An Integrated Program to Enhance Groundwater Supplies through Infiltration of Stormwater: Progress and Challenges in Incentivizing Sustainability

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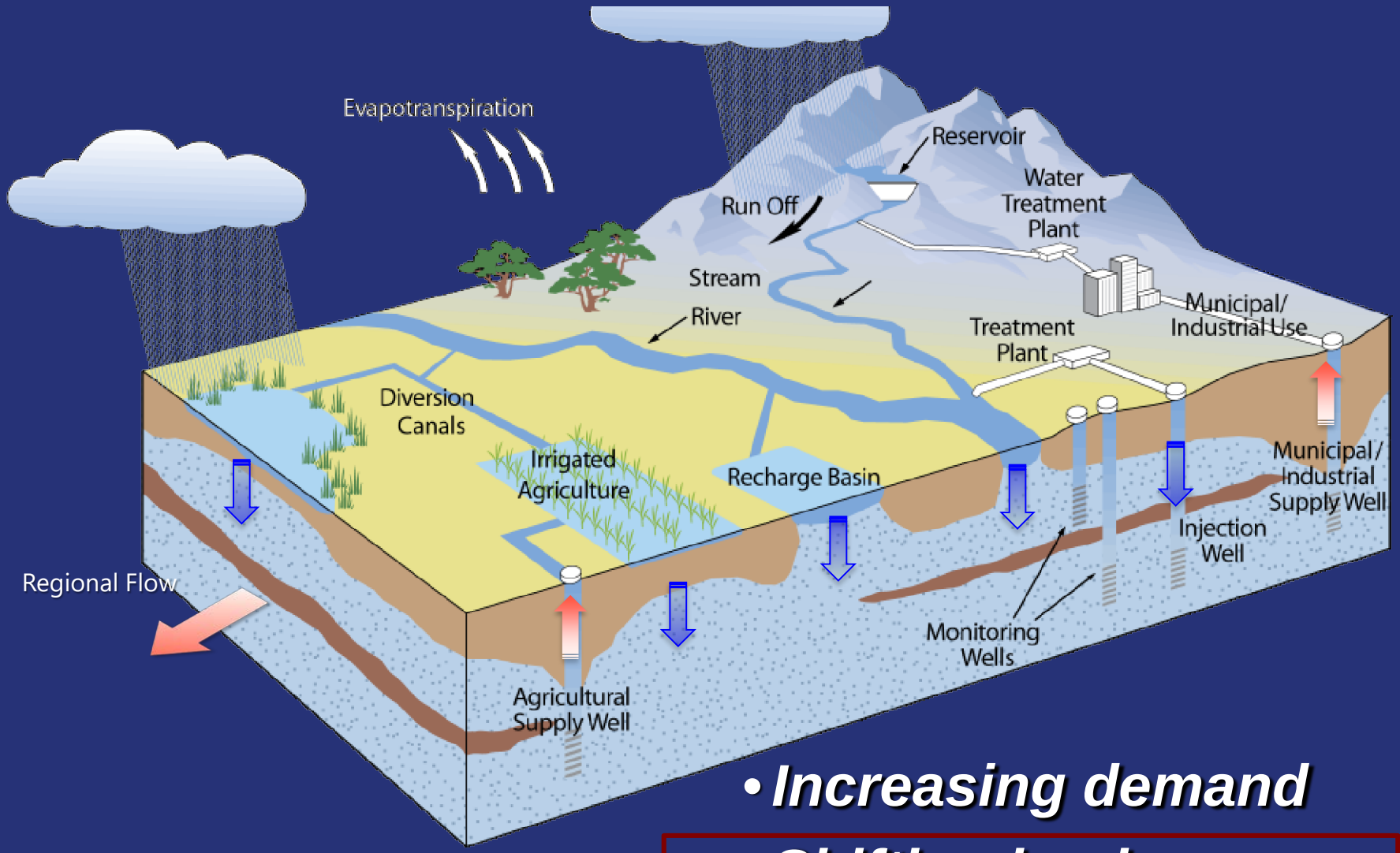
BSMAR-16
San Diego, California
6 March 2018

16th BIENNIAL SYMPOSIUM ON MANAGED AQUIFER RECHARGE

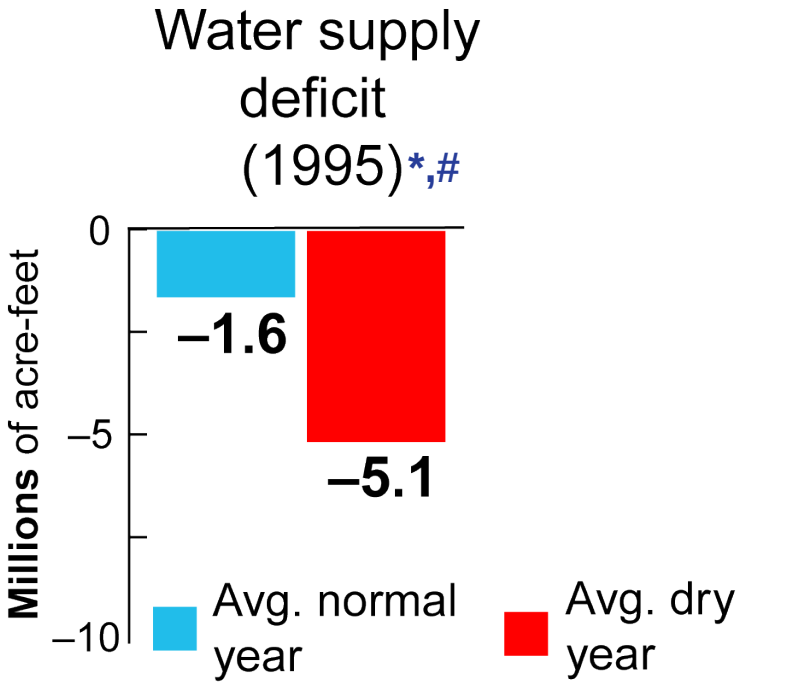
California's GW Supplies Face a Triple Threat



- *Increasing demand*
- *Shifting land use*
- *More intense rainfall*

Less GW Recharge

How Severe Is California's Water Imbalance?



Deficit = supply – demand

** Data from DWR Water Plan Updates*

 # Normal/Dry 160-98, based on conditions up to 1995

analysis from *Beganskas and Fisher* (2017)

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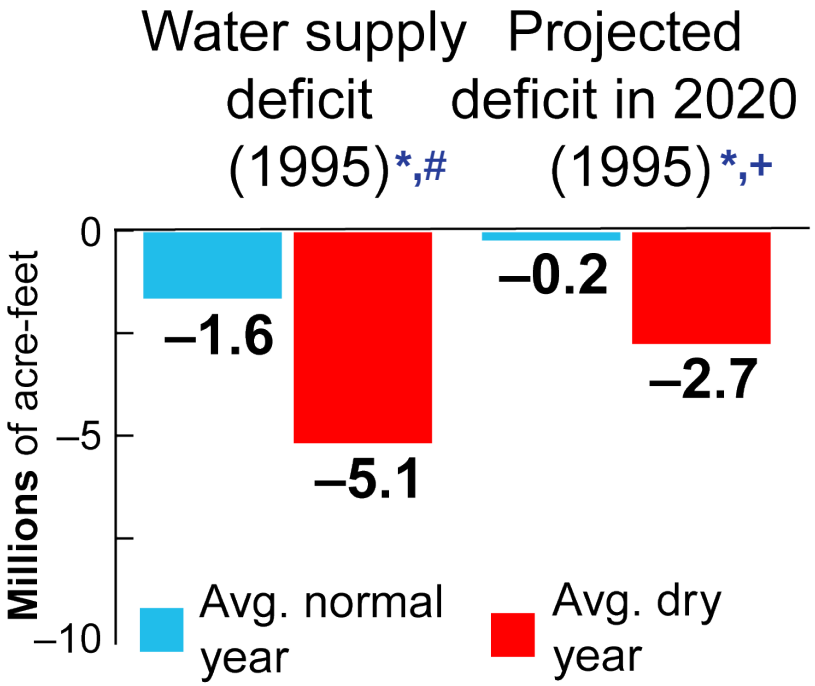

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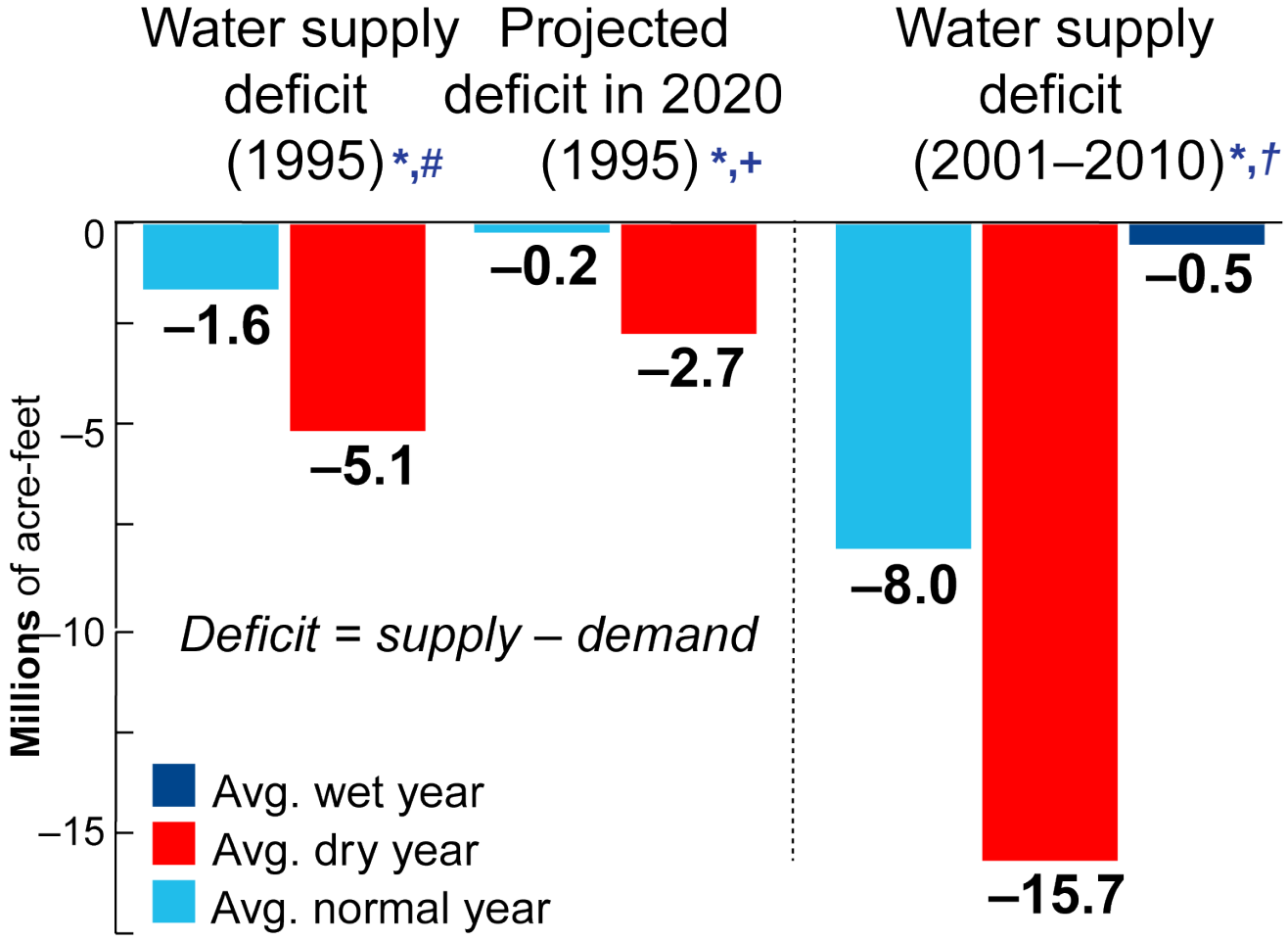

