



State Water Board Division of Water Quality's Recycled Water Activities



Brazilian Association of Sanitary
and Environmental Engineers

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Recycled Water, Desal, and CECs Unit Chief
Sustainable Water Plans and Policies
Division of Water Quality

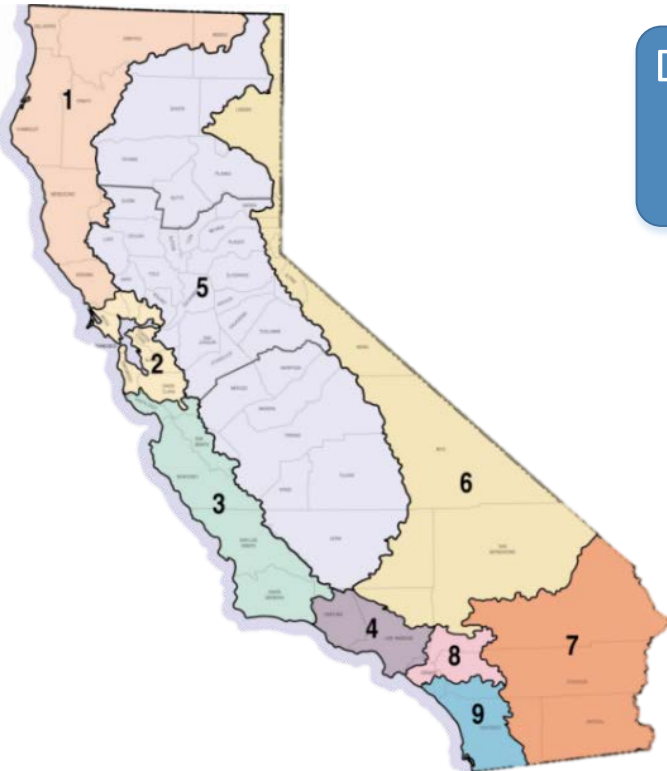
Water Boards and Recycled Water



California Environmental Protection Agency

Regional Water Boards

State Water Board



Division of
Water
Quality

Division of
Drinking
Water

Division of
Water
Rights

Division of
Financial
Assistance

Office of Public
Participation

Office of Research,
Planning, and
Performance

Office of Information
Management and
Analysis



Water Boards and Recycled Water

Division of Water Quality

Groundwater Branch

Sustainable Water Plans and Policies Section

Recycled Water, Desalination, and CECs

Recycled Water Policy

Recycled Water Research

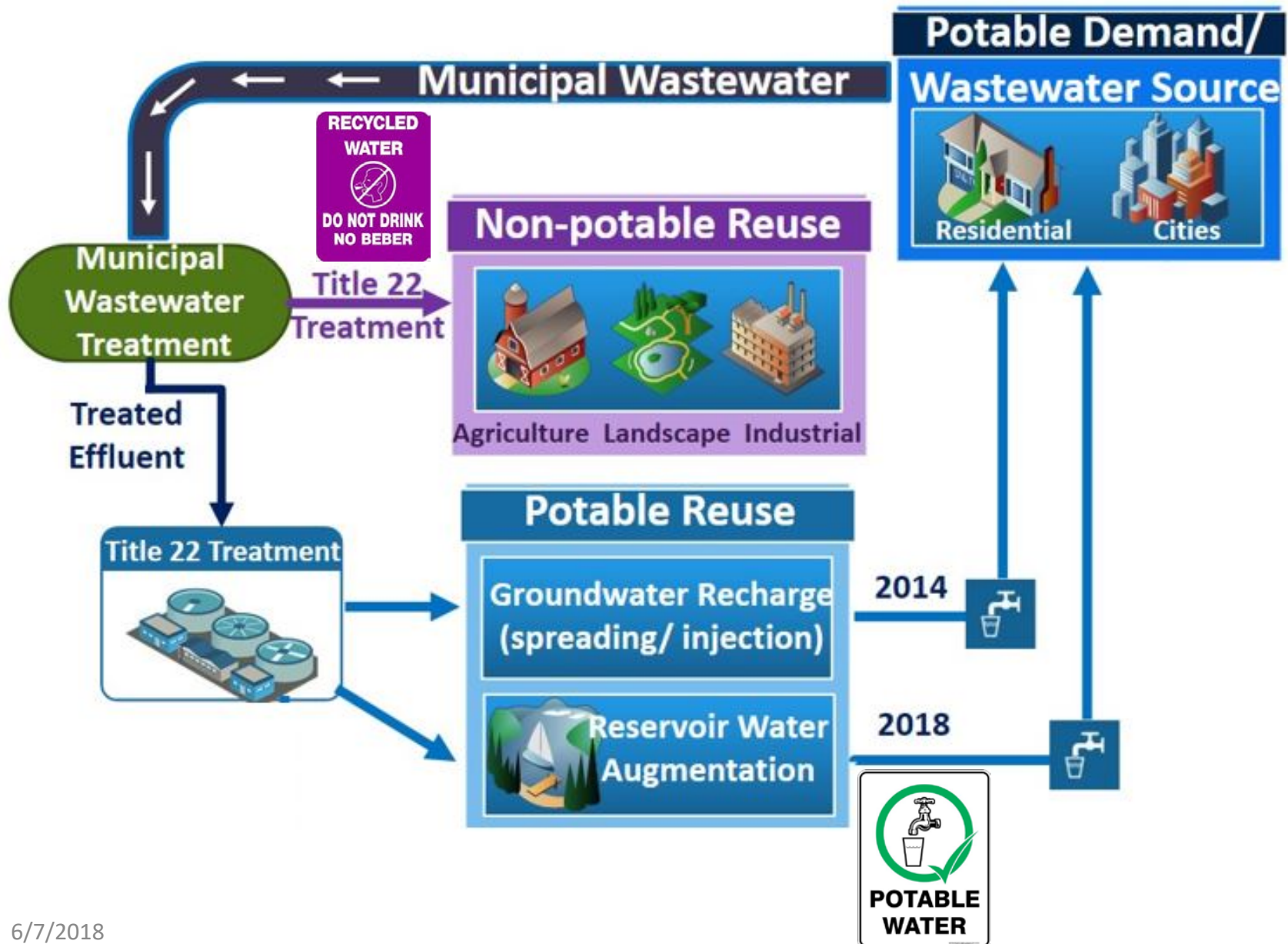
Salt & Nutrient Management Planning

Constituents of Emerging Concern (CECs)

Seawater Desalination

STORMS
Strategy to
Optimize
Resource
Management
of Storm
Water

Recycled Water from Municipal Sources



Undisinfected Secondary

- Non food trees
- Non-milk pasture
- e.g., Non-human seed
- e.g., Pathogen processed food
- Ornamental nursery/sod (restricted)
- Flushing sewers

Disinfected 23

- Cemeteries
- Freeway
- Golf Course (restricted)
- Ornamental/sod (unrestricted)
- Pasture (milk)
- Non-edible vegetation
- Landscape impoundment
- Industrial cooling (no mist)
- Industrial boiler
- Fire
- Backfill consolidation
- Soil Compaction
- Concrete
- Dust control
- Road/sidewalk cleaning



Disinfected 2.2

- Food crop: no contact
- Orchards: no contact
- Vineyards: no contact
- Restricted recreation

Disinfected Tertiary

- Food crops
- Parks/playground
- School yards
- Residential landscape
- Golf (unrestricted)
- Irrigation
- Rec impoundment
- Ind. Cooling
- Flush toilet
- Prime drains
- Industrial w. contact
- Fire (structural)
- Decorative fountains
- Laundries (commercial)
- Backfill
- Snow making
- Car wash (comm.)

