Groundwater Recharge practices in production vineyards and SGMA implementation

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Outline

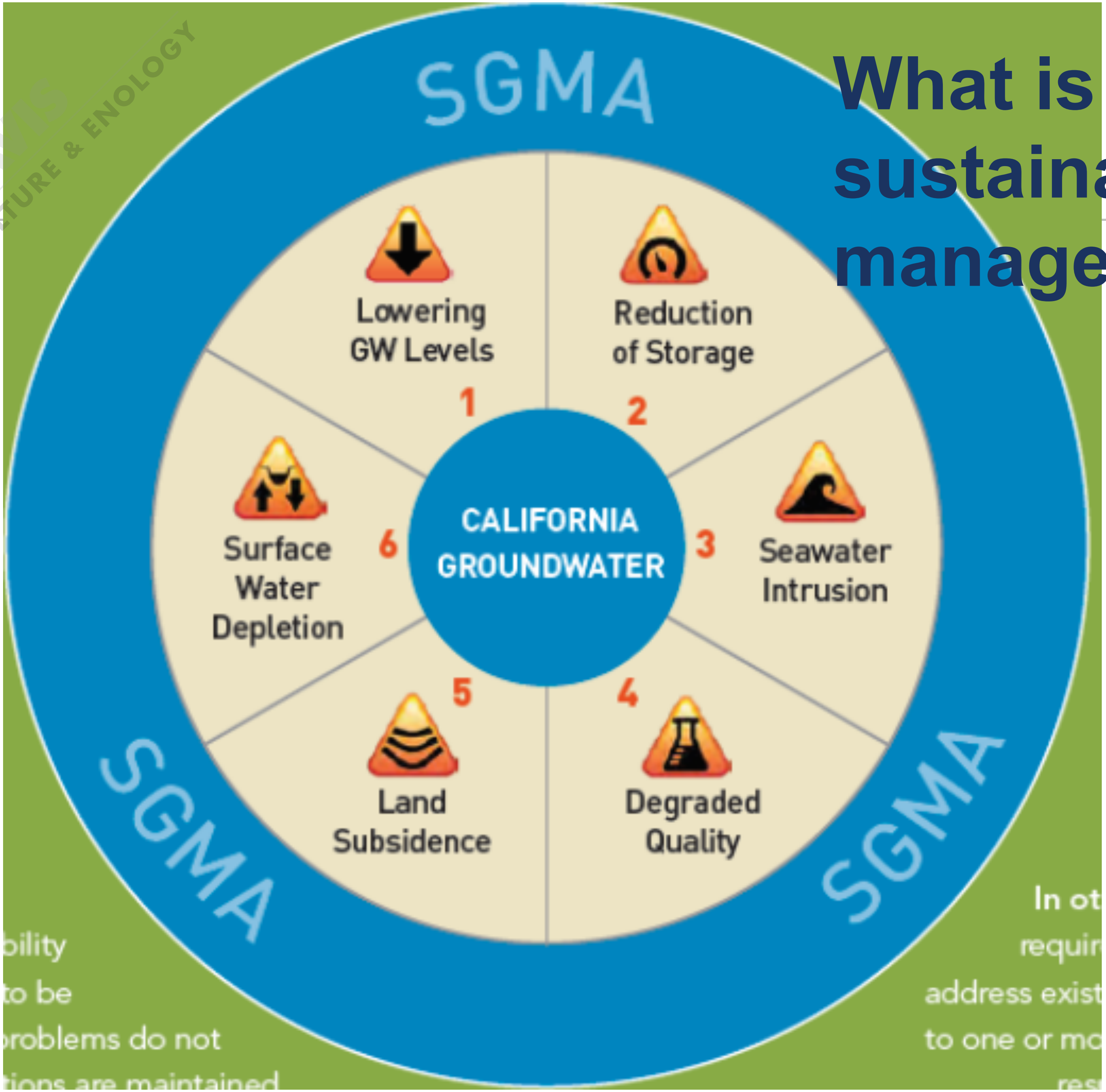
- Introduction to SGMA
- Aquifer recharge as a tool to support SGMA implementation
- Cosumnes river example: winter irrigation on vineyards → design and data collection

SGMA (Sustainable Groundwater Management Act)

- Historic drought
- Became law on January 1, 2015
- Medium/high priority basins must be managed sustainably
- Emphasis on local control with State oversight
  - State intervenes if local action not taken
- Requires Groundwater Sustainability Agencies (GSAs)
- Requires Groundwater Sustainability Plans (GSPs)

Who is interested?