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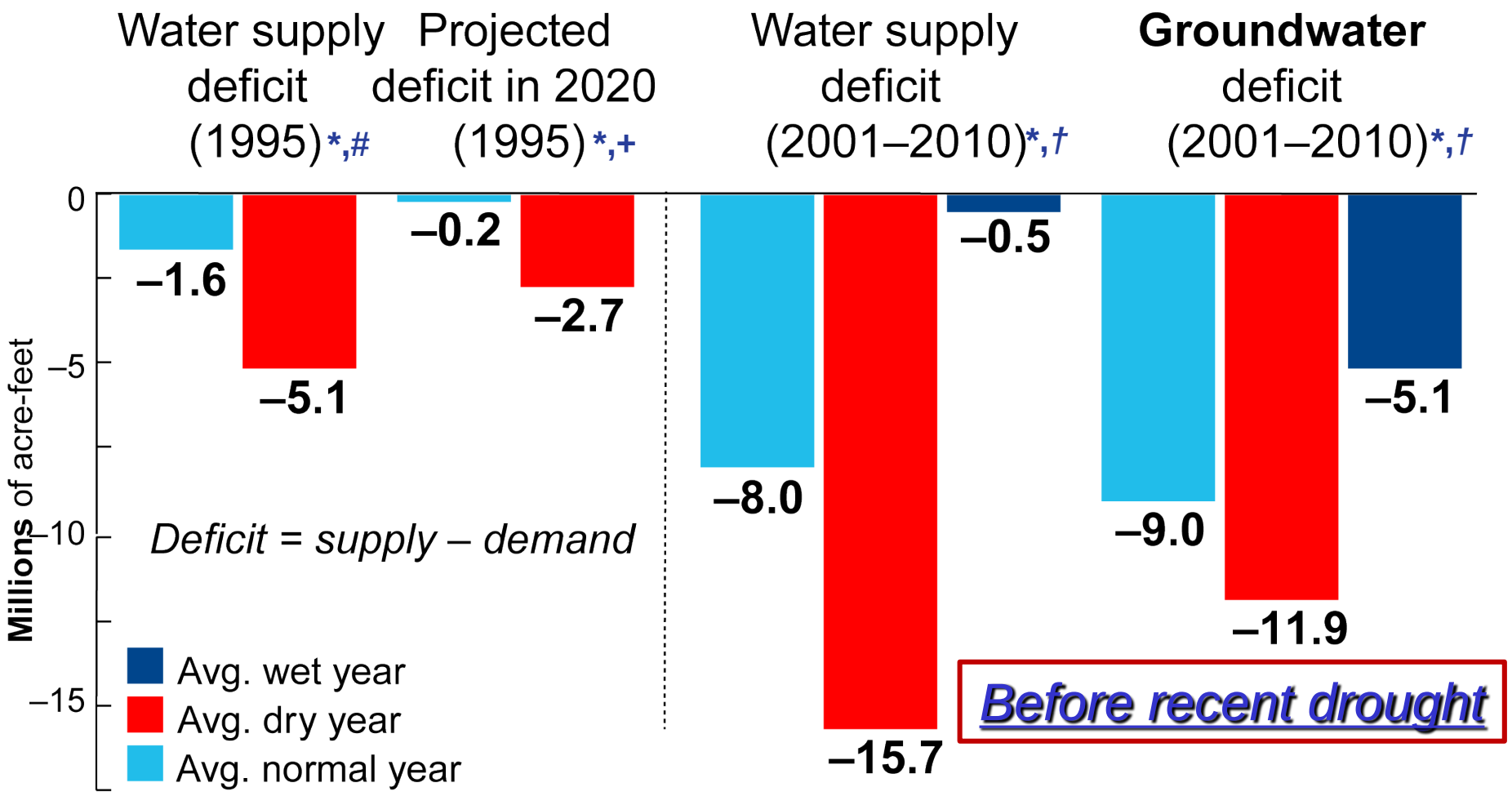
† Normal/Dry/Wet 160-13, from 2001-10 data

Pretty Severe!



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Integrated Program for MAR

- ***Map*** locations where enhanced recharge might be best accomplished
- ***Model*** availability of stormwater from hill slopes [+]
- Design/create field projects and ***measure***/validate:
  - benefits to water *supply* [#]
  - improvements to water *quality* [#]
- ***Monetize*** activities and policies[†] that incentivize stakeholders and strengthen partnerships

[+] ***Beganskas et al. (Wed AM)***
[#] ***Gorski et al. (Wed AM)***
[†] ***Pensky et al. (Wed AM)***

The Recharge Initiative
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www.rechargeinitiative.org

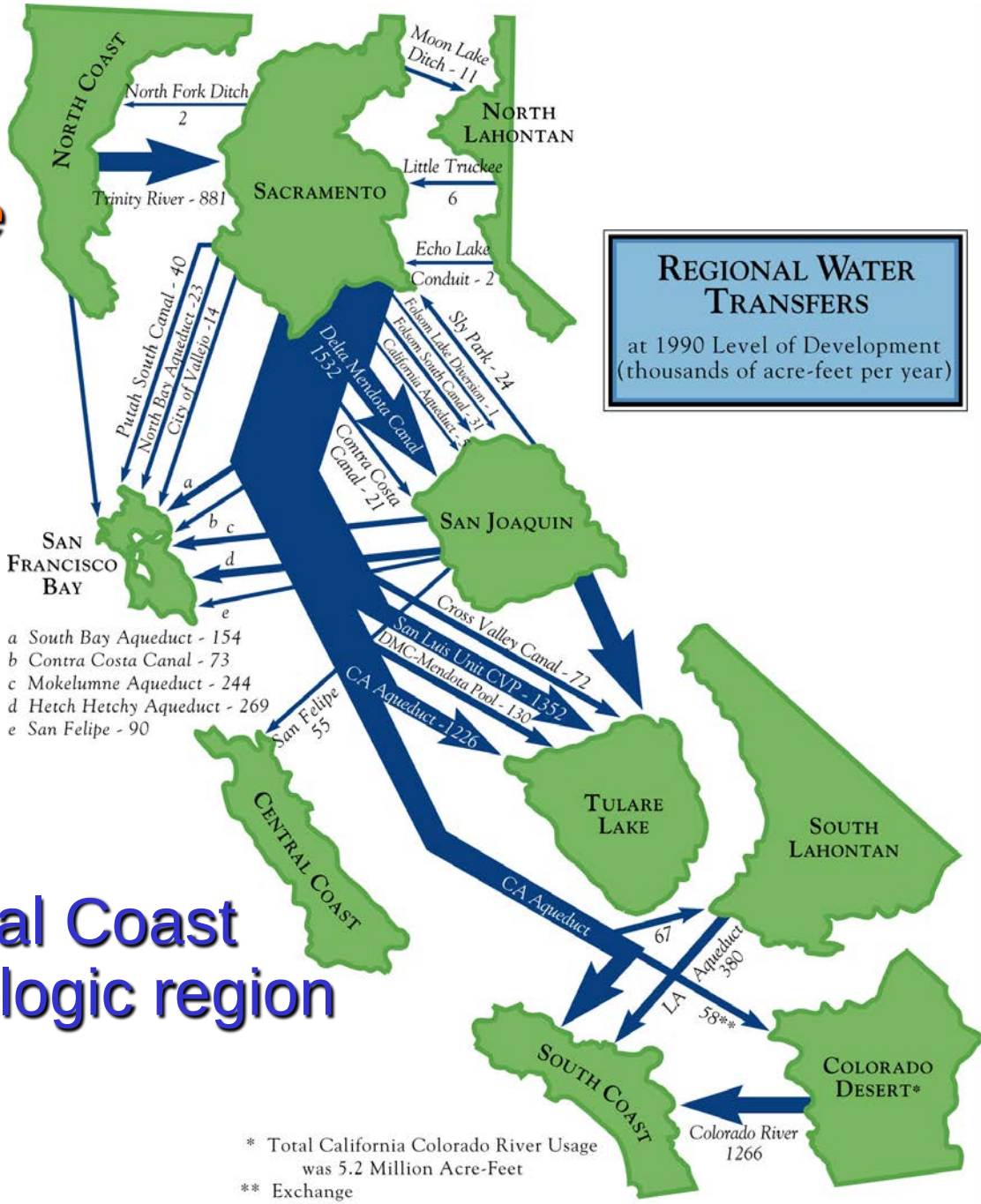
Central Coast: heavily reliant on groundwater

