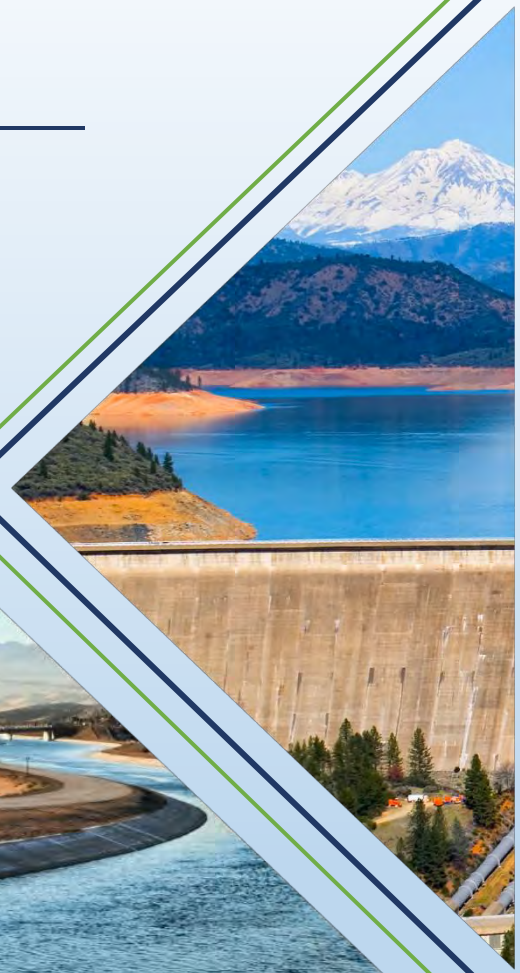
WATEREUSE SYMPOSIUM
SEPTEMBER 10-13
Renaissance Phoenix Downtown
Phoenix, Arizona

Groundwater Recharge with Recycled Water on Agricultural Lands in California (WE&RF 16-03)

October 19, 2017

Dave Richardson



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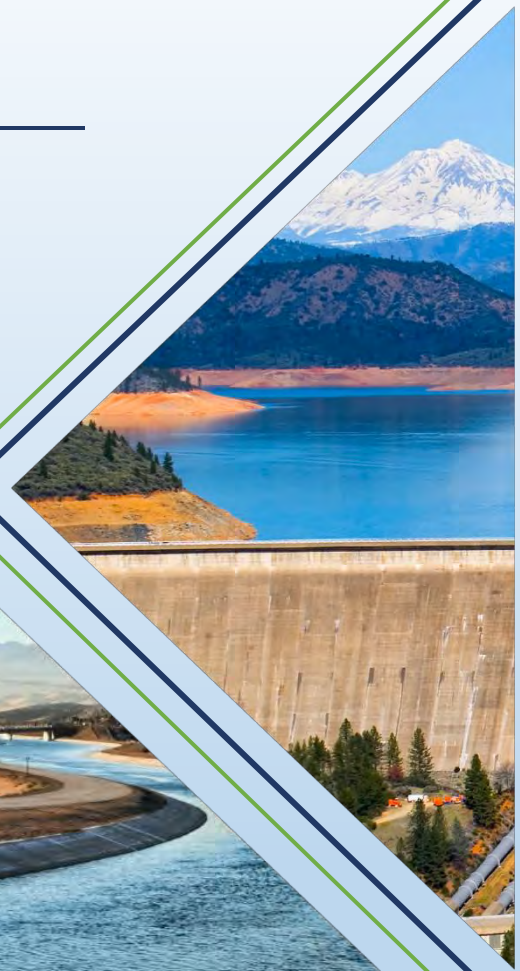

AGENDA

A. Project Status/Background/Benefits
B. Potential Issues Overview
C. Potential Regulatory Issues
D. Next Steps

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Contributors

Research Team

- Woodard & Curran: Dave Richardson, Rob Morrow, Jim Blanke
- Bahman Sheikh
- Prof. Dr.-Ing. Jörg E. Drewes
- Theresa A. Dunham, Somach Simmons & Dunn
- Mike Wackman