Disinfected Tertiary

- Indirect Potable Reuse:
- Groundwater Replenishment via Surface Application

Full Advanced Treatment RO/Oxidation

- Indirect Potable Reuse:
- Groundwater replenishment via Subsurface Application
- Direct Potable Reuse:
- Reservoir Water Augmentation



Est. 2023

Raw water augmentation

Surface Spreading

Direct Injection

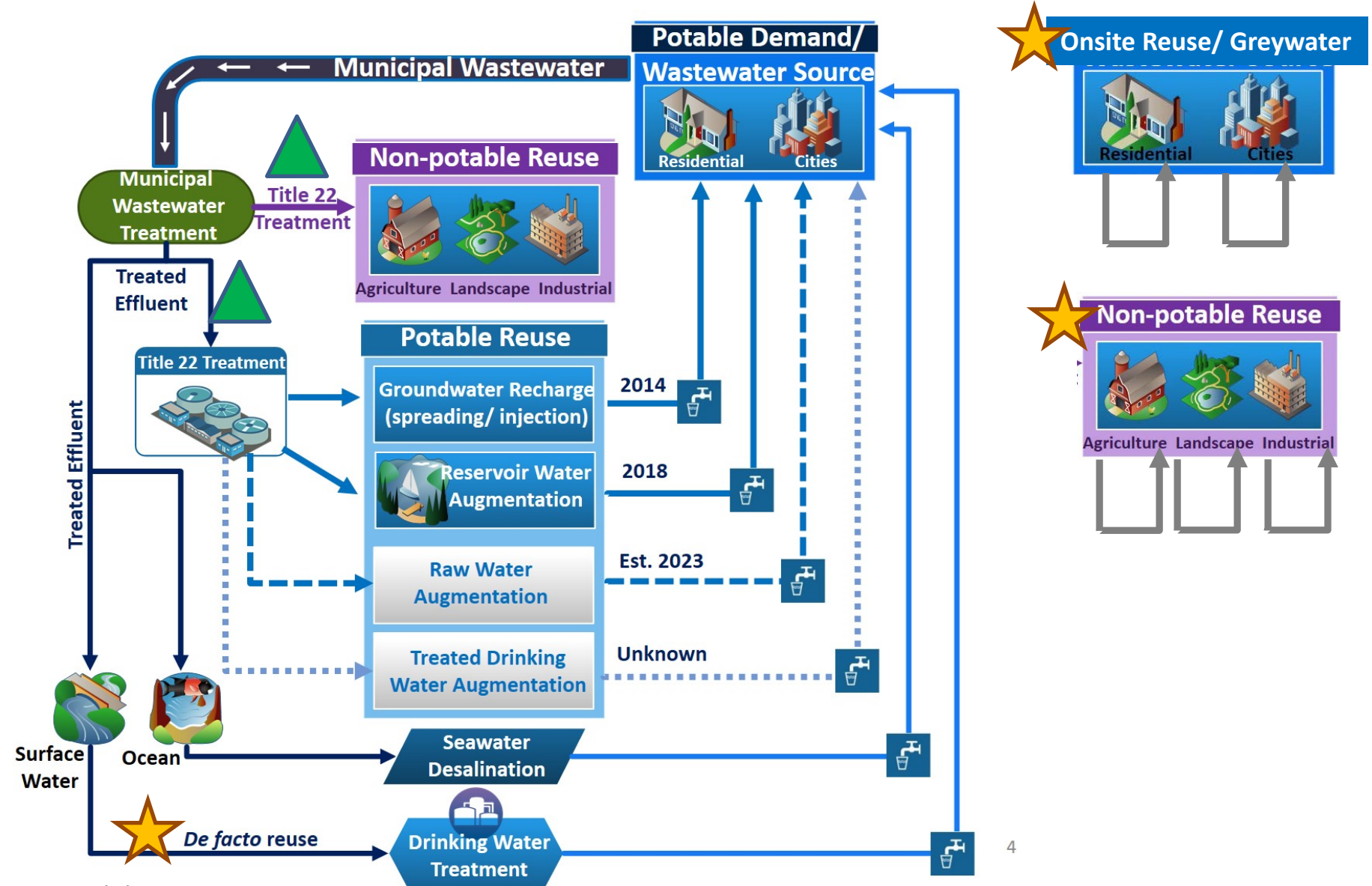
Soil-aquifer treatment

Vadose Zone

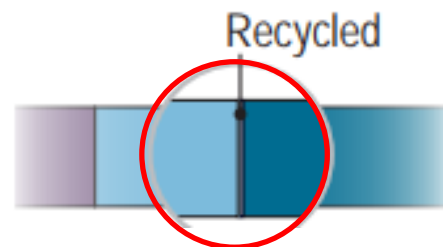
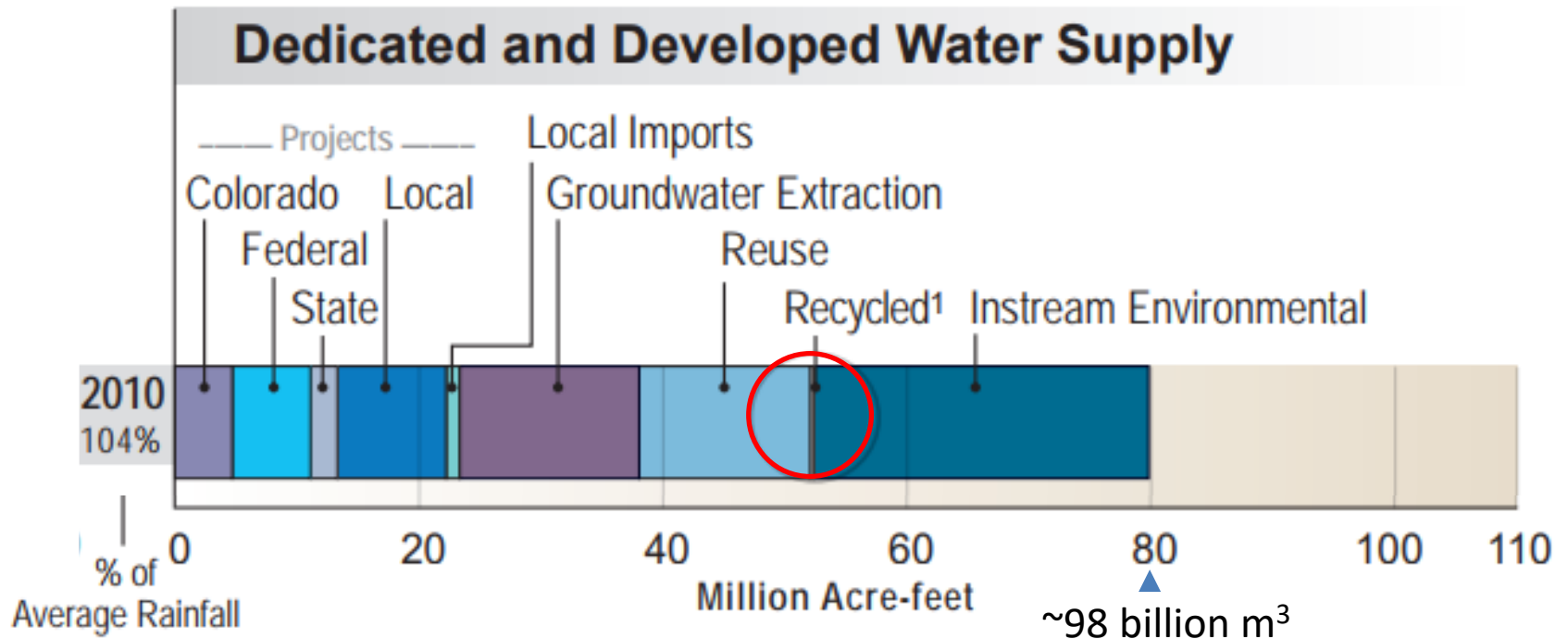
Groundwater