GW = 83% of demand

Simultaneously a challenge and an opportunity for our region

DWR Water Plan Update 160-98

Central Coast: Virtually "off the grid" in terms of large-scale water transfers



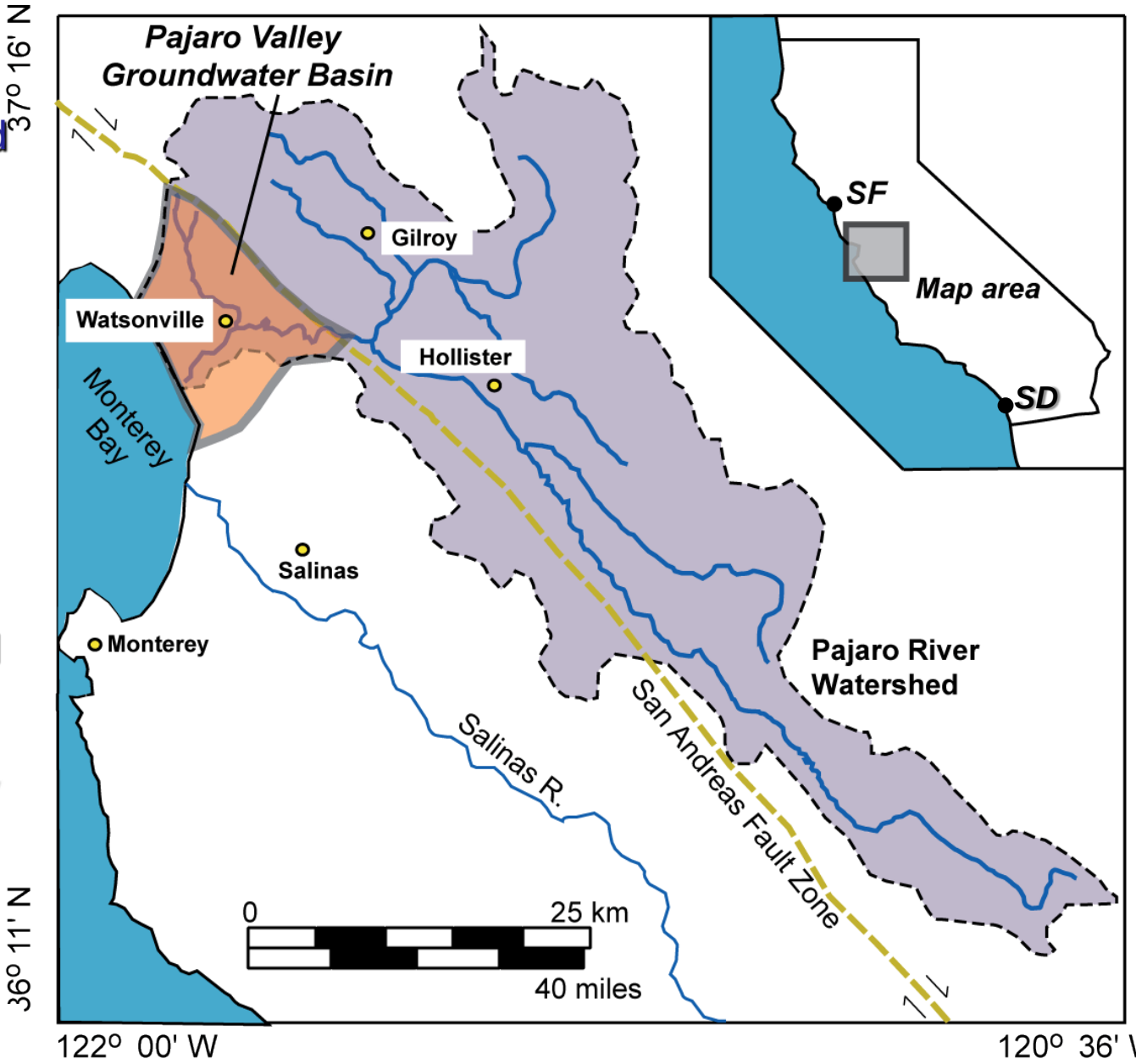
Central Coast hydrologic region

Pajaro River and Pajaro Valley Groundwater Basins

- PVGB, lower PR basin, mostly Santa Cruz and northern Monterey Counties
- Primary fresh water resource is groundwater
- PVWMA: Special Act district (1984)
- PVWMA serves 70,000 acres, 30,000 irrigated

Major crops:
Strawberries, cane berries, table crops, organic (30%)

→$1B farm revenue



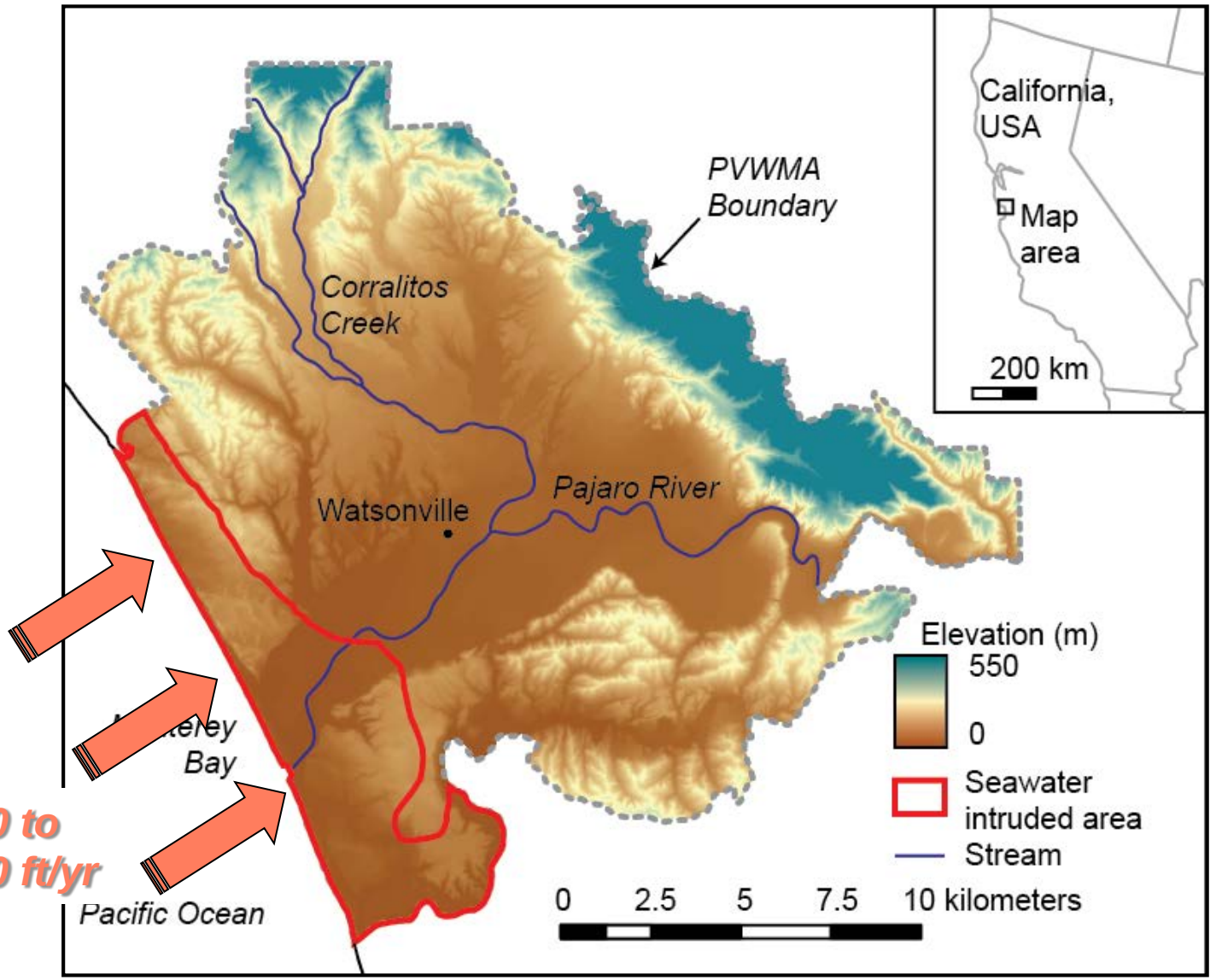
Overdraft is a regional challenge

Pumping:
~55k ac-ft/yr

City of Watsonville:
~7k ac-ft/yr

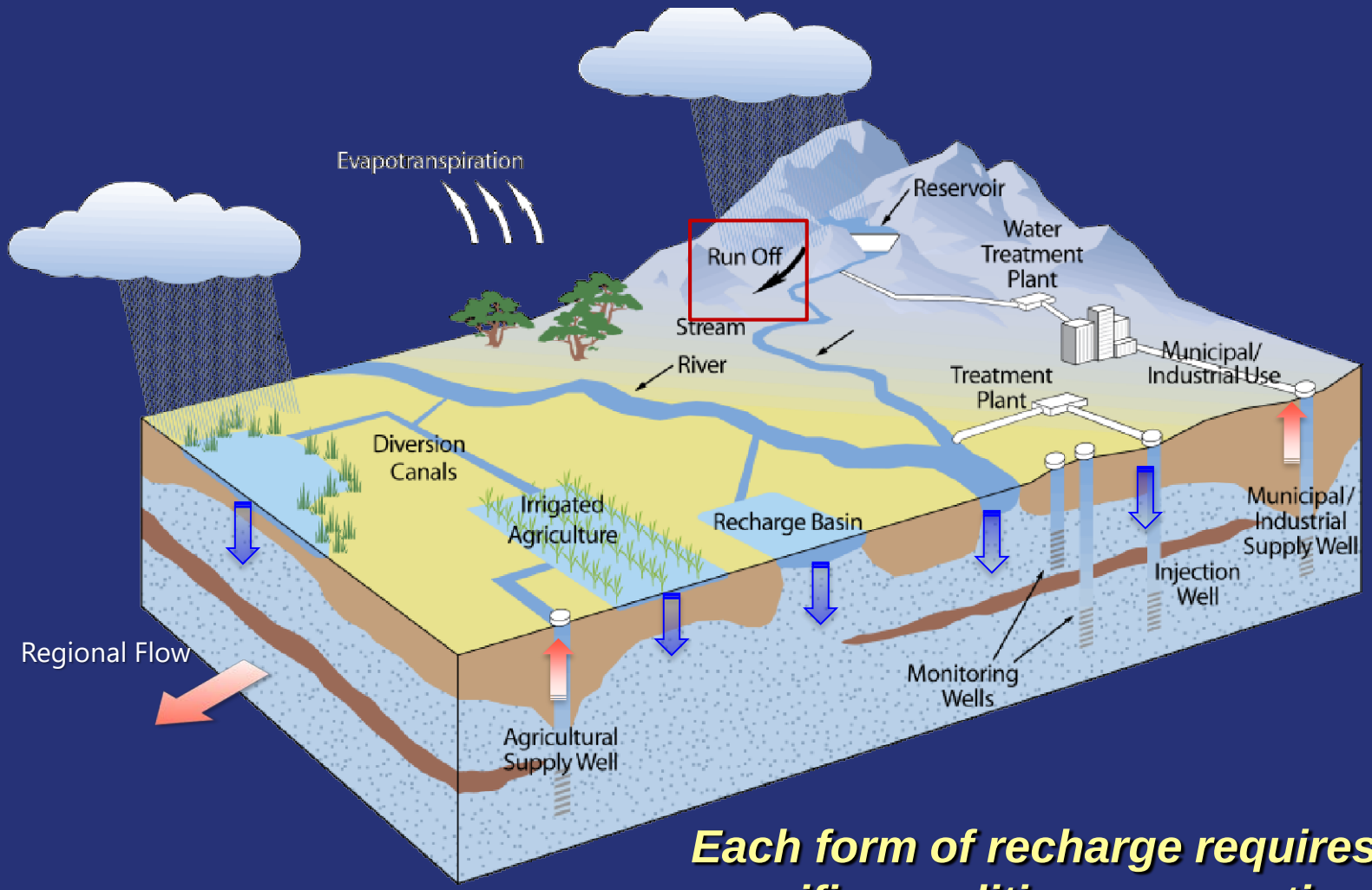
Sustainable yield:
~40k–45k ac-ft/yr (depends on pumping distribution, time horizon, natural variability)

Overdraft:
~10k–15k ac-ft/yr (depends on definition, annual conditions)



map from PVWMA, 2012

Many forms of groundwater recharge (natural, managed)



