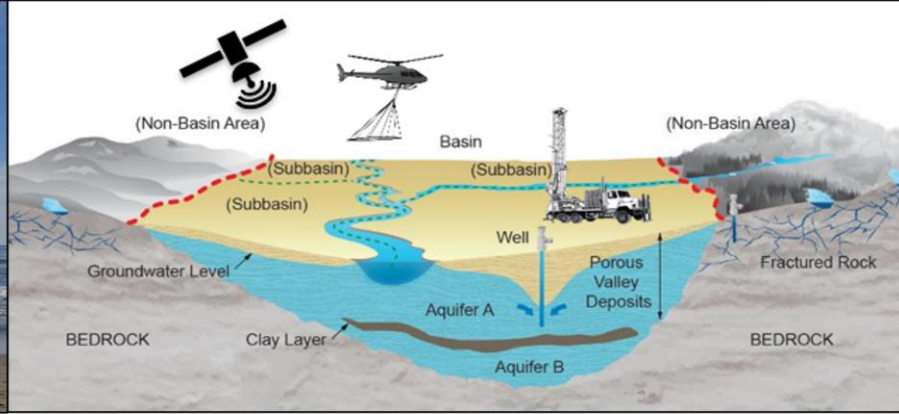




California's Groundwater - Basin Characterization Program



Aquifer Recharge Potential in Practice: Lessons from Sacramento Valley

Nicole Jacobsen, PG
Woodard & Curran

CWEMF 2026 Annual Meeting



CALIFORNIA DEPARTMENT OF WATER RESOURCES
SUSTAINABLE GROUNDWATER
MANAGEMENT OFFICE



S.S. Papadopoulos & Associates, Inc.



Ecogite Consulting



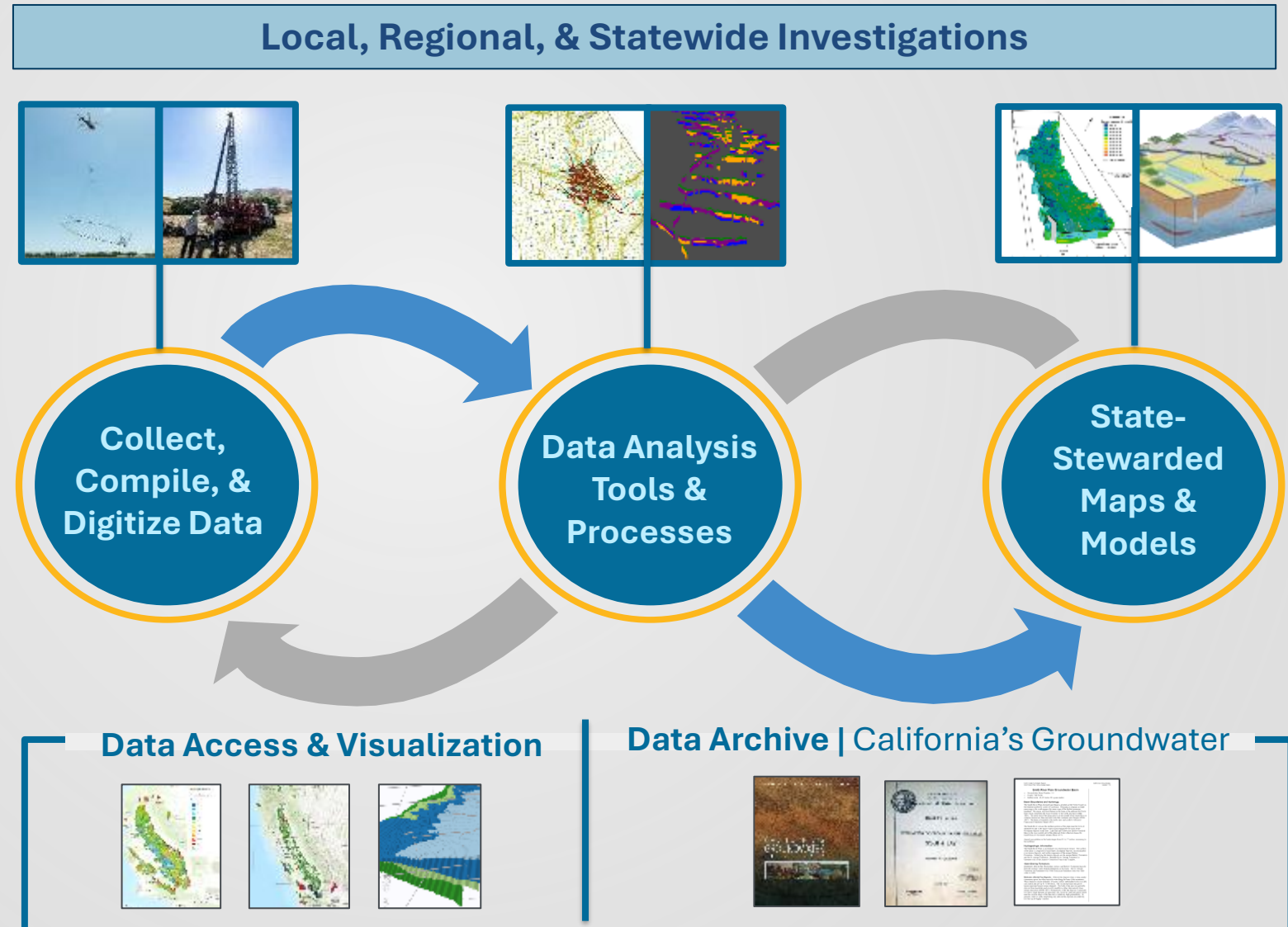
Basin Characterization Program Overview

Goals for State-Stewarded Maps and Models

- **Aquifer Recharge Potential**
- Texture Model
- Aquifer Storage
- Hydrostratigraphic Model
- Important Aquifers
- Extent of Corcoran Clay
- Depth to Basement
- Base of Fresh Water
- Subsidence

Basin Characterization Exchange (BCX)

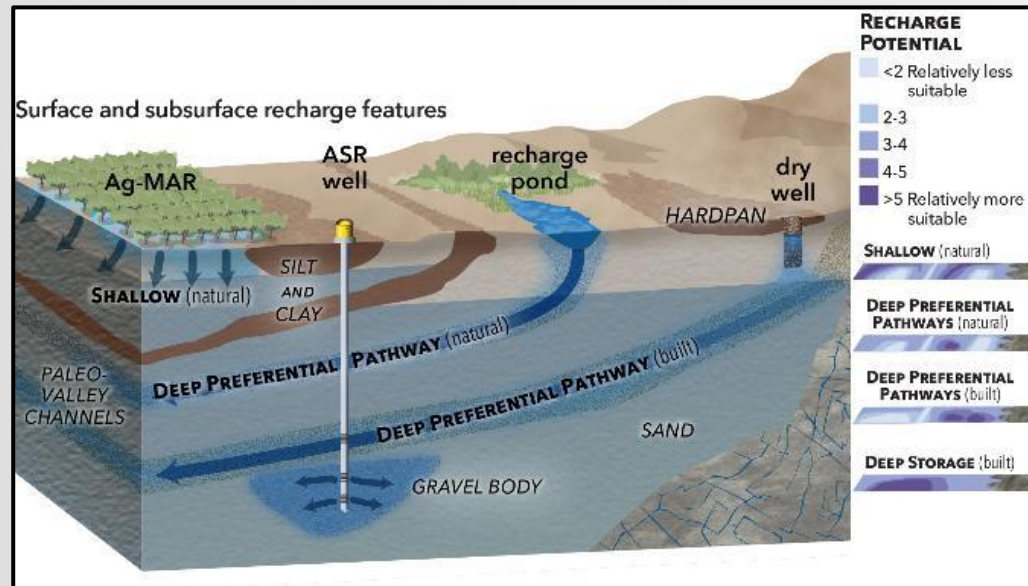
- Community of Practice
- Tribal, Local, State, & Federal Agencies
- NGOs, Academia & Private Sector



Aquifer Recharge Potential (ARP) Overview

ARP maps identify locations that have relatively **more and less potential** for managed aquifer **recharge**