Technical Advisory Committee

- Sacramento County Farm Bureau
- California Farm Bureau Federation
- Sustainable Conservation
- The Nature Conservancy
- U.C. Davis
- Regional San (Jose Ramirez)
- North San Joaquin Water Cons. District
- Constellation Brands, Woodbridge Winery

WE&RF Research Manager

- Kristan VandenHeuvel

WE&RF Project Subcommittee

- Chris Impellitteri, USEPA
- Bob Holden, MRWPCA
- Monica Gasca, LACSD
- Katharine Dahm, USBR
- Sally McCraven, Todd

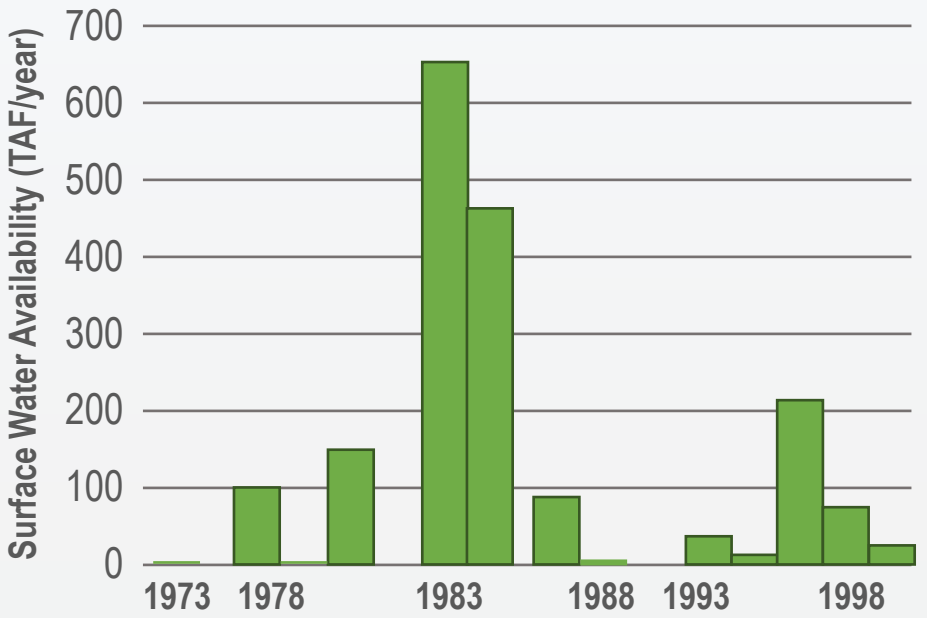
Regulators

- California State Water Resources Control Board
  - Division of Drinking Water
  - Division of Water Quality
- Regional Water Quality Control Boards

Recharge of surface water on agricultural lands is limited by available and reliable supplies