Each form of recharge requires specific conditions, properties, design, operations –

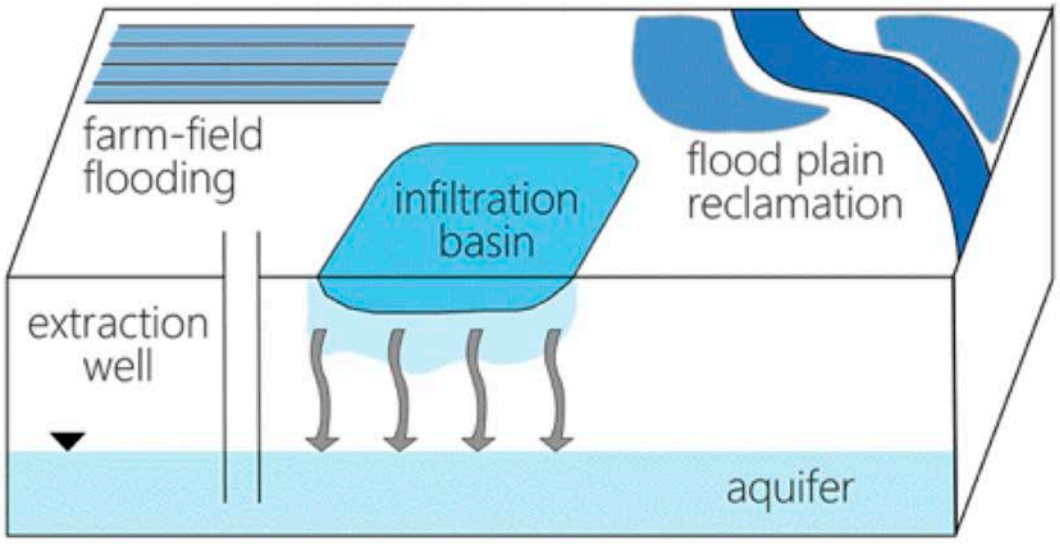
"all recharge is local"

Many forms of groundwater recharge (natural, managed)

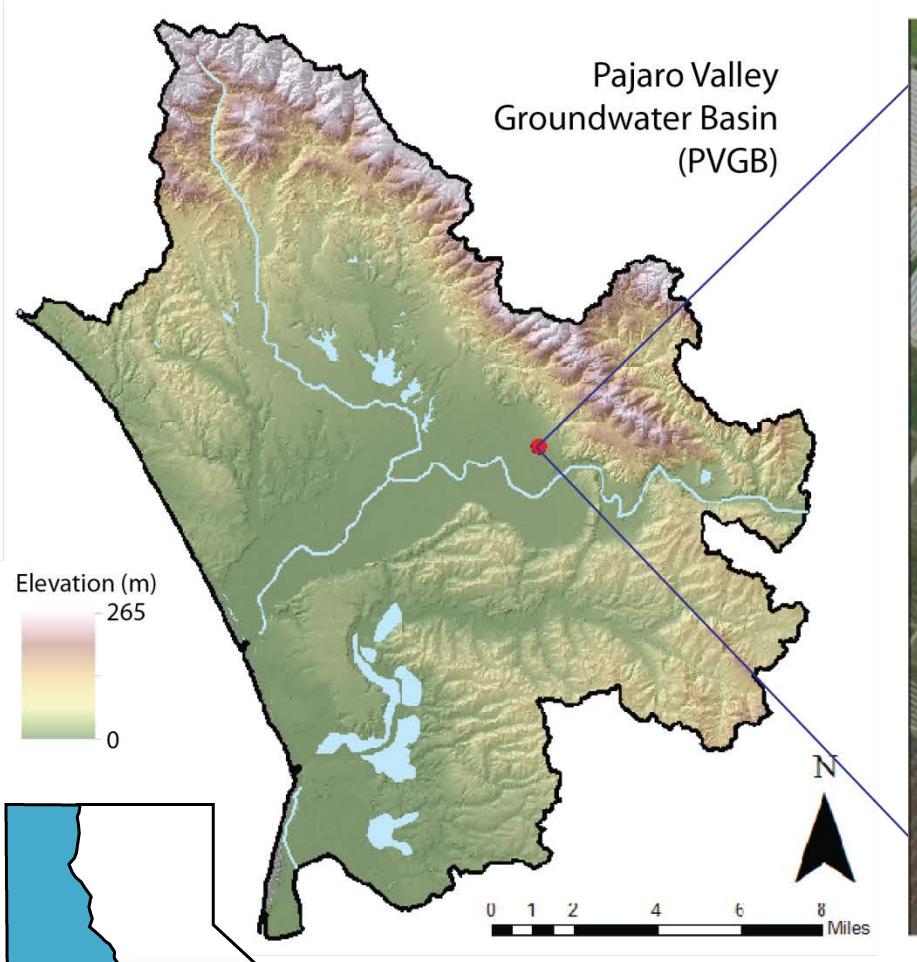
Choices for infiltration

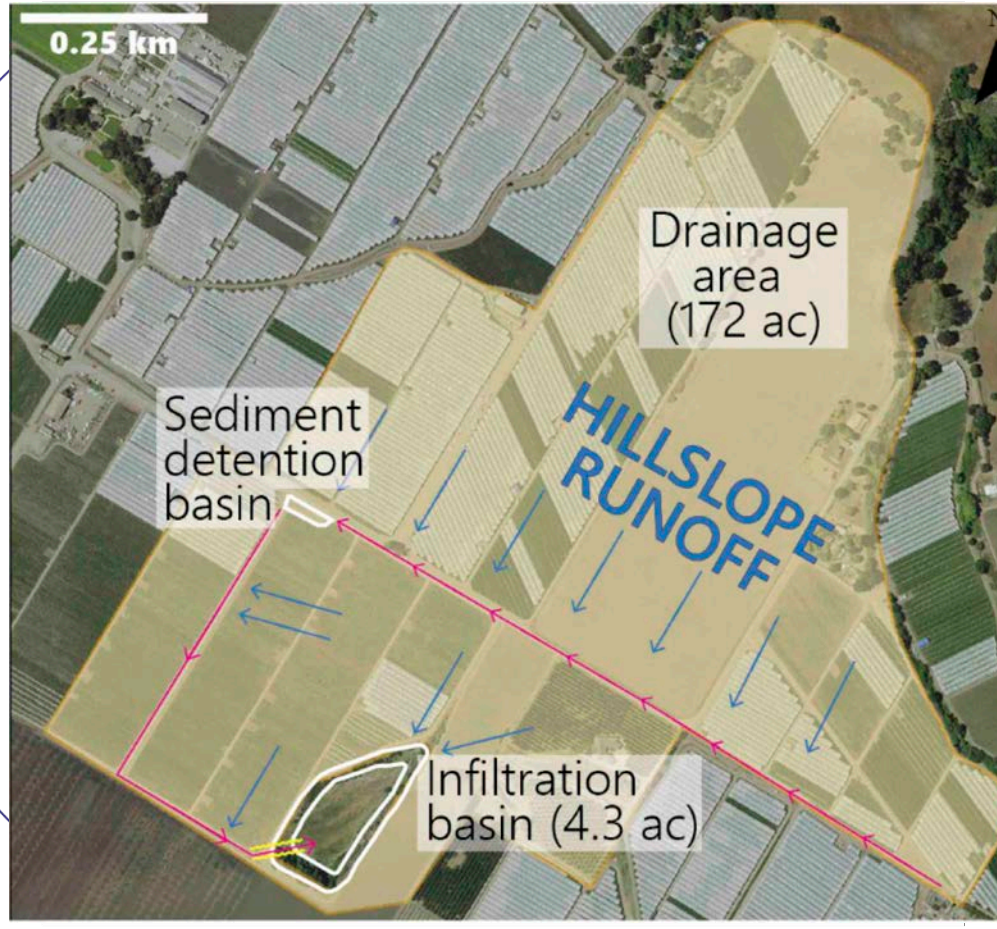
"Managed" recharge

- **Well recharge**
- **Surface recharge**
  - Basin/trench
  - Farm field flooding
  - Flood plain reoccupation
  - Stream bank filtration



Distributed Stormwater Collection – Managed Aquifer Recharge (DSC-MAR)

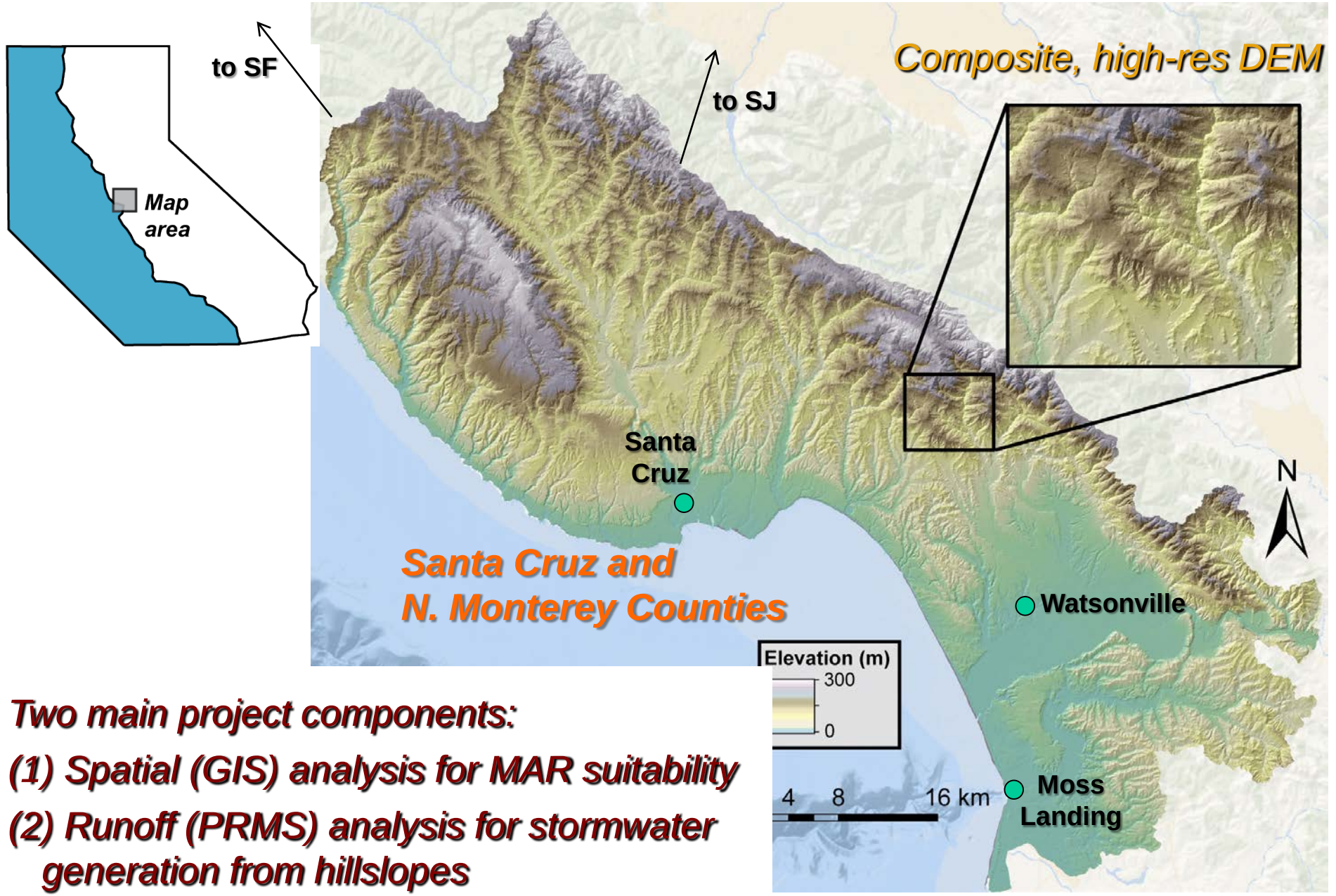




Bokariza Ranch, *Project goal: ~100 ac-ft/yr*

modified from *Beganskas and Fisher (2017)*

Where to Place DSC-MAR Projects?