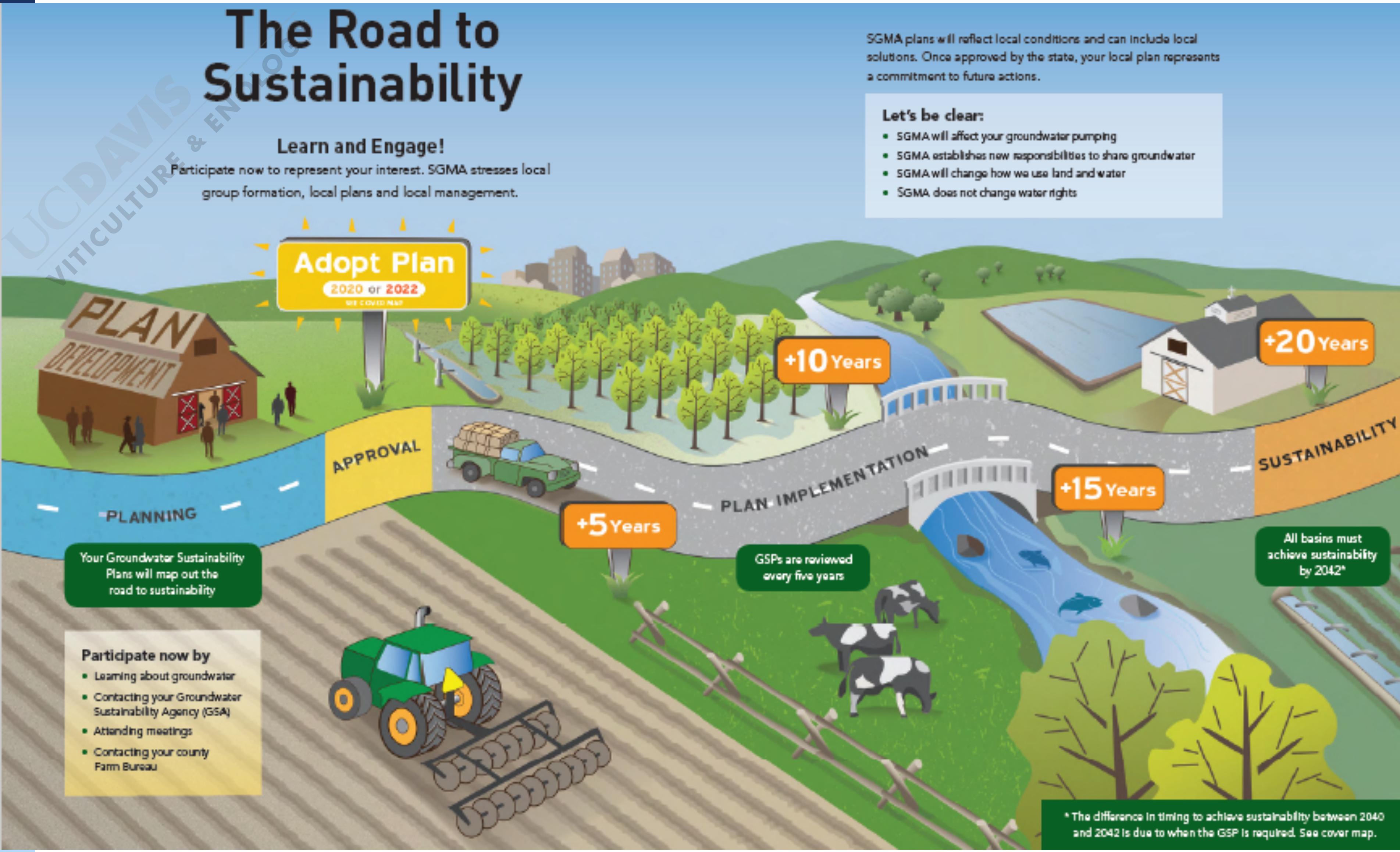
What is sustainable management?



Keys to success

GSP accepted by DWR and local stakeholders

- Effective communication and community involvement
- On time, effective, and successful plans and implementation
- Tools (database, models) useful into the future



LEARN and ENGAGE! Participate NOW to represent your interest! SGMA stresses LOCAL group formation, LOCAL plans and LOCAL management!

Groundwater Sustainability Plans

- Plan requirements
  - Measurable objectives/milestones to meet sustainability goal
  - Technical information
    - **Hydrogeological conditions of the aquifer**
    - **Historical and projected water demands**
    - **Potential areas of recharge**
    - **Measurable objectives and milestones toward sustainability**
    - **Monitoring and management plan**
- Result in “sustainable conditions” within 20 years of adoption
- Must be approved by DWR by 2022

SGMA – opportunities and challenges

GSP development and implementation: balancing act – between different interests, between water supply and water demand, between beneficial uses.

SGMA Background – GSA Management Tools

Groundwater Sustainability Agencies empowered to:

- Conduct studies
- Register and monitor groundwater wells
- Require reports of groundwater extraction
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-
-