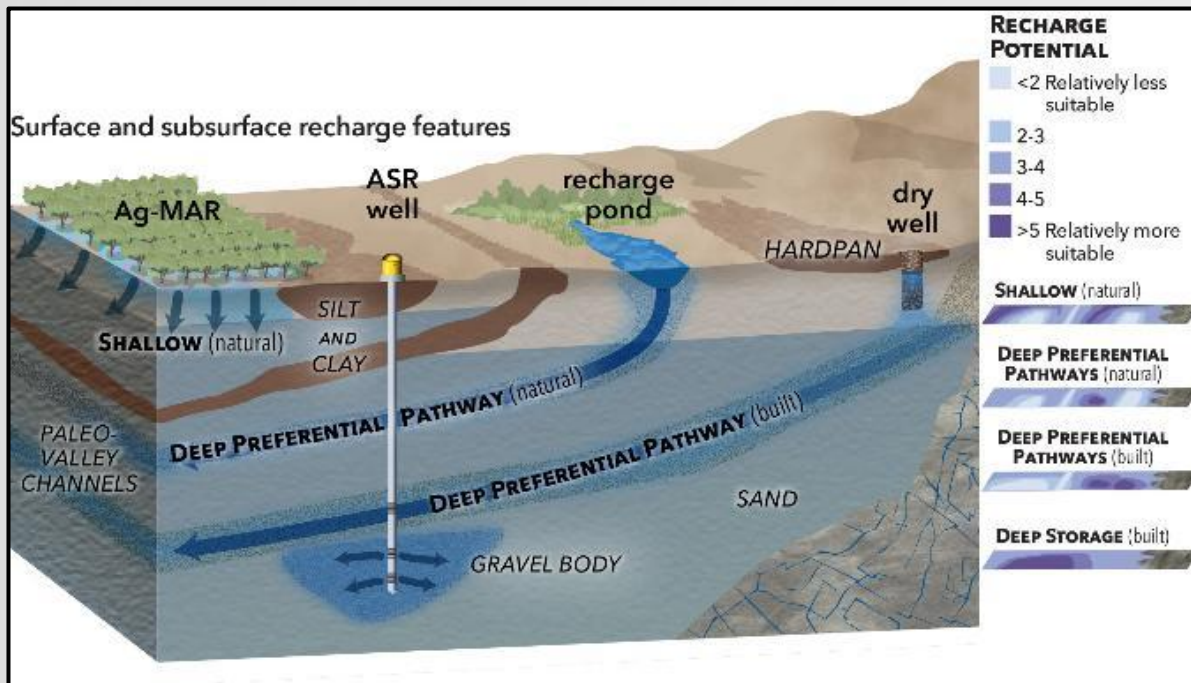
The focus is on **basin characterization** and **natural infrastructure**, *not* anthropogenic considerations (e.g., water rights, conveyance, land use, etc.)



Four ARP map types:

- Shallow (Natural)
- Shallow (Built)
- Deep Preferential Pathways (Natural)
- Deep Preferential Pathways (Built)

Aquifer Recharge Potential (ARP) Overview



Recharge Goals:

- Flood mitigation
- Shallow / deep groundwater well supply
- Habitat rehabilitation
- Subsidence mitigation

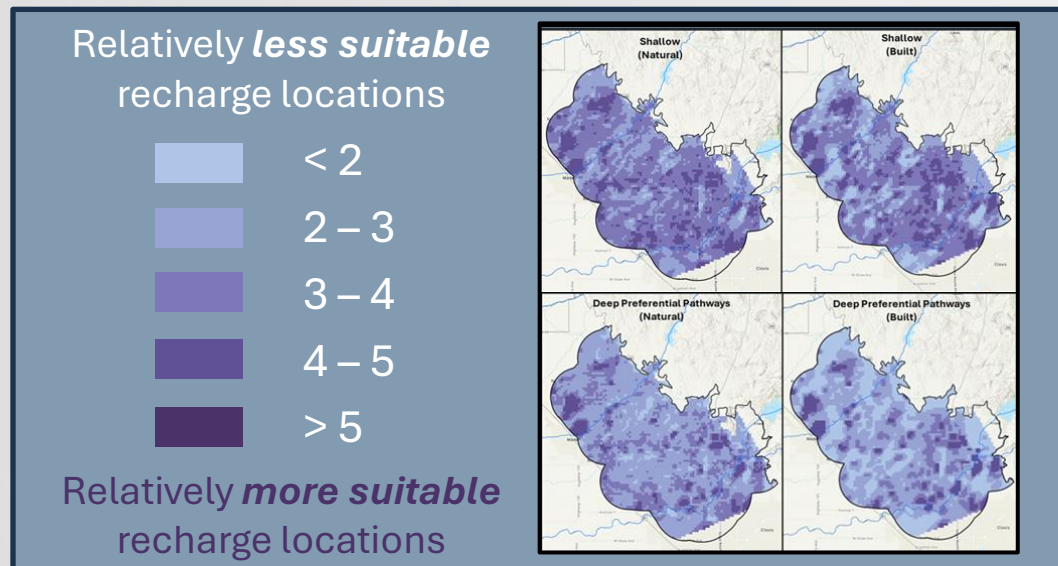
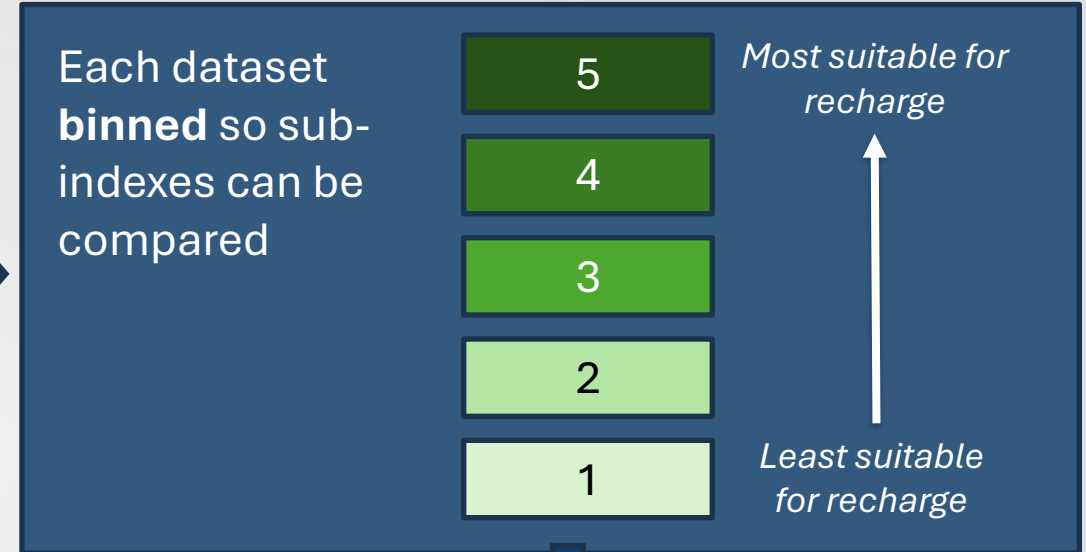
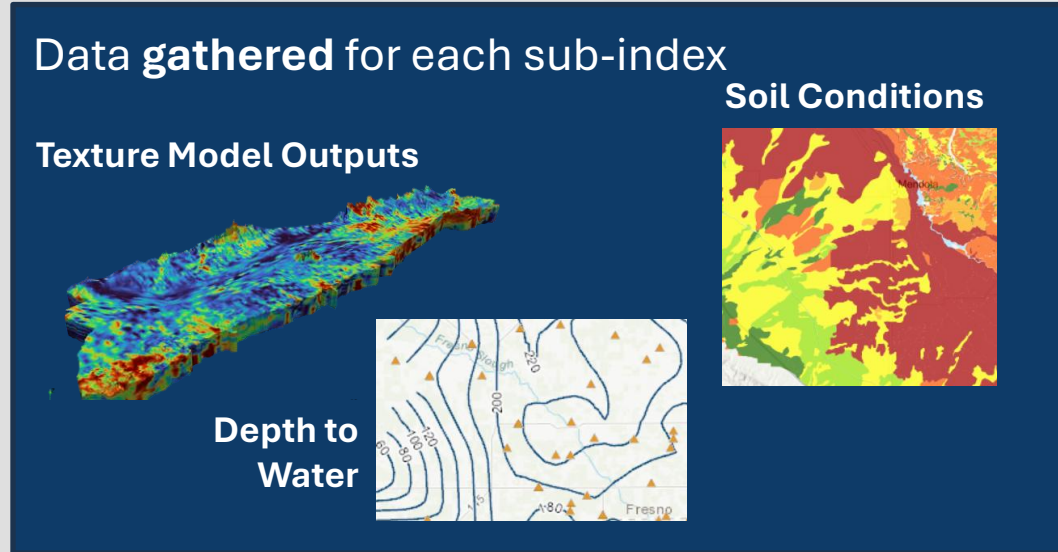
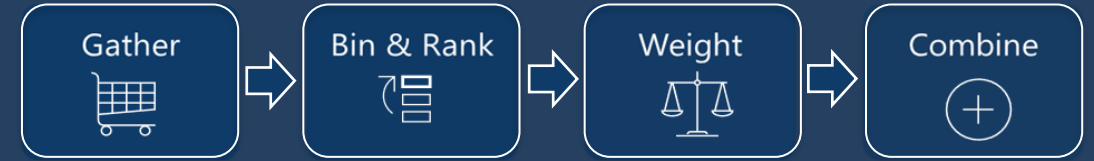
Recharge Methods:

- On Farm Recharge
- Recharge Basin
- Reverse Tile Drains
- Dry Well
- Injection Wells

Target Aquifer:

