SANTA CRUZ MID-COUNTY GROUNDWATER SUSTAINABILITY PLANNING

Advisory Committee Meeting #16

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

Wednesday, February 27, 2018, 5:00 – 8:30 p.m.
Simpkins Family Swim Center, Santa Cruz

Welcome and Introductions

- Groundwater Sustainability Plan (GSP) Advisory Committee
- Staff
- Public

Meeting Objectives

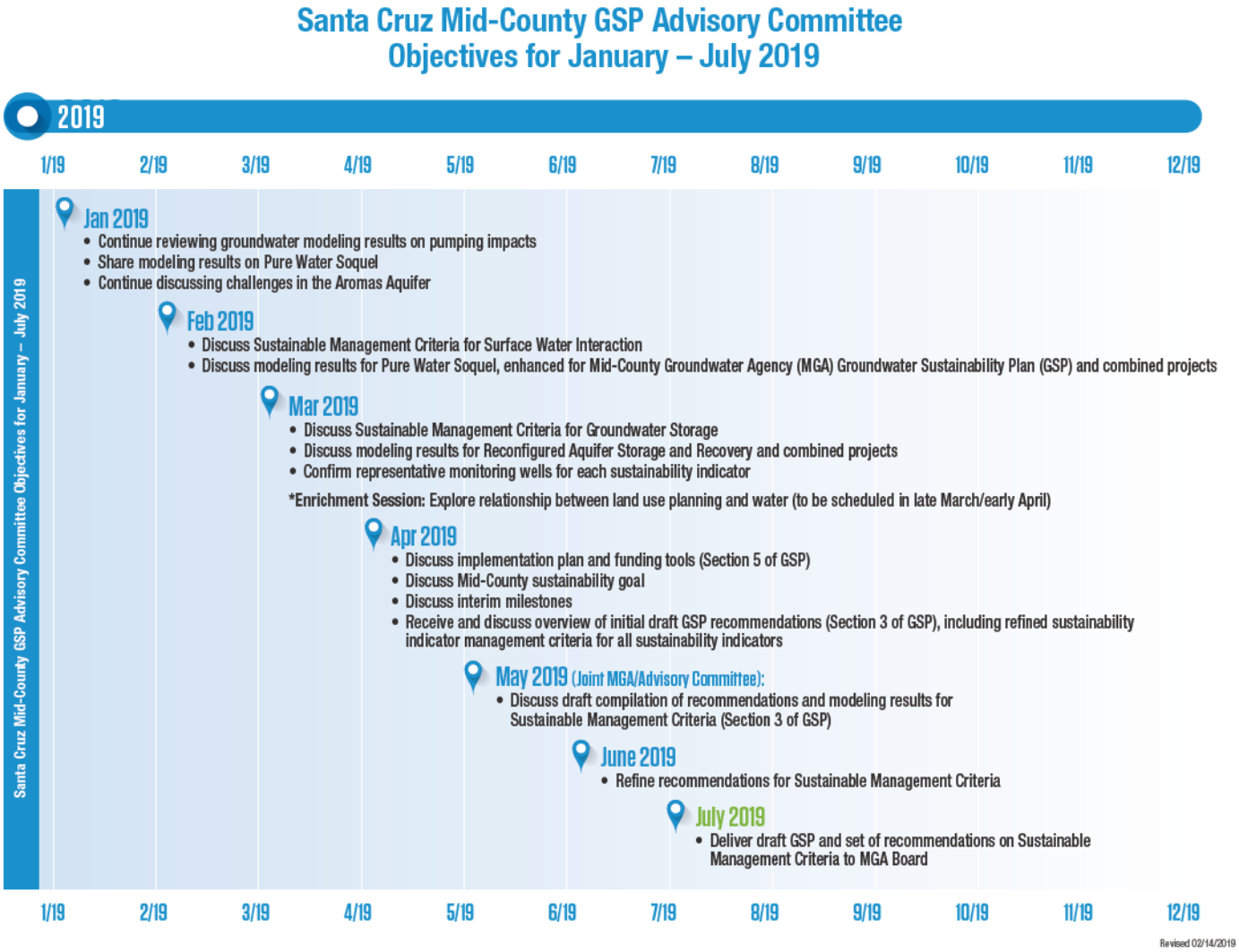
- Discuss groundwater modeling results for various sustainability strategies
  - Pure Water Soquel, Enhanced for Santa Cruz Mid-County Groundwater Agency (MGA) Groundwater Sustainability Plan (GSP)
  - Combined projects
- Discuss draft proposed Sustainable Management Criteria for "Surface Water Interaction" Sustainability Indicator

Agenda

5:00	Welcome, Introductions, Objectives, Agenda, and GSP Project Timeline
5:10	Oral Communications
5:20	Project Updates
5:25	Groundwater Modeling Results for Pure Water Soquel and Combined Projects
6:45	Public Comment
6:55	*Break*
7:10	Proposed Draft Sustainable Management Criteria for Surface Water Interaction
8:10	Public Comment
8:20	Confirm January 23, 2019 Advisory Committee Meeting Summary
8:25	Recap and Next Steps
8:30	*Adjourn*

GSP Project Timeline

GSP 2019 Project Timeline



Oral Communications

Project Updates

- Groundwater modeling enrichment session (February 11, 2019)
- Santa Margarita Basin informational meetings
- DWR update

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

GROUNDWATER MODELING OF MGA SUSTAINABILITY STRATEGIES

GSP Advisory Committee – February 27, 2019

Item 4: Groundwater Modeling Results for MGA Sustainability Strategies

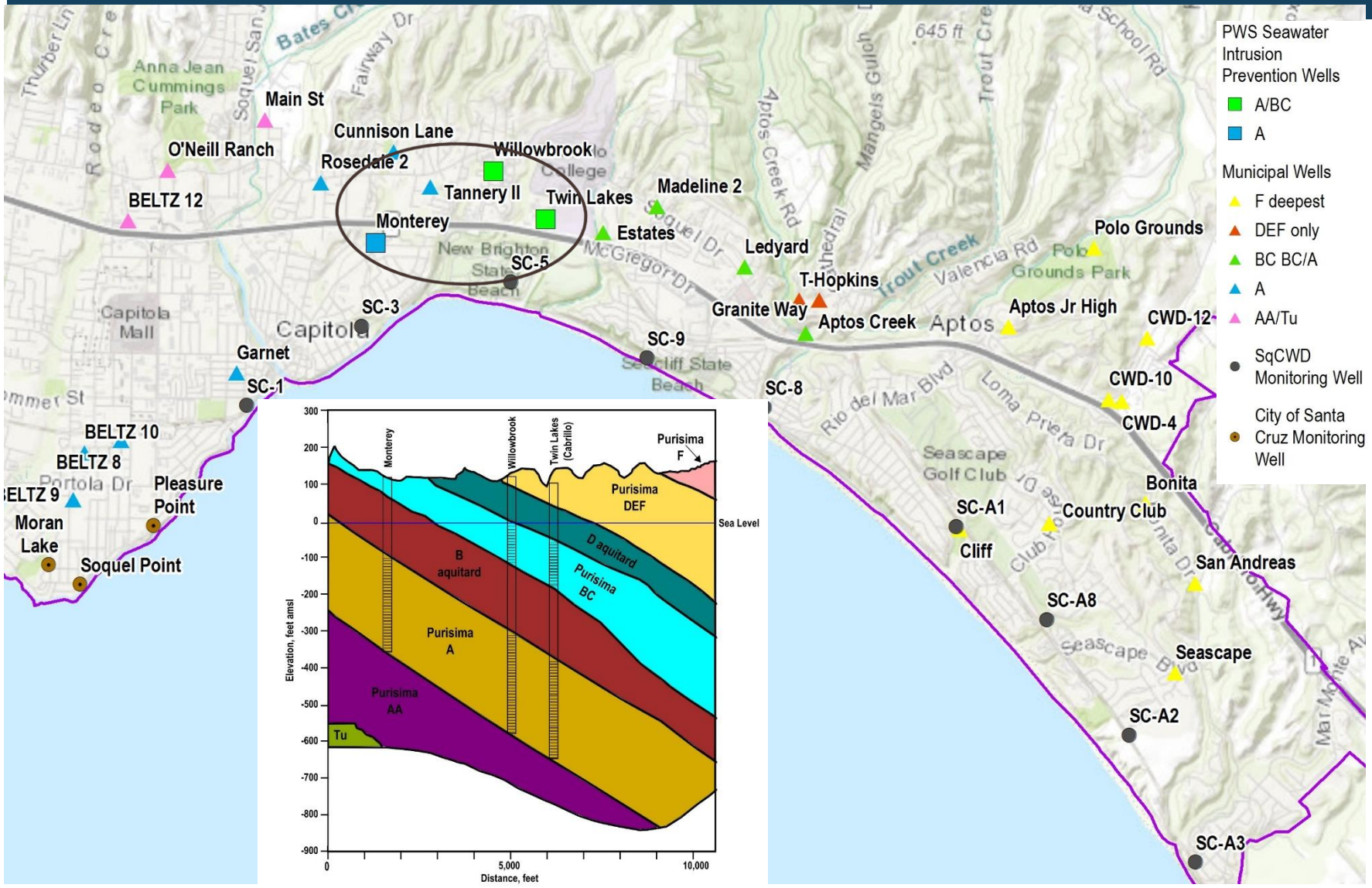
Pure Water Soquel Environmental Project:

Pure Water Soquel is a groundwater replenishment and seawater intrusion prevention project using advanced water purification methods to purify recycled water for replenishing the groundwater basin and protecting against seawater intrusion. The project is District Board approved. The following is an evaluation of the potential for benefits to the Mid County Groundwater Basin from Pure Water Soquel.

SqCWD Pure Water Soquel

- Included in the Soquel Creek Water District (SqCWD)'s Community Water Plan
- Environmental Impact Report (EIR) certified and Project Approved 12/18/2018
- Designed to prevent further seawater intrusion into the SqCWD service area of the Mid-County Basin
  - Recharge of 1,500 AFY purified water into Purisima
  - Reduced pumping in Aromas
  - Total pumping to meet projected demand

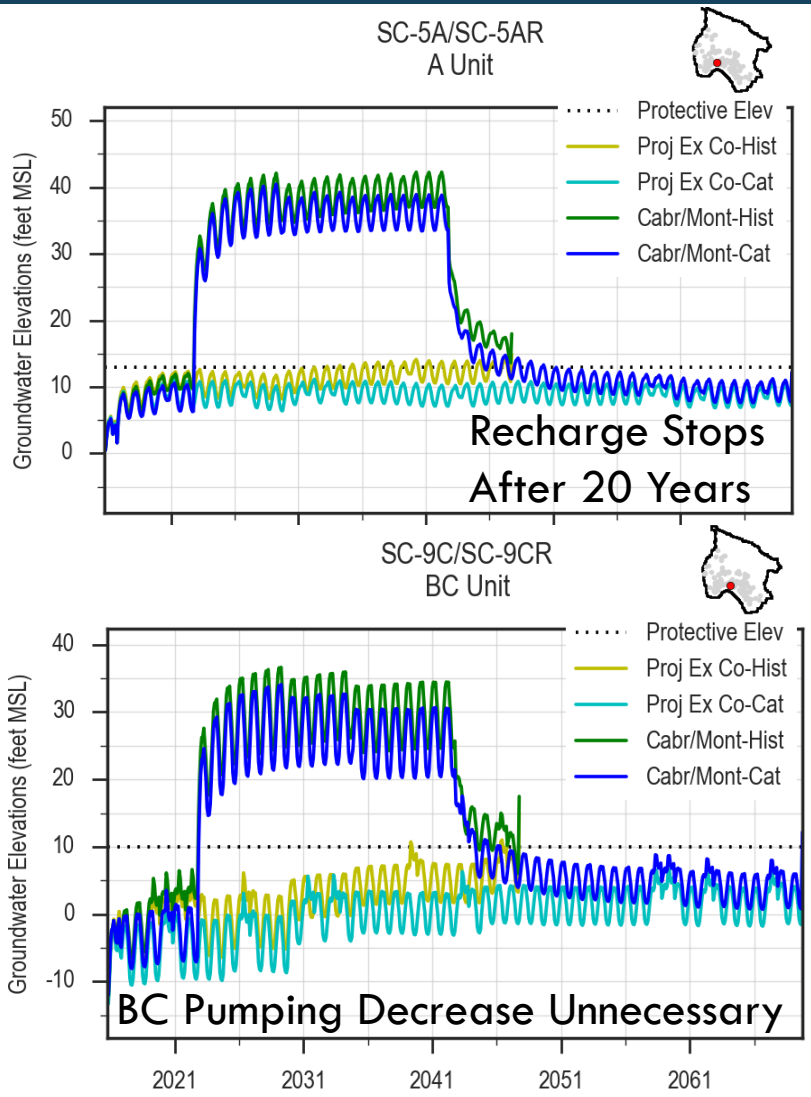
Seawater Intrusion Prevention Wells



Project Pumping Redistribution

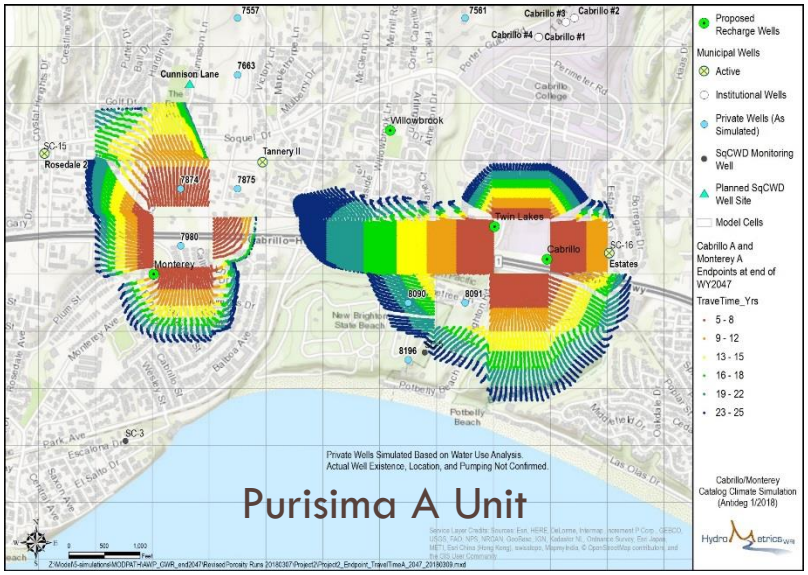
Groundwater Modeling for EIR

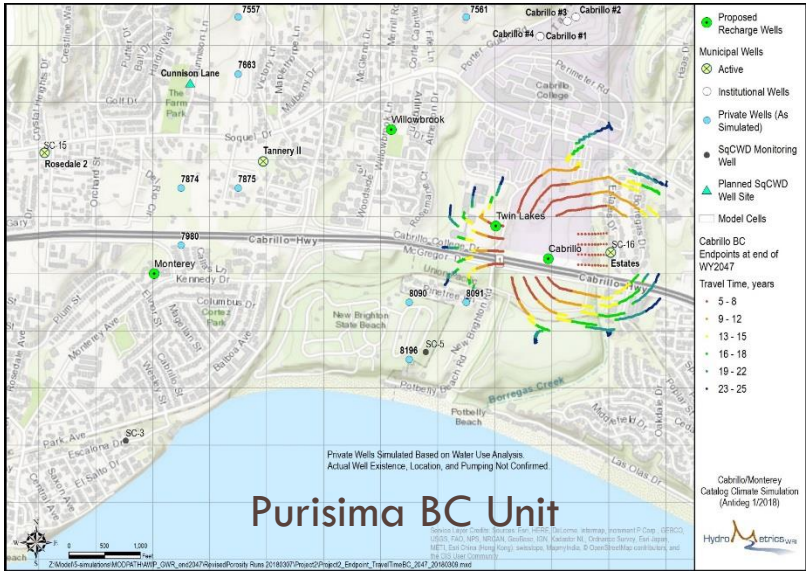
- Evaluate Environmental Effects
  - Compare to Projected Existing Conditions
- Lessons for Sustainability
  - Need to Continue Recharge Instead of Stopping after 20 Years as Modeled
  - Additional Pumping Redistribution Possible