⇒Implement capital projects to meet goals

management

- Some requirements do not apply to small groundwater users

MAR as a tool to facilitate SGMA

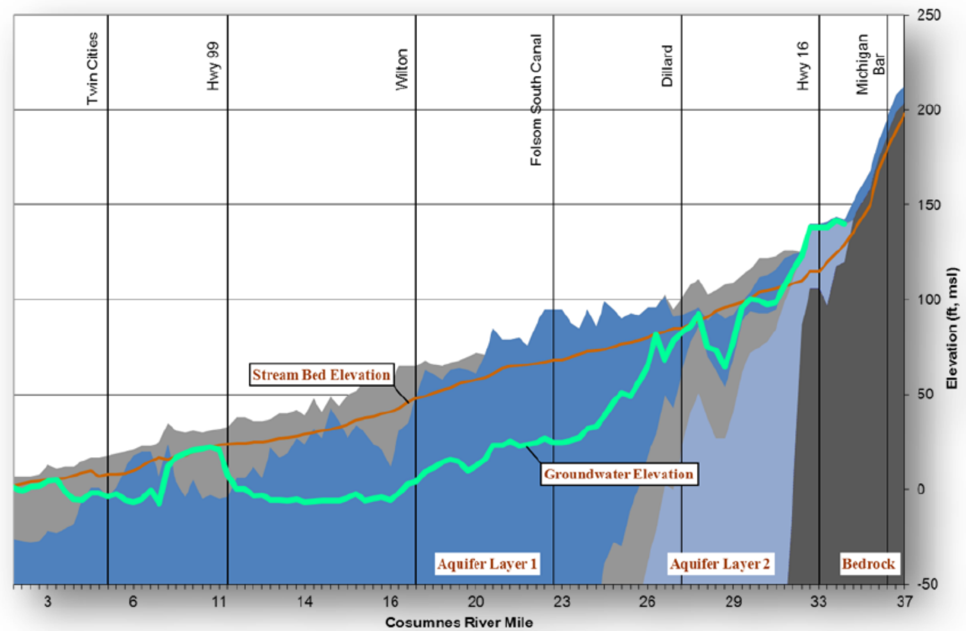
- Managed groundwater recharge to improve groundwater resources and enhance sustainability
- What more do we need to know to enhance MAR application in agricultural fields?
- Which are the main knowledge gaps?
  - Scientific/technological
  - Social

Cosumnes river example: what is the benefit and how can be demonstrated?

- Need consistent and continuous measures to show:
  - Where is the recharge water moving? Towards the South American subbasin? Towards the Cosumnes subbasin? Back in the river?
  - How can the river (and its habitat) and the aquifer both benefit from recharge?
  - How can the stakeholders benefit from it?
    - Energy
    - SGMA
  - What is the impact on the crops?

The Cosumnes River Runs Dry

- Allow the Cosumnes River to run for longer periods during the spring and summer and begin flowing earlier in the fall.

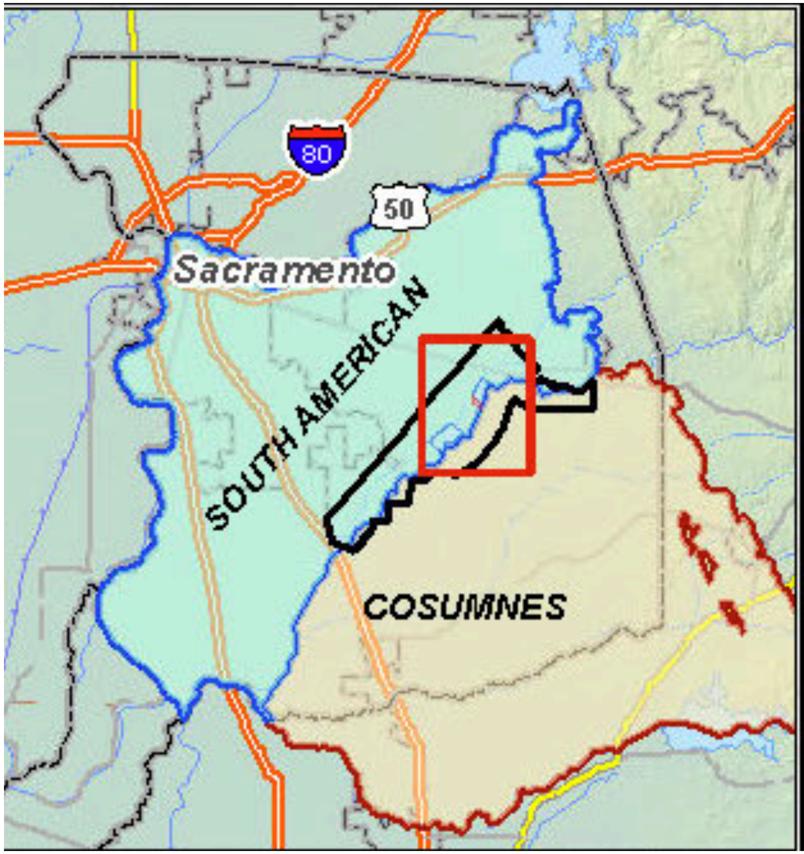


Dry Cosumnes River Bed in August, 2010

Nature Conservancy; The Promise of Reservoir Re-Operation: Implications for Integrated Water Management

Cosumnes River Groundwater Recharge

- Integrated team, complementary skills
  - Omochumne-Hartnell Water District (OHWD)
  - Larry Walker Associates (LWA)
  - Cosumnes Coalition/TNC
  - UC Coopertive Extension
  - Sacramento State University



Comprehensive pilot study

- Irrigation design and installation
- Continuous groundwater monitoring
- ET and plant stress monitoring (UC Cooperative Extension)
- Extensive modelling