- Shallow: 0-50 feet
- Deep: 50 – 400+ feet below ground surface

ARP Approach



Each sub-index **weighted** based on importance to each recharge type

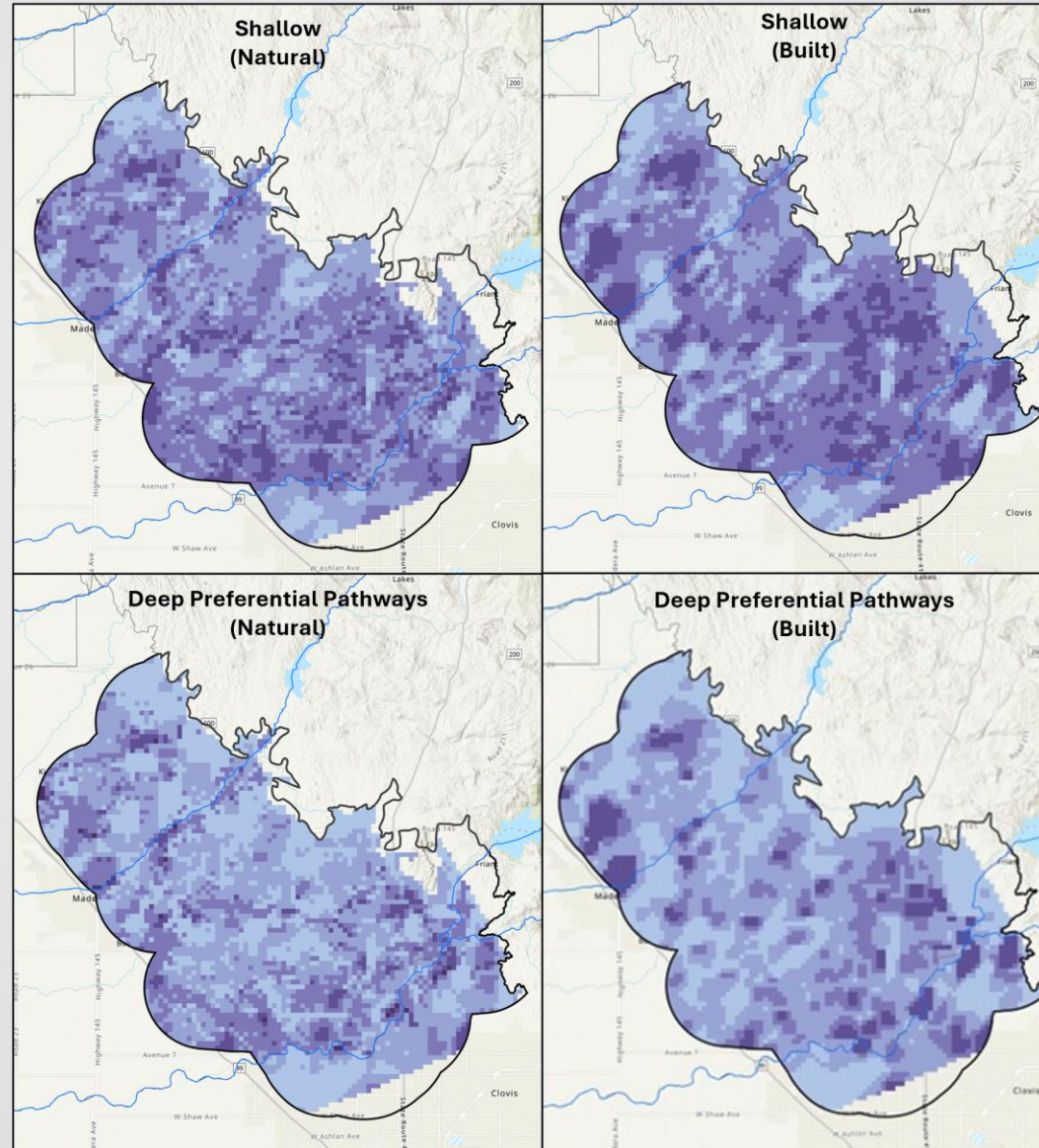
	Datasets				
	Soil Conditions	Depth to Water	Depth to Shallow Fine-Grained Layer	Shallow Sediment Coarseness	Interconnected Coarse Bodies
ARP Map Type	Weights				
Shallow (Natural)	5	3	2	5	3
Shallow (Built)	0	3	2	5	3
Deep Preferential Pathway (Natural)	3	1	0	0	5
Deep Preferential Pathway (Built)	0	1	0	0	5

ARP Results

Relatively *less suitable*
recharge locations



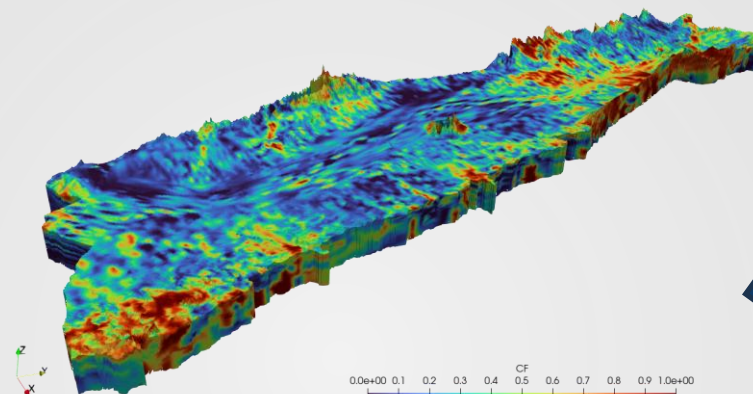
Relatively *more suitable*
recharge locations



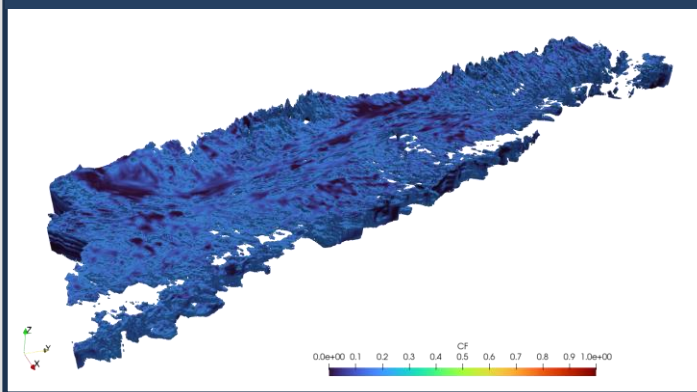


The Role of Texture Models in ARP Analyses

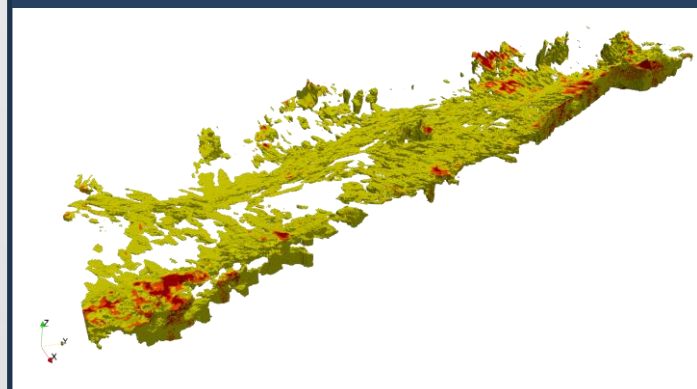
In ARP Maps, Texture Model controls:



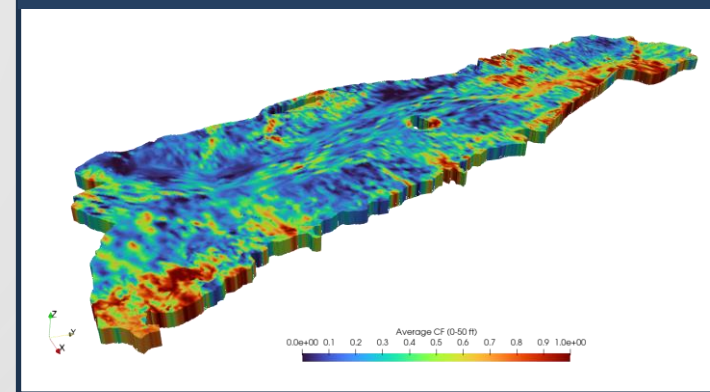
Shallow Fine Clays



Interconnected Coarse Bodies



Average Sediment Coarseness



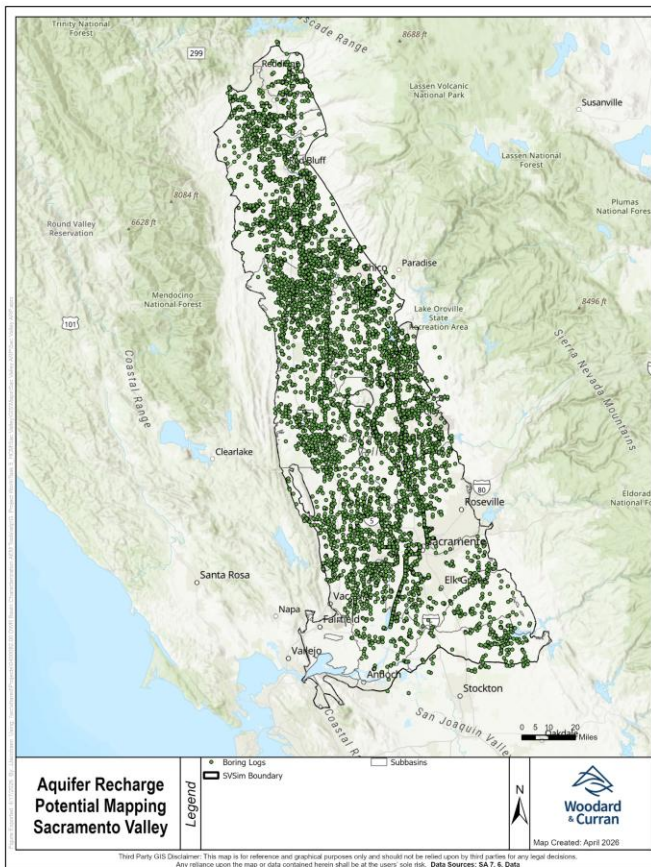
Example from
Sacramento Valley
Investigation Area