Two main project components:

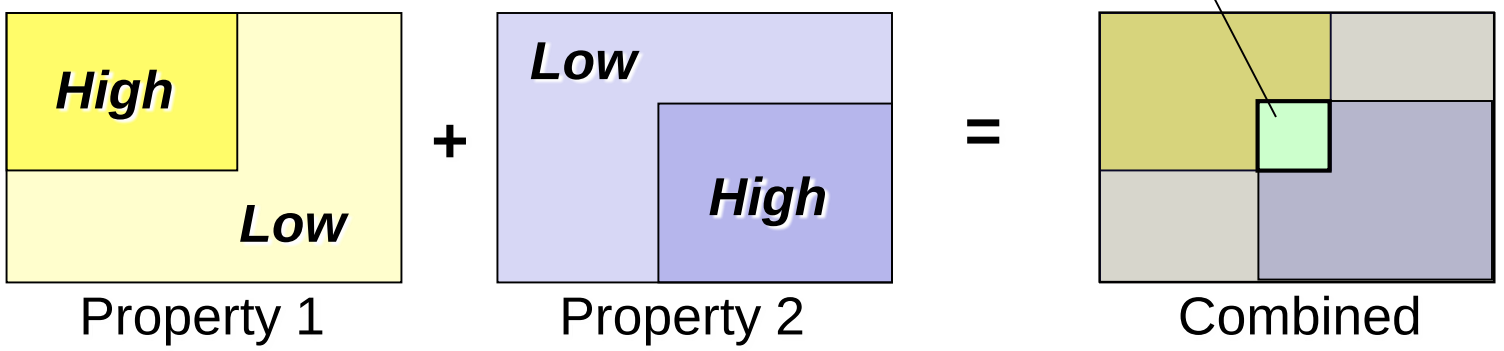
(1) Spatial (GIS) analysis for MAR suitability

(2) Runoff (PRMS) analysis for stormwater generation from hillslopes

Combining spatial data to assess MAR Suitability

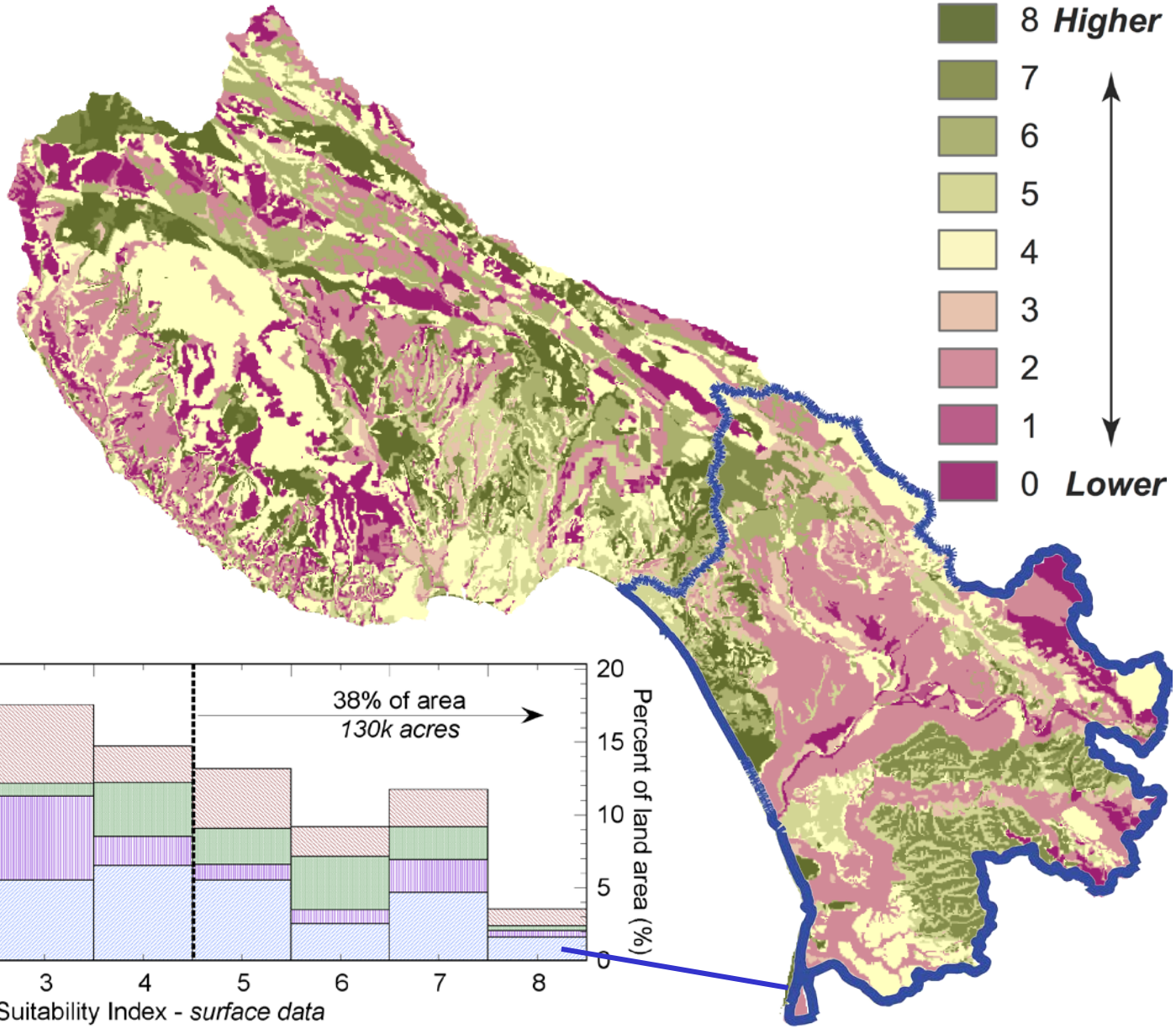
- *Compile, patch, reconcile, regrid, reproject datasets*
- *For each dataset, categorize for conditions that are more/less favorable for DSC-MAR*
- *Combine datasets to create maps showing composite suitability*

Schematic example:

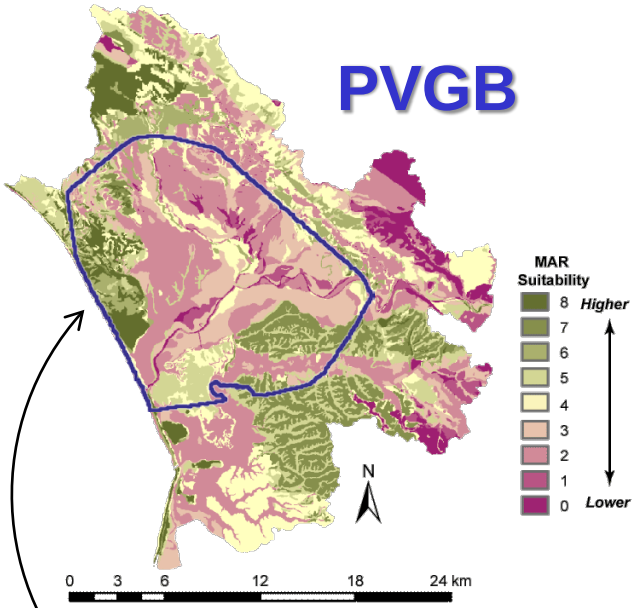


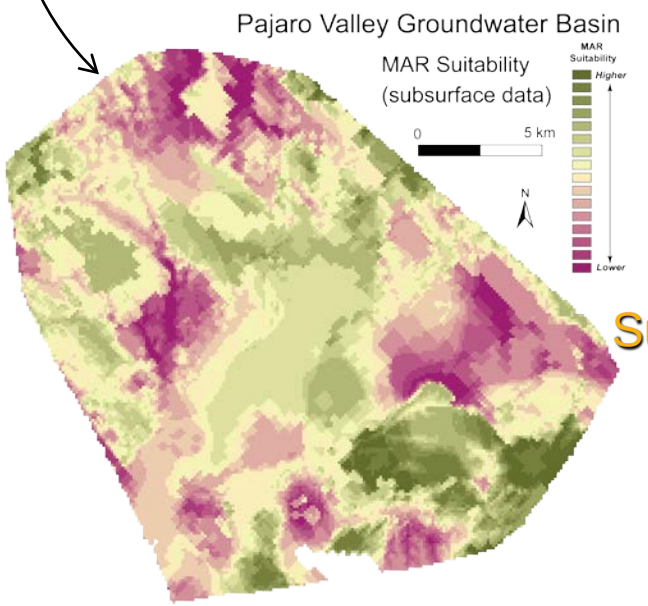
Suitability for Managed Aquifer Recharge based on Surface Factors