Recycled Water ▲ vs. Reuse ★

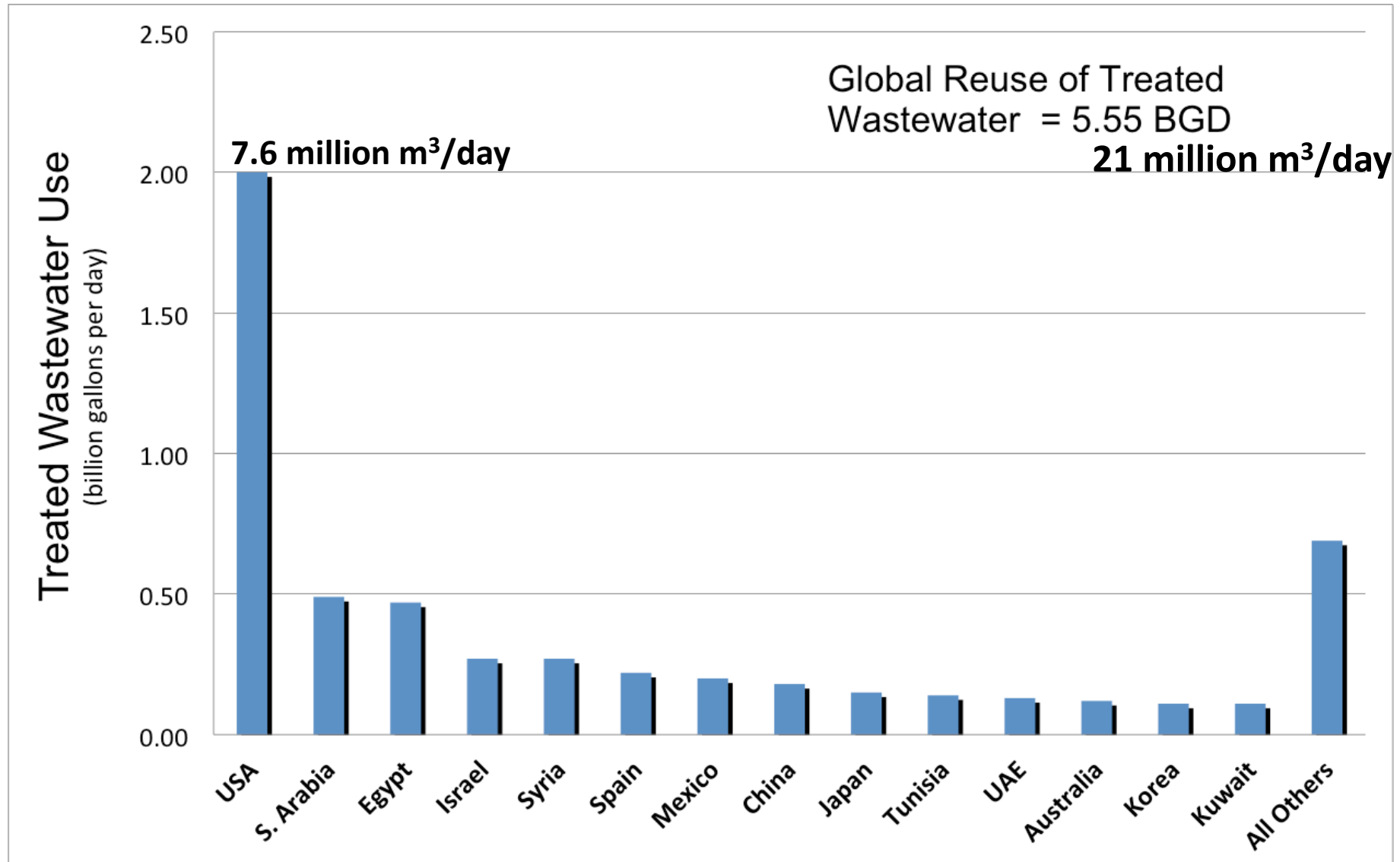


2010 California Water Supply Portfolio

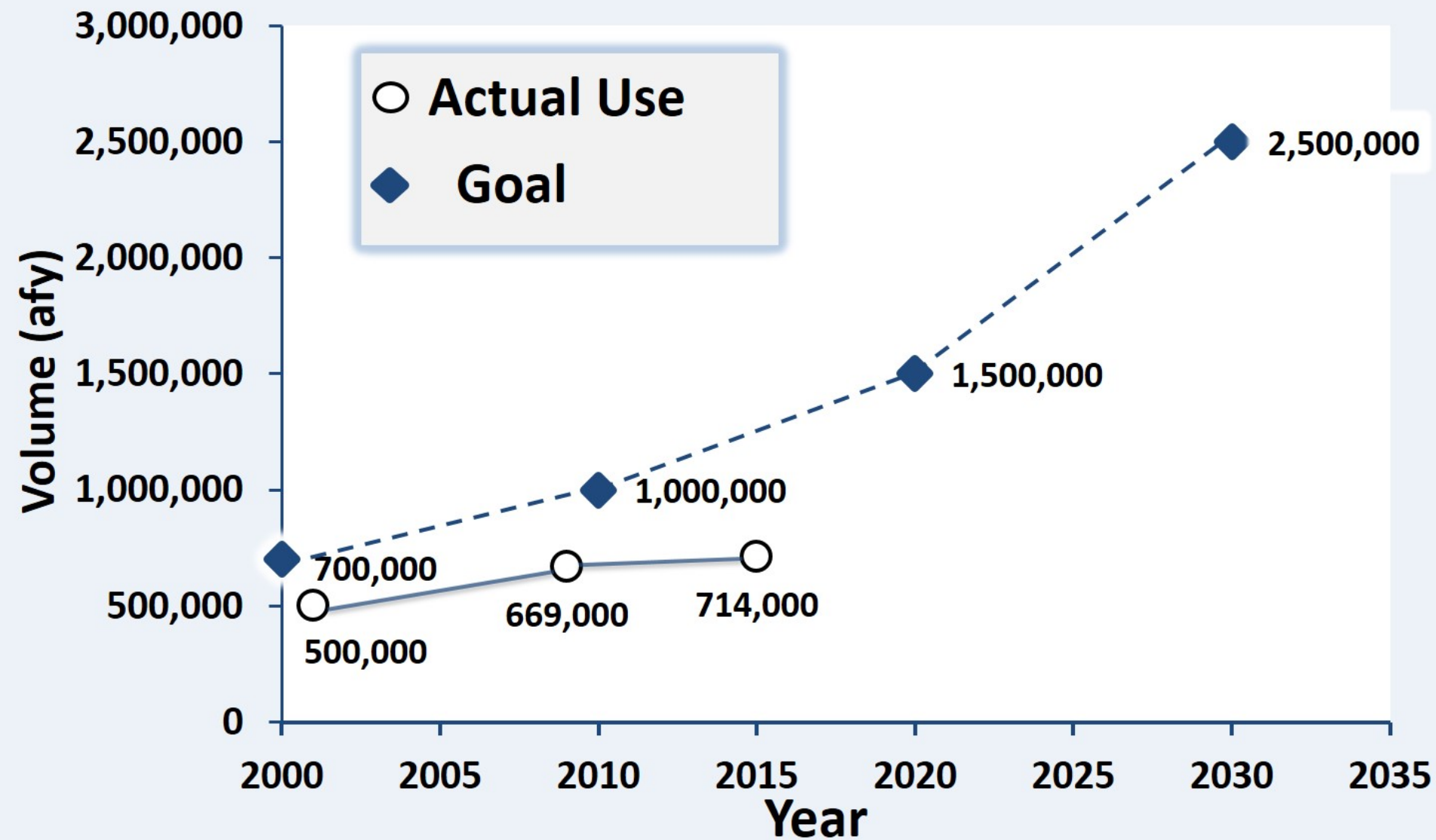


From 2001 – 2010 recycled municipal water varied from 0.2 to 0.7 million acre feet per year (246 billion - 863 billion m³)

Global Reuse of Treated Wastewater



Recycled Water Use and Goals

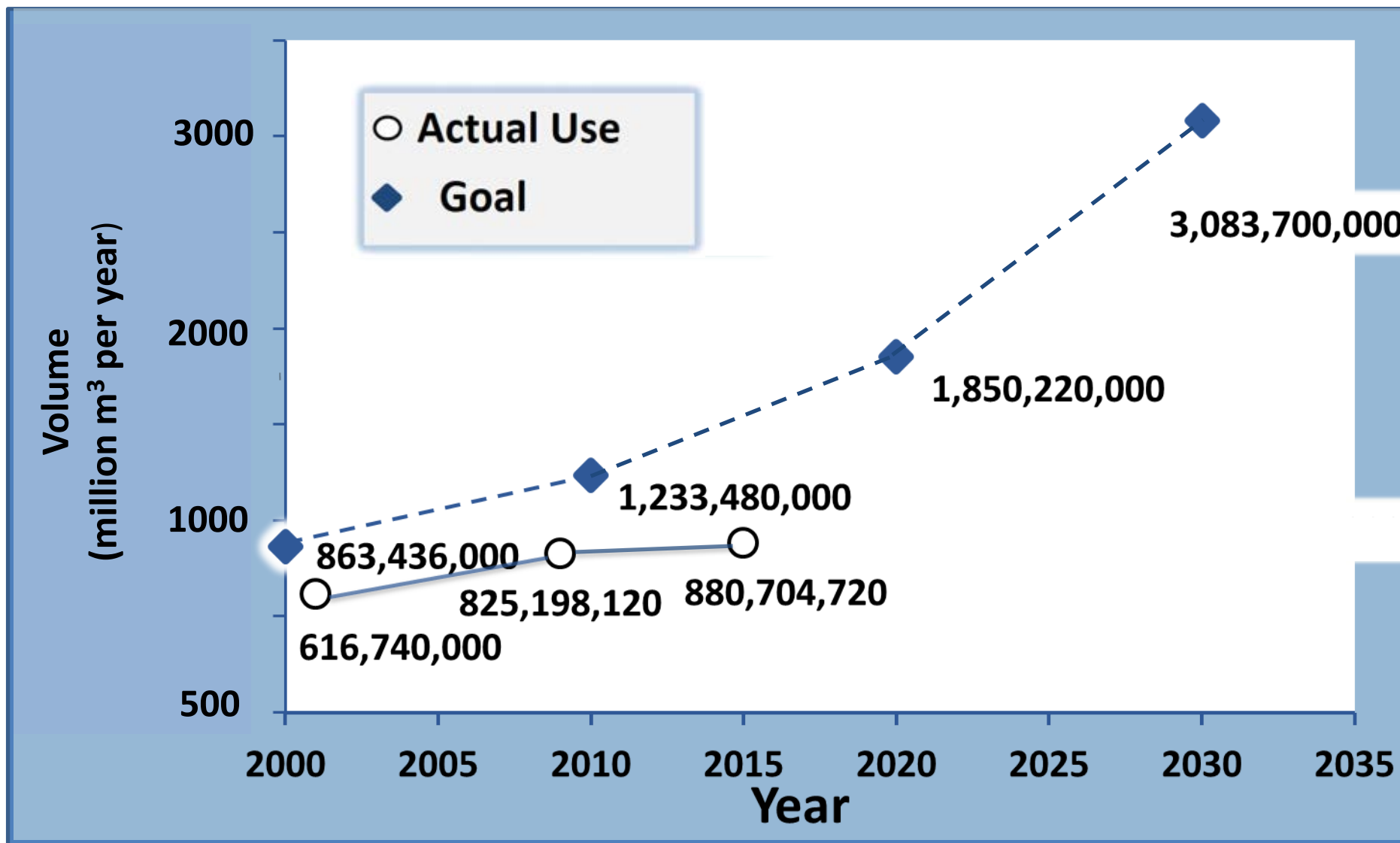


Source: CWC (California Water Plan), Recycled Water Policy (RWP)