→ To understand benefits of recharge to aquifers, river, and GDEs

→ Many institutions and stakeholders involved

→ Synergistic effort

Dry Cosumnes River Bed in August, 2010

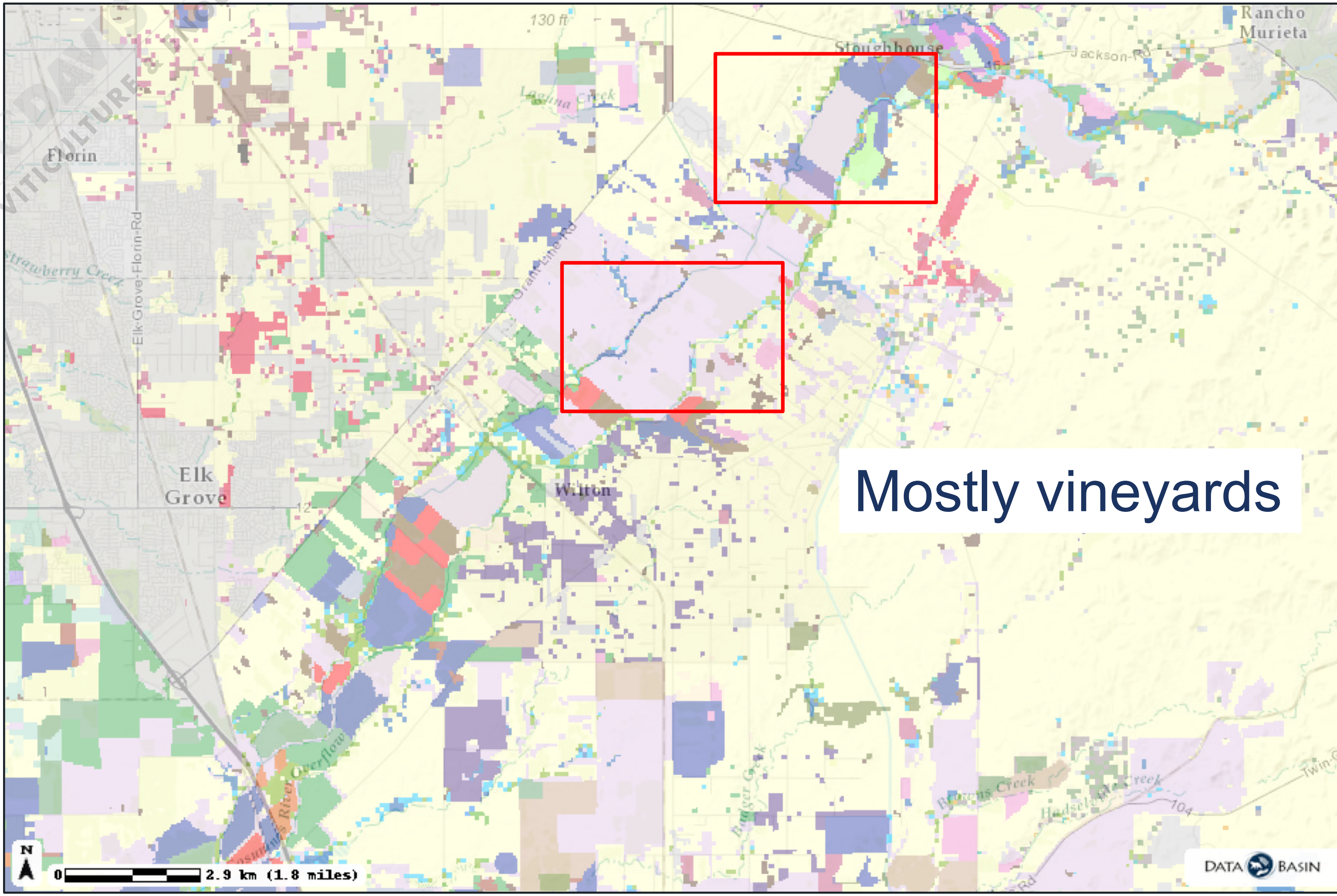
Groundwater Recharge By Flooding Agricultural Land

TABLE 1. Survey results of tree crop vulnerability to saturated conditions

Crop	Rootstock	Tolerance to saturation before budbreak	Tolerance to saturation after budbreak	Recommended N fertilizer rate
				lbs N/ac/yr
Almonds	Peach; peach x almond hybrid	1	1	250
Almonds	Plum; peach x plum hybrid	2–3	1	250
Avocados	—	0	0	150
Cherries	—	1	0	60
Citrus	—	0	0	100
Wine grapes	—	4	2	15–30
Olives	—	?	?	<100
Pears	*P. betulaefolia*	4	4	100–150
Pears	*P. communis*	4	3	100–150
Pears	*Cydonia oblonga*	3–4	2–3	100–150
Pistachios	—	?	?	200
Plums/prunes	Peach	1	1	150
Plums/prunes	Plum; peach x plum hybrid	2–3	1	150
Pomegranate	—	?	?	100
Walnuts	—	2–3	1	200

The following scores were used to estimate vulnerability: 0 - No tolerance for standing water; 1 - tolerant of standing water up to 48 hours; 2 - tolerant of standing water up to 1 week; 3 - tolerant of standing water up to 2 weeks; 4 - tolerant of standing water > 2 weeks; ? - tolerance unknown.