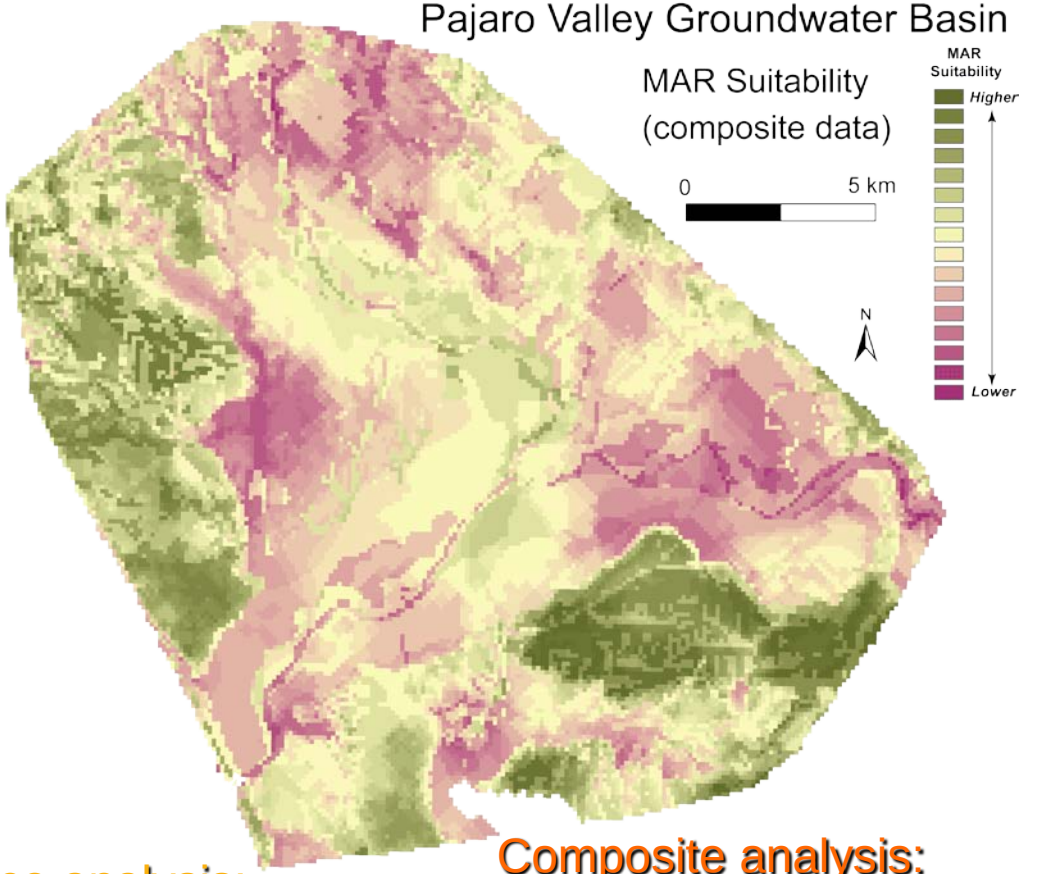
- *Combine soils, bedrock info*
- *Additional considerations include: slope, land use, veg (discussed below)*



Suitability for Managed Aquifer Recharge based on Surface+Subsurface Conditions







Subsurface analysis:

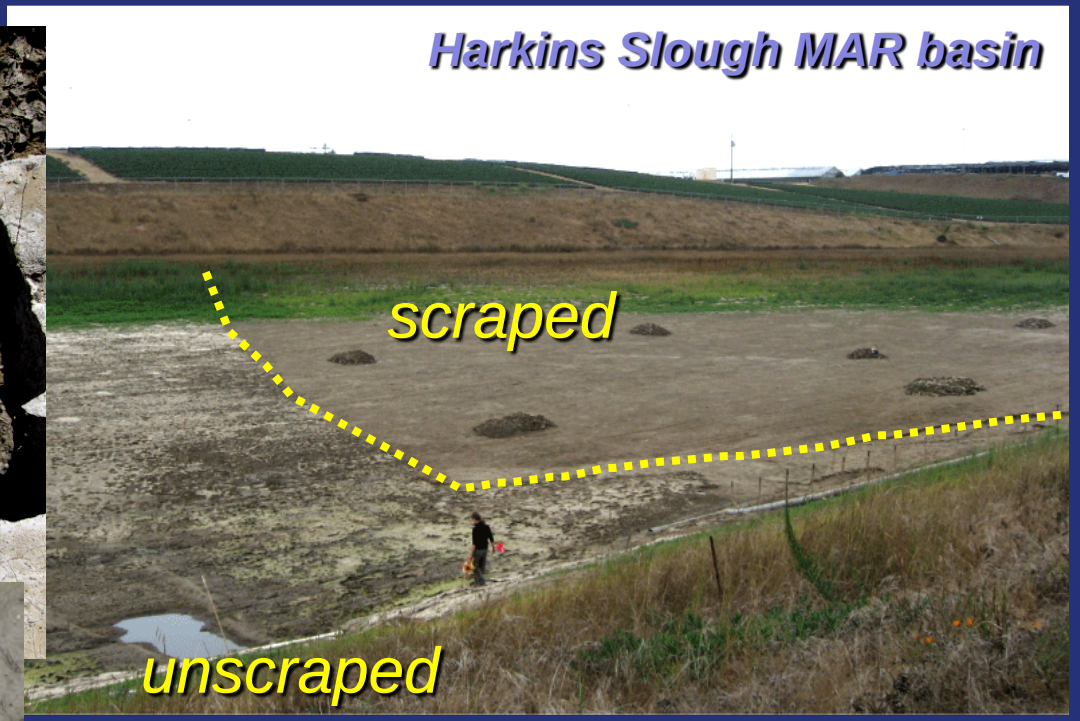
- Transmissivity (*K* x *b*)
- Vadose zone thickness
- Available storage
- Change in storage

Composite analysis: covers a fraction of the subregion – where there are subsurface datasets

Teo et al. (2018-in prep)

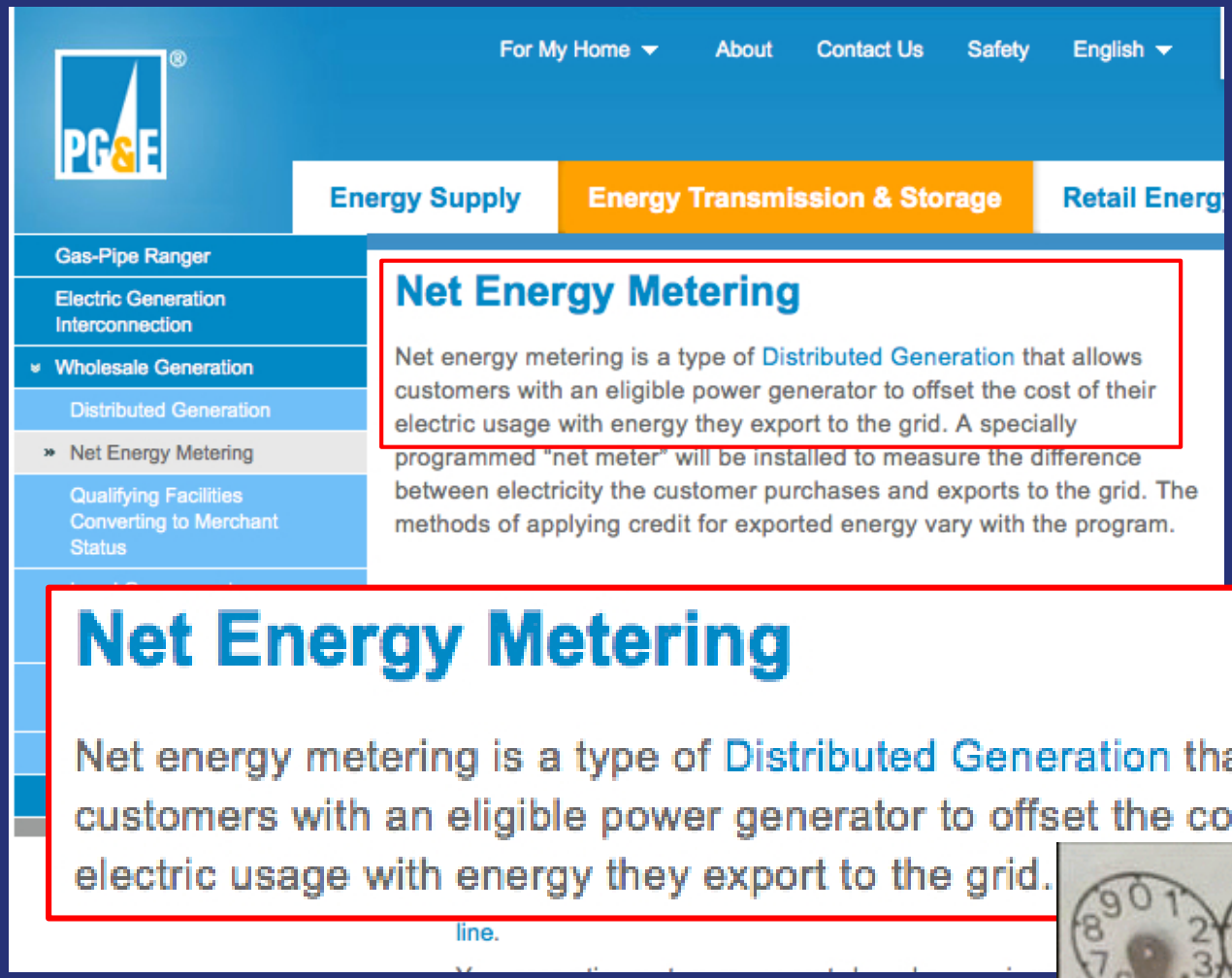
Costs to Growers/Landowners for DSC-MAR

- *Land taken from production/reduced access*
- *Maintenance of infiltration structures (basins, dry wells)*



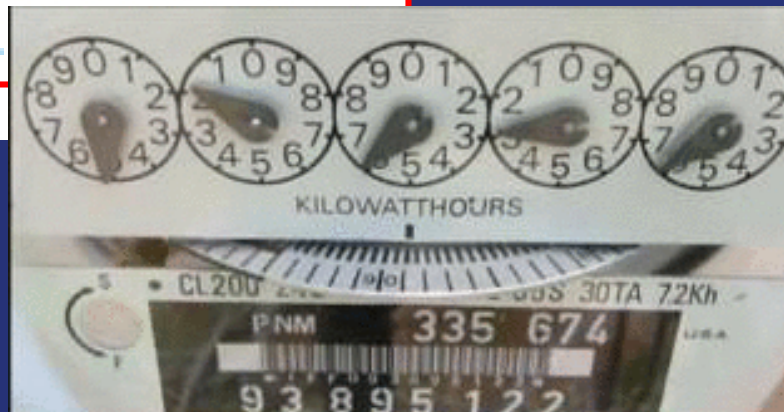
How can participation be incentivized?