Baseline: 2001 Survey, 2009 Survey, 2015 Survey

1 Acre-foot= 1233.48 m³; the volume of water to cover one acre one foot deep

Recycled Water Use and Goals

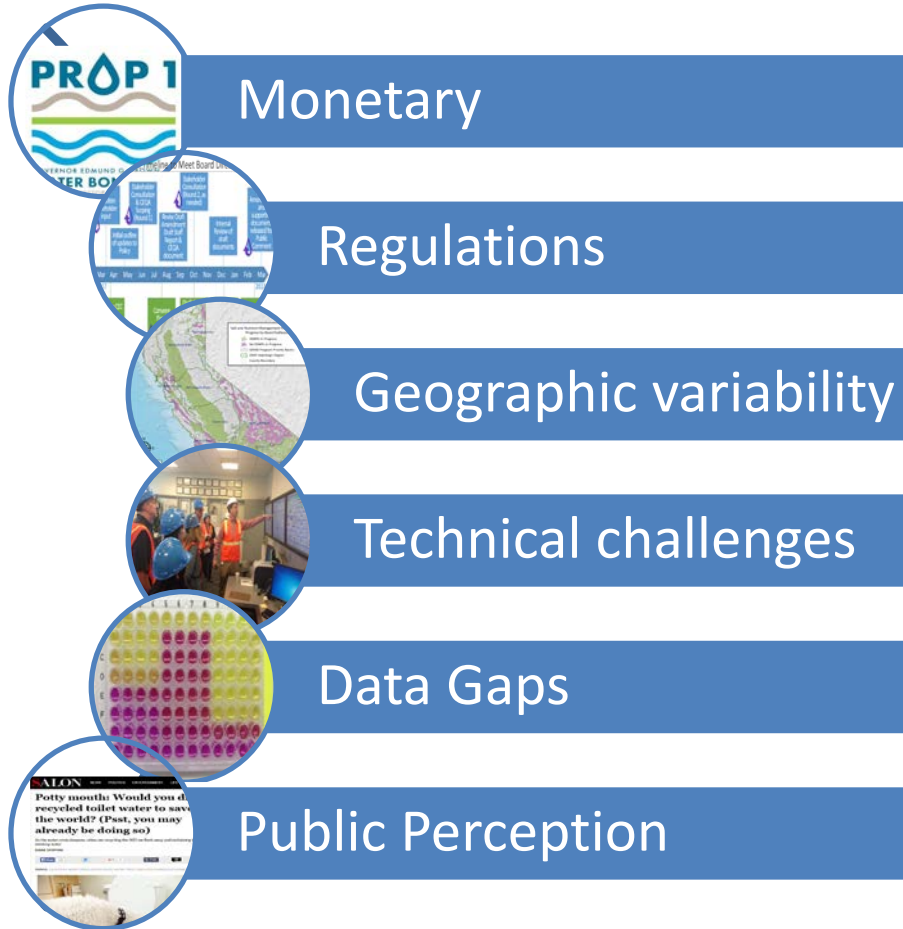


Source: CWC (California Water Plan), Recycled Water Policy (RWP)

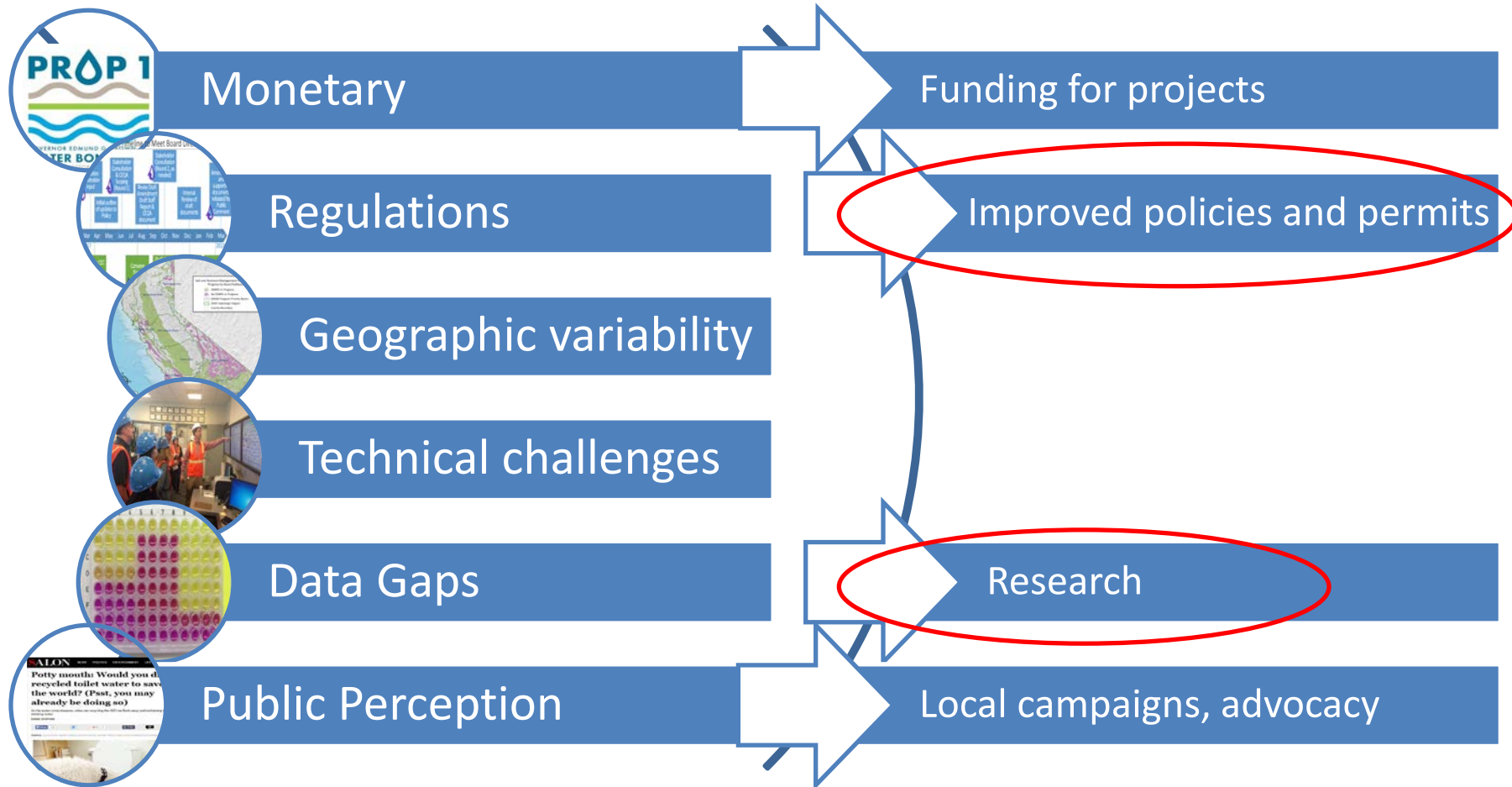
Baseline: 2001 Survey, 2009 Survey, 2015 Survey