Groundwater Modeling in EIR

- EIR also includes particle tracking to evaluate fate of purified water
- Area where purified water travels is much smaller than area where groundwater levels are affected





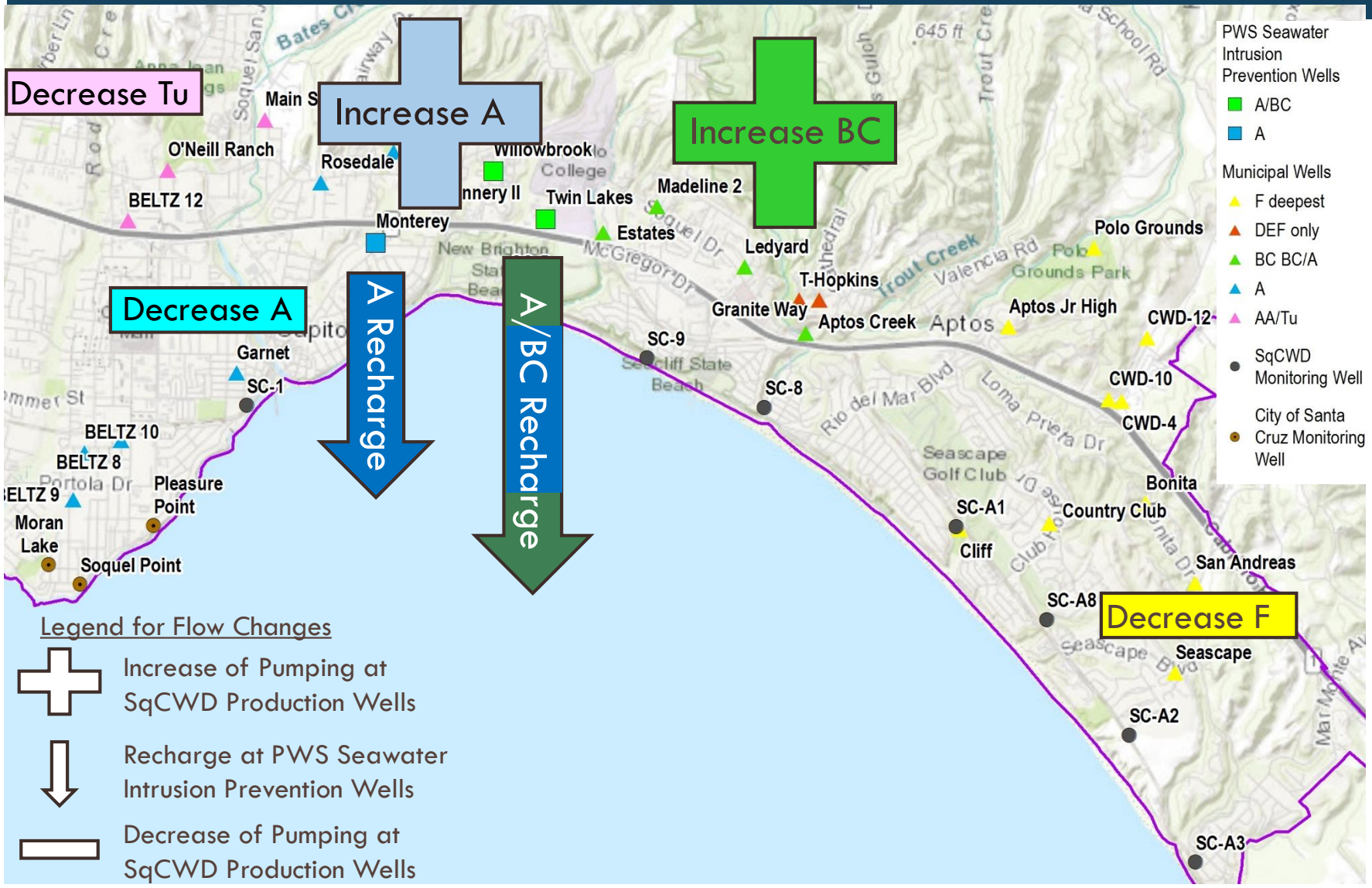
Evaluate Enhancements to Pure Water Soquel for Sustainability

- Modify Pumping Distribution to Enhance Basinwide Sustainability
- Pure Water Soquel with Enhancements as Only Project/Action for Sustainability
- Project Continues Beyond 20 Years
- Catalog Climate for Climate Change
- Sea Level Rise Simulated

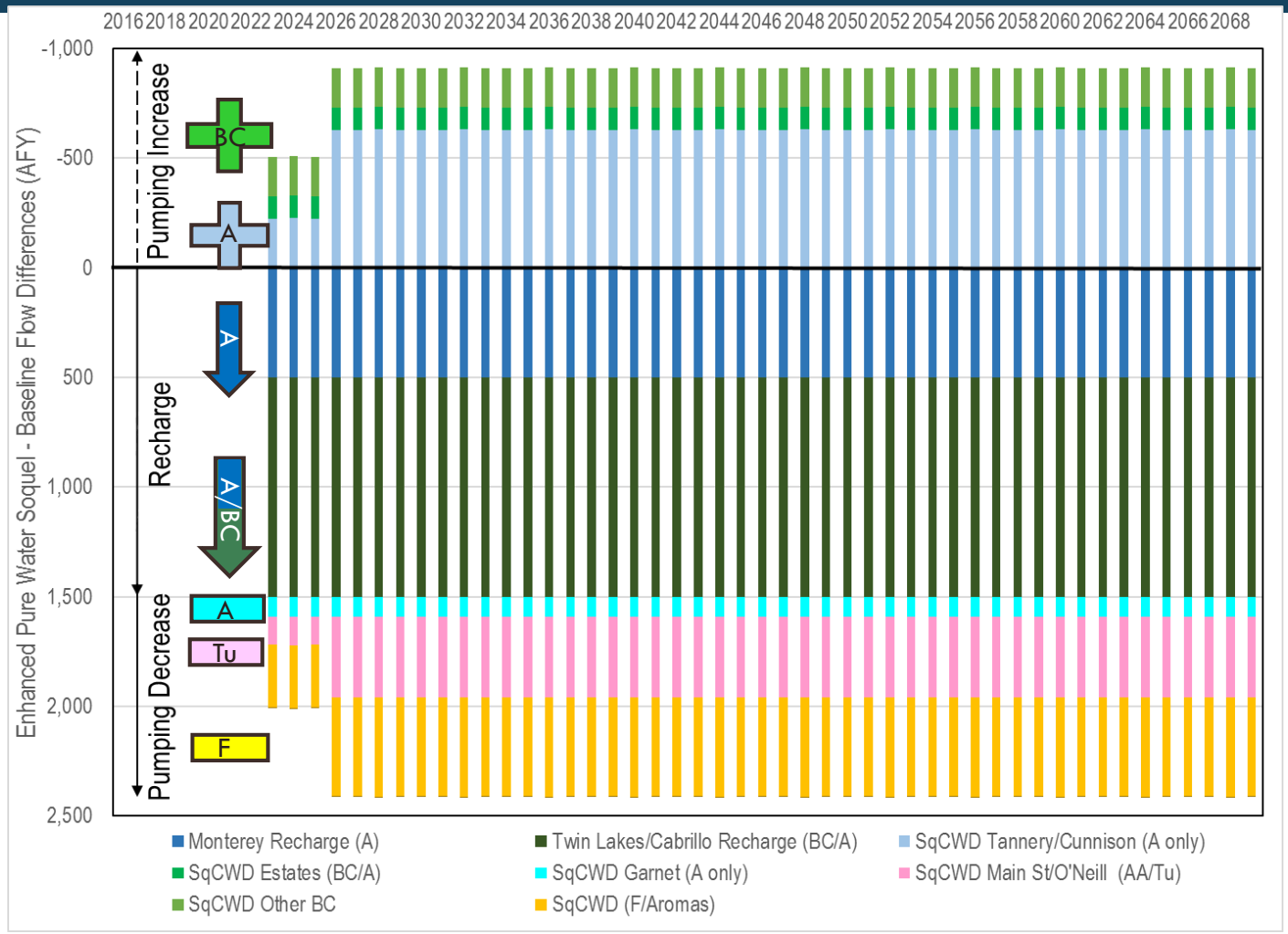
Different Assumptions from EIR

Assumption	SqCWD Pure Water Soquel in EIR	Pure Water Soquel with Enhancements for GSP
SqCWD Demand	Decreases after bounce back as projected in SqCWD UWMP	Stable after bounce back
Recharge of Purified Water into Purisima A/BC	Recharge decreases with demand and stops after 20 years	Recharge stable at 1,500 AFY and continues after 20 years
Water Transfer	215 AFY from City of Santa Cruz in non-critically dry years	No transfer either direction
Pumping Distribution	Based on SqCWD, 2017	Based on MGA, 2018
SqCWD Drought Curtailment	Lower summer pumping by SqCWD in critically dry years for projected existing conditions	No curtailment applied

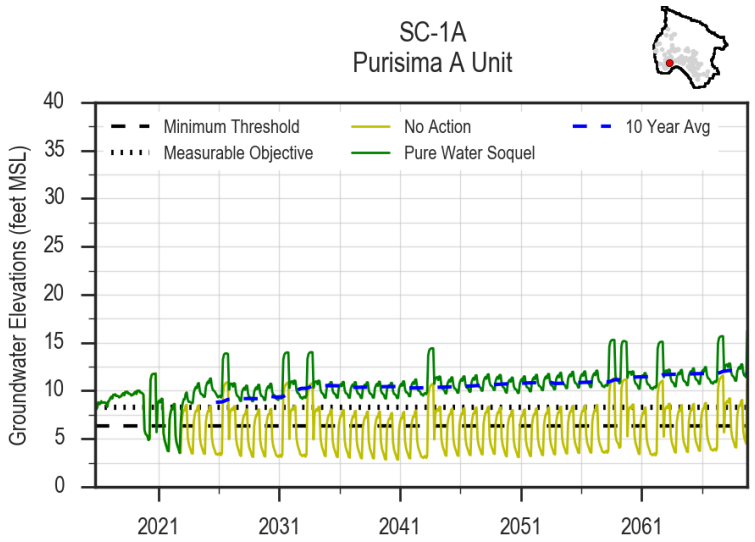
Project Pumping Redistribution with Enhancements

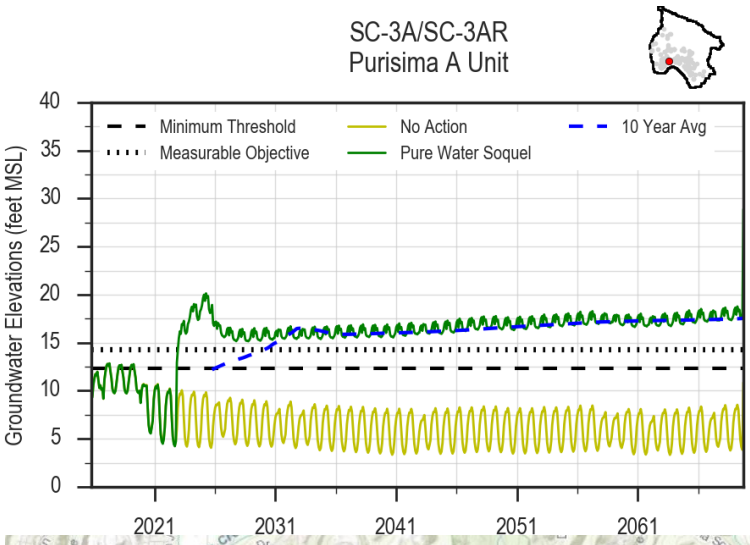


Recharge and Pumping Changes



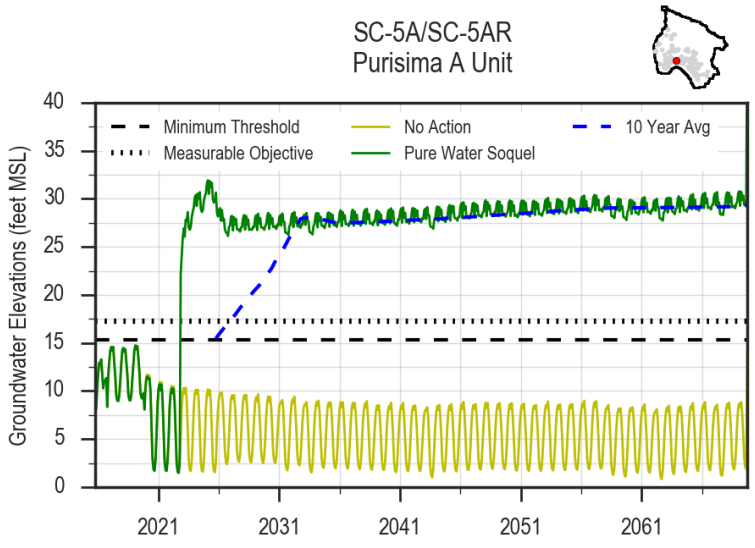
Purisima A Unit (SqCWD Wells)