A.T. O'Green, et al., Soil suitability index identifies potential areas for groundwater banking on agricultural lands, California Agriculture, 2015.

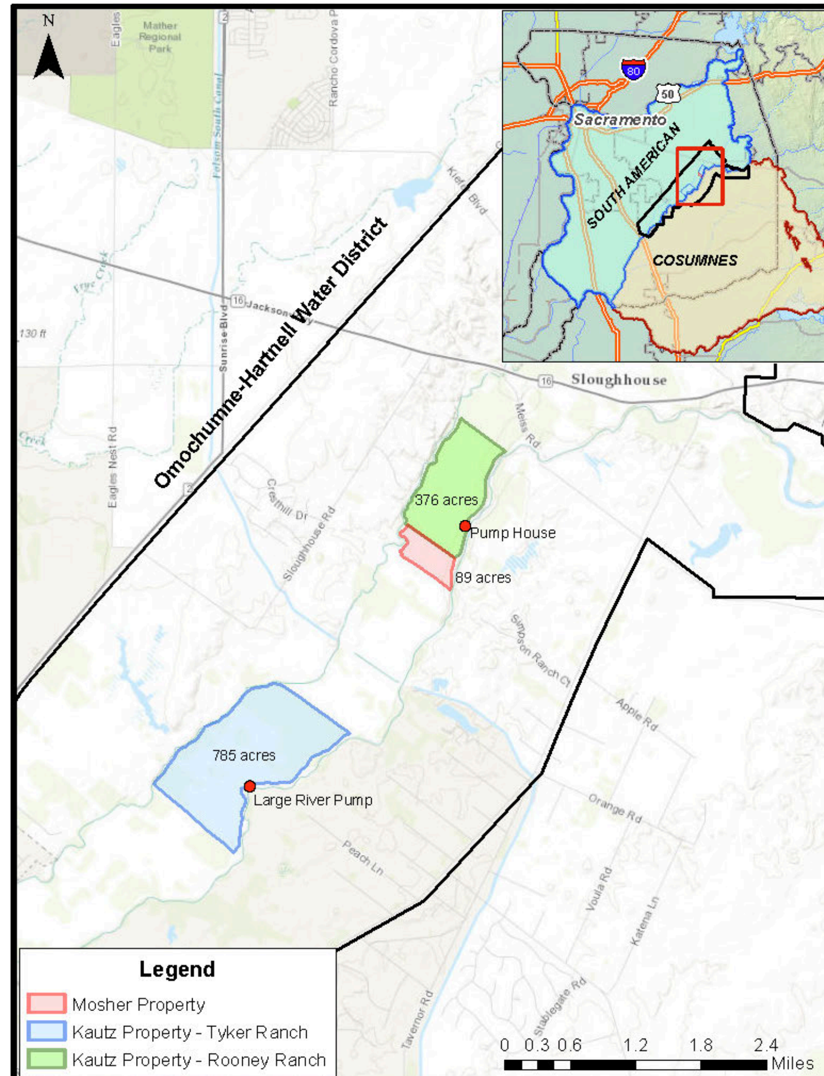


Mostly vineyards

Annual Grassland | Vineyards (includes table grapes, wine grapes, and raisins) | Tomatoes (processing) | Corn (Field and Sweet) | Safflower | Turf farms | Pasture

Recharge Site

- Region between Deer Creek and Cosumnes River → **ideal** for GW banking:
  - readily transmissible and low salinity soils,
  - suitable topography, and root zone residence time.
  - ag fields with good water access, crop suitability, soil permeability, and land owner interest and agreement.



Overall System Design

- 10 year period → use two existing diversions on the River to flood dormant ag fields in the off-(irrigation) season (Nov-March) when streamflow is high and excess water is available.
- **GOAL** → divert a minimum of 4,000 AF per year, but system designed to divert/recharge up to 6,000

Available Water for Diversion

- 50% of water years have enough flow in the river to allow 6,000 AF diversion
- 70% of water years would allow at least 4,000 AF diversion.

