical use;
- Lack of comprehensive data on produced water quality and its impacts to crops, humans, and ecosystems;
- Lack of thorough scientific and regulatory process to demonstrate adequate oversight.

# What is the potential impact to California water resources?

- Produced water volume is small compared to total agricultural use, even assuming it all could be treated to usable quality.
- Can it outcompete other alternative water sources economically?
- A portion of high-quality produced water is recent recharge.
- California plans to reach net-carbon neutrality by 2045. Is produced water a long-term resource?

# What does it entail?

- Describe the scientific and policy history of how contemporary Title-22 recycled water regulations were drafted and revised;
- Discuss the thinking and rationale behind the regulations that were enacted, especially the fit-for-purpose approach;
- Compare the current status of OPW reuse science and regulation, and recommend a path forward to create a similarly effective and feasible set of regulations

# The Key to Economically Successful Remediation Is Optimizing the SYSTEM

- Water treatment is only part of the solution
- Despite claims of a “silver bullet”, economic water treatment is a commodity business
- Treatment should be “fit for purpose” and no more

- Optimization for Every Scenario
- Feed more Data, reap more benefits!



Thank You!



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