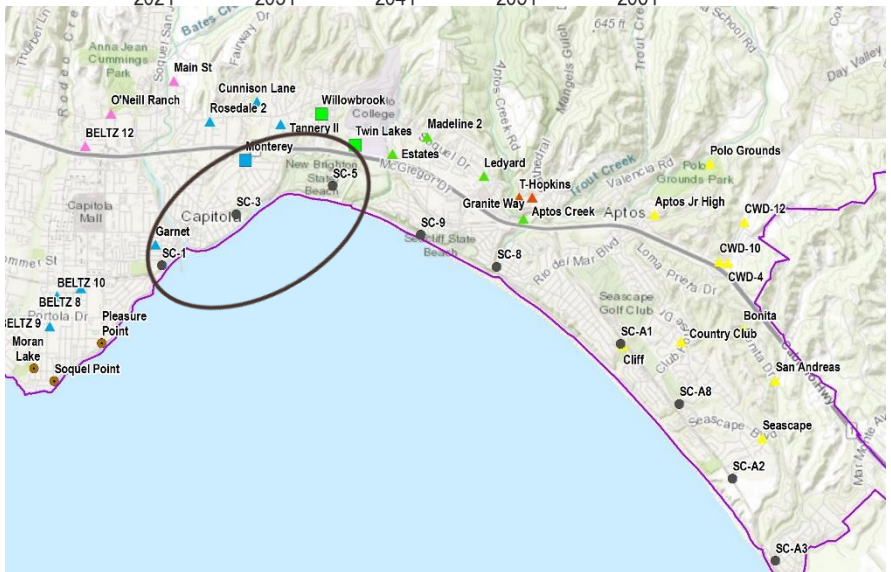




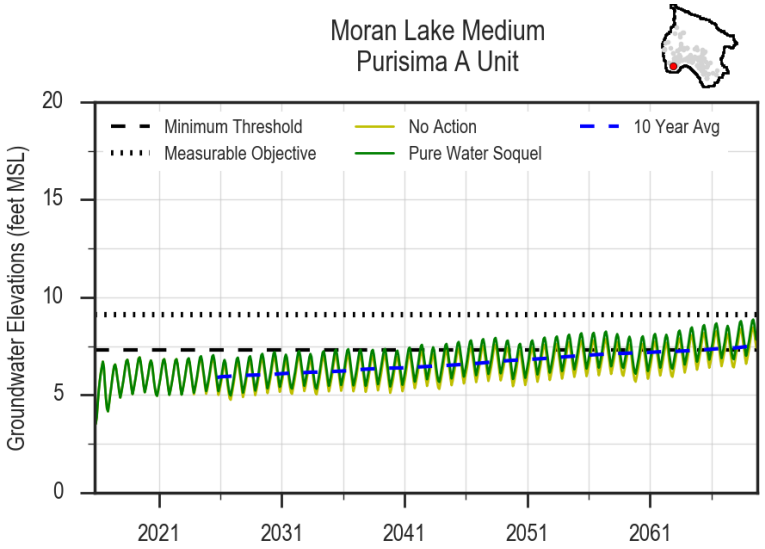
PWS
10 Yr Avg

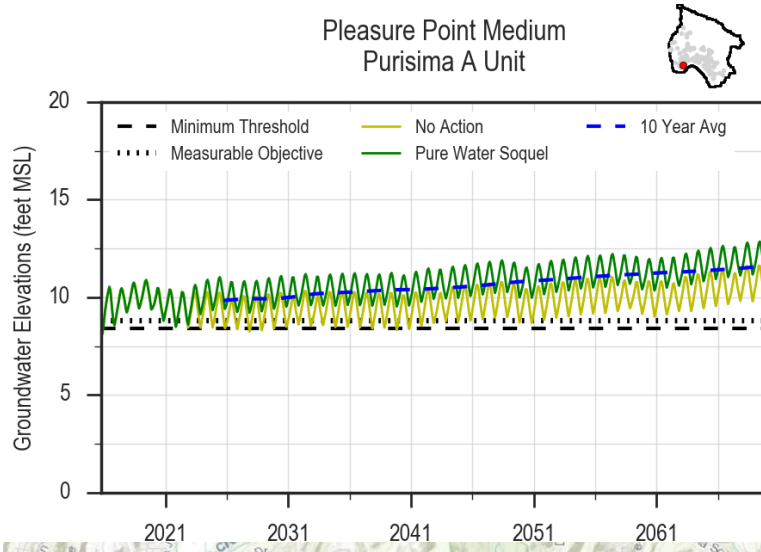
Baseline



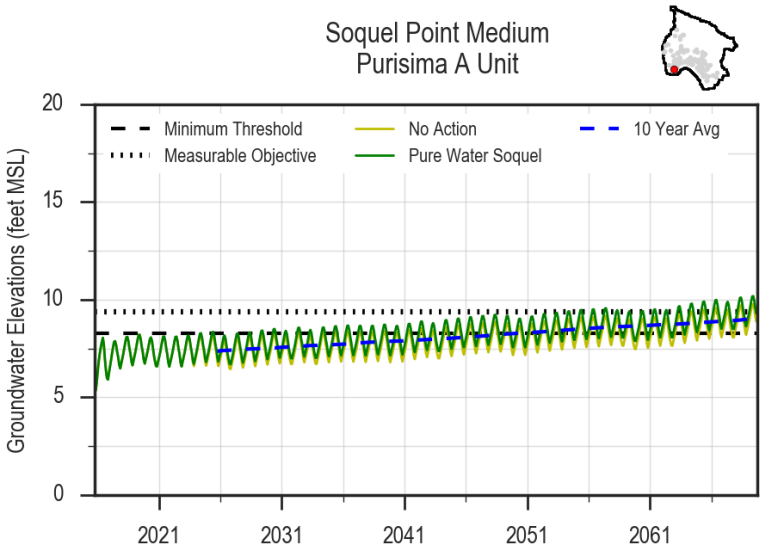


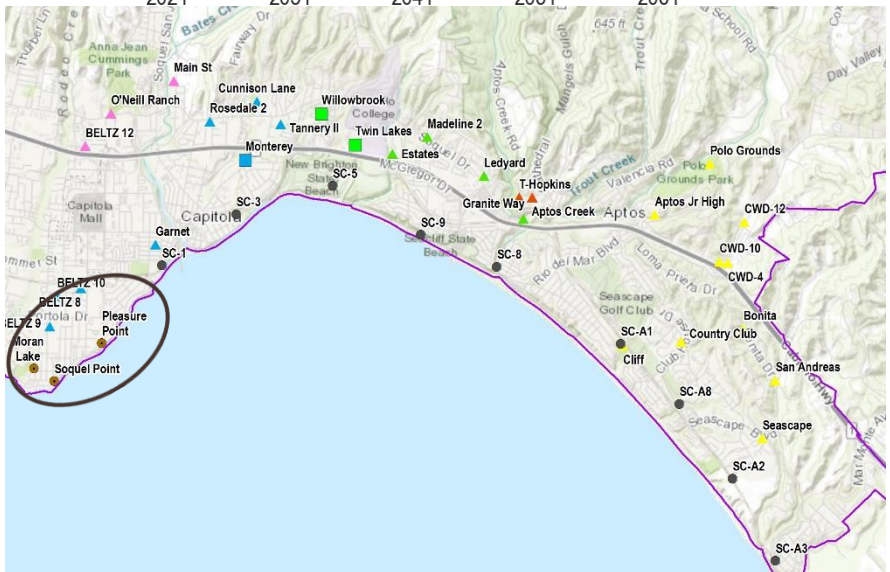
Purisima A Unit (City Wells)