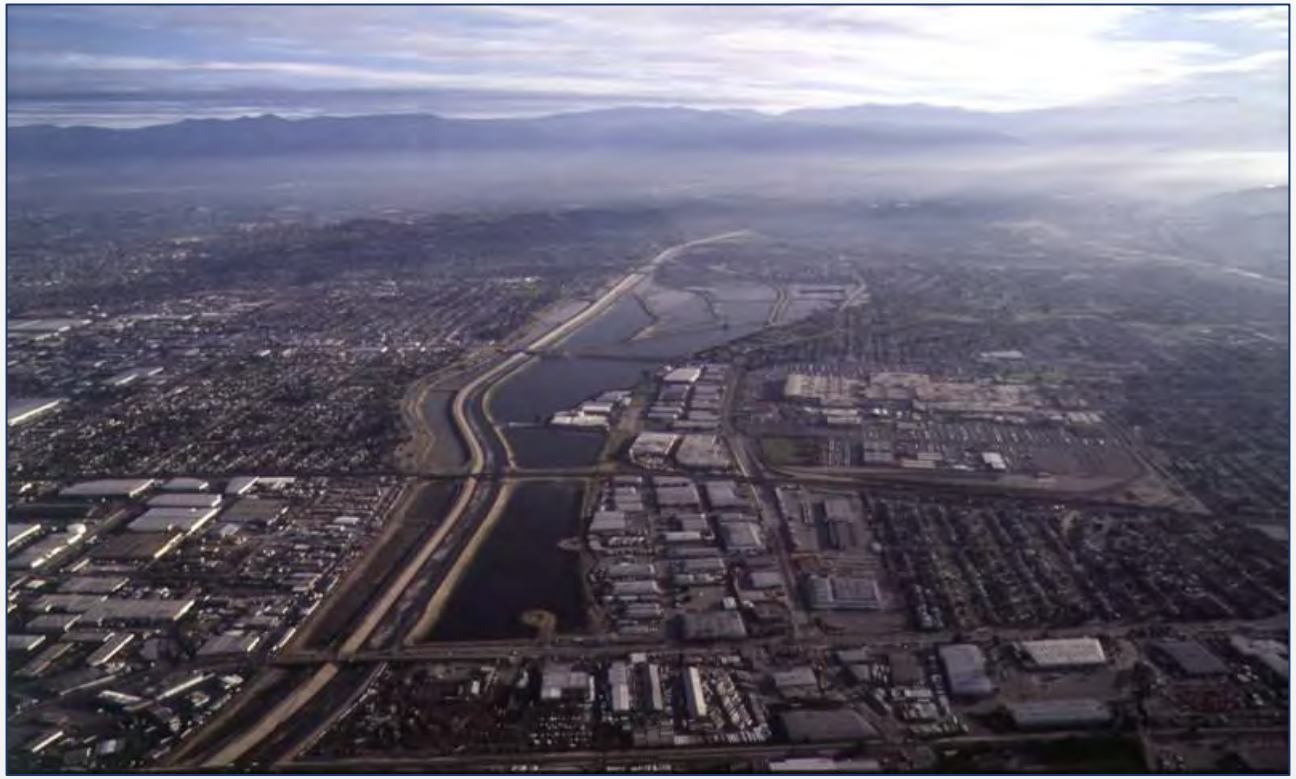
Surface Water Recharge on Agricultural Lands

Example (Kings River, CA) Surplus Surface Water Supply



Groundwater recharge with recycled water maximizes reuse but requires dedicated land for recharge

Montebello Forebay Spreading Grounds



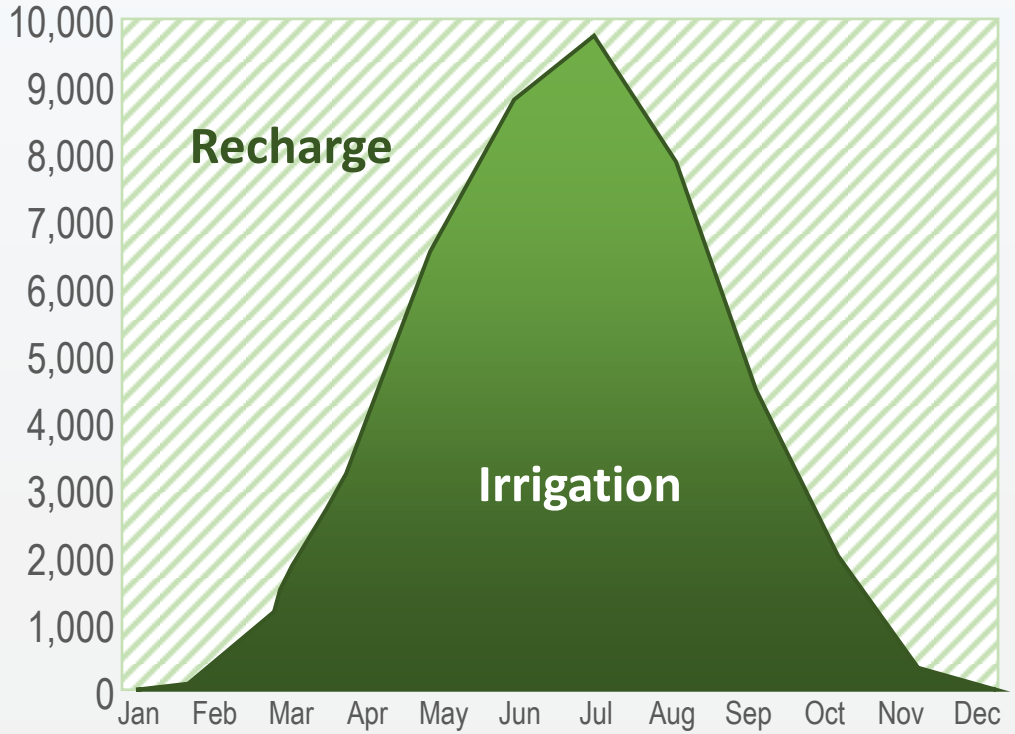
Source: Sanitation Districts of Los Angeles County