1 Acre-foot= 1233.48 m³; the volume of water to cover one acre one foot deep

Impediments to Water Recycling in California

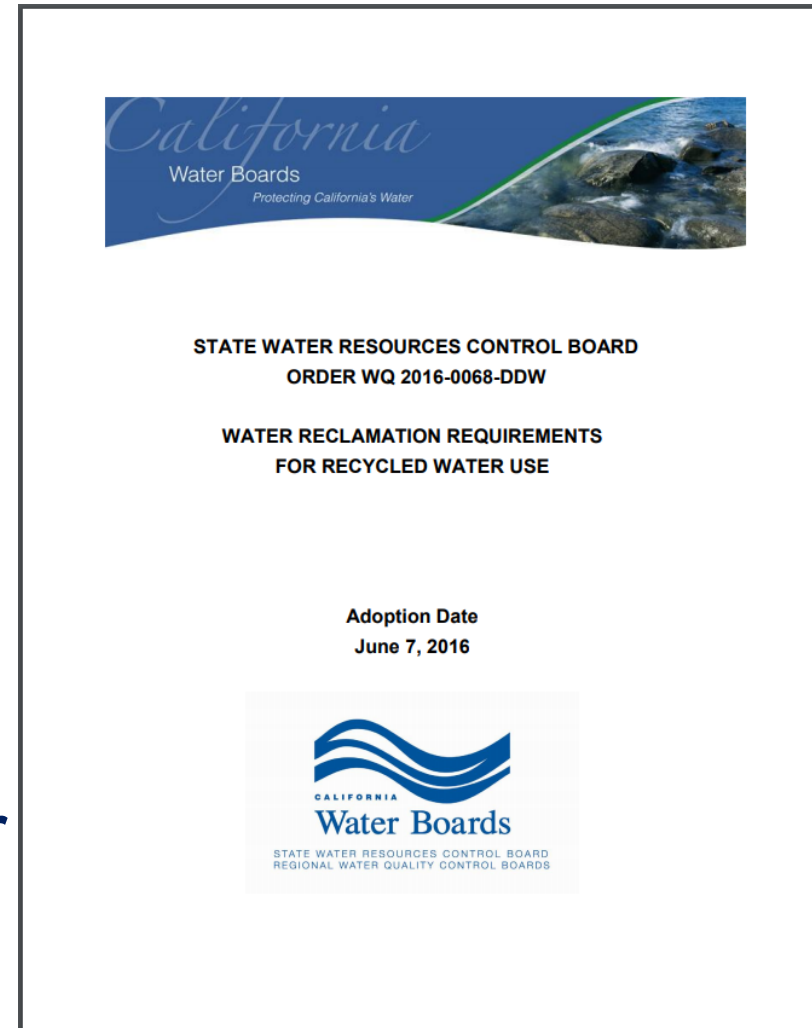


Tools to overcome impediments



Water Reclamation Requirements for Recycled Water Use (General Order)

- Streamlines permitting for non-potable recycled water projects
- Conditionally delegates authority to an Administrator to manage a Water Recycling Program and issue Water Recycling Permits to recycled water users



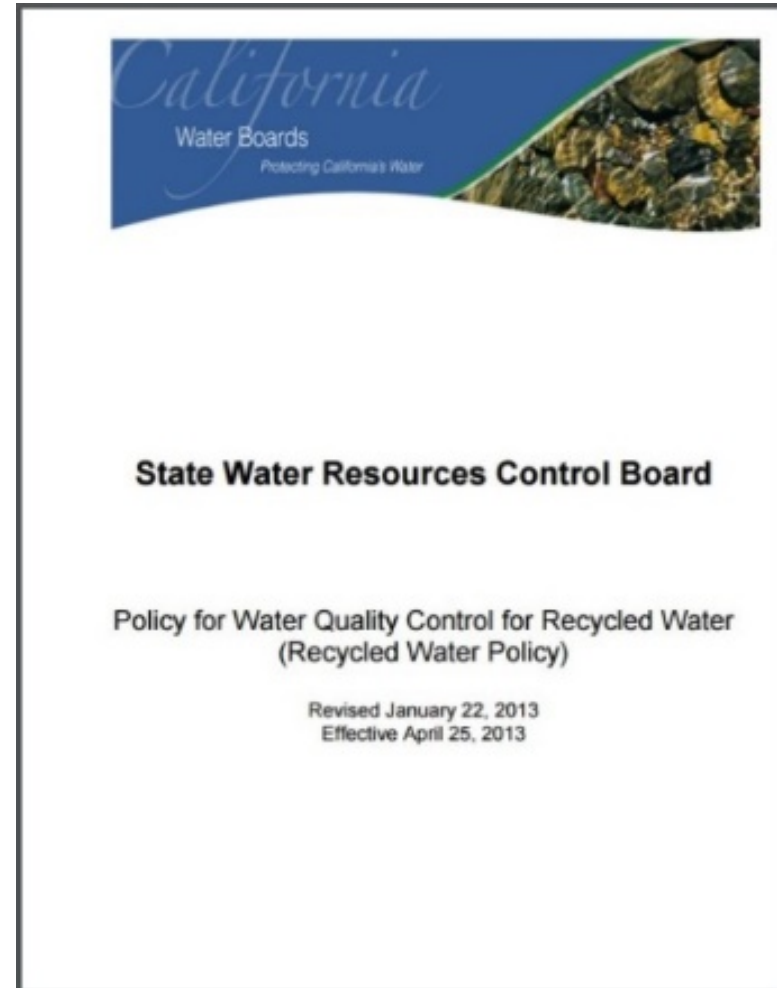
Recycled Water Policy Purpose

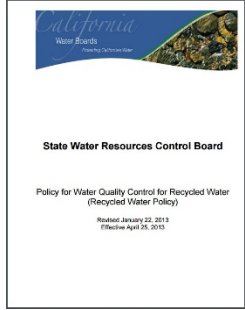
Promote the use of
recycled water while
protecting public health
and water quality
through consistent,
streamlined permitting of
recycled water projects

2009
Adopted

2013
Amended

2016
Resolution



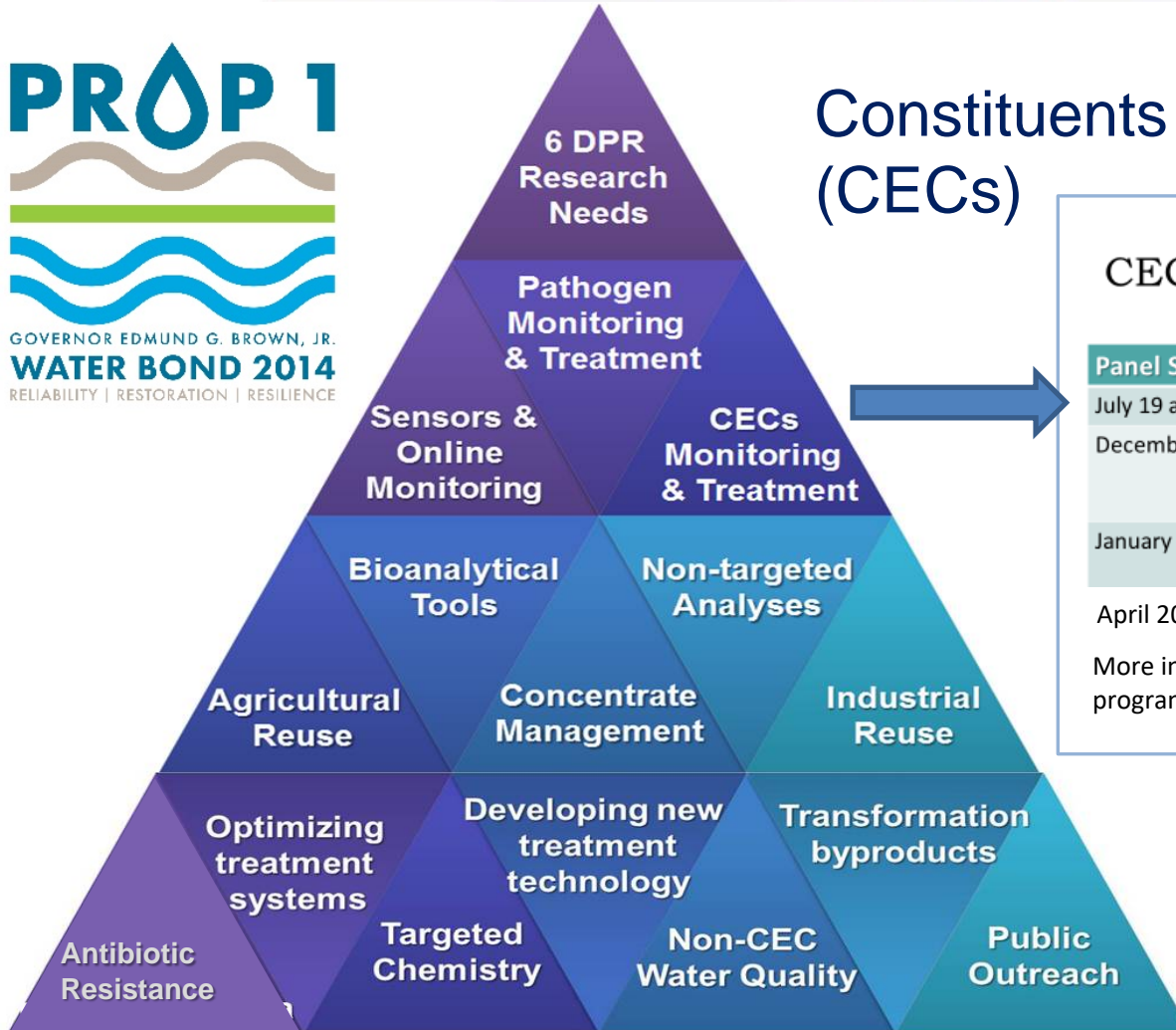


Proposed Amendment to the Recycled Water Policy

- Narrative goal decrease municipal wastewater discharged to the ocean
- Require reporting of production and use
- Identify groundwater basins where salt and nutrient management plans are needed
- Streamline permitting
- Update CEC monitoring requirements



Constituents of Emerging Concern (CECs)