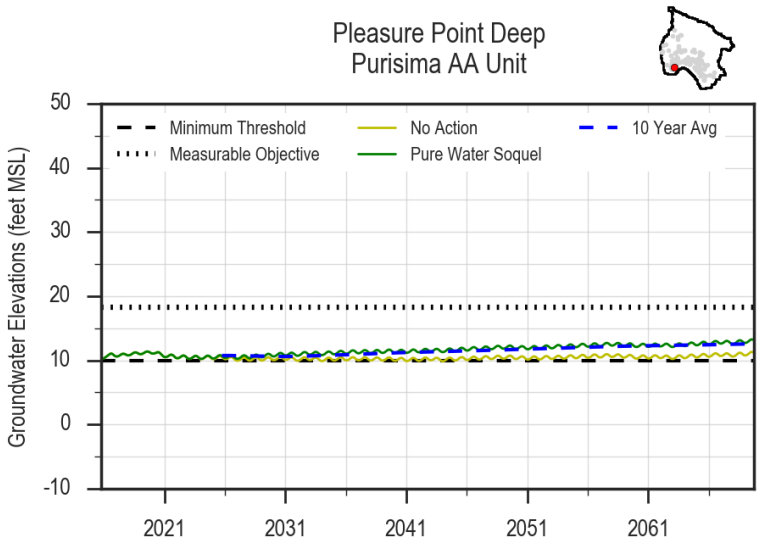


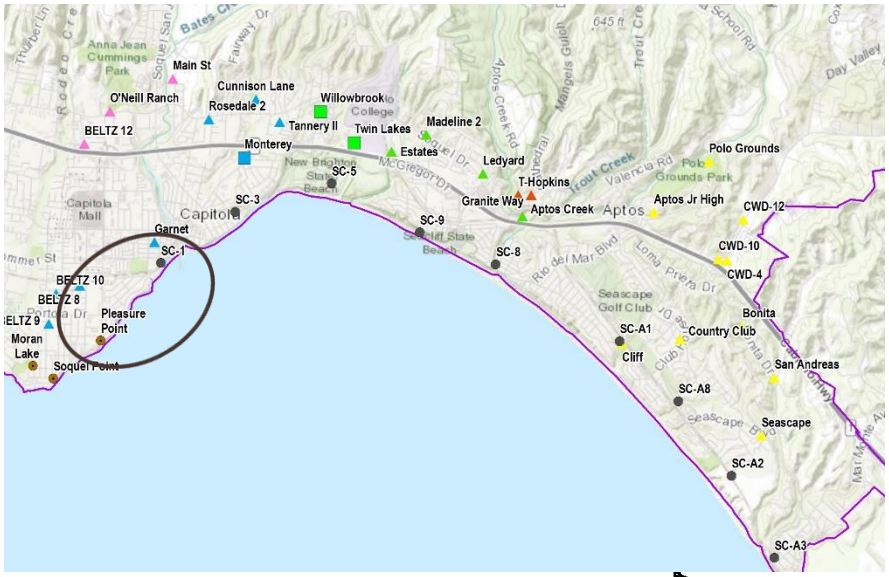
PWS
10 Yr Avg
Baseline

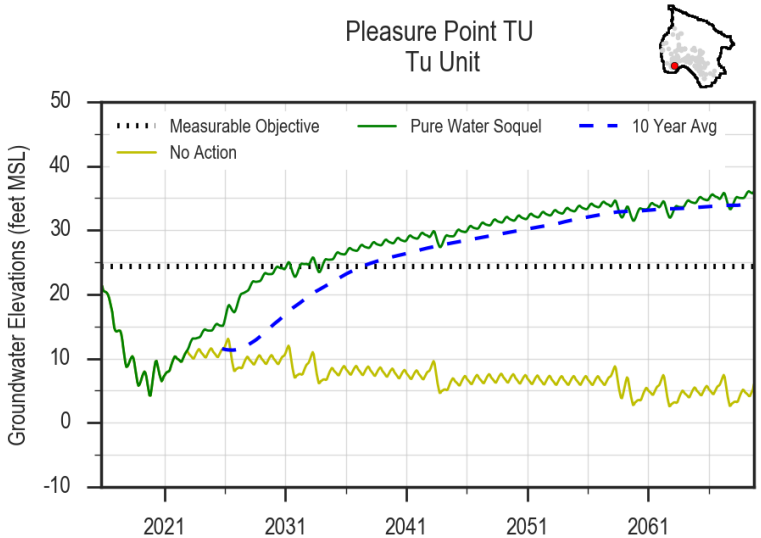


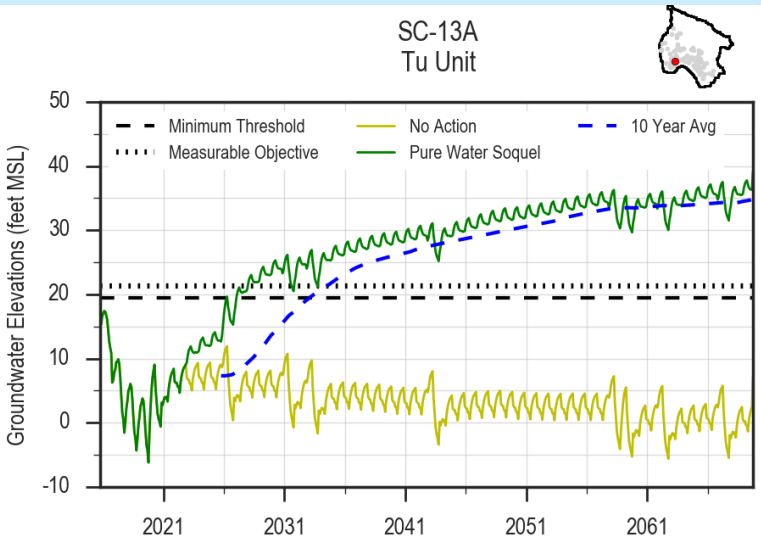


Purisima AA and Tu Units





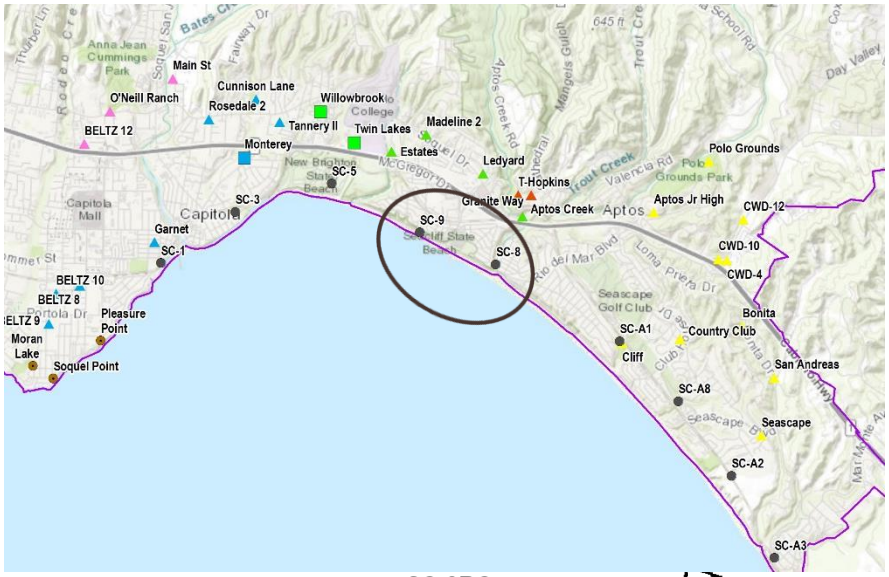


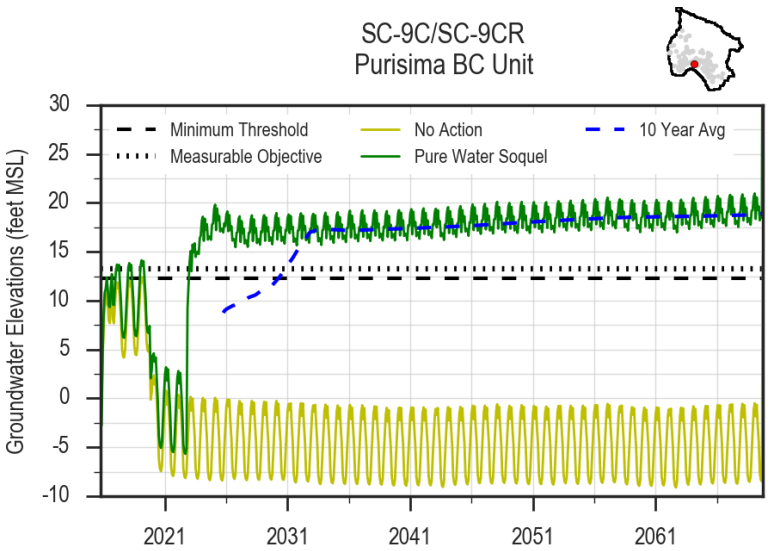


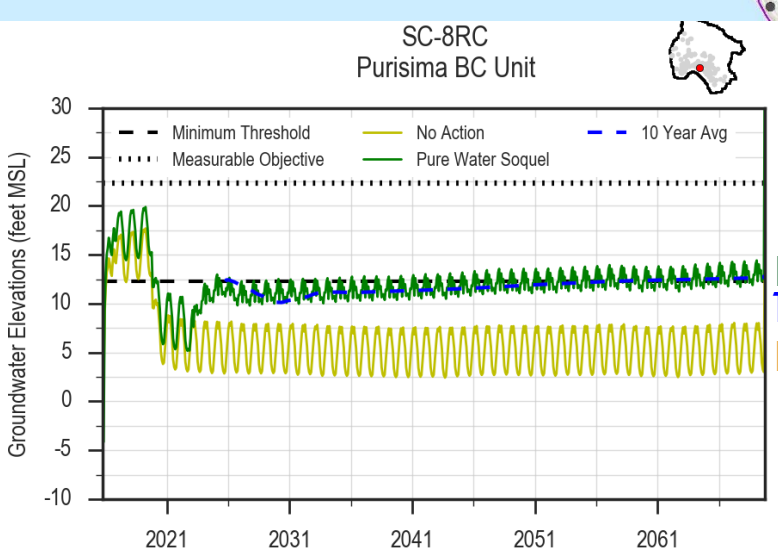
PWS
10 Yr Avg

Baseline

Purisima BC Unit







PWS
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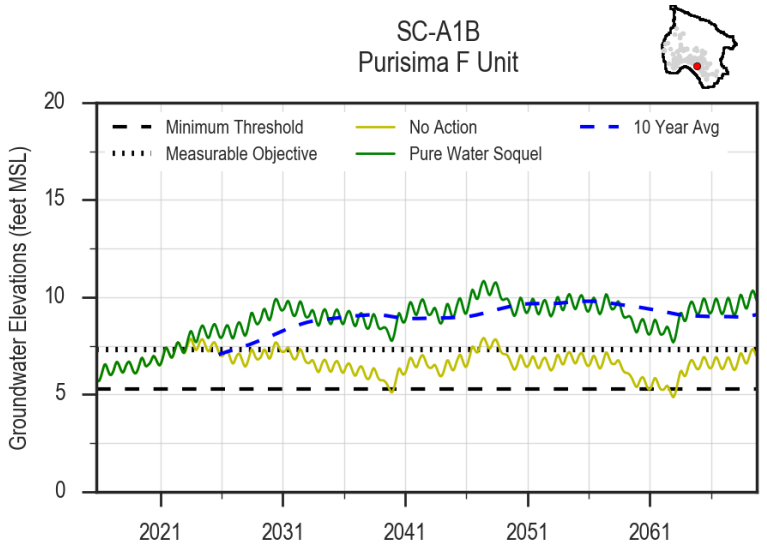
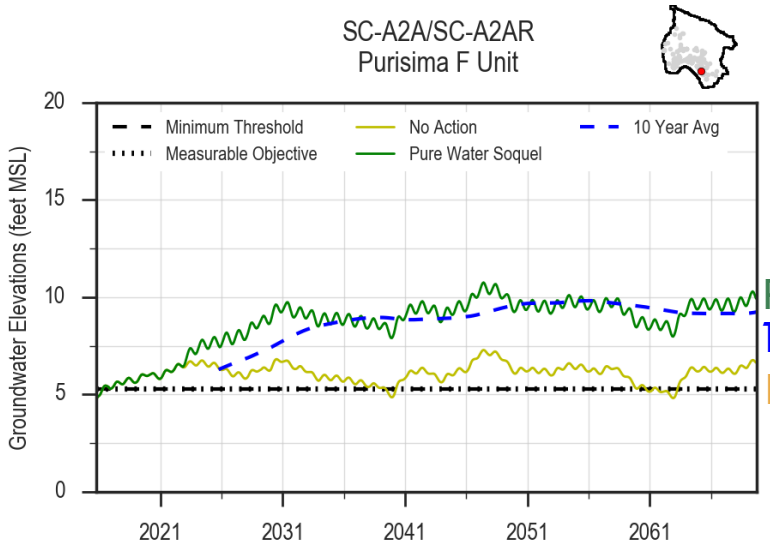
Baseline

Aromas Area (Purisima F Unit)





PWS
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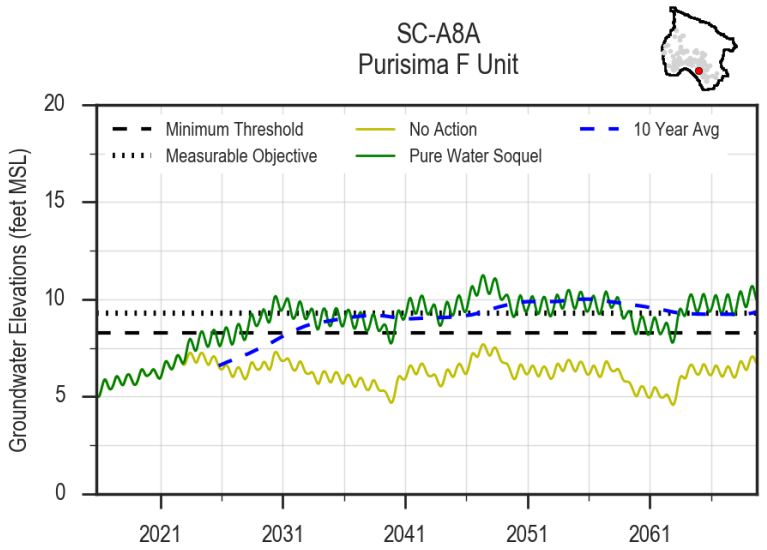
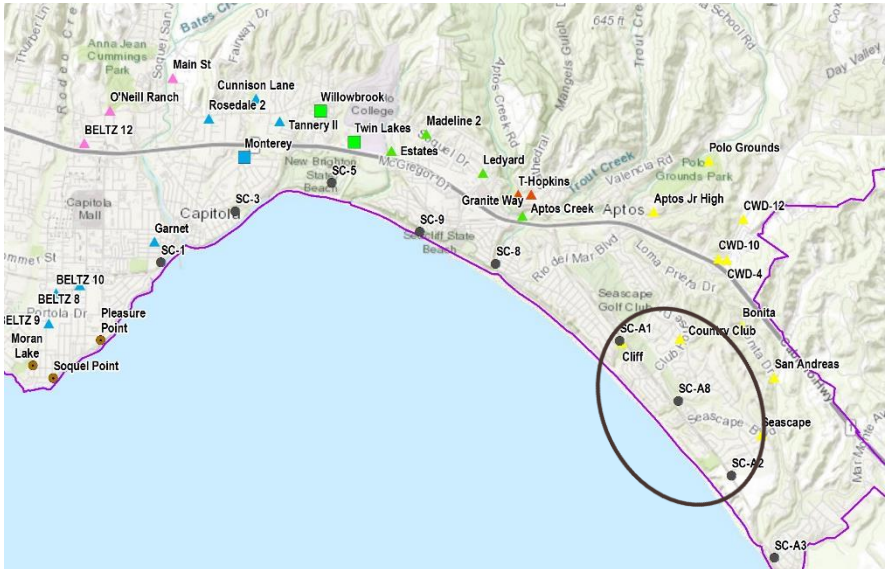
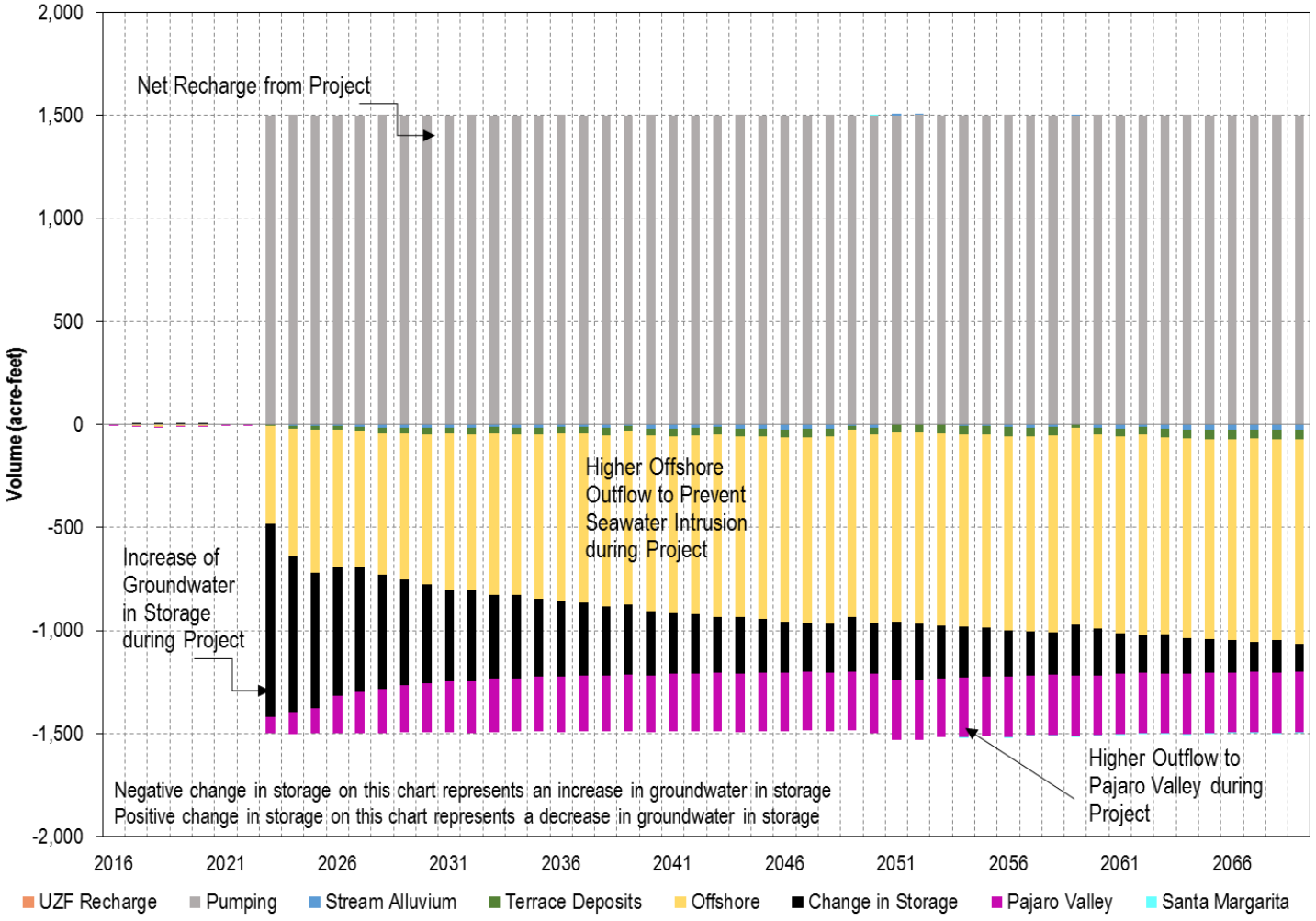
Baseline





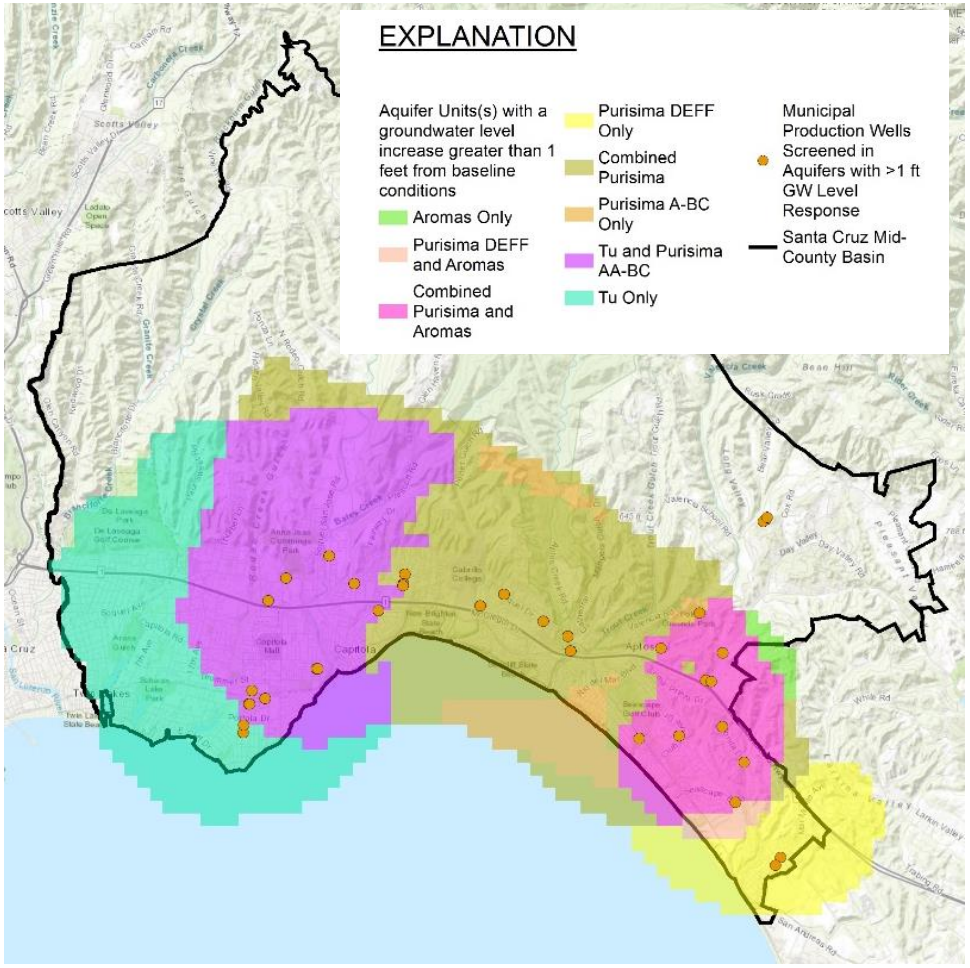
Water Budget Change from Enhanced Pure Water Soquel