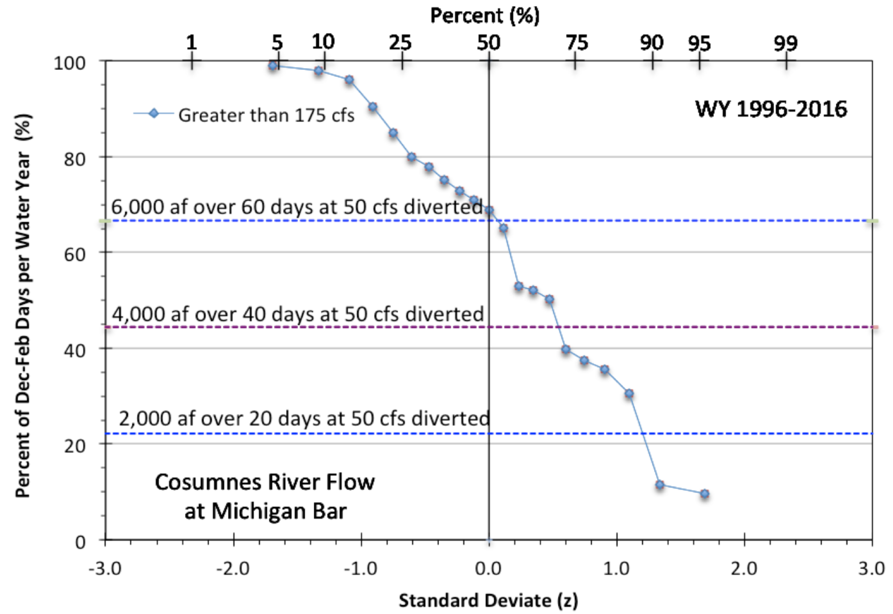


Table 1. Percent exceedance of years with the listed number of days in December through February with diversion. Volumes diverted assume 50 cfs diversion when flows at Michigan Bar exceed 175 cfs, and 7.5 cfs diversion when flows at Michigan Bar are between 75 cfs and 175 cfs.

Available Dec-Feb Days with 50 cfs of Diversion	Volume Diverted (af)	Percent Exceedance (%) WY 1908-2016	Percent Exceedance (%) WY 1996-2016
All	6,000	7	<5
60	6,000	45	52
40	4,000	67	71
20	2,000	87	88

Groundwater Monitoring

- Monitoring to show performance of the project required by the grant
- GW monitoring for quantity and for water quality, and ET and soil moisture will provide a quantitative metric of the off-season irrigation on local groundwater levels and storage

The Cosumnes Coalition

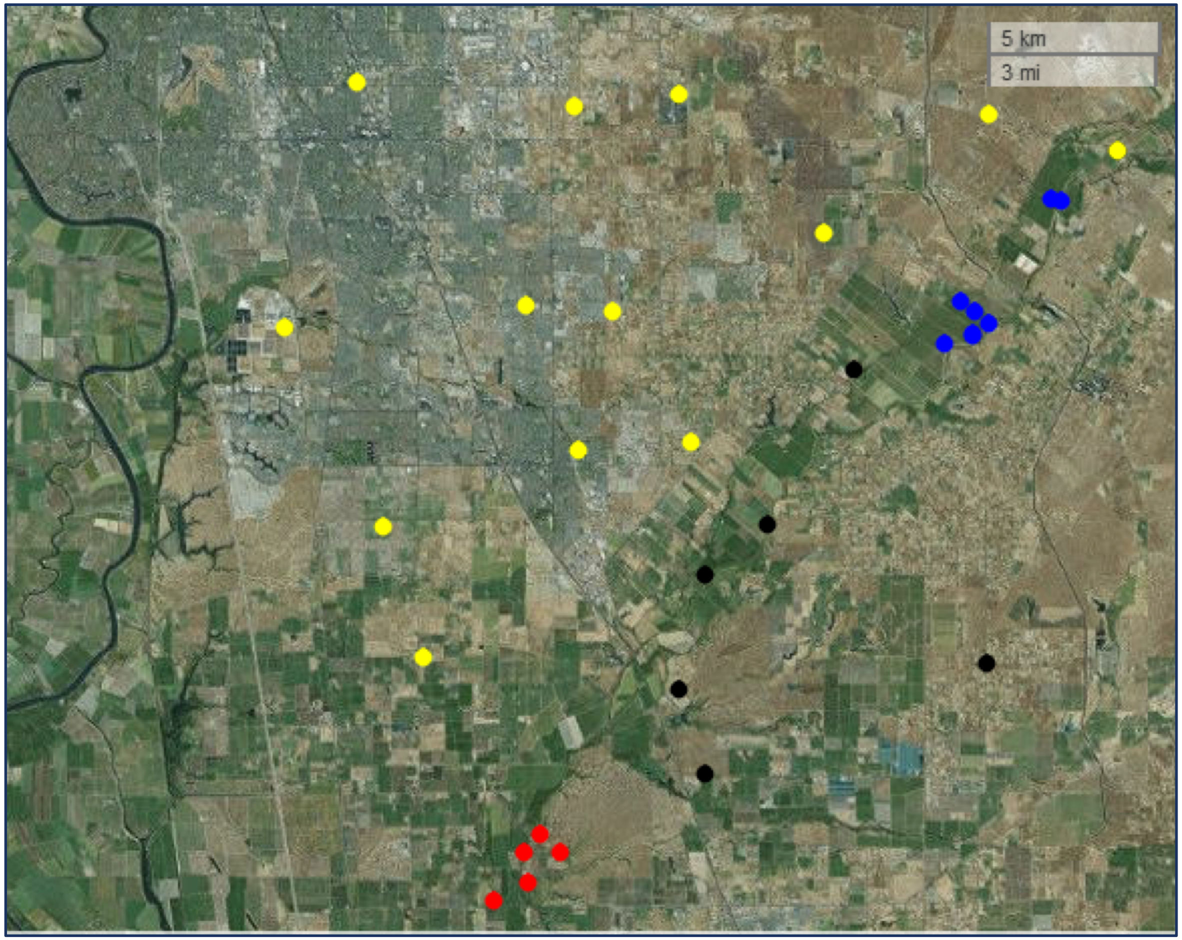
Groundwater Observatory: continuous monitoring program