DRAFT

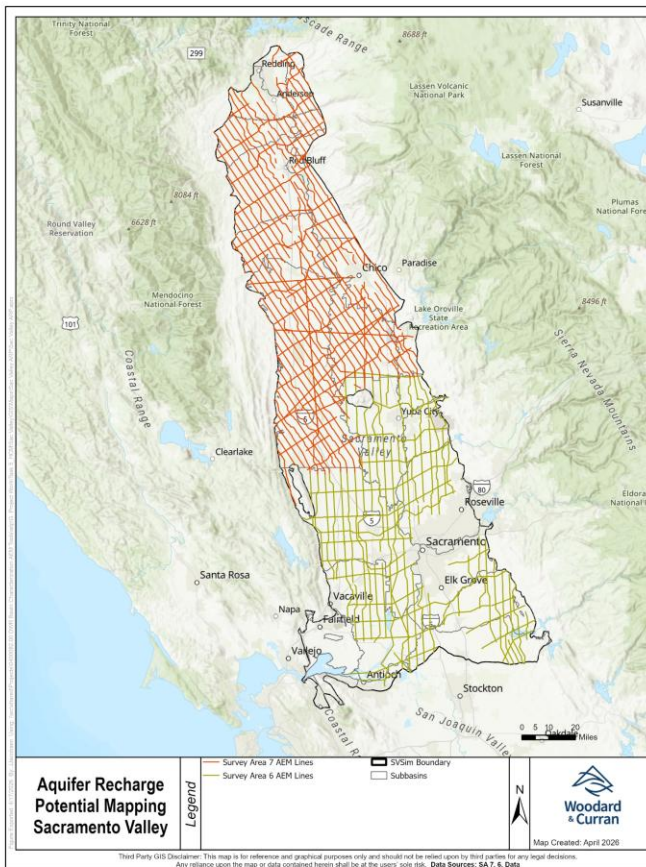


Sacramento Valley Texture Model Inputs

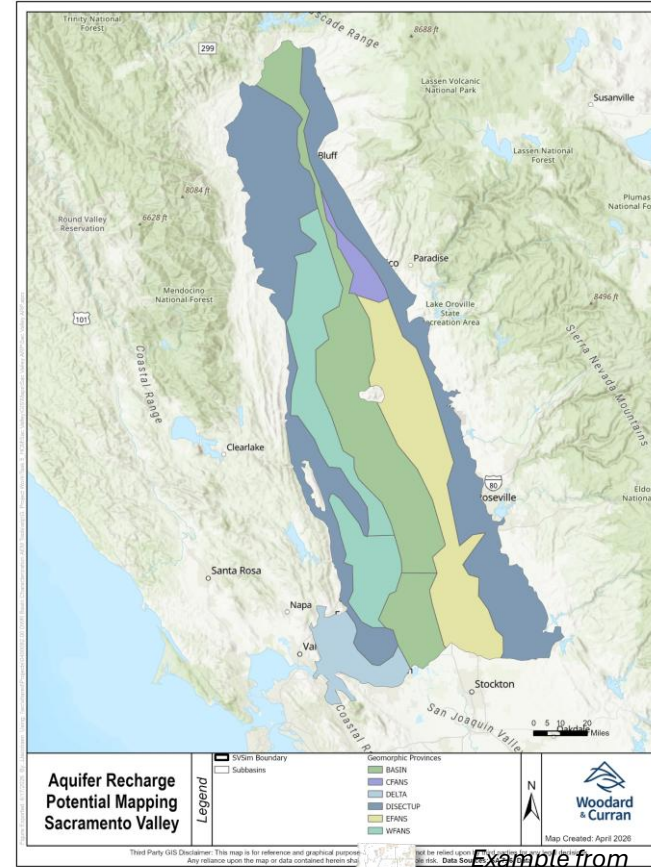
Boring Logs



AEM Coarse Fraction Data



Geomorphic Zones

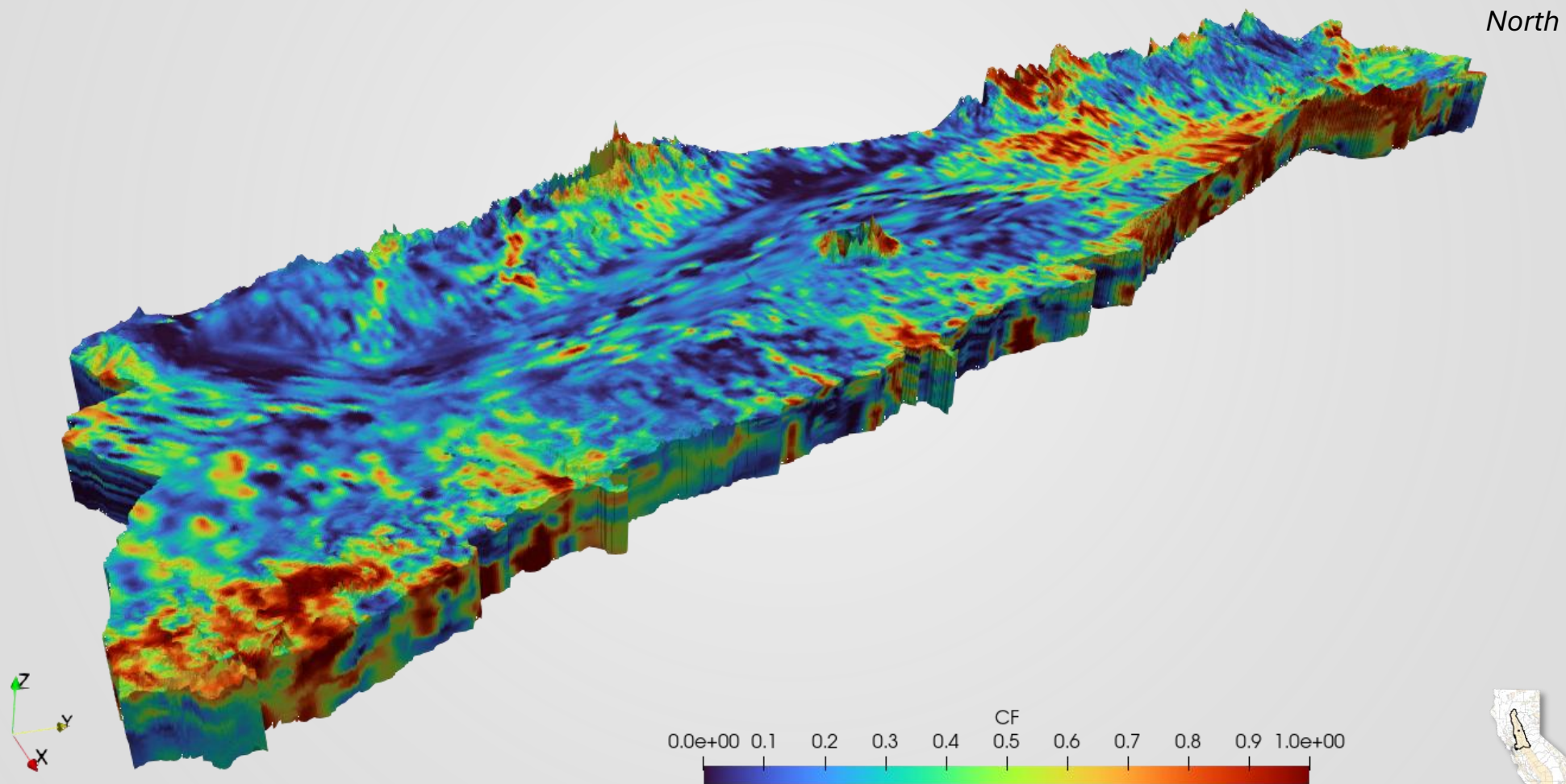


Example from
Sacramento Valley
Investigation Area

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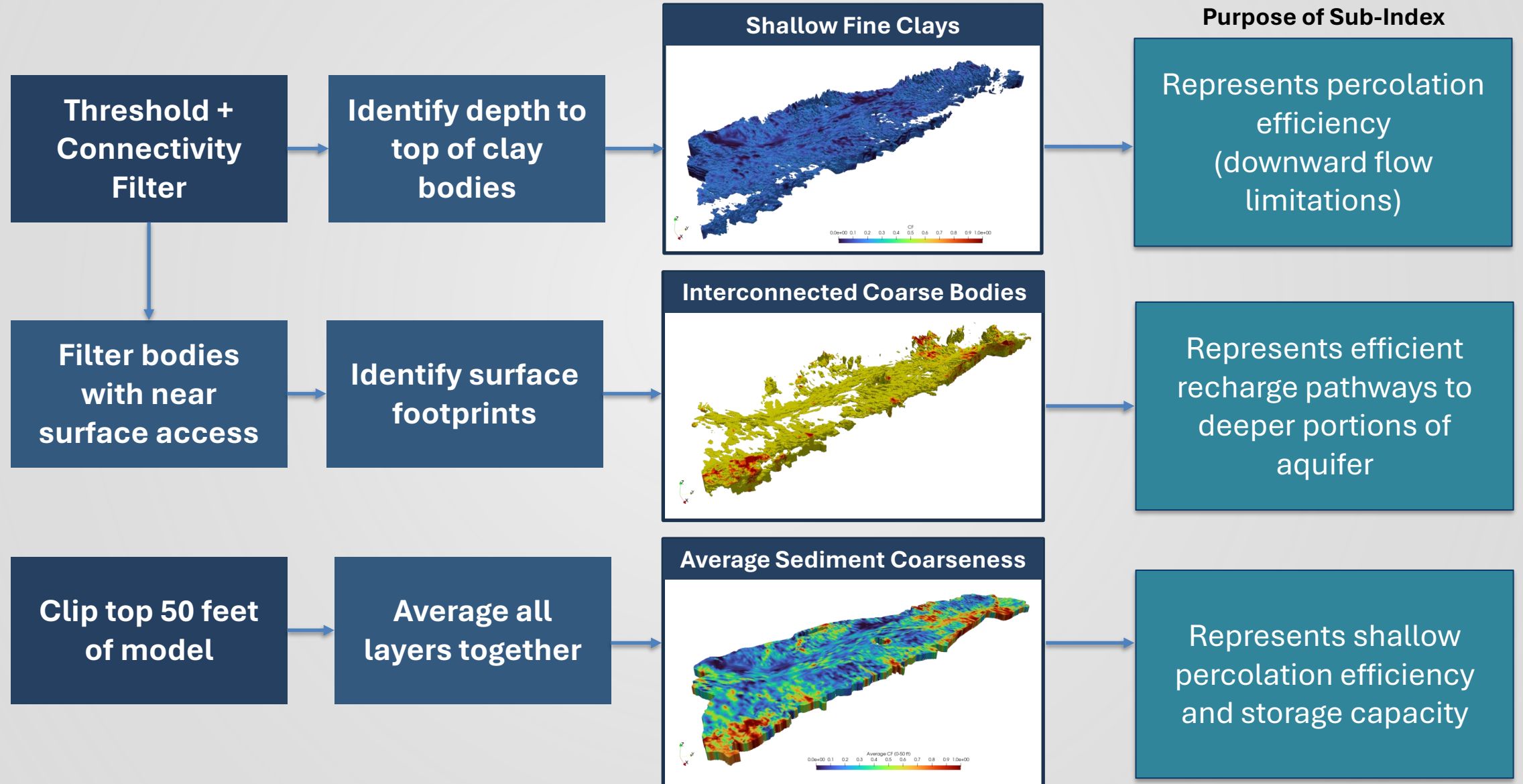
Sacramento Valley Texture Model



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Texture Model Sub-Indicies





Soil Conditions

Purpose of Sub-Index

Represents infiltration capacity through soils

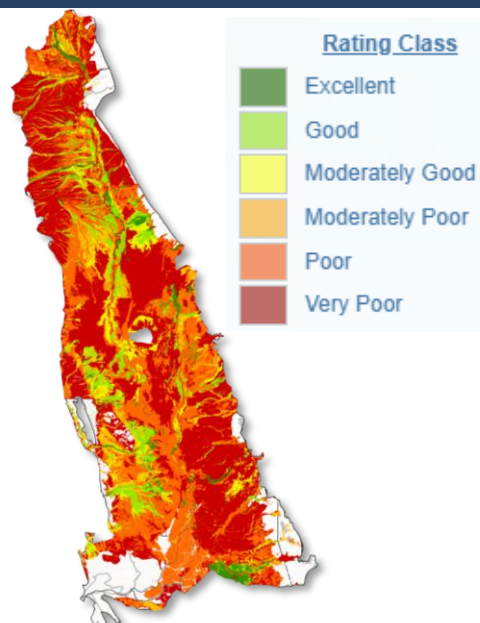
Data Source: SAGBI dataset

UC DAVIS

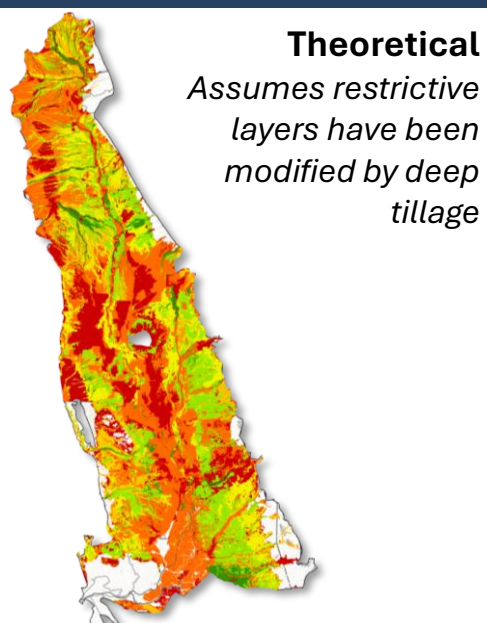
University of California
Agriculture and Natural Resources

- ▶ Deep Percolation
- ▶ Root Zone Residence Time
- ▶ Chemical Limitations
- ▶ Topographic Limitations
- ▶ Surface Condition