Area Groundwater Levels Increased by Enhanced Pure Water Soquel

Areas and aquifer units where <u>combination</u> of recharge at seawater intrusion prevention wells and pumping redistribution raise groundwater levels

NOTE: Areas where groundwater levels increase are much larger than areas where purified water travels (see slide 5)



Questions and Discussion

Item 4: Groundwater Modeling Results for MGA Sustainability Strategies

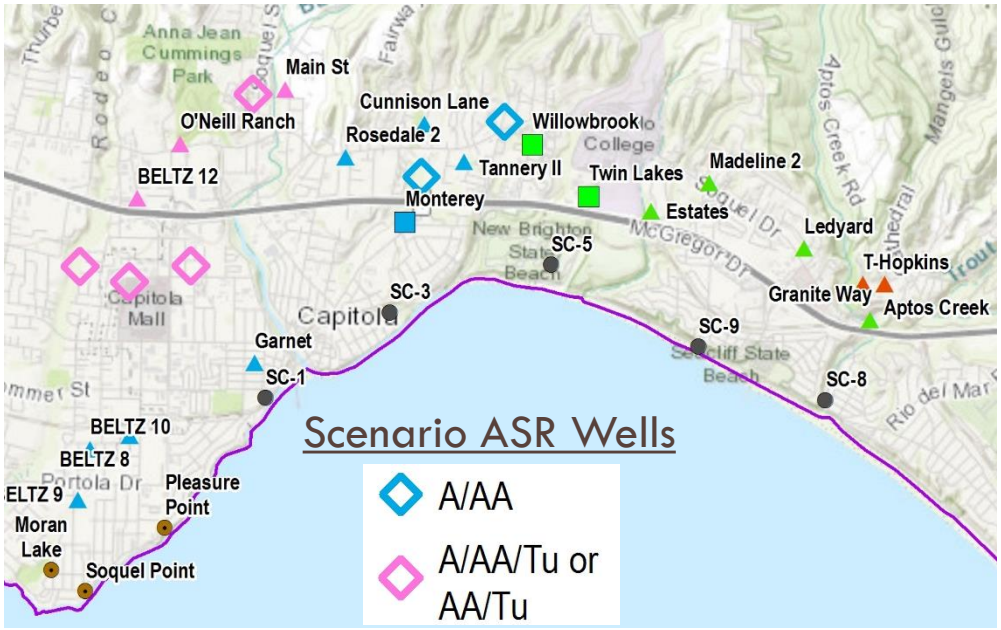
Preview of Modeling for Combination of Pure Water Soquel and City of Santa Cruz Aquifer Storage and Recovery

City ASR Phase I Feasibility Scenarios

Scenarios for Phase I feasibility study

Designed to meet City water shortage only

Modeling shows benefits for sustainability

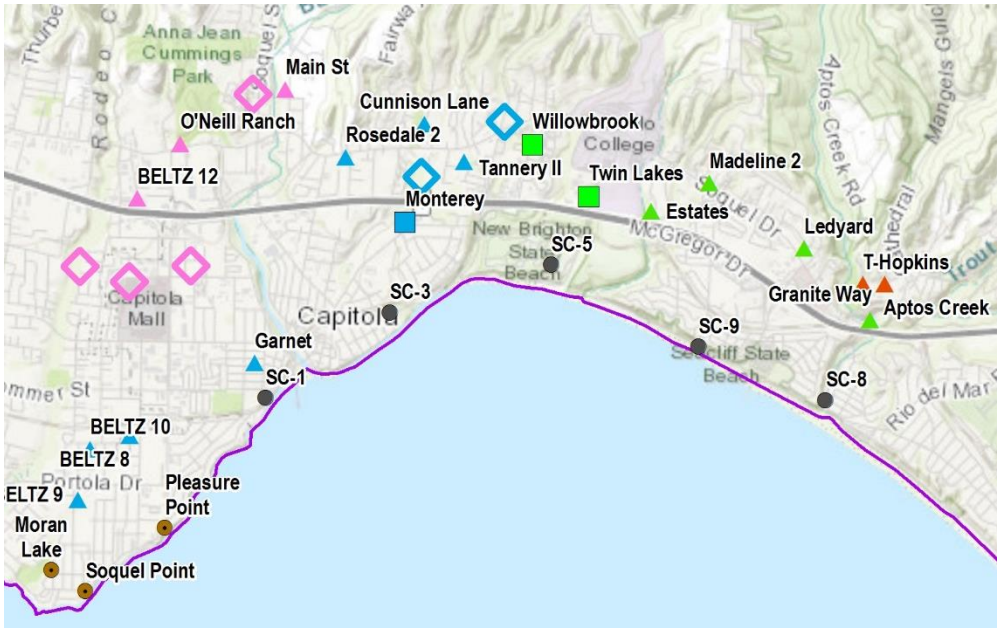


- In-lieu only
  - Reduced pumping at SqCWD Purisima wells
  - Recovery pumping at new City wells
- ASR only
  - Injection at new City wells
  - Recovery pumping at same wells as injection
- In-lieu + ASR
- Baseline (No Projects)

Scenarios developed by Pueblo Water Resources

Combination of City ASR & Pure Water Soquel Scenarios

Simulations of combination of City ASR & Pure Water Soquel to be presented at future meeting



- In-lieu + PWS
  - In-lieu reduced pumping at SqCWD Purisima wells
  - PWS increased pumping at some of the same wells
  - Not compatible to simulate; would need to reconfigure
- ASR only + PWS
  - Injection and recovery at new City wells
  - Injection at PWS wells and pumping at SqCWD wells
  - Compatible to simulate

Questions and Discussion

Item 4: Groundwater Modeling Results for MGA Sustainability Strategies

Item 4.1: Climate Change Scenario Selection for Groundwater Sustainability Plan

Climate Change Modeling for GSP

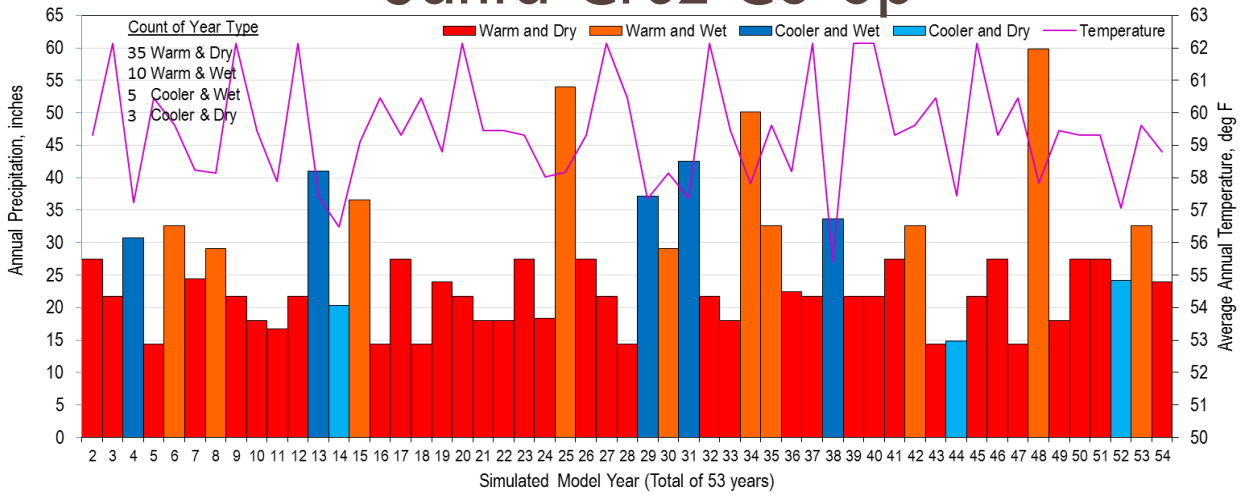
- Required to evaluate sustainability over future 50 year conditions incorporating climate change
- DWR guidance (July 2018) provides climate change data sets
  - Not required to use: "Local considerations and decisions may lead GSAs to use different approaches and methods"
- Model Technical Advisory Committee recommended Catalog Climate approach as appropriate for planning for Mid-County Basin

Climate Catalog Approach

- Use historical data instead of global circulation models (GCMs)
  - Concern that coarse spatial resolution of GCMs cannot realistically represent local weather patterns
  - Suggested by TAC Member Andy Fisher
  - Approach followed by So. Cal. Metropolitan WD
  - Select years from history to form catalog of years to randomly select for simulation with more weight to warmer years
- Model input data at stations

Catalog Climate Scenario

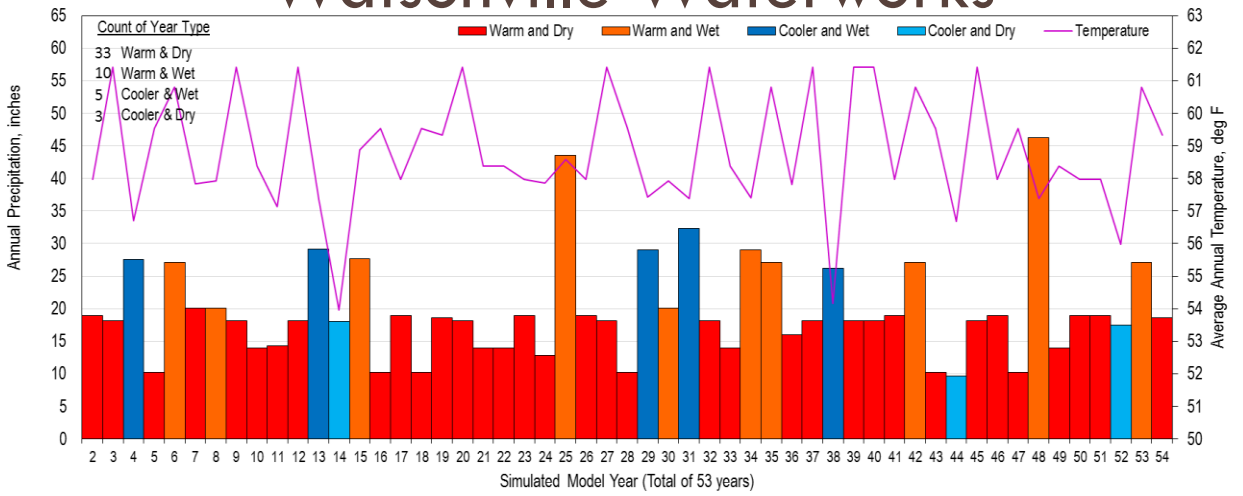
Santa Cruz Co-op



Annual Temperature, deg F	
Scenario Average	59.4
1985-2015 Average	57.9
1977-2016 Average	57.8
Pre-1977 Average	56.6
1894-2016 Average	57.0

Annual Precipitation, inches	
Scenario Average	26.0
1985-2015 Average	29.0
1977-2016 Average	29.9
Pre-1977 Average	28.7
1894-2016 Average	29.1

Watsonville Waterworks

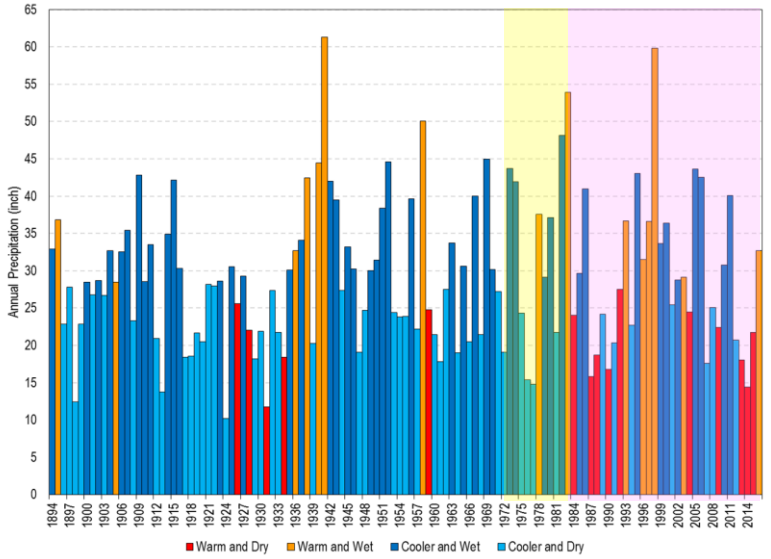


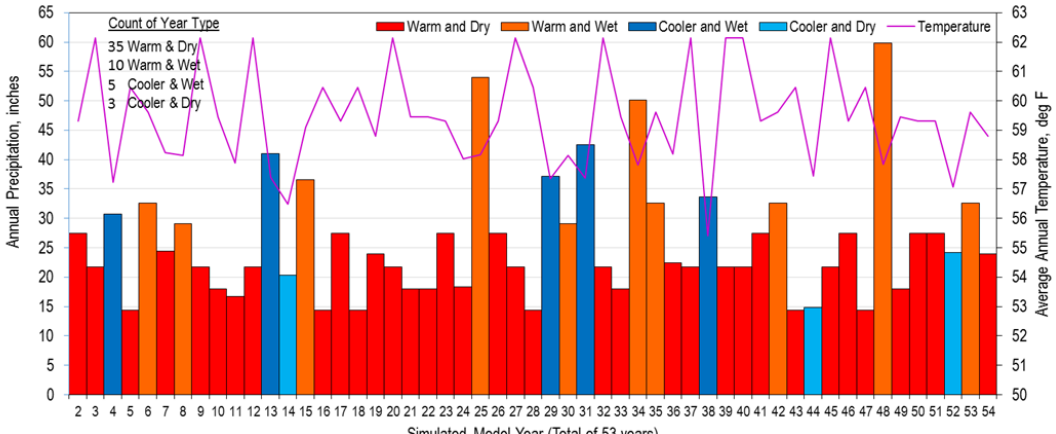
Annual Precipitation, inches	
Scenario Average	19.8
1985-2015 Average	21.9
1977-2016 Average	22.8
Pre-1977 Average	20.1
1894-2016 Average	21.1