- Need observations to manage the GW system
- Continuous recording pressure transducers to capture relevant changes in GW levels at any time
- Telemetry-equipped GW observatory
- Data available in the form of well hydrographs on a web-based dashboard

→ Landowners and growers interested in understanding benefits of recharge and groundwater paths and directions (critical for SGMA)

Monitoring Network in the basin

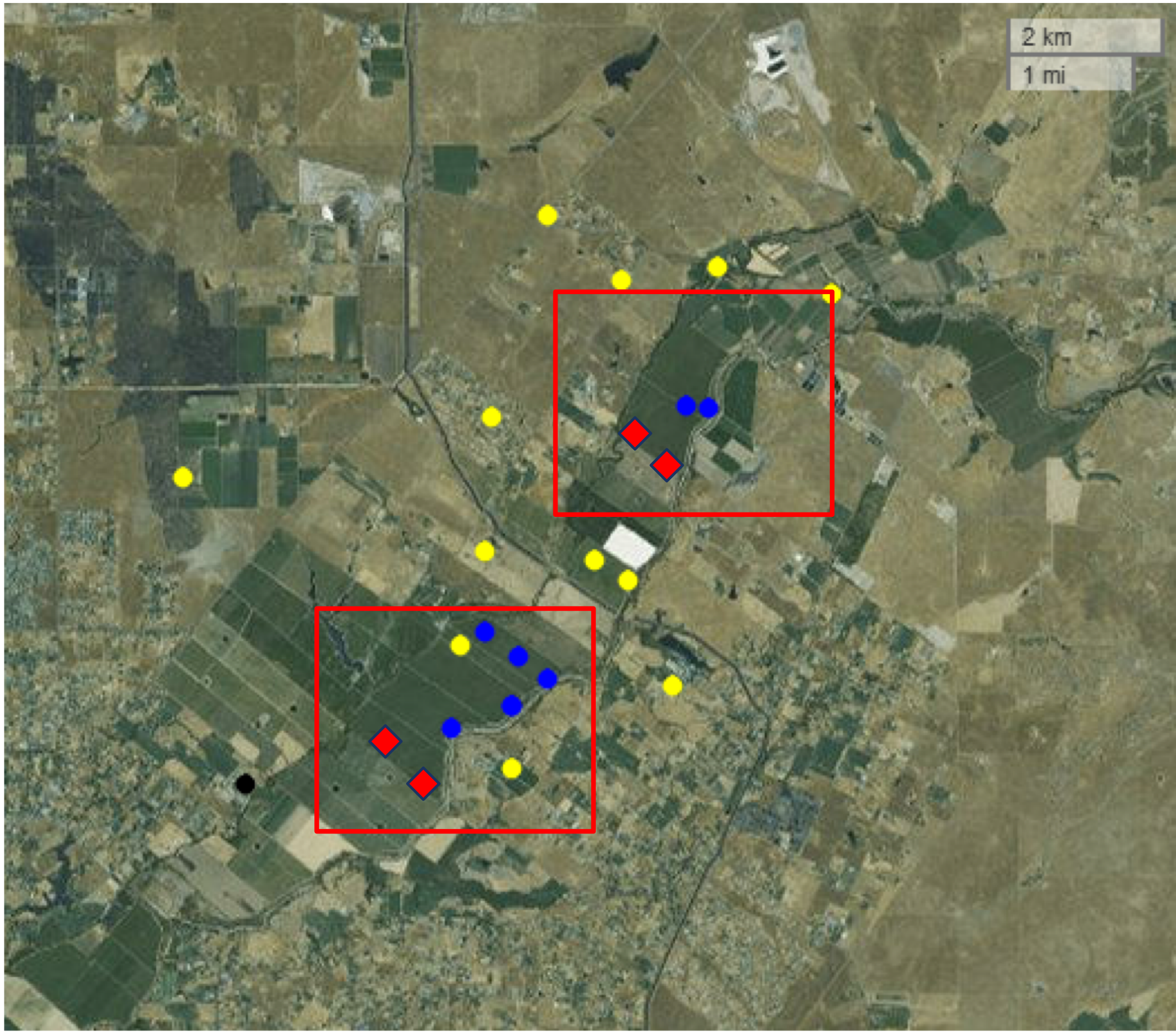
- 5 lower Cosumnes sites (Oneto-Denier field site)
- 5-10 Cosumnes corridor wells plus wells of recharge project
- 5-10 South American River Sub-basin wells



Partners: UC Water, OHWD, Cosumnes Coalition, Sacramento County

Recharge scale monitoring network

- Verified for monitoring (blue)
- Existing, but not verified (yellow)
- **4 new wells drilled in February 2019**
- Importance of monitoring the southern side



Soil and infiltration rate analysis

How is the water moving into the soil profile?