There is a Workable Example: Net Energy Metering



- *generate energy locally*
- *account for net usage*
- *excess power goes on the grid for sale (and eventual use)*

- *Requires*
  - *reliable measurement and accounting*
  - *formula to calculate benefit/rebate*
  - *stakeholder and Agency trust*



Example: Net Recharge Calculations

Irrigated area: 75 irrigated acres

Applied water: 2.5 ft

Annual precipitation: 1.5 ft (18 inches)

Runoff/precipitation = 0.4 (appropriate for intense events)

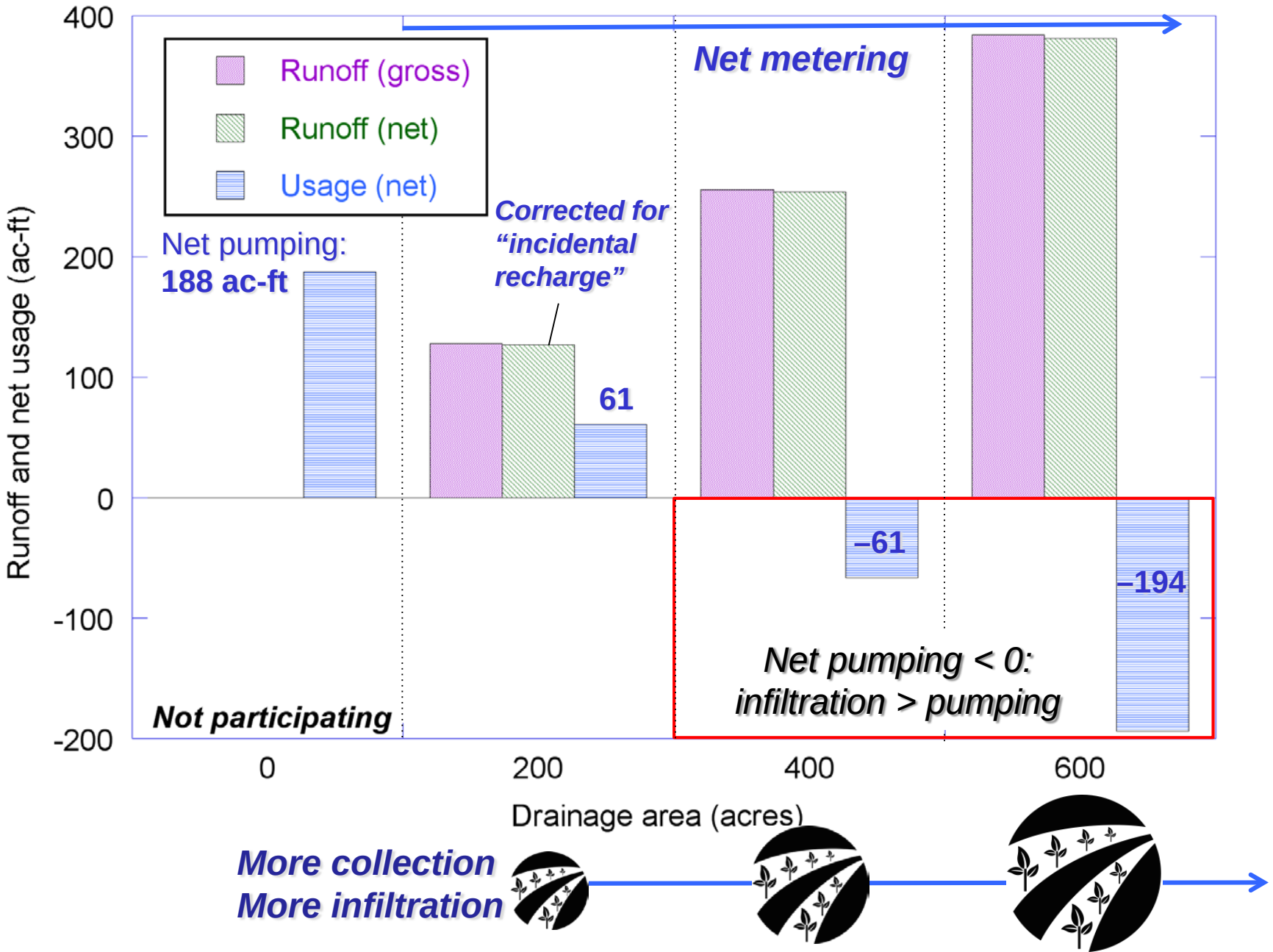
Options:

Drainage:	**200**	**400**	**600 acres**
Infiltration:	**2**	**4**	**6 acres**

Augmentation fee = $203/ac-ft
(***outside*** of Delivered Water Zone)

Recharge Net Metering rebate: 50% of net infiltration

Example: Net Recharge Calculations



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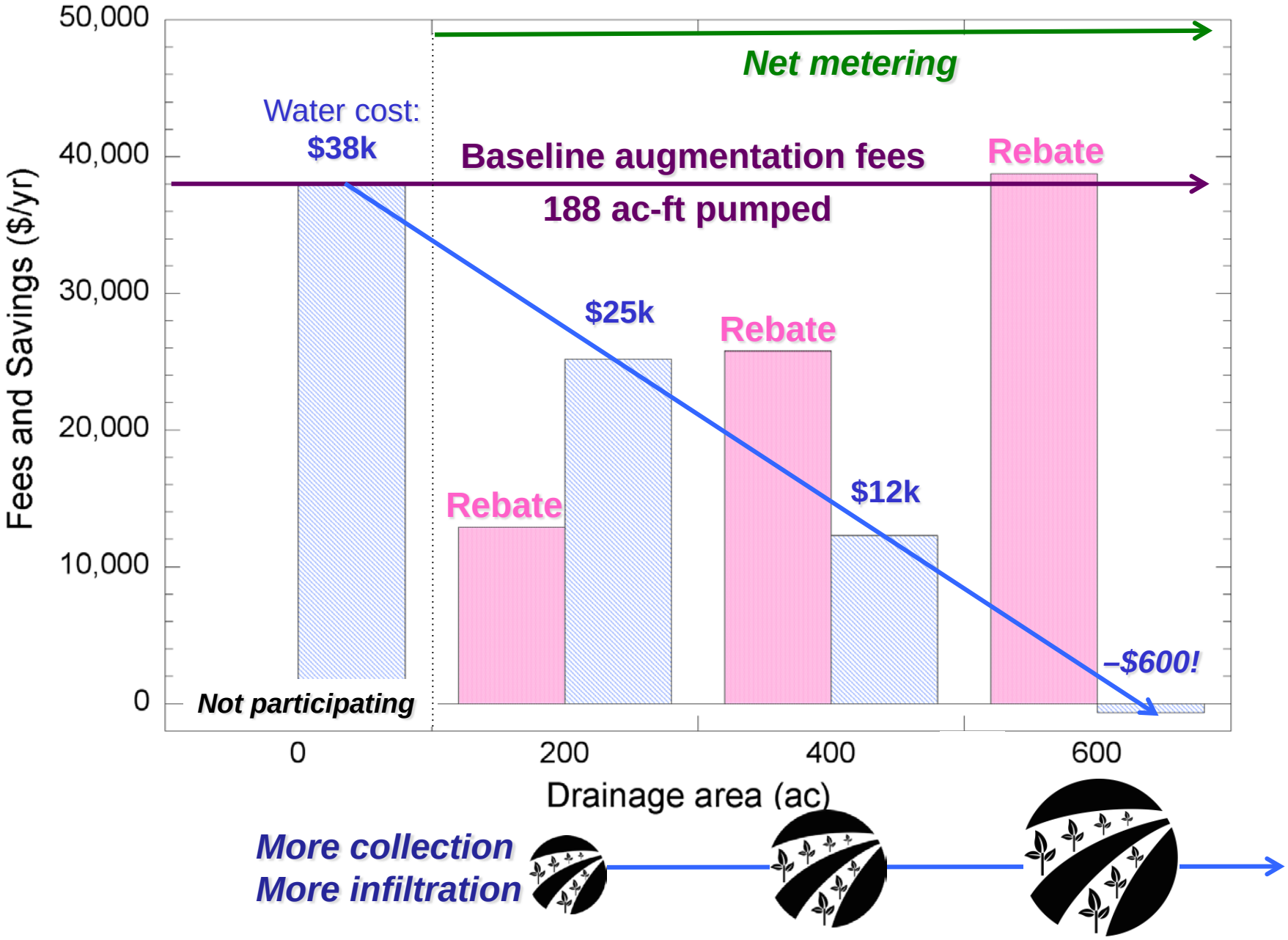

Recharge Net Metering (ReNeM) in the PVGB
(five-year pilot program, 10/2016-9/2021)

- ***Goal: 1000 ac-ft/yr (8-10 field projects?)***
- ***Third-party certifier (TPC) identifies sites, raises capital, develops engineering, plans/builds for measurement***
- ***TPC works with landowners/tenants to validate***
- ***TPC certifies performance, reports to agency***
- ***Agency applies formula to calculate rebate (= credit)***

<u>Program status</u>

- ***Two sites operational, another constructed, one more funded/planned for construction…***
- ***Multiple requests for site consideration…***

Recharge Net Metering (ReNeM)…
…requires three kinds of support

- ***Capital costs***
  site ID, design, engineering, installation
- ***Validation***
  measurements, sampling, certification
- ***Rebates (Incentives)***
  offset for operation and maintenance costs

In the PVGB:

Costs are competitive, program can be revenue positive

Recharge Net Metering (ReNeM)…
…is not Groundwater Banking

An aquifer is a bank like a colander is a bucket

ReNeM:

- **Incentivizes *infiltration*, not recharge, not storage**
- **No right to recovery, benefits accrue to basin**
- **Incentive is performance based, year by year**
- **Incentive applied as a rebate of fees**

Different schemes may be needed in other basins…

*Challenges and Bottlenecks**

- *Agreement on terms, requirements, liability, obligations.*

- *Between UCSC, RCD, and participants*
- *Between water agency, RCD and UCSC*
- *Multiple phases, cross referencing*
- *A work in progress…*

**for many kinds of managed recharge*

*Challenges and Bottlenecks**

- **Agreement on terms, requirements, liability, obligations.**
- ***Water rights, "reasonable and beneficial," public benefit?***

for many kinds of managed recharge

*Challenges and Bottlenecks**

- **Agreement on terms, requirements, liability, obligations.**
- **Water rights, "reasonable and beneficial," public benefit?**
- ***Accounting for benefits, services†, TBL (social, env., econ.)***

Enhanced recharge →

- ***More supply into storage***
- ***Dilution of salts/nutrients***
- ***Reduce SW intrusion (coast)***
- ***Better SW-GW connection***
- ***Thermal regulation of streams***

Harder to measure

***for many kinds of managed recharge**

† ***Pensky et al. (Wed AM)***

*Challenges and Bottlenecks**

- *Agreement on terms, requirements, liability, obligations.*
- *Water rights, "reasonable and beneficial," public benefit?*
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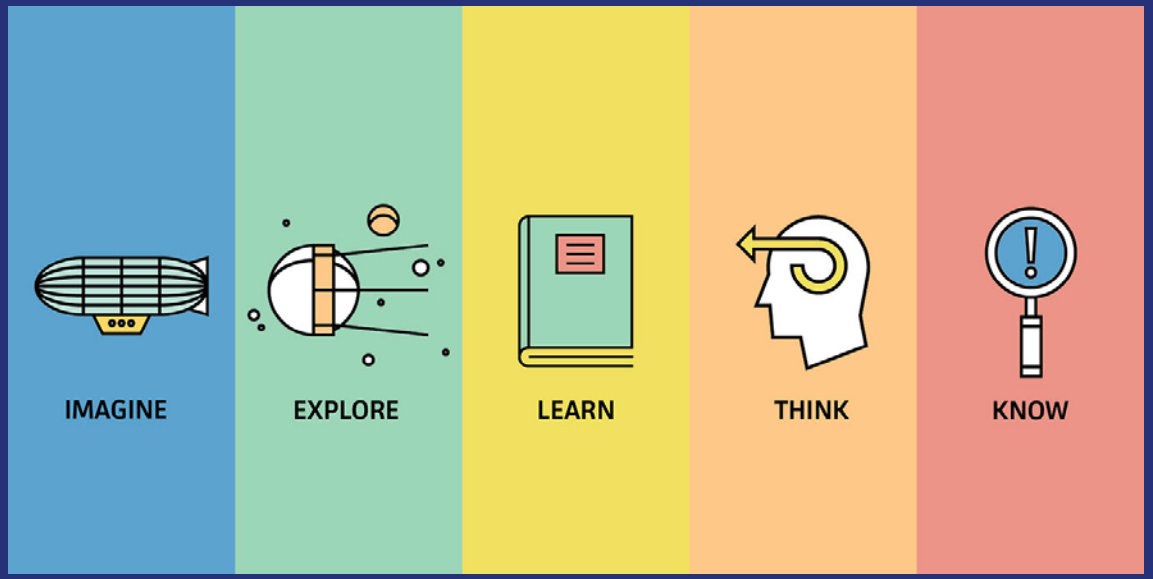
- *Establish and apply templates, best practices*