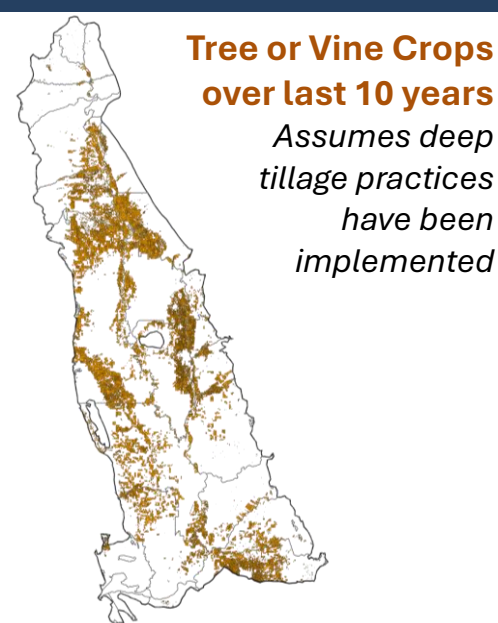
SAGBI Unmodified



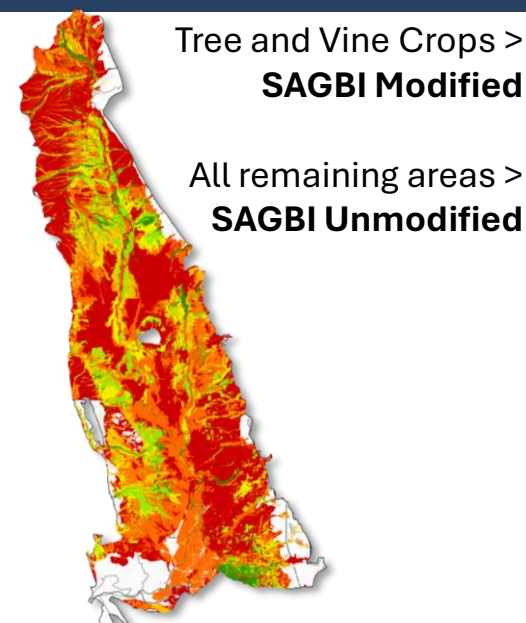
SAGBI Modified



Tree + Vine Crops



SAGBI Combined





Depth to Water

Purpose of Sub-Index

Represents
storage capacity and
management objectives

Data Source: SGMA Data Viewer

Groundwater Levels

Seasonal Reports

☒ Depth ☐ Elevation ☐ Change

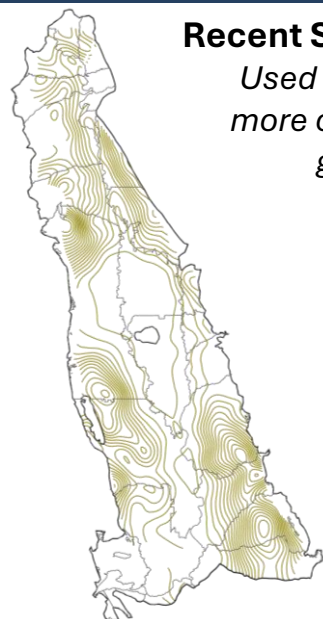
Spring x ▾

2023 x ▾

☐ Depth Points

☒ Depth Contour

Spring 2023 DTW

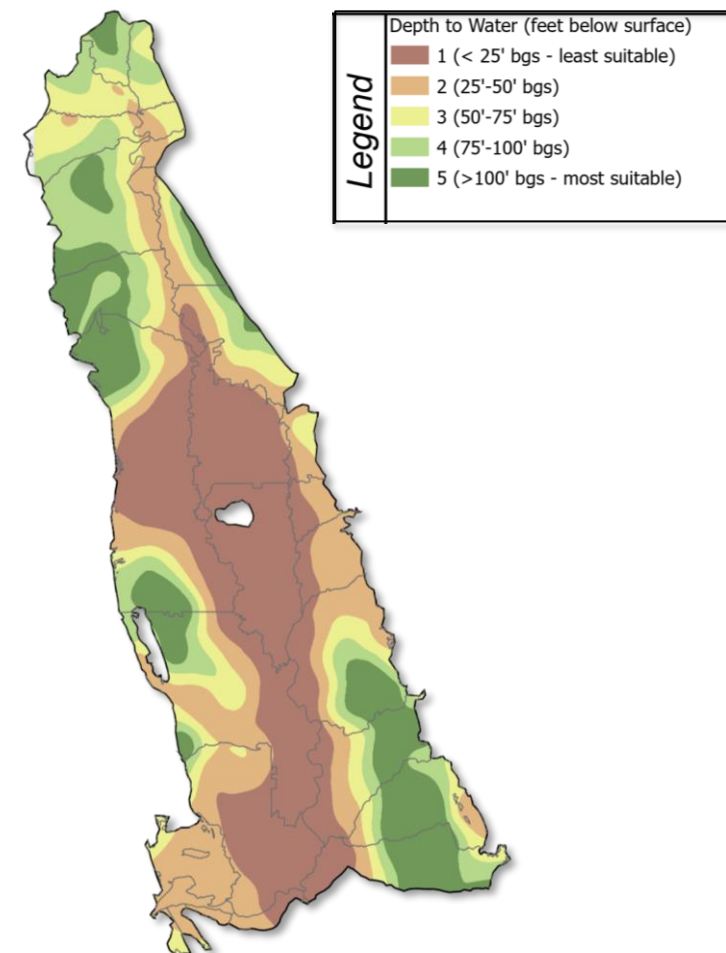


Recent Spring High

*Used to represent
more conservative
groundwater
conditions*

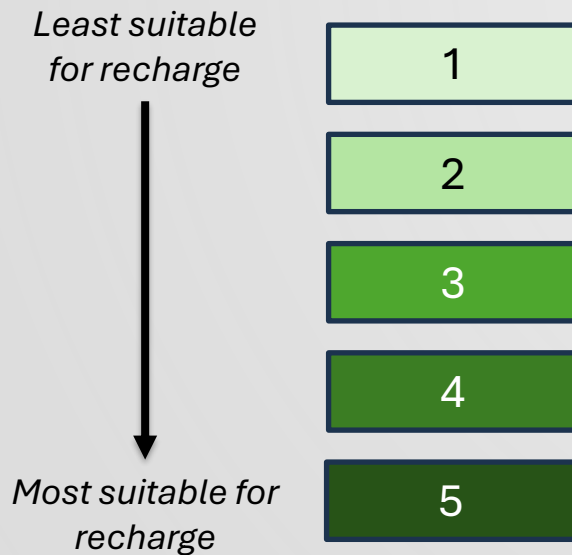
Interpolate point
or contour data

Depth to Water Surface



Bin and Rank Data

- Each sub-index is ‘binned’ so sub-indexes can be compared on similar basis
- Bins established based on if values would enhance or hinder recharge



Rank Number	Soil Conditions	Depth to Groundwater	Depth to Shallow Fine-Grained Layer	Shallow Sediment Coarseness	Interconnected Coarse Body
	<i>SAGBI score (unitless)</i>	<i>Depth to groundwater from ground surface (feet)</i>	<i>Depth to groundwater ground surface (feet)</i>	<i>Percent classified as coarse grained (%)</i>	<i>Percent coarse (%)</i>