Model Increase in Evapotranspiration: +6%

Climate Scenarios for City ASR

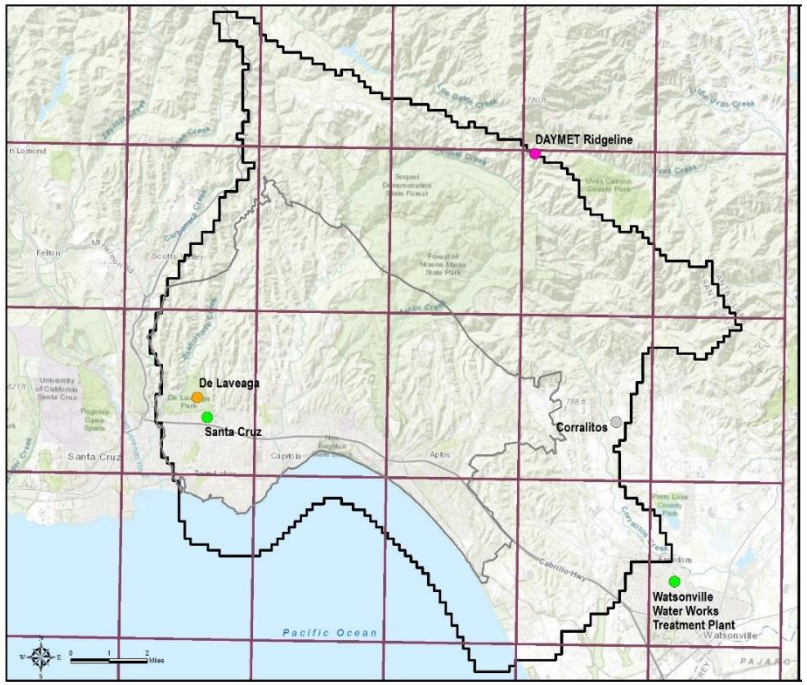
1. 1985-2015
2. 1973-1984
3. 2020-2069
   - Downscaled GCM: GFDL2.1-A2
4. 2020-2069
   - Catalog Climate
   - Under development: calculation of surface water availability





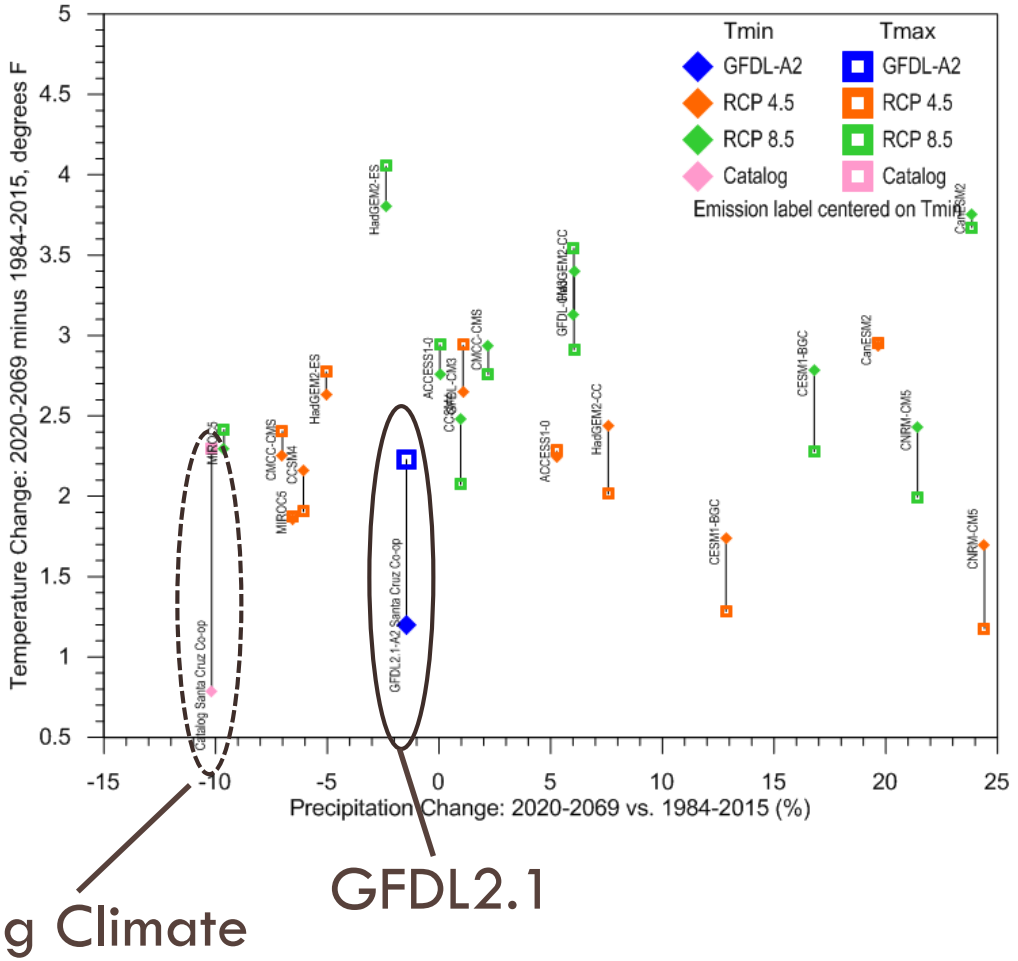
Downscaled Global Circulation Model (GCM)

- GFDL2.1-A2 used for City WSAC planning
  - CMIP3 released in 2010
- City calculated surface water available for ASR based on GFDL2.1
- Climate downscaled to stations for GSFLOW model input



Comparison to CMIP5 Used by State

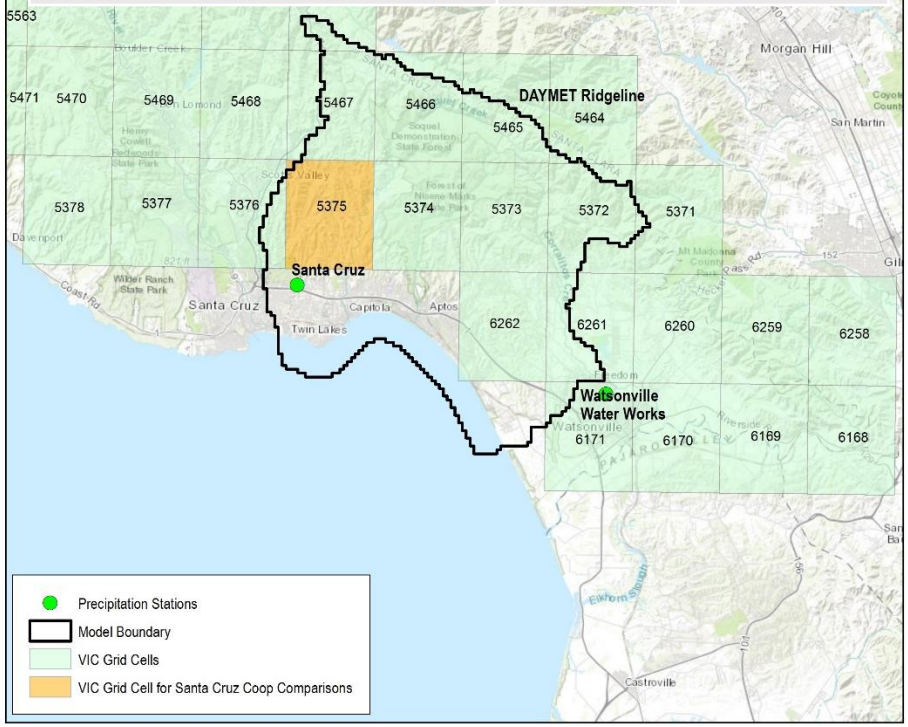
- Compared Catalog Climate and GFDL2.1 to 2013 ensemble used by state
- Drier than most CMIP5 models for Santa Cruz
- Not as hot as most CMIP5 models for Santa Cruz



DWR Climate Change Factors

- DWR provided climate change factors to apply to historical period
- Use of data and methods are optional
  - Transient analysis may be appropriate where local models and data are best available science

Change Factors	2030	2070
Evapotranspiration	1.05	1.08
Precipitation	1.04	1.03



Questions and Discussion

Public Comment

Break

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

DEPLETION OF INTERCONNECTED SURFACE WATER

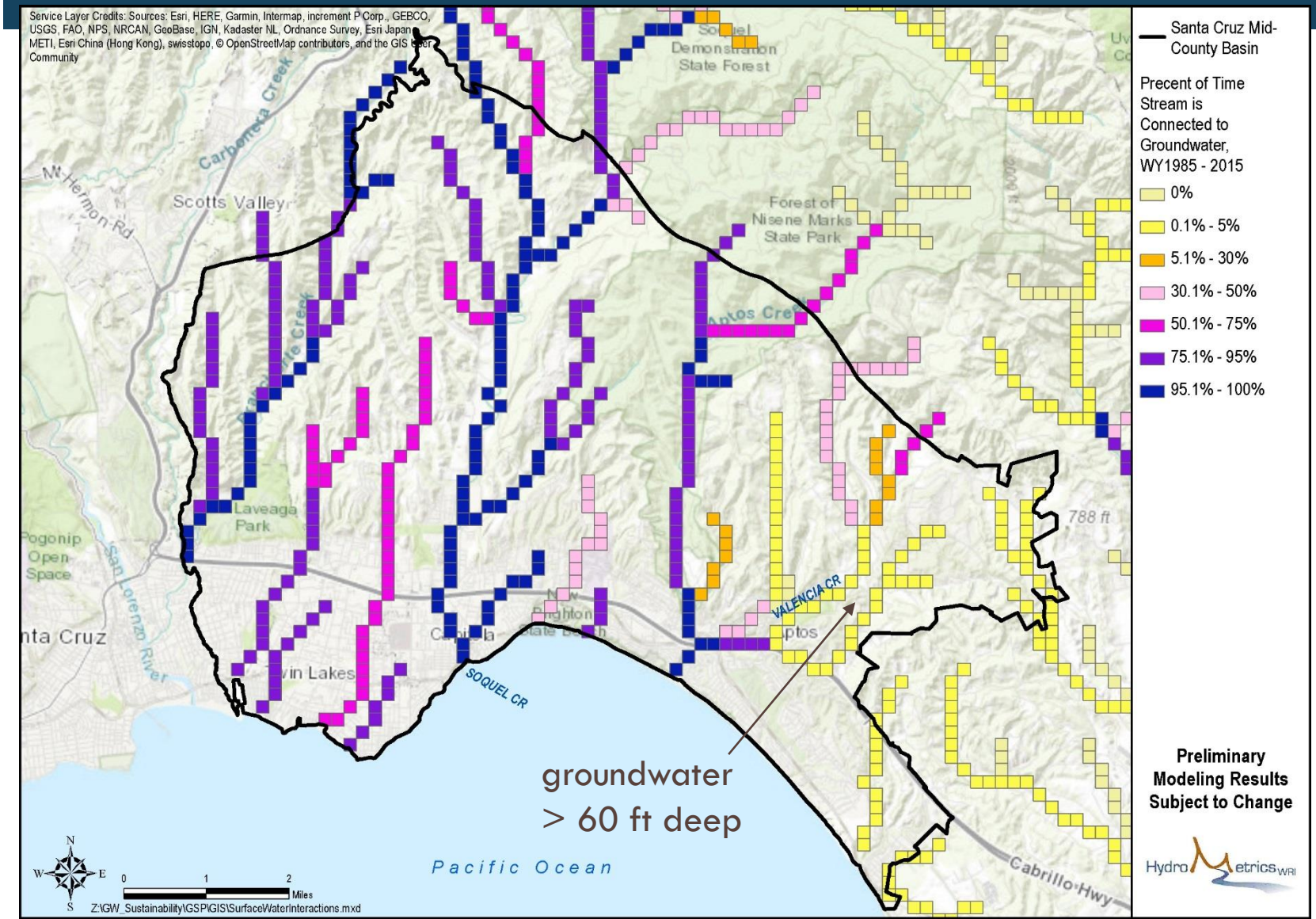
GSP Advisory Committee – February 27, 2019

Presentation Outline

- Surface water connection to groundwater in the Mid-County Basin
  - Where it is connected
  - How it is connected
- Monitoring locations
  - Existing
  - Proposed
- Preliminary Sustainable Management Criteria
  - Minimum Thresholds
  - Measurable Objectives

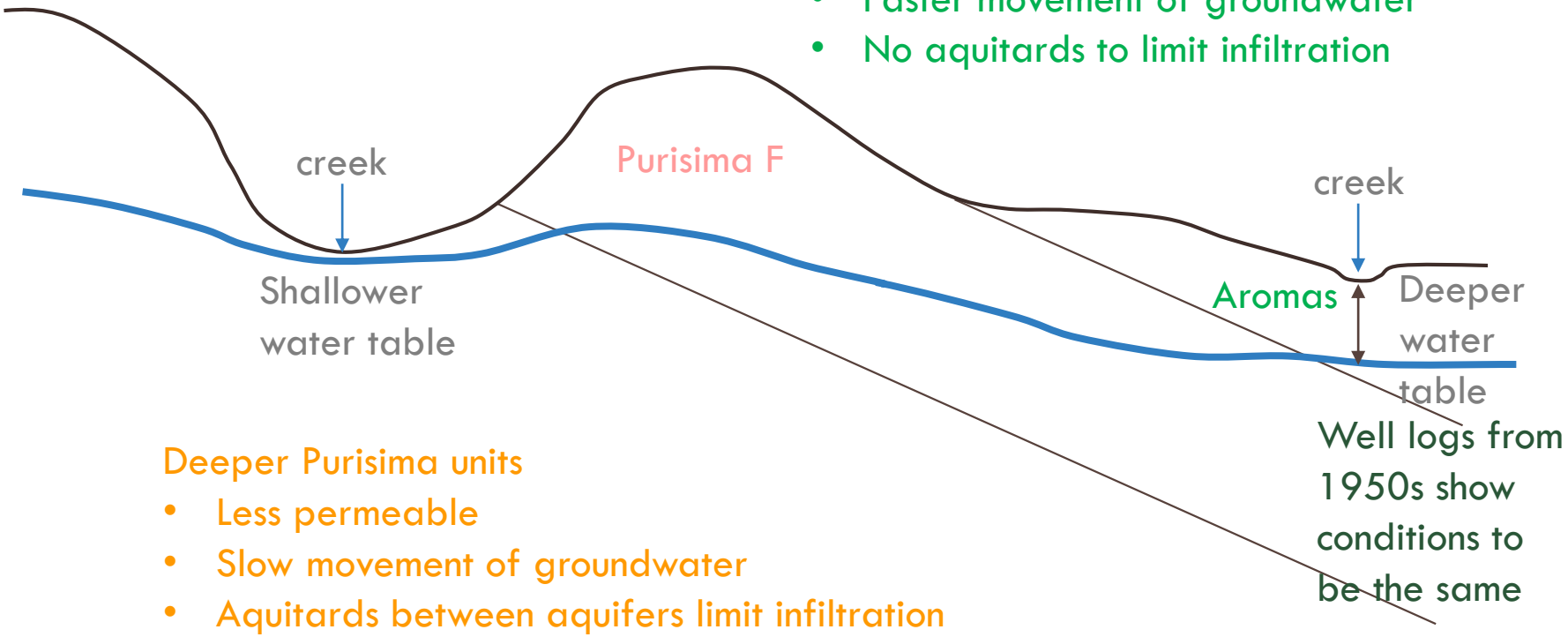
Surface Water Connection to Groundwater

Where is Surface Water Connected to Groundwater?