Agricultural irrigation with recycled water can on use only about half of available RW annually

Agricultural Irrigation with Recycled Water

Source: Bob Holden, MRWPCA

GWR opportunities during low irrigation demand



Benefits of Groundwater Recharge with Recycled Water on Agricultural Lands (Ag-GWR-RW)

- Beneficial use of surplus winter recycled water
- Beneficial use of compatible agricultural land (dormant / between crops)
- Minimal new infrastructure (when combined with ag reuse projects)
- Environmental benefits (higher GW tables, conserve habitat)

Purpose of Ag-GWR-RW White Paper

- Assimilate relevant current knowledge
- Define on-site operational challenges and propose ways to resolve or mitigate those challenges
- Investigate existing regulatory frameworks and consider an approach to meet the intent of those regulations
- Identify additional research needs and potential demonstration project

Translating Ag Reuse to Ag-GWR-RW

Source: Bob Holden, MRWPCA

- Distribution systems supports GWR with limited investment

Ag-GWR-RW Candidates

- Suitable crops and cropping pattern
- Suitable hydrogeological setting
- No tile drains
- Available RW in winter
- Salt/Nutrient management

Translating Recharge with Surface Water to to Ag-GWR-RW

- Increased salt and nutrient loading
- Increased pathogen / organics potential
- Introduces additional regulations
- Higher level of oversight / monitoring

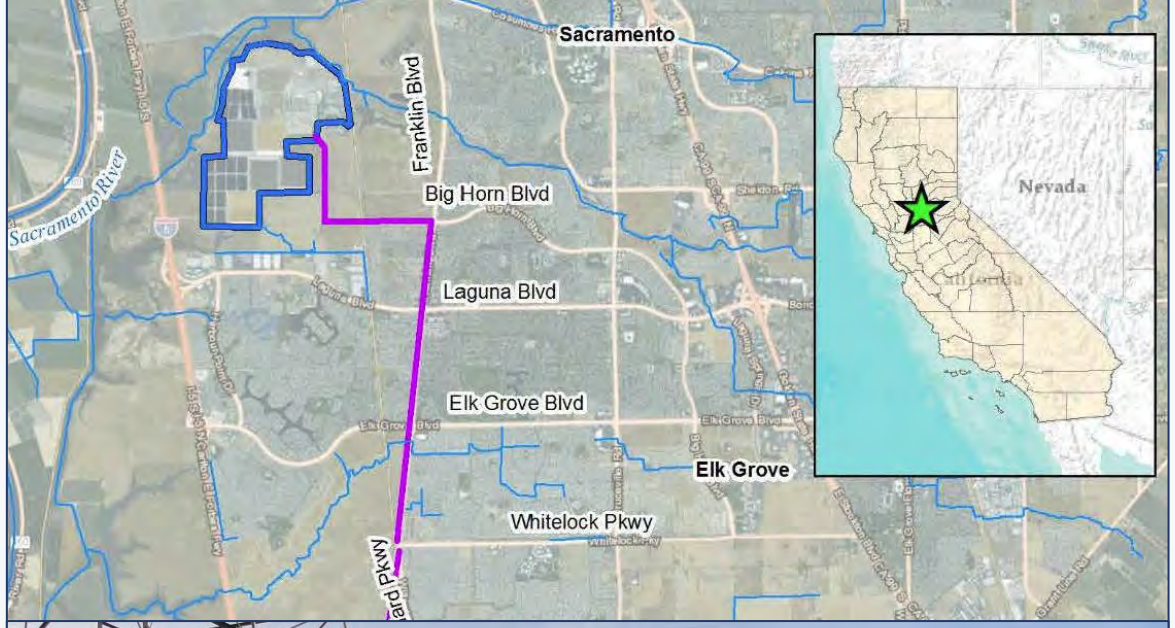
South Sacramento County Ag Reuse Program