1 (least suitable for recharge)	0-15	0-25 feet	0-16.4 feet	0-30%	No access to an interconnected coarse body in top 15 feet
2	>15-29	>25-50 feet	>16.4-32.8 feet	>30-50%	No value defined
3	>29-49	>50-75 feet	>32.8-49.2 feet	>60-70%	50-75%
4	>49-69	>75-100 feet	>49.2-98.4 feet	>70-90%	>75-90%
5 (most suitable for recharge)	>69-85	>100 feet	>98.4 feet, or not present	>90-100%	>90-100%
6 (most suitable SAGBI only)	>85-100	-	-	-	-



Weight Data

	Datasets				
	Soil Conditions	Depth to Water	Depth to Shallow Fine-Grained Layer	Shallow Sediment Coarseness	Interconnected Coarse Bodies
Purpose	Infiltration capacity through soils	Storage capacity and management objectives	Downward flow limitation	Shallow percolation efficiency	Efficient percolation pathways to deeper aquifer
ARP Map Type	Weights				
Shallow (Natural)	5	3	2	5	3
Shallow (Built)	0	3	2	5	3
Deep Preferential Pathway (Natural)	3	1	0	0	5
Deep Preferential Pathway (Built)	0	1	0	0	5

Combine



ARP Results

Shallow (Natural)

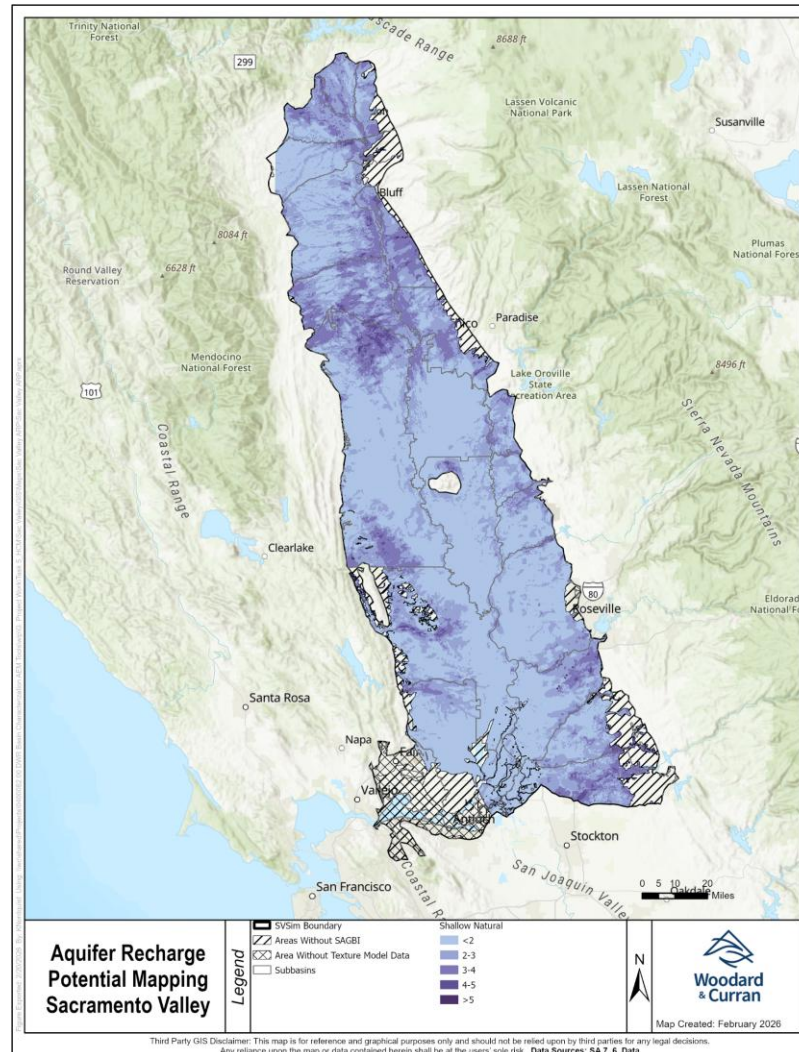
Relatively *less suitable*
recharge locations



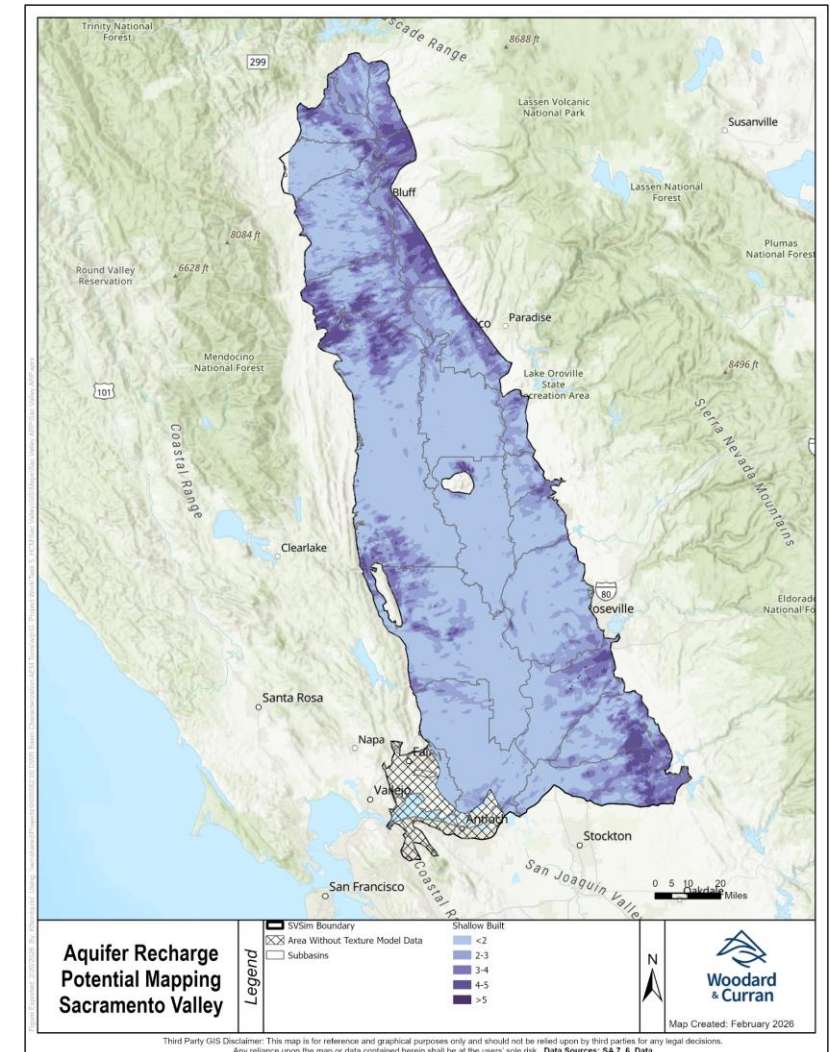
Relatively *more suitable*
recharge locations