CEC Science Advisory Panel

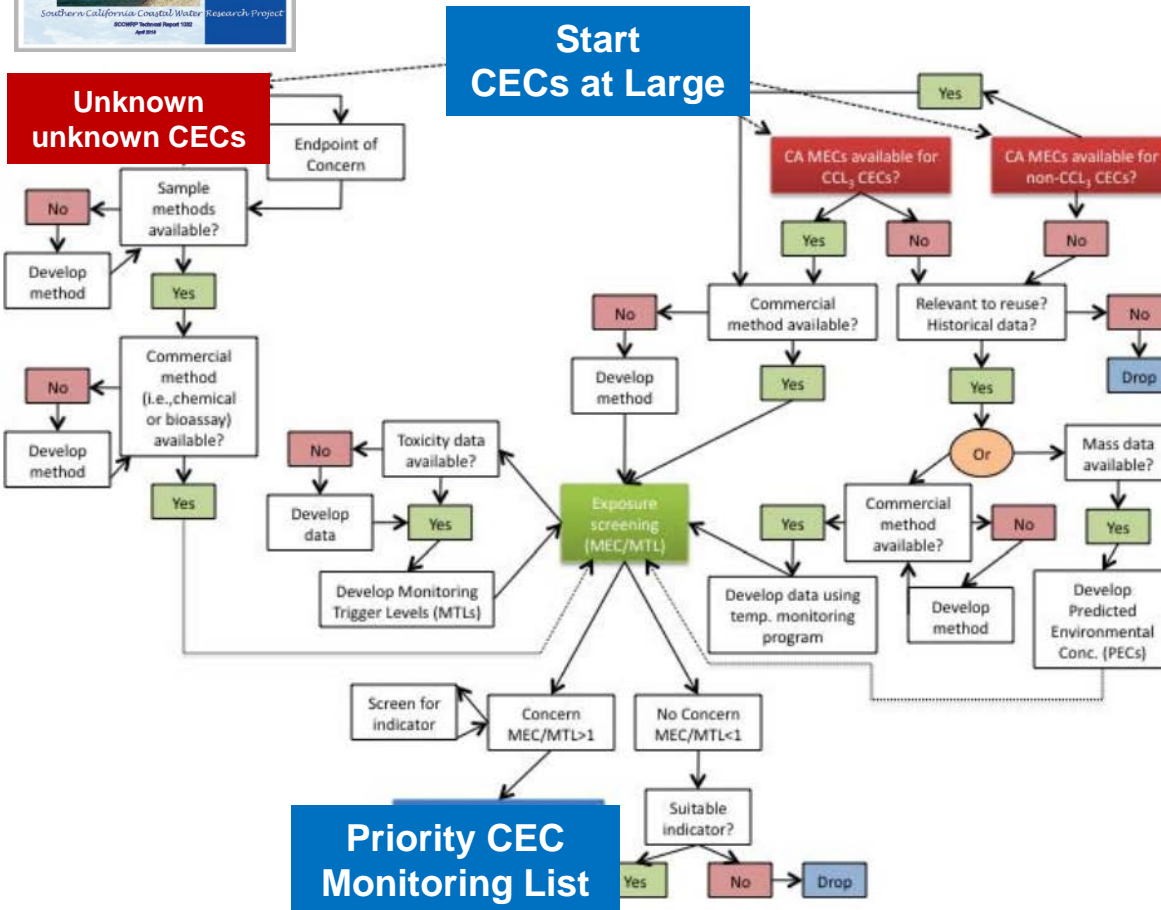
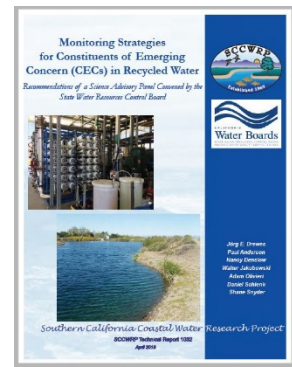


Panel Schedule	
July 19 and 21, 2017	Panel Meeting #1, Costa Mesa, CA
December 15, 2017	Panel Meeting #2 1001 I Street, Klamath Room Sacramento, CA or Webcast
January 2018	Draft Report released for 30 day public comment
April 2018	Final Report

More info: https://www.waterboards.ca.gov/water_issues/programs/water_recycling_policy/recycledwater_cec.shtml

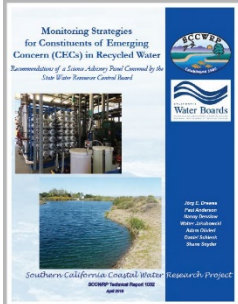
Research Topic Areas

CEC Science Advisory Panel for Recycled Water



- Risk-based approach
- Are there monitoring methods?
- Is it present at a concentration of concern?

Figure 8.1. Conceptual CEC prioritization scheme.



CEC Science Advisory Panel Recommendations

GROUNDWATER RECHARGE - SURFACE APPLICATION

Table 1: Health-based and performance indicator CECs

Constituent	Constituent Group	Relevance/Indicator Type
1,4-Dioxane	Industrial chemical	Health
N-Nitrosodimethylamine (NDMA)	Disinfection byproduct	Health
N-Nitrosomorpholine (NMOR)	Industrial chemical	Health
Gemfibrozil	Pharmaceutical	Performance
Iohexol	Pharmaceutical	Performance
Sucralose	Food additive	Performance
Sulfamethoxazole	Antibiotic	Performance

Table 2: Surrogates for CECs

Ammonia
Dissolved Organic Carbon (DOC)
Nitrate
Total fluorescence
Ultraviolet (UV) Light Absorbance

RESERVOIR WATER AUGMENTATION AND GROUNDWATER RECHARGE - SUBSURFACE APPLICATION

Table 1: Health-based and performance indicator CECs

Constituent	Constituent Group	Relevance/Indicator Type
1,4-Dioxane	Industrial chemical	Health
NDMA	Disinfection byproduct	Health & Performance
NMOR	Industrial chemical	Health
Sucralose	Food additive	Performance
Sulfamethoxazole	Antibiotic	Performance

Table 2: Surrogates for CECs

Electrical Conductivity
DOC
UV Light Absorbance

Table 3: Bioanalytical screening tools for CECs

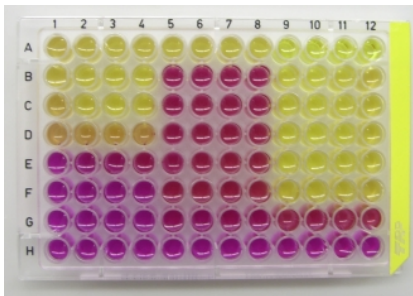
Endpoint Activity	Relevant CECs	Adverse effect
Estrogen receptor- α (ER- α)	Estradiol, bisphenol A, nonylphenol	Feminization, impaired reproduction, cancer
Aryl hydrocarbon receptor (AhR)	Dioxin-like chemicals, polycyclic aromatic hydrocarbons, pesticides	Cancer, impaired reproduction

Improving Analytical Tools for CEC Monitoring

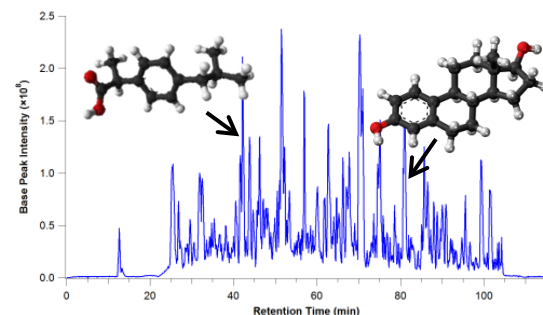
Targeted Chemistry



Bioanalytical



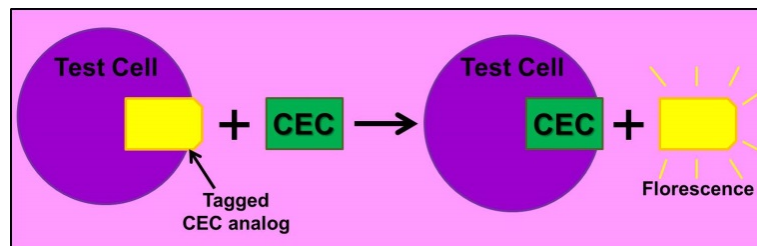
Non-targeted Analytical (NTA)



