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

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

Research Team
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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 only use about half of available RW annually.

Source: Bob Holden, MRWPCA

Agricultural Irrigation with Recycled Water

GWR opportunities during low irrigation demand

Source: Bob Holden, MRWPCA
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

- Distribution systems support 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

Source: Bob Holden, MRWPCA
Translating Recharge with Surface Water 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
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
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
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
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
## Research Recommendations (1 of 2)

<table>
<thead>
<tr>
<th>Research Category</th>
<th>Research Topic</th>
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<tbody>
<tr>
<td><strong>Crop Impacts</strong></td>
<td>Understand the timing and duration of drying cycles; additional nutrient or amendment needs; and rootstock or variety selection</td>
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<td><strong>Soil Impacts</strong></td>
<td>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.</td>
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<td><strong>Nutrients</strong></td>
<td>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.</td>
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<td><strong>Pathogens</strong></td>
<td>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.</td>
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## Research Recommendations (2 of 2)

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<td>Chemicals of Emerging Concern</td>
<td>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.</td>
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<td>Pesticides</td>
<td>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</td>
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<td>Determine period prior to recharge operations for no pesticide application through use of tools such as the Windows Pesticide Screening Tool (WIN-PST)</td>
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<td>Heavy Metals</td>
<td>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.</td>
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