- Temperature probes and pressure transducers in shallow piezometers
- Soil samples
- Rain gages
- Continuous camera

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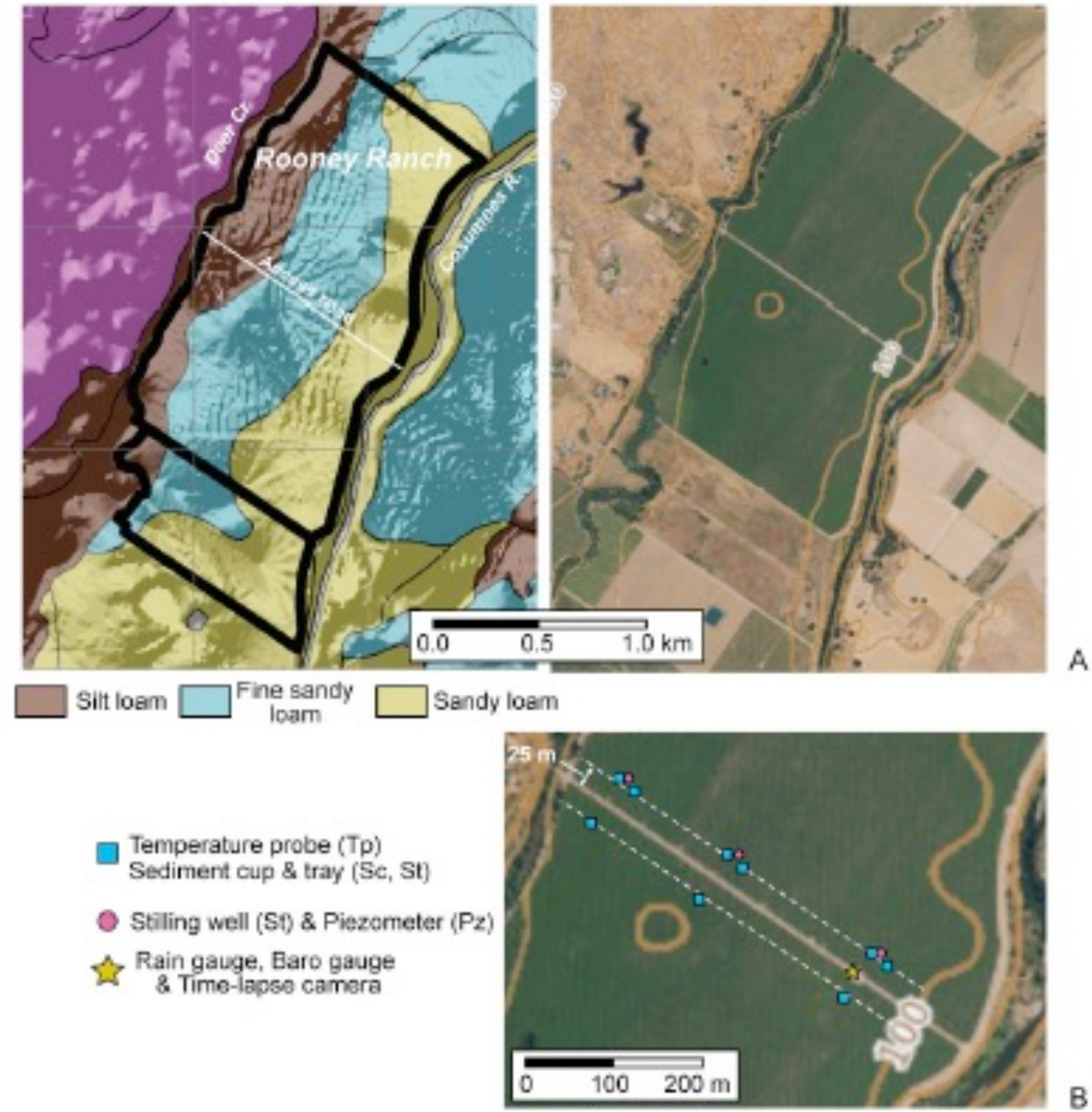
Data collection set-up



Groundwater quality monitoring goals

- Stable isotopes → track movement of recharged water through aquifer
- Major ion chemistry → see if reactions between recharged water and local groundwater could clog pore space and slow infiltration
- Trace elements, nutrients, pesticides → ensure that recharge is not degrading groundwater quality

SACRAMENTO STATE

Groundwater quality monitoring expectations

- Infiltration should not be affected by reactions between recharge water and local groundwater. This area naturally flooded and infiltration is still high
- Groundwater quality should not be degraded. Even if nutrients or pesticides are flushed out of the soil, the additional recharge will help dilute those contaminants

Summary: MAR as a tool to facilitate SGMA

- Managed groundwater recharge to improve groundwater resources and enhance sustainability: need to support GSAs in overcoming challenges and develop opportunities
- What more do we need to know to enhance MAR application in agricultural fields?
- Which are the main knowledge gaps?
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Summary

- Key to SGMA success:
  - Local management,
  - Outreach effort and community involvement,
  - Good science, and
  - Data collection
  - Successful projects
- Need to support GSAs in overcoming challenges and develop opportunities

THANK YOU!

QUESTIONS?