Example from
Sacramento Valley
Investigation Area

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Shallow (Built)



Combine



ARP Results

Deep Preferential Pathways (Natural)

Deep Preferential Pathways (Built)

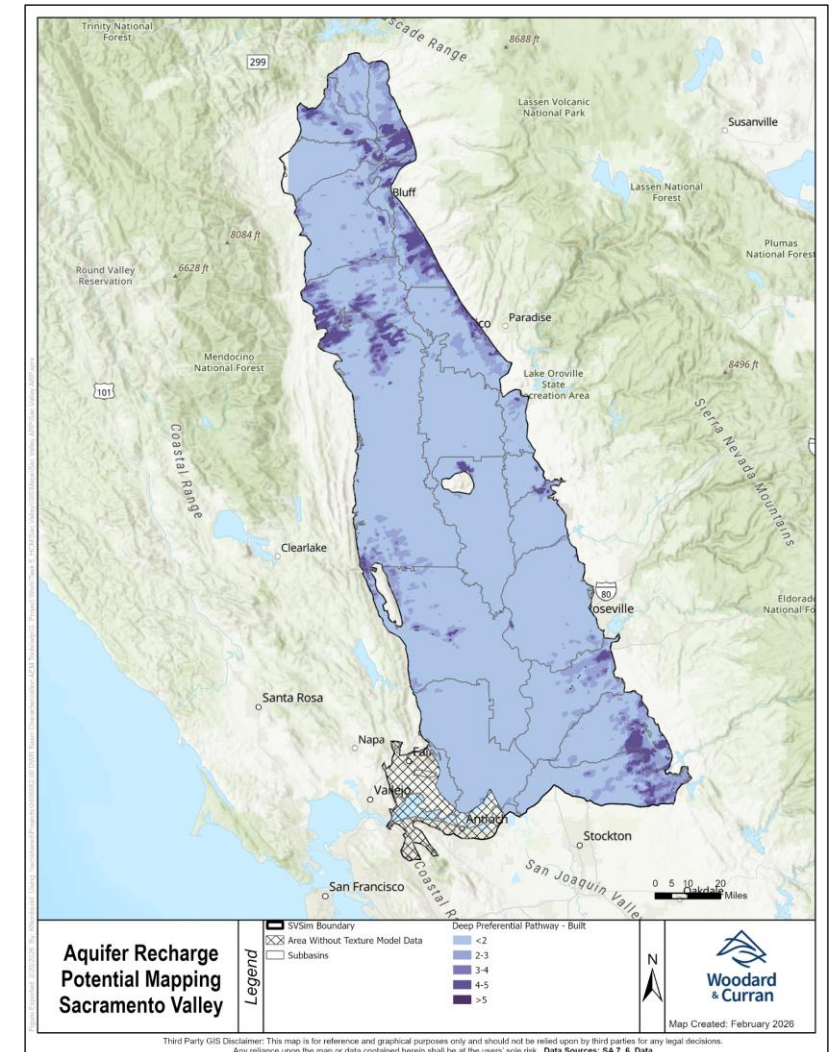
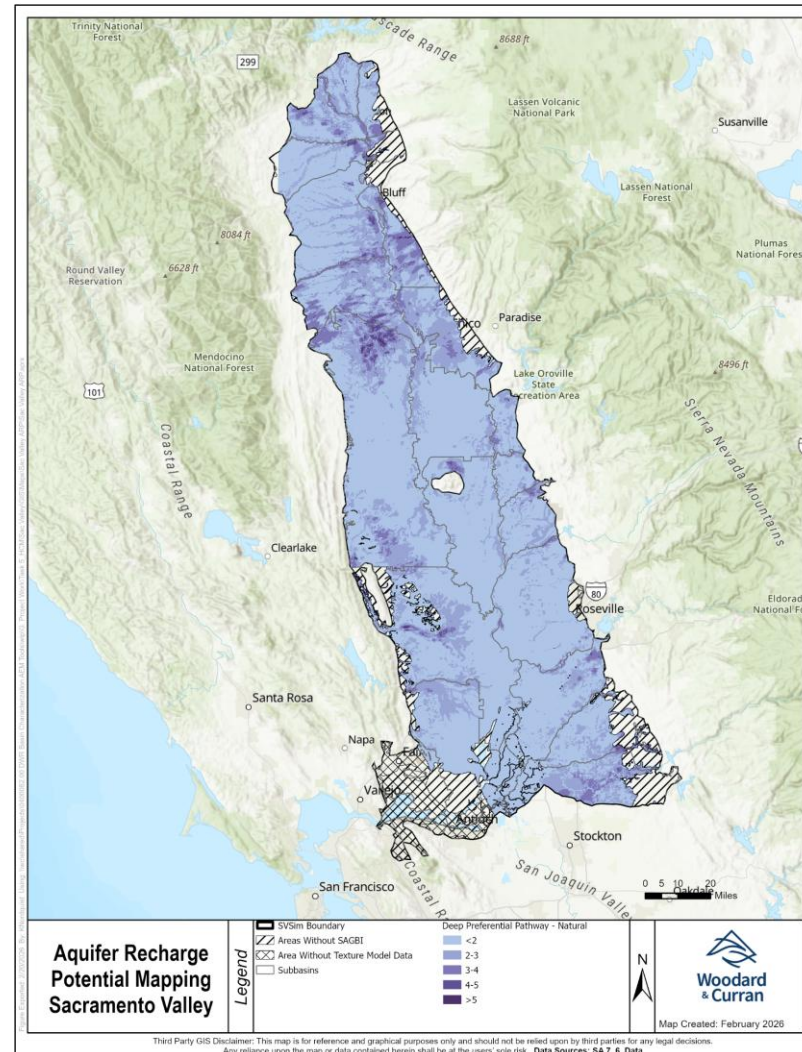
Relatively *less suitable*
recharge locations



Relatively *more suitable*
recharge locations

Example from
Sacramento Valley
Investigation Area

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Key Takeaways



ARP provides a **robust screening tool** to identify areas with relatively higher or lower **aquifer recharge potential**



High-quality datasets enhances resolution and **understanding of subsurface texture**, resulting in more reliable texture models



Integrating **improved texture models** into the ARP framework enables a more **informed evaluation** of recharge potential



ARP is **adaptable** for local needs and considerations

ARP Resources and Tools

ARP Process Document available online



California Department of Water Resources
Sustainable Groundwater
Management Office