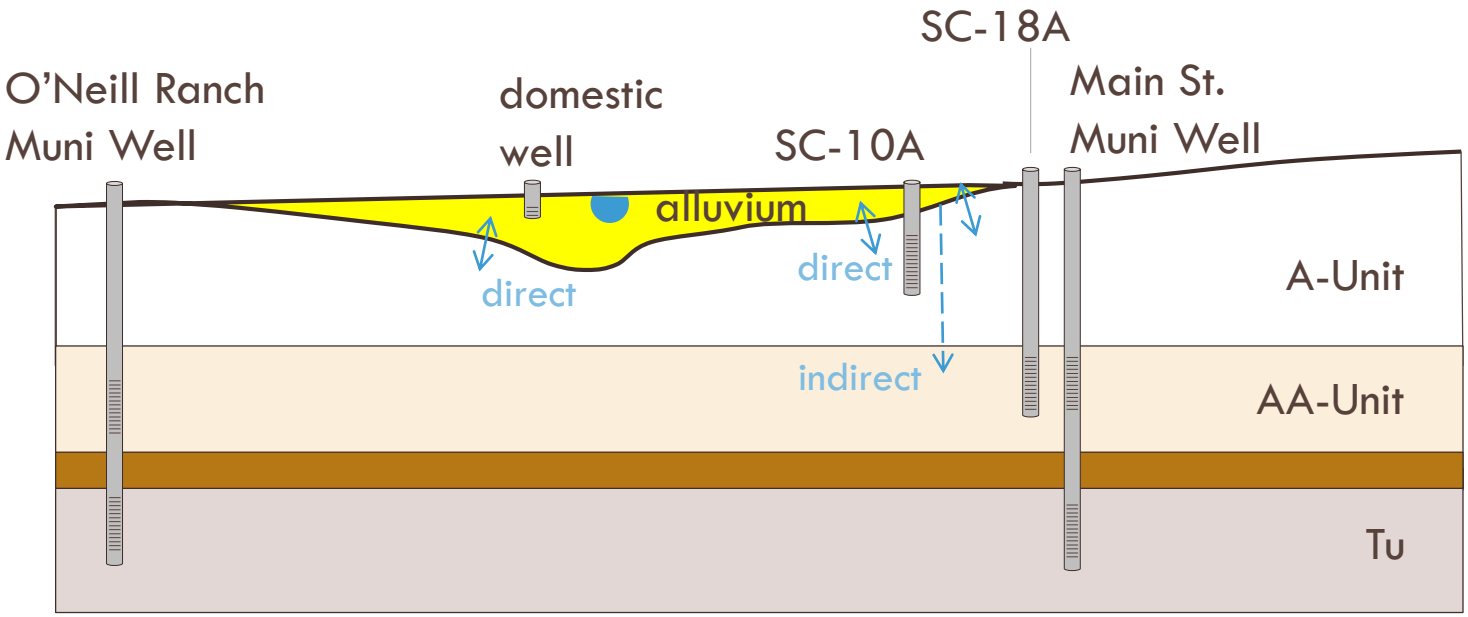
Purisima vs. Aromas

Aromas Red Sands & Purisima F
- More permeable
- Faster movement of groundwater
- No aquitards to limit infiltration



Deeper Purisima units
- Less permeable
- Slow movement of groundwater
- Aquitards between aquifers limit infiltration
- Groundwater table mimics topography

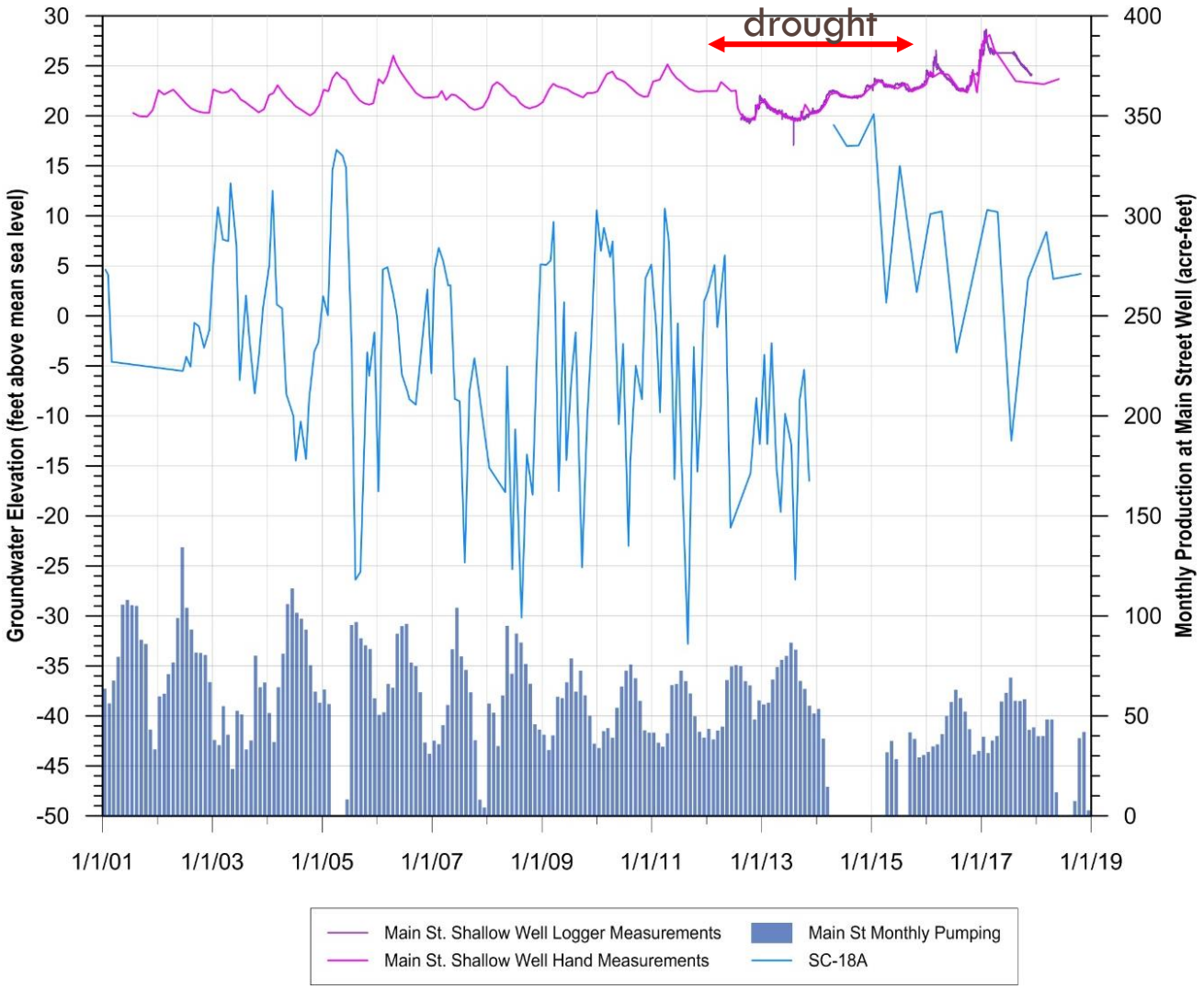
Conceptual Connection in the Purisima



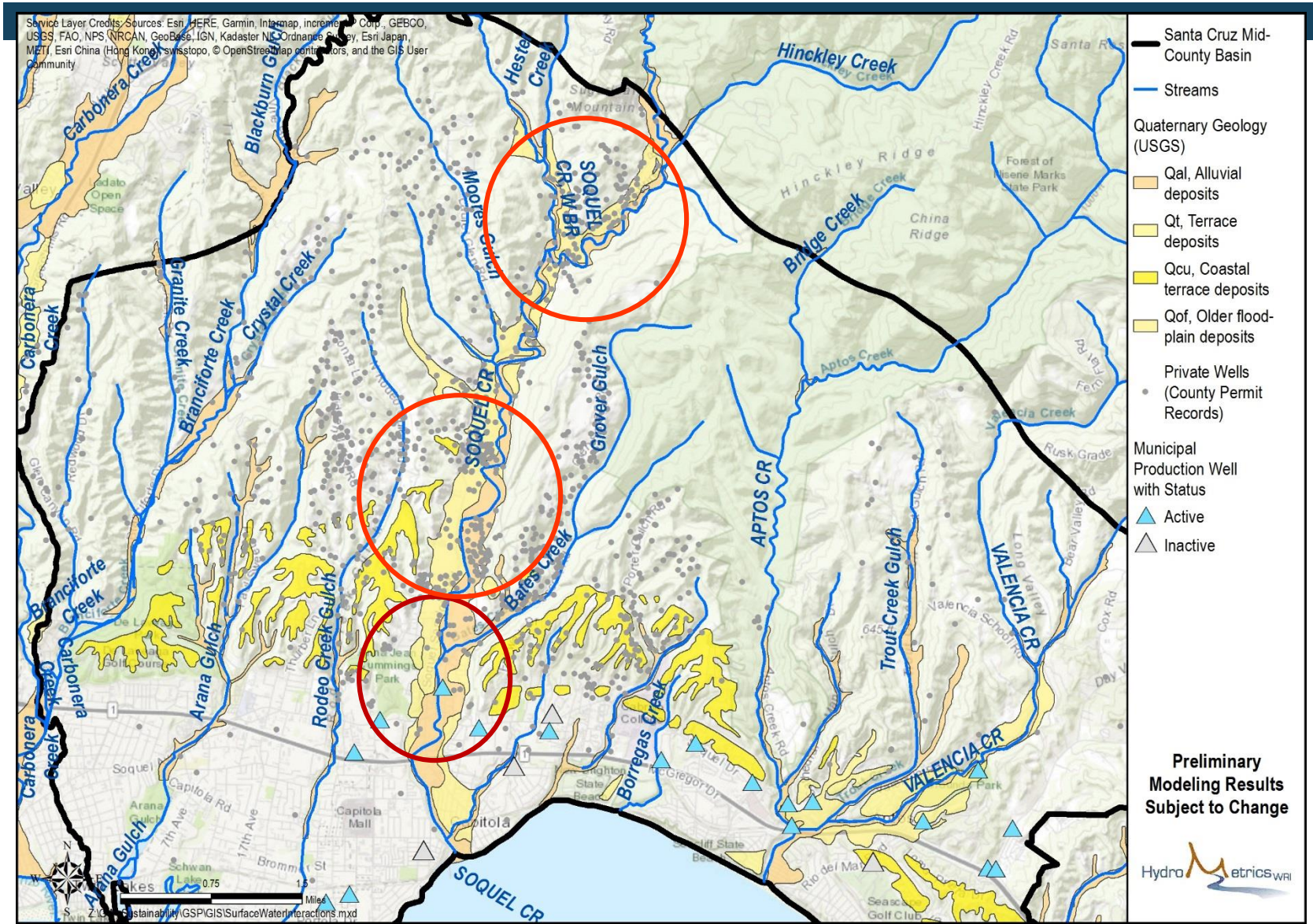
- Most municipal production wells are screened in units not directly in contact with alluvium
- There are some private domestic wells screened in the alluvium

Shallow Alluvium Connected to Underlying Purisima AA and A-Units

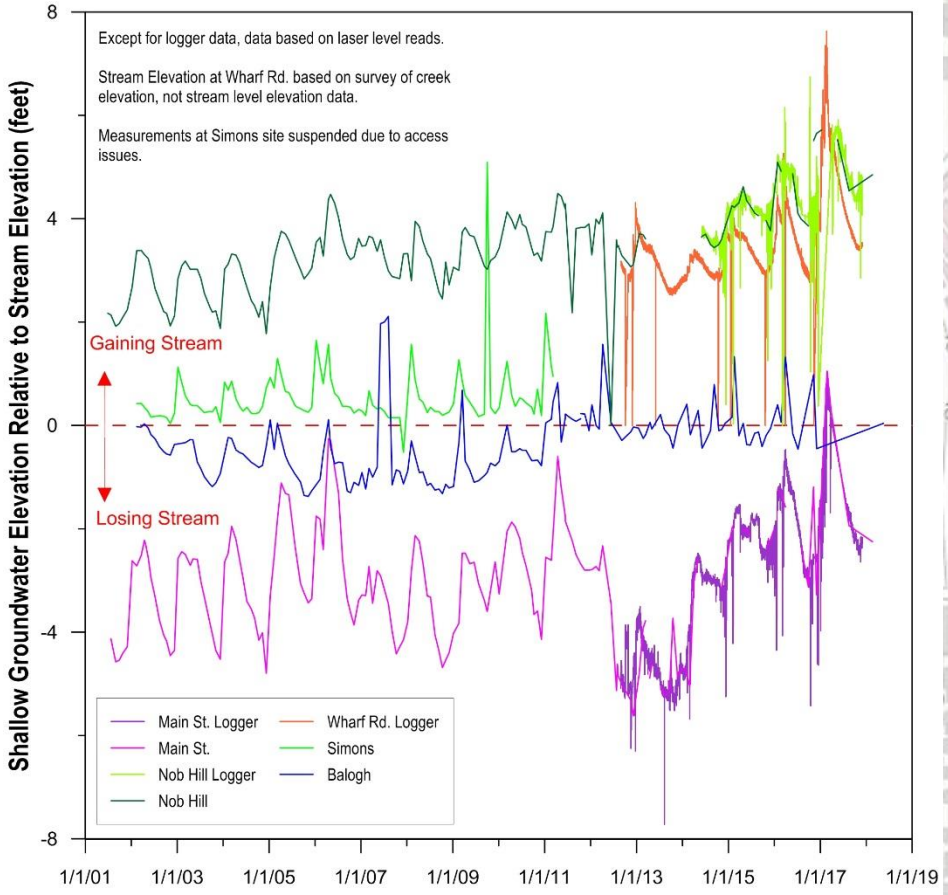
- Shallow level fluctuations from pumping & rainfall/creek
- Shallow level recovery while Main St prod well not pumping
- Shallow groundwater high does not correspond with AA-unit level high because of timing of pumping