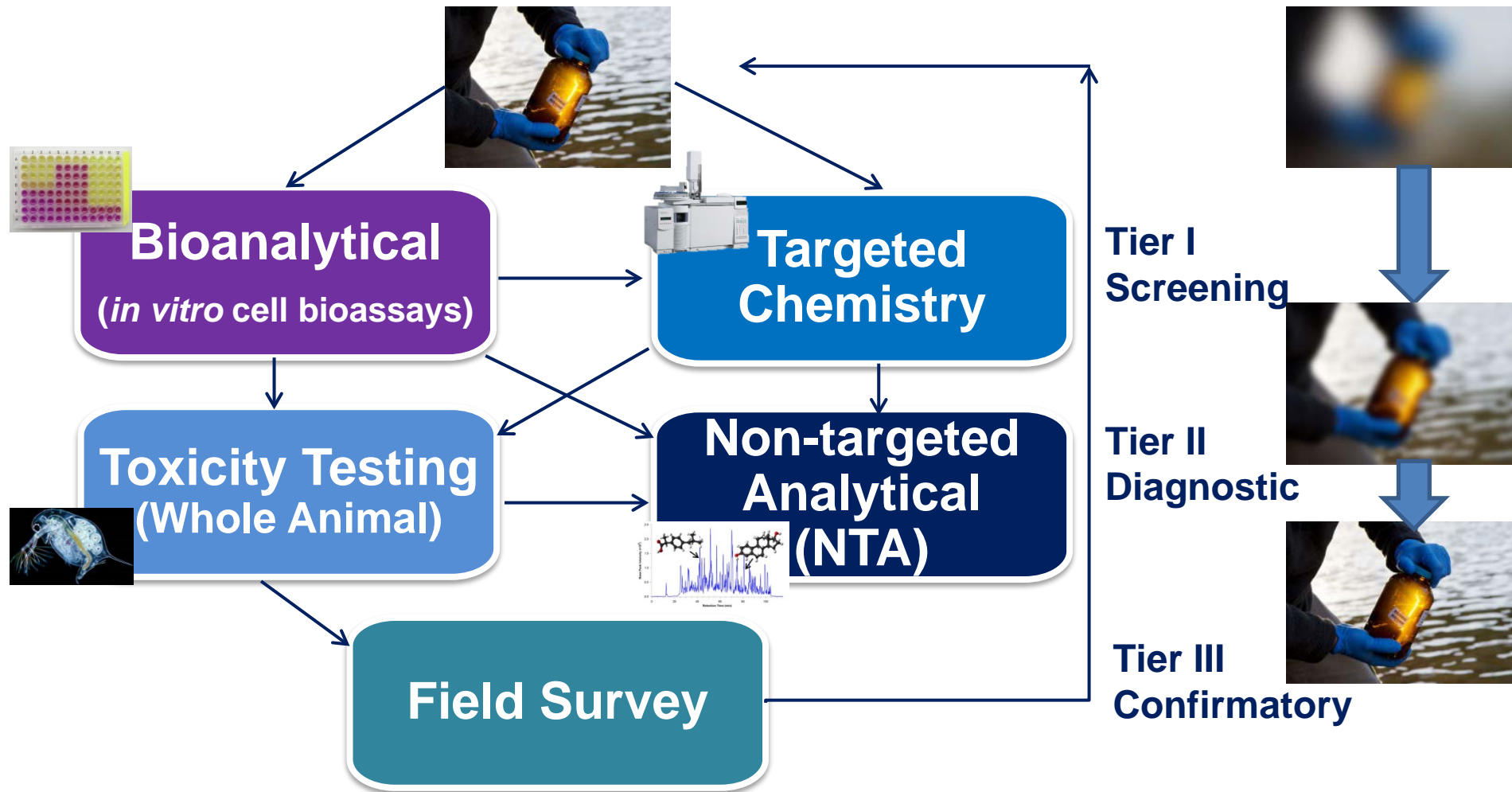
Known Knowns

Known Unknowns

Unknown Unknowns

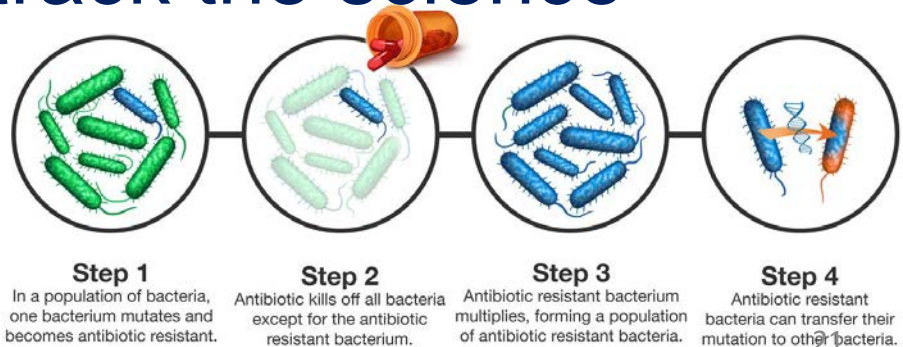


CEC Ambient Monitoring Framework

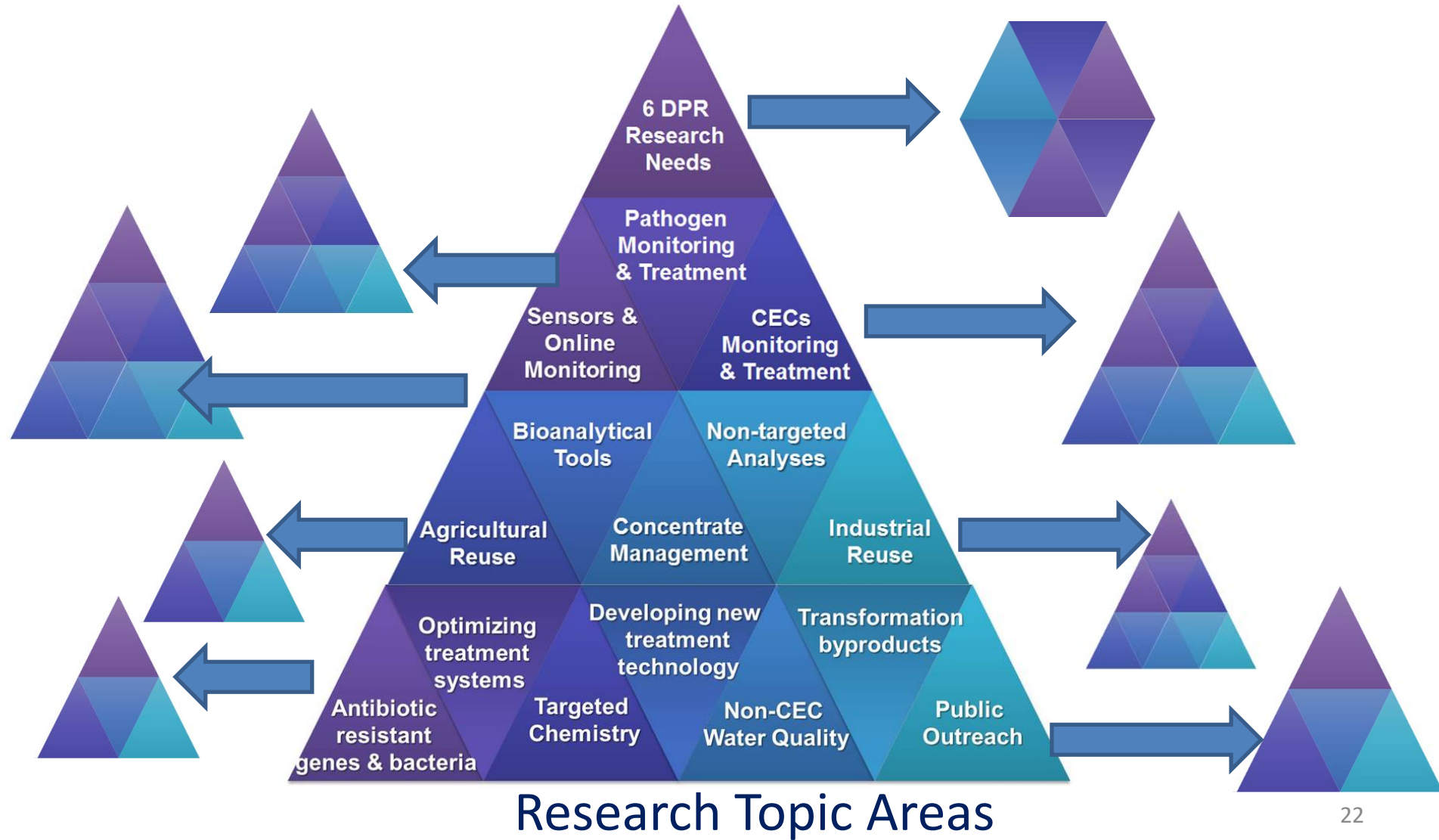


Antibiotic resistant bacteria and antibiotic resistance genes (ARBs/ARGs)

- Potentially an issue for any wastewater discharge into the environment
- Challenging to investigate occurrence, removal through treatment, and risks
- Lack of standardized methods
- Encourage research track the science