Recycled Water for Ag Irrigation

- 16,000 acres
- ~33,000 AFY
- ~$250M

Recycled Water for Recharge

- Up to 17,000 AFY of recycled water
- 500+ acres



Potential Issues Overview

Participant Considerations

- Cost Considerations
- Crop Health Risk
- Regulatory Risk

Recycled Water Supply Considerations

- Availability of Recycled Water
- Proximity of Recycled Water
- Recycled Water Quality
- Application Method
- Surface Water Supplies

Water Quality Protection

- Salt and Nutrients
- Pathogens
- Chemicals of Emerging Concern
- Pesticides
- Heavy metals

GW Basin Setting Considerations

- Hydrogeological Characteristics
- Assimilative Capacity
- Potable Wells
- Institutional Structures

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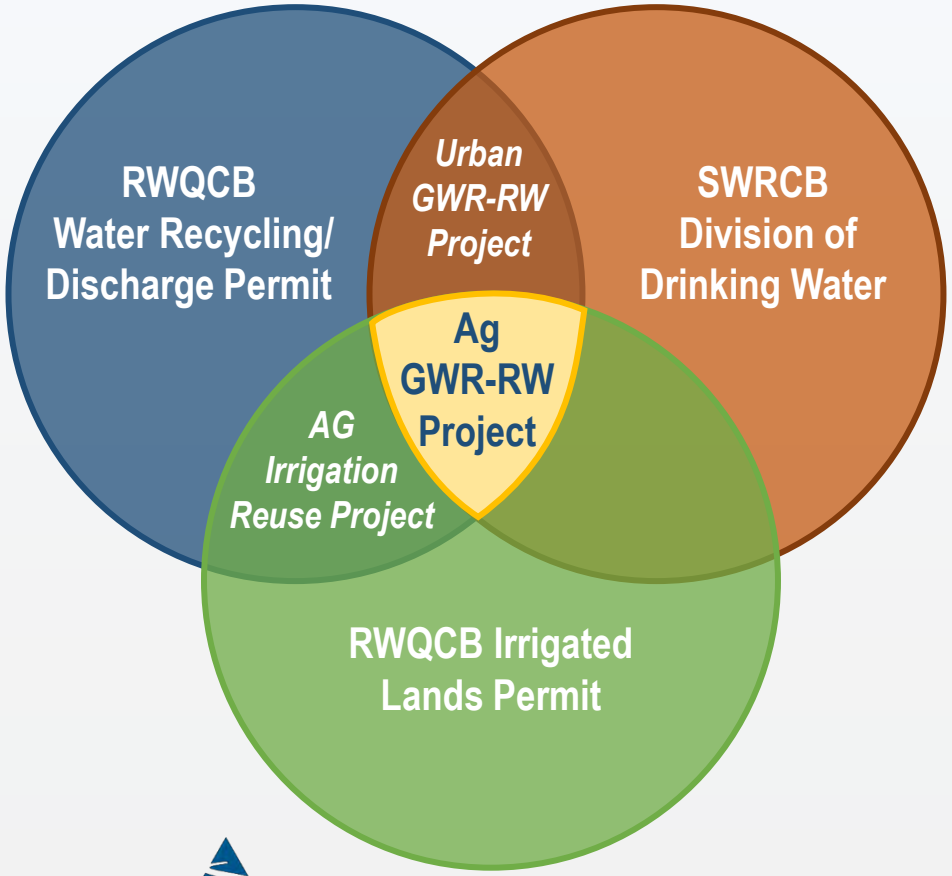
Regulatory Overlap / Conflicts