Develop tools/methods

*Challenges and Bottlenecks**

- *Agreement on terms, requirements, liability, obligations.*
- *Water rights, "reasonable and beneficial," public benefit?*
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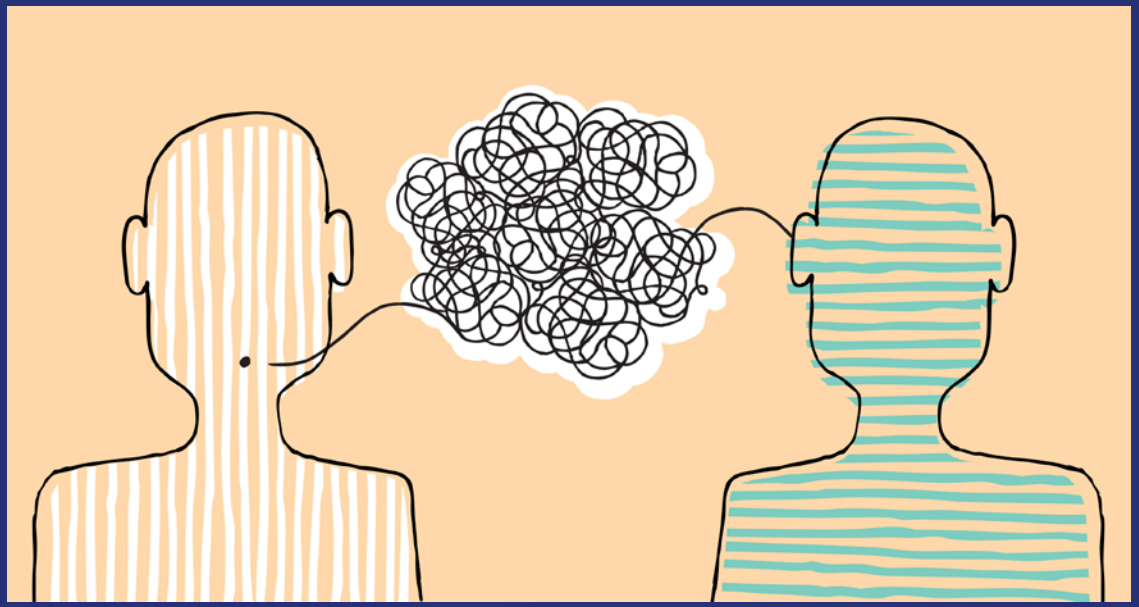
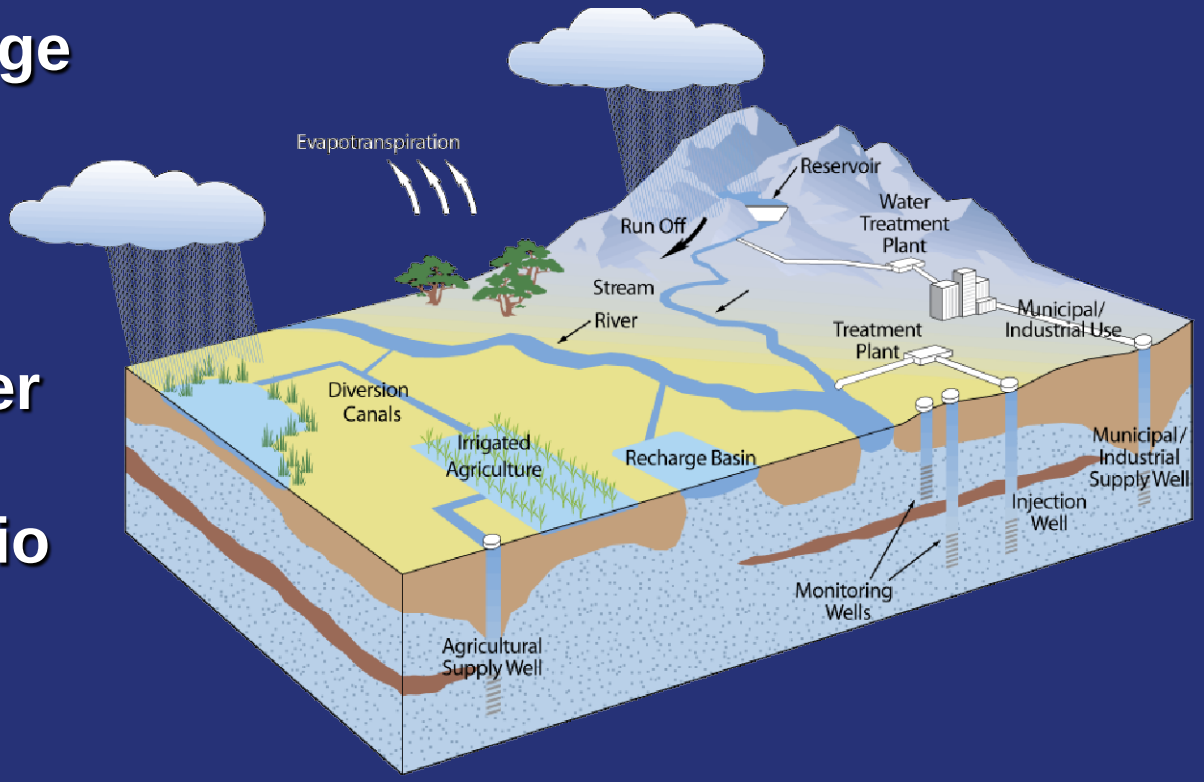
- *Establish and apply templates, best practices*
- *Misunderstandings*



- *Recharge ≠ storage*
- *Infiltration vs. recharge*
- *FloodMAR*
- *Stormwater*
- *Risks*

Summary and Ongoing Work

- Stormwater can improve groundwater in CA
- *Find the best locations* to enhance recharge
- Design systems to *measure performance*
- Improve water quality along with supply
- Groundwater recharge provides many benefits, justifies incentives
- MAR with stormwater can be part of a successful portfolio for sustaining groundwater



The Recharge Initiative

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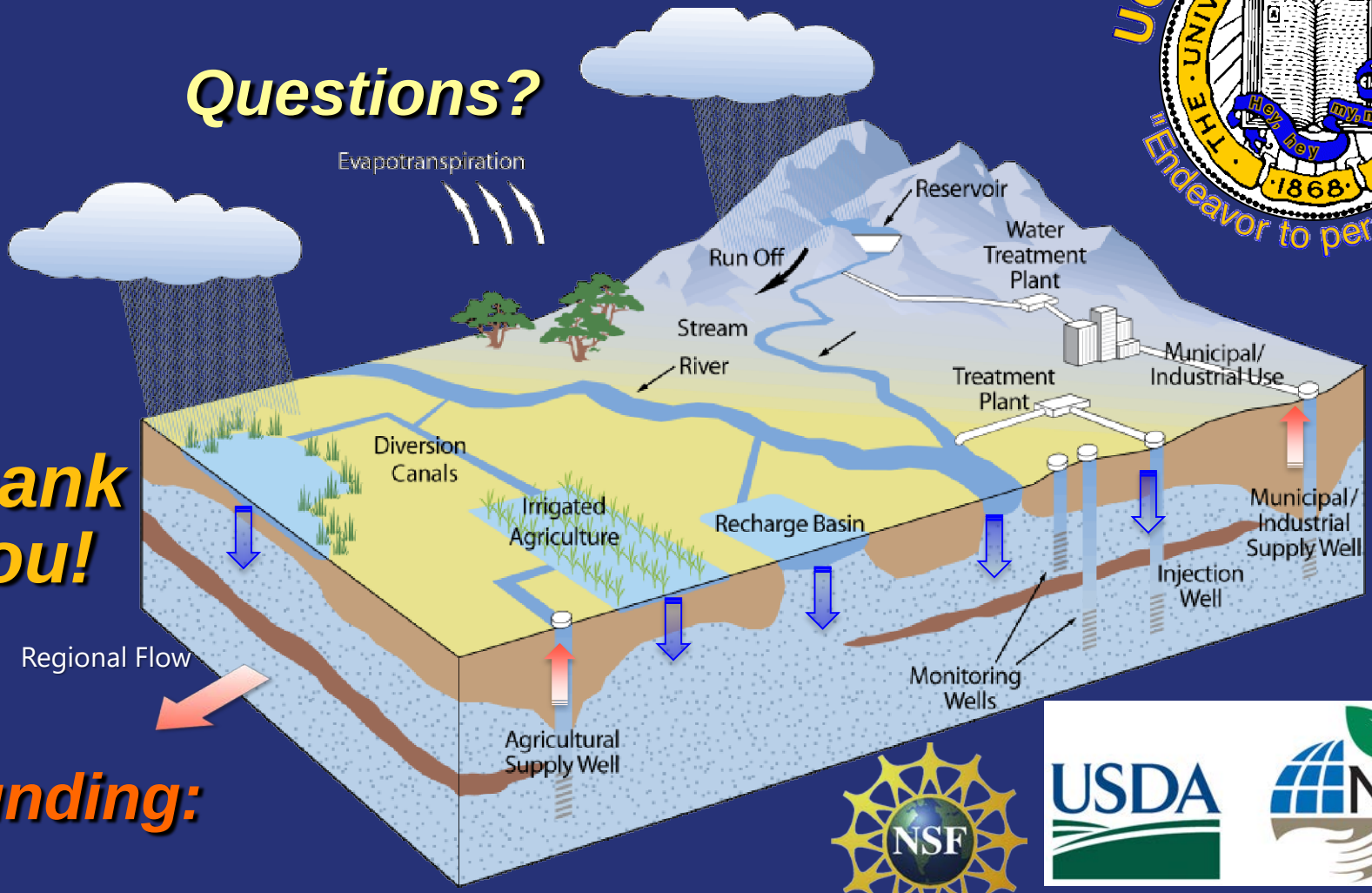
www.rechargeinitiative.org

UCSC Hydrogeology

"Endeavor to persevere..."

Questions?



Thank you!

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