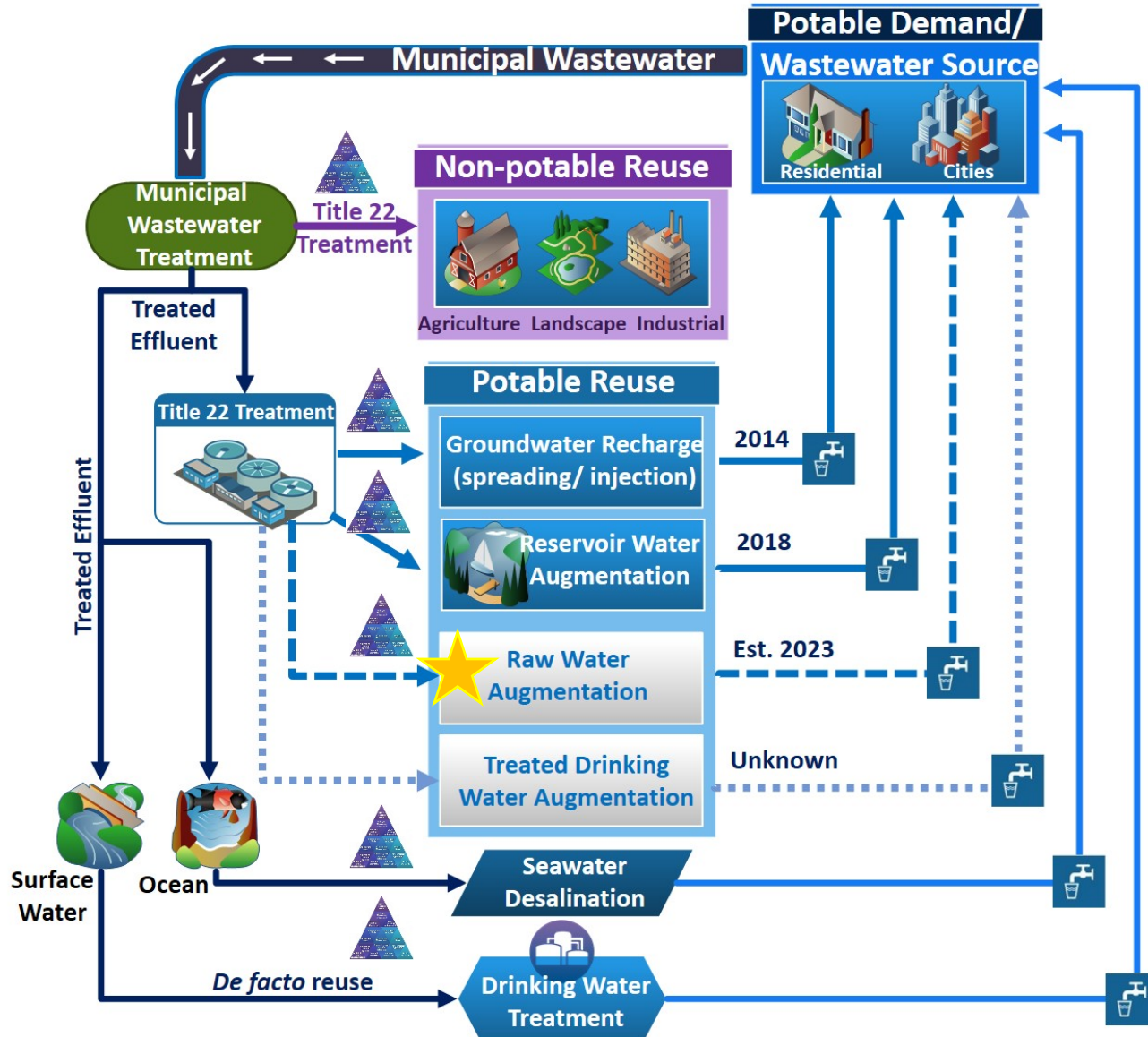


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Research to support potable and non-potable uses of recycled water



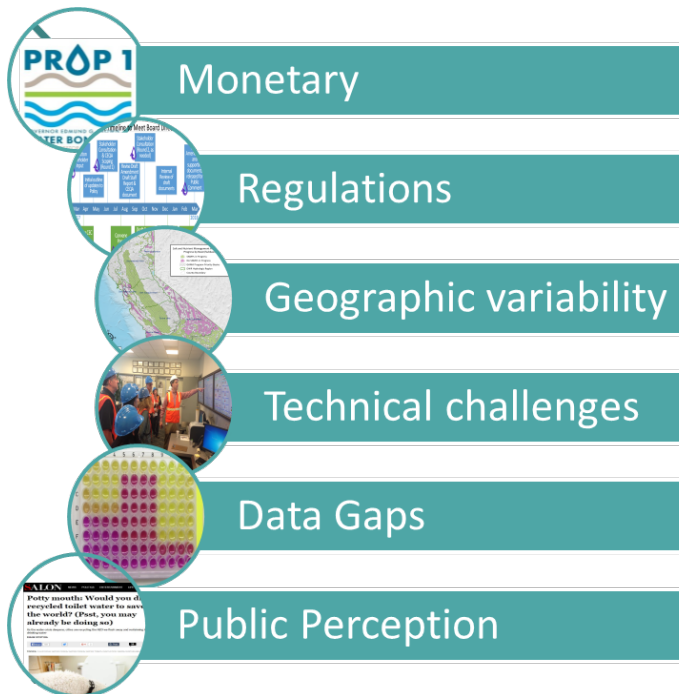
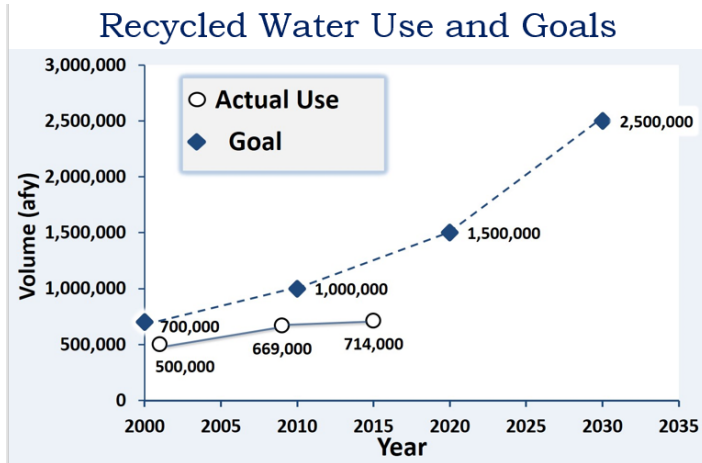
THE
Water
Research
FOUNDATION



- Fill the data gaps
- Expand production and use of recycled water

4

Take Away



Contact Information



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Supplemental Information

Undisinfected Secondary

Disinfected 23

Disinfected 2.2

Disinfected Tertiary

Disinfected Tertiary

Full Advanced Treatment RO/Oxidation

▪ Oxidized wastewater: wastewater in which the organic matter has been stabilized, not subject to decay, and contains dissolved oxygen

- Oxidized wastewater
- Median concentration of total coliform bacteria is less than a MPN of 23 per 100 mL during the last 7 days of analysis
- Total coliform bacteria does not exceed a MPN of 240 per 100 mL in more than one sample in any 30 day period

- Oxidized wastewater
- Median concentration of total coliform bacteria is less than a MPN of 2.2 per 100 mL during the last 7 days of analysis
- Total coliform bacteria does not exceed a MPN of 23 per 100 mL in more than one sample in any 30 day period

- Disinfection by a chlorine process following filtration that provides a CT value of not less than 450 mg-min/L at all times with a modal contact time of at least 90 minutes.
- OR
- Disinfection process combined with a filtration process that demonstrates a 5-log (99.999%) virus removal.

- Median concentration of total coliform bacteria in the disinfected water does not exceed a MPN of 2.2 per 100 mL during the last 7 days of analysis.
- Total coliform bacteria does not exceed a MPN of 23 per 100 mL in more than one sample in any 30 day period.
- A MPN of 240 total coliform bacteria per 100 mL is not exceed for any sample.

- For RO Membranes: Minimum rejection of sodium chloride no less than 99.0%; average rejection no less than 99.2%.
- Tests are operated at a recovery no less than 15%.
- Sodium chloride rejection is based on 3 or more successive measurements.
- Influent pH must be in between 6.5 and 8.0.
- Influent sodium chloride concentration no greater than 2,000 mg/L prior to testing.
- No more than 5% of sample results have TOC concentrations greater than 0.25 mg/L during first 20 weeks of full-scale operation.

- MNP – Most Probable Number
- CT – product of total chlorine residual and modal contact time.
- TOC – Total Organic Carbon
- RO – Reverse Osmosis

Types of Potable Reuse



Regulations adopted in 2014

*Includes advanced treatment through soil aquifer treatment



Regulations adopted in 2018



Regulations mandated by 2023



Regulations, timing unknown

Types of Potable Reuse

- “Indirect potable reuse for groundwater recharge” means the planned use of recycled water for replenishment of a groundwater basin or an aquifer that has been designated as a source of water supply for a public water system
- “Reservoir water augmentation” means the planned placement of recycled water into a raw surface water reservoir used as a source of domestic drinking water supply for a public water system or into a constructed system conveying water to such a reservoir
- “Raw water augmentation,” which means the planned placement of recycled water into a system of pipelines or aqueducts that deliver raw water to a drinking water treatment plant that provides water to a public water system
- “Treated drinking water augmentation,” means the planned placement of recycled water into the water distribution system of a public water system