California GWR-RW Regulations

- Pathogens (travel time)
- Chemicals of Emerging Concern (TOC, blending)

California Anti-Degradation

- Salt / Nutrient Management

California Irrigated Lands Program

- Additional loading
- Landowner liability

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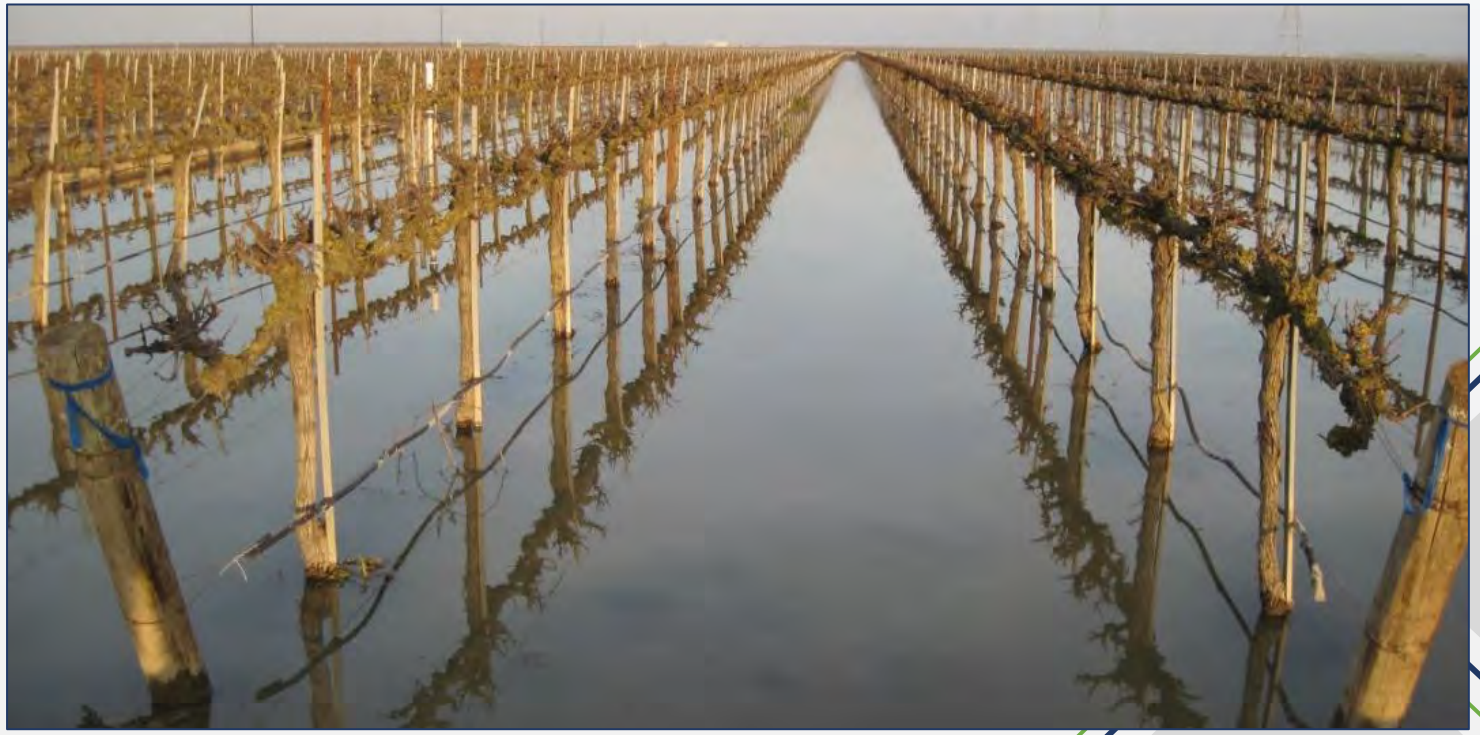
Ag-GWR-RW Considerations