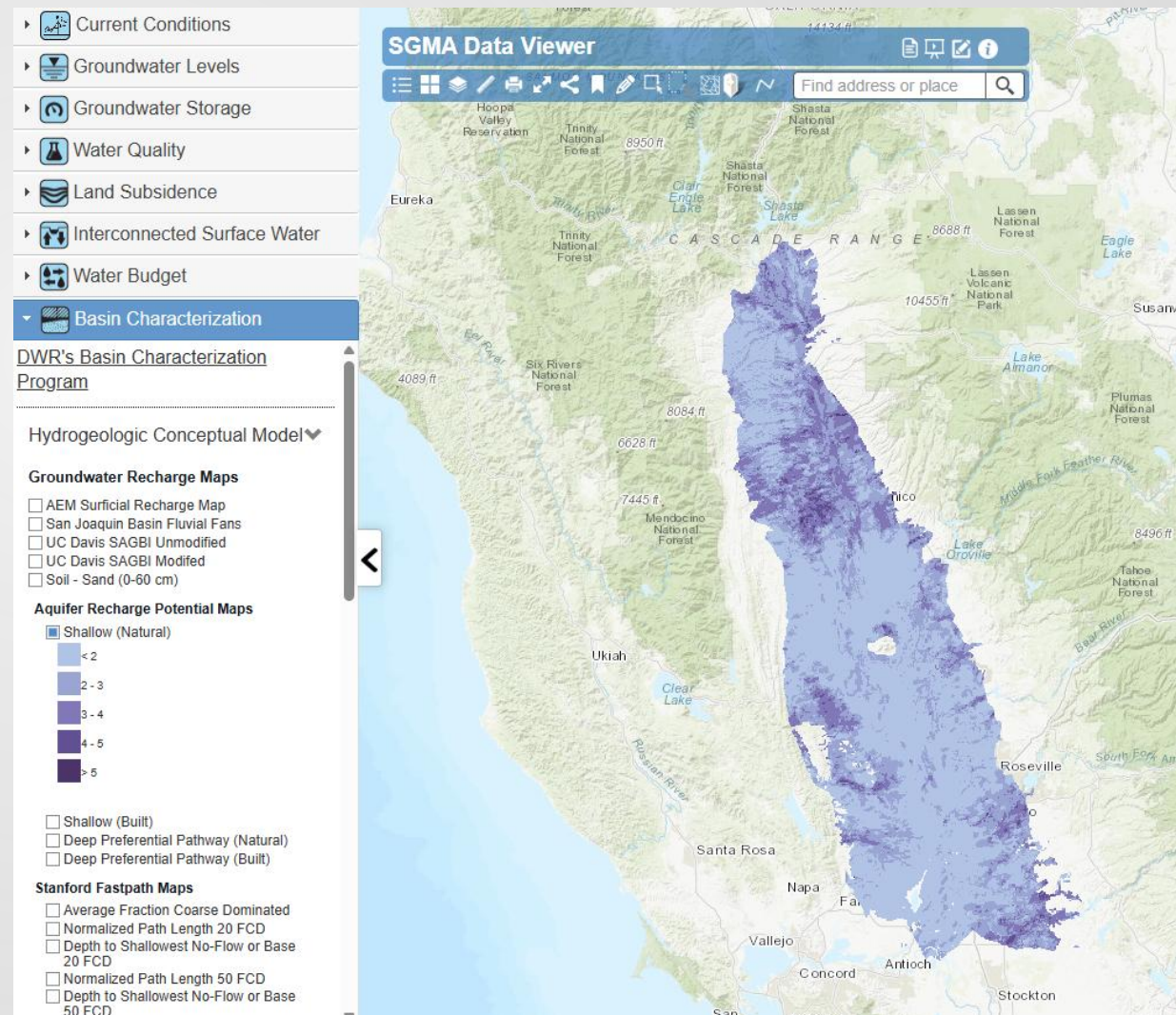
Aquifer Recharge Potential Mapping

Process Document
Version 2025.2
October 2025

Draft

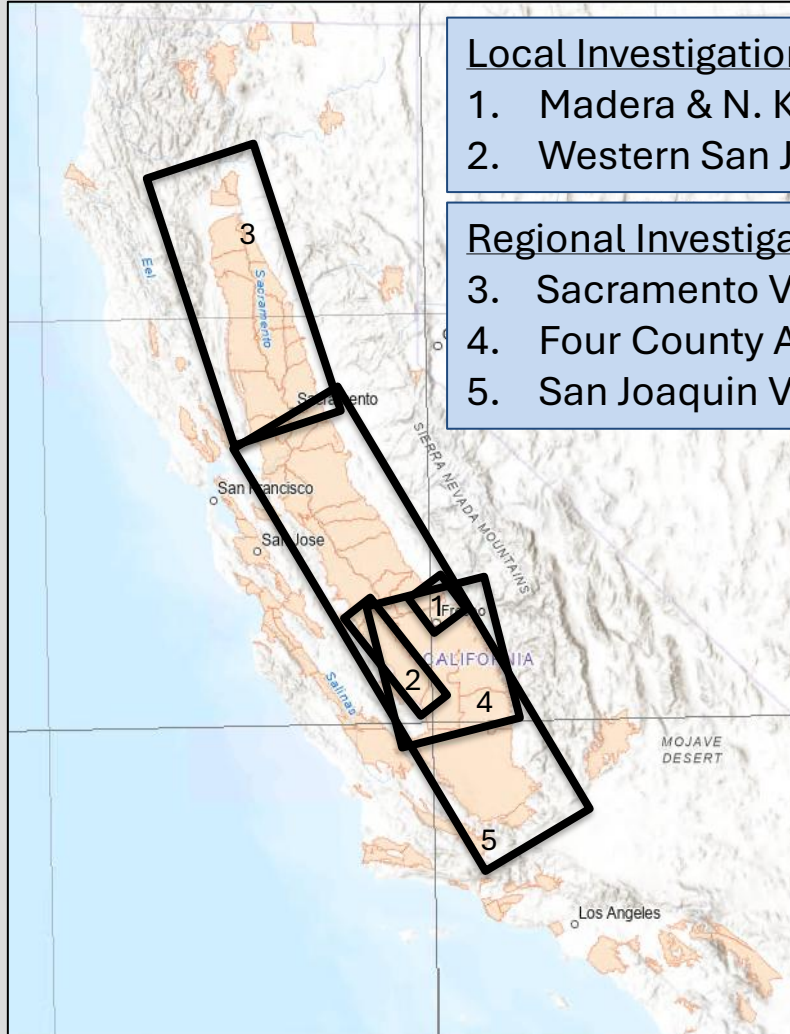
[https://data.cnra.ca.gov/dataset/
dwr-basin-characterization](https://data.cnra.ca.gov/dataset/dwr-basin-characterization)

ARP Maps available on SGMA Data Viewer



Next Steps for ARP

Upcoming phases of Texture model + ARP Maps:



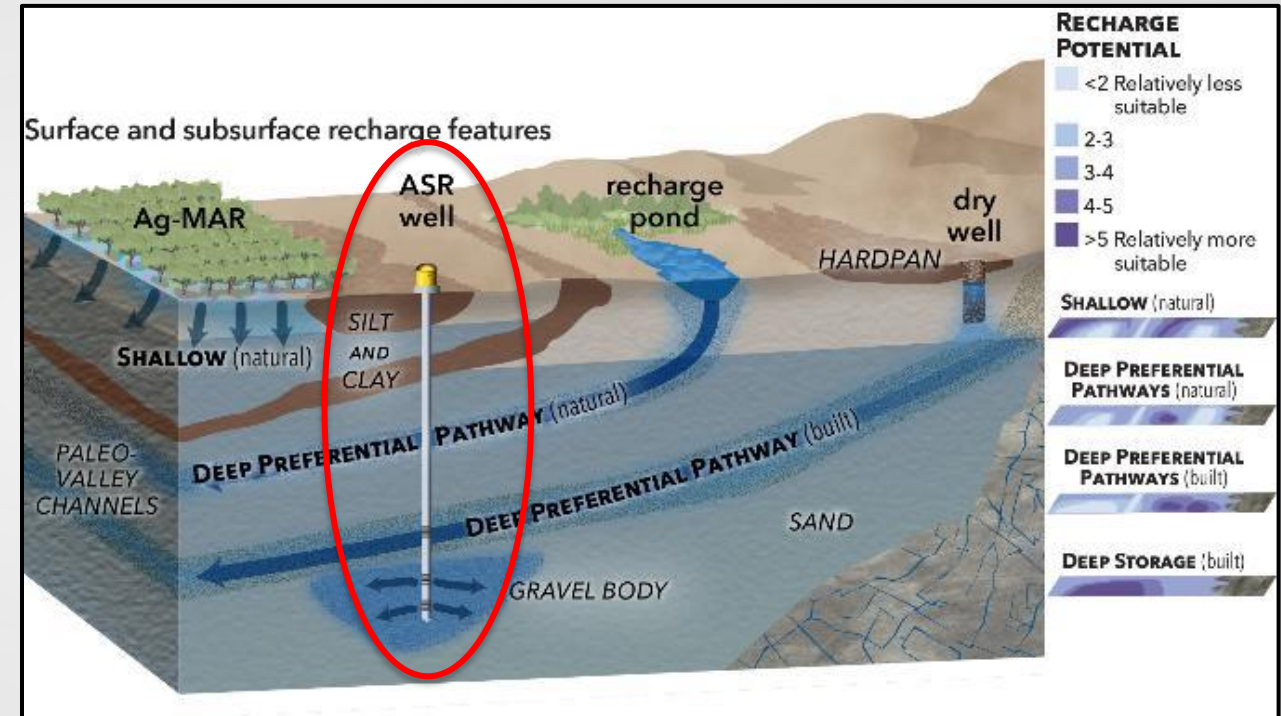
Local Investigations

1. Madera & N. Kings
2. Western San Joaquin Valley

Regional Investigations

3. Sacramento Valley
4. Four County Area
5. San Joaquin Valley

New Deep Storage/ASR Map in Development



Future Enhancements to ARP Process

- Integration with GRAT
- Recharge pathway tracking

Acknowledgements



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SUSTAINABLE GROUNDWATER
MANAGEMENT OFFICE

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- Michael Ou

RAMBOLL

- Paul Thorn

Thank you!



Nicole Jacobsen, PG

Email: jjacobsen@woodardcurran.com

Basin Characterization Program:

<https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118/Basin-Characterization>

**Tools, Maps, Models, and Data Available on
the CNRA Open Data Portal:**

[https://data.cnra.ca.gov/dataset/
dwr-basin-characterization](https://data.cnra.ca.gov/dataset/dwr-basin-characterization)

Program Email:

Basin.Characterization@water.ca.gov