- Intermittent (~3 months) operations
- Large aerial extent
- Native soil with high biological activity
- Potable wells – typically small, shallow for residences within ag land



Components of a Successful Ag-GWR-RW Project

Recharge supply

- Surface water
- Recycled water

Agricultural land

- Suitable land
- Suitable crops
- Potable well locations

Hydrogeological

- Suitable soil
- Suitable groundwater

Economics

- Owner risks and benefits balanced
- Multiple benefits considered
- Costs borne by beneficiaries
- Willing owner / farmer

Implementation

- Clear regulatory pathway
- Institutional structures in place or to be developed

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Top Ag-GWR-RW Issues

Assuming recycled water, hydrogeological conditions, and crop types/patterns are conducive to Ag-GWR-RW

- Crop Impacts
- Soil Impacts
- Groundwater Protection - Salt & Nutrients
- Public Health Protection - Pathogens

Regulatory Issues: GWR-RW Permit (DDW, RWQCB)

Pathogens

- Issues
  - Minimum travel time
- Management Measures
  - Disinfected tertiary treatment
  - Soil aquifer treatment
  - Prevent on-site sources
  - Groundwater monitoring

Chemicals of Emerging Concern

- Issues
  - Lack of large blend water supply
- Management Measures
  - Soil aquifer treatment
  - Wastewater-derived TOC
  - Monitoring per SWRCB CEC Expert Panel

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Regulatory Issues: Anti-Degradation

Salts

- Issues
  - Existing assimilative capacity
  - Legacy salts / nutrients
  - Relatively high in recycled water
- Management Measures
  - Consider loading in context of overall GW basin management
  - Source control
  - Blend water, where feasible

Nutrients

- Issues
  - Same as salts
- Management Measures
  - Nitrification / denitrification @ WWTP
  - Soil aquifer treatment
  - Wet / dry soil cycles
  - Winter cover crops
  - Blend water, where feasible

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Research Recommendations (1 of 2)

Research Category	Research Topic
Crop Impacts	Understand the timing and duration of drying cycles; additional nutrient or amendment needs; and rootstock or variety selection
Soil Impacts	Analyze the effects of alternating water supplies with elevated SAR from recycled water and lower SAR from rainfall and surface water to build an understanding of potential impacts of Ag-GWR-RW on soil structure and permeability.
Nutrients	Develop an understanding of how cover crops can limit nutrient loading from winter application of recycled water, including on fallow fields as well as on vineyards and nut tree orchards.
Pathogens	Quantify the removal efficiency of pathogens during travel through the vadose zone for land with Ag-GWR-RW. These findings could be used to justify minimum retention time appropriate for Ag-GWR-RW setting.

Research Recommendations (2 of 2)

Research Category	Research Topic
Chemicals of Emerging Concern	Identify the remobilization potential of organic matter on ag land and potential impacts on TOC concentrations in the underlying groundwater and redox conditions in the subsurface affecting CEC removal.
Pesticides	Determine pesticides with highest contamination risk through use of tools such as the CA Dpt of Pesticide Regulation's Ground Water Protection Program and the UC Cooperative Extension
	Determine period prior to recharge operations for no pesticide application through use of tools such as the Windows Pesticide Screening Tool (WIN-PST)
Heavy Metals	Developing an understanding of the risks to heavy metal mobilization and how the timing, volume, and quality of recharged recycled water can be altered to minimize the risk.

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THANK YOU!

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