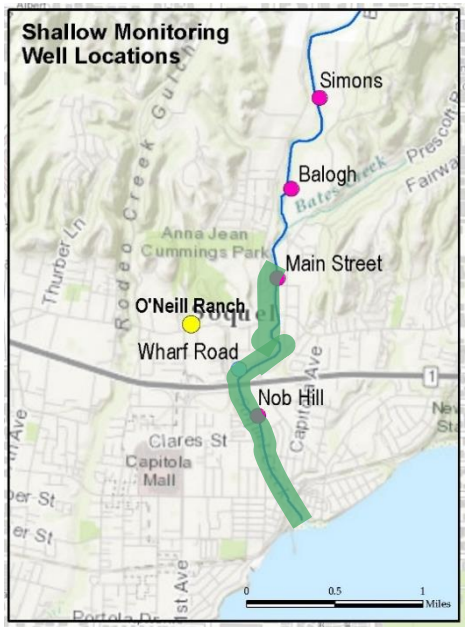
Soquel Creek & Nearby Pumping



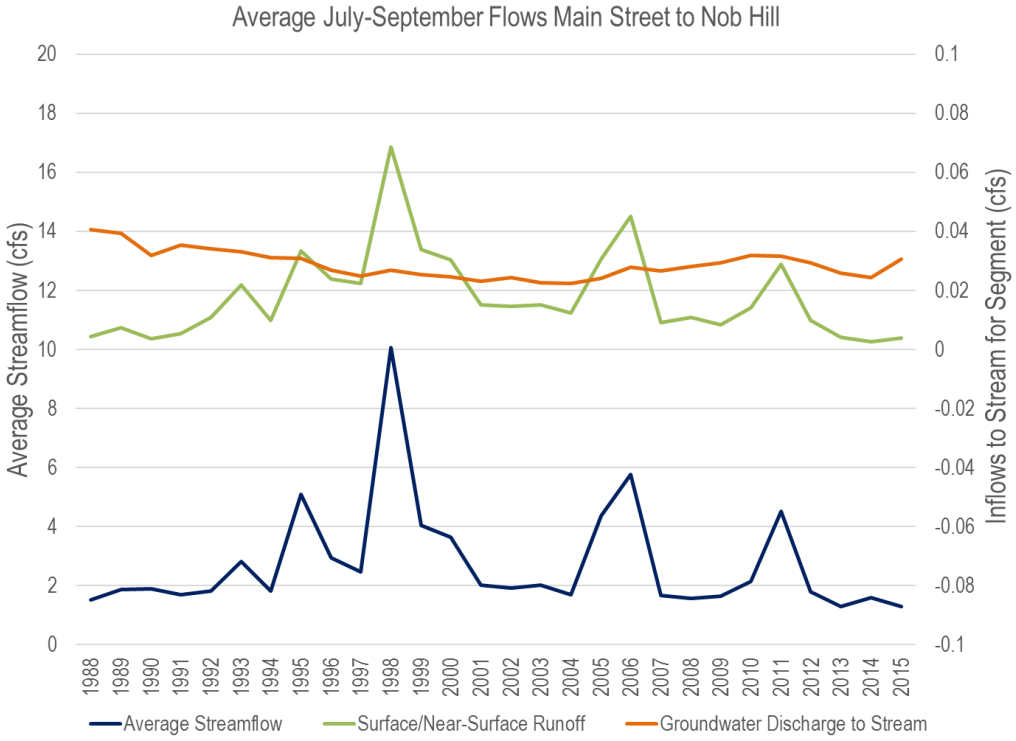
Area of Municipal Pumping



What Influences Creek Flows



Inflow	Outflow
Rainfall runoff	Evapotranspiration
Interflow	Surface Diversions?
Inflow from Groundwater	Outflow to Groundwater

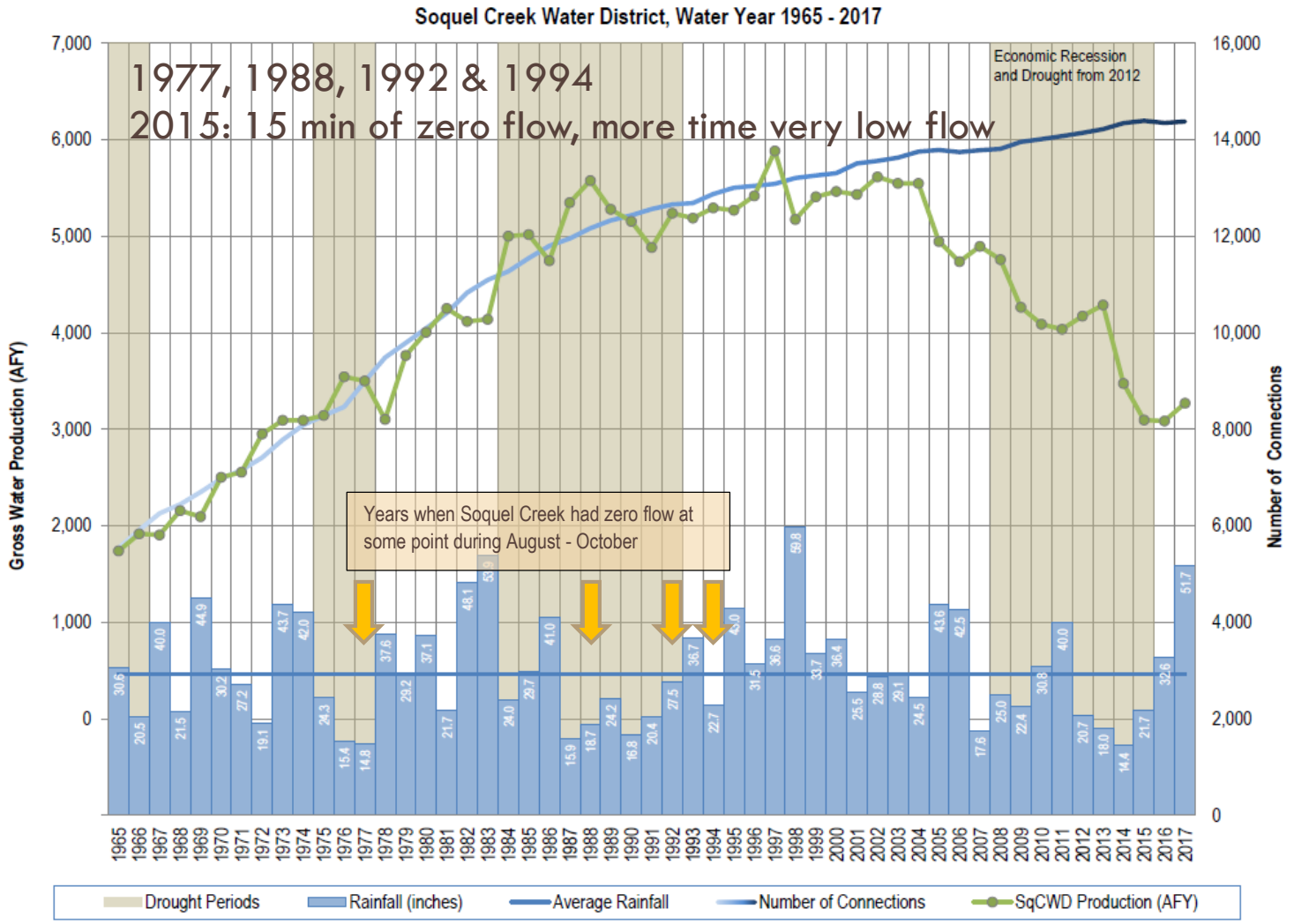


Groundwater modeling shows small groundwater flows to Creek in area where shallow groundwater affected by municipal pumping

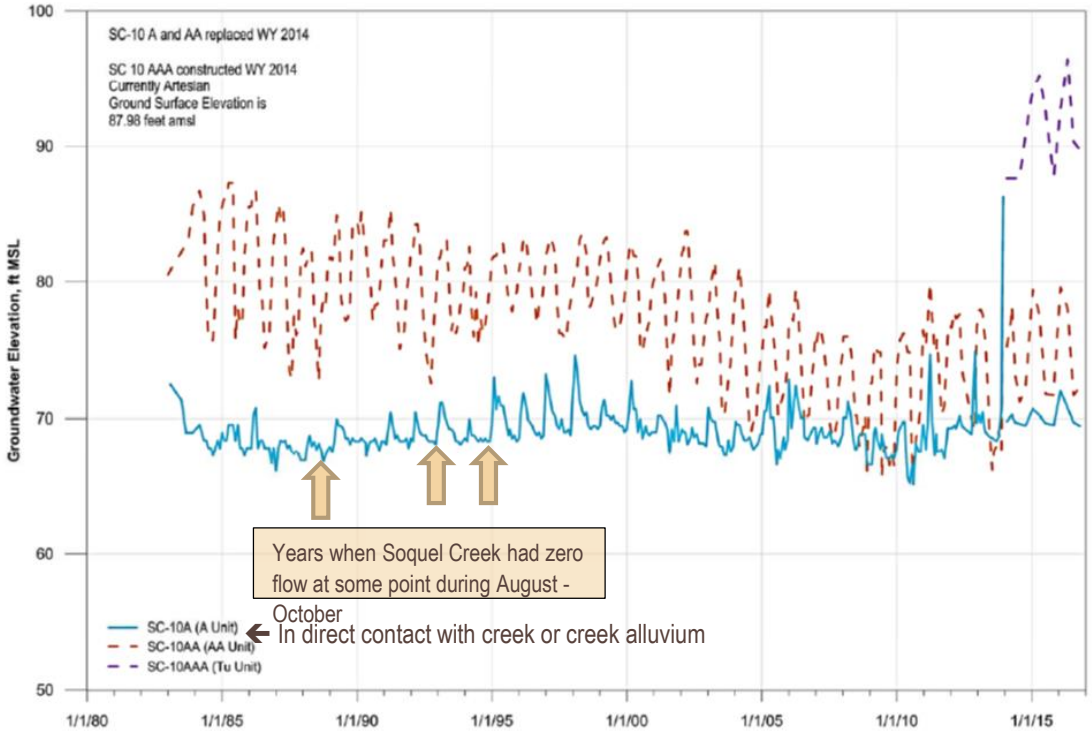
When Does Soquel Creek Have Zero Flow?

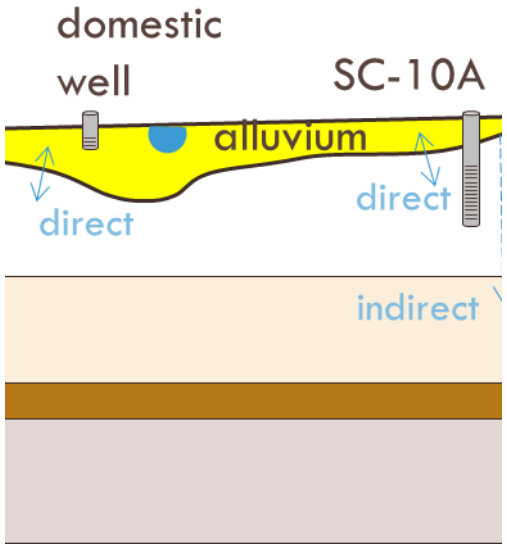
- There does not appear to be a correlation between low groundwater levels and times when the creek goes dry
- There is more correlation with the timing of rainfall and when the creek goes dry
- Surface diversions during low flow period may also cause creek to dry up

Linking Periods When Soquel Creek Had Zero Flow to Groundwater Levels



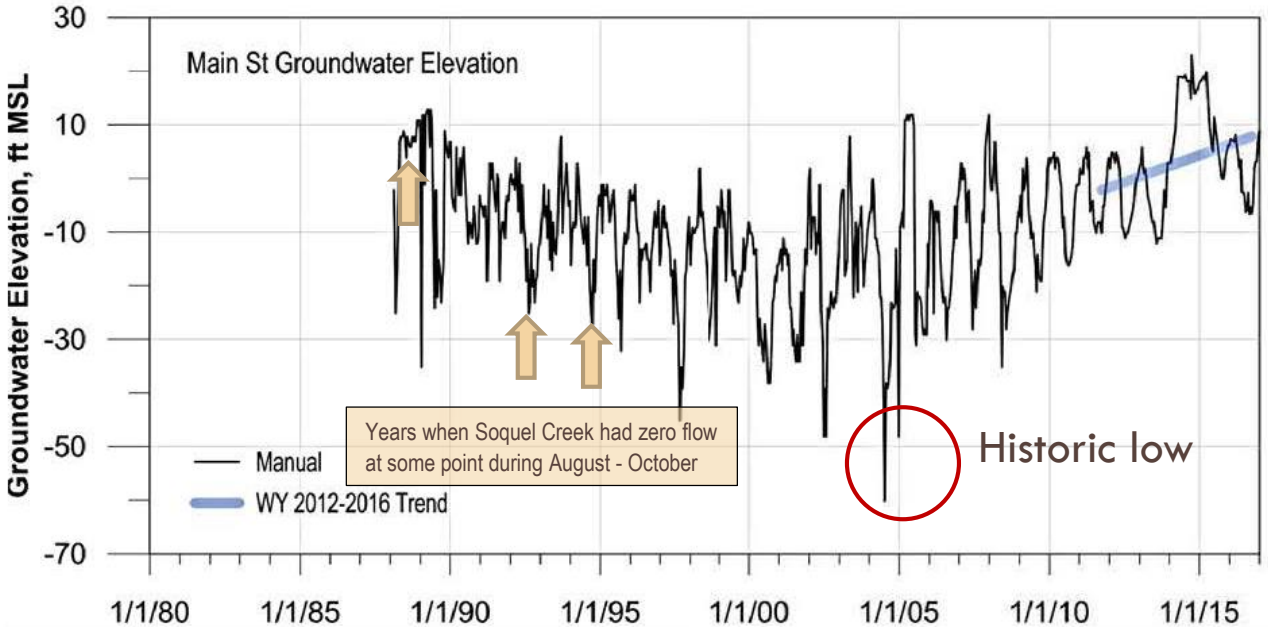
Monitoring Well SC-10 (Purisima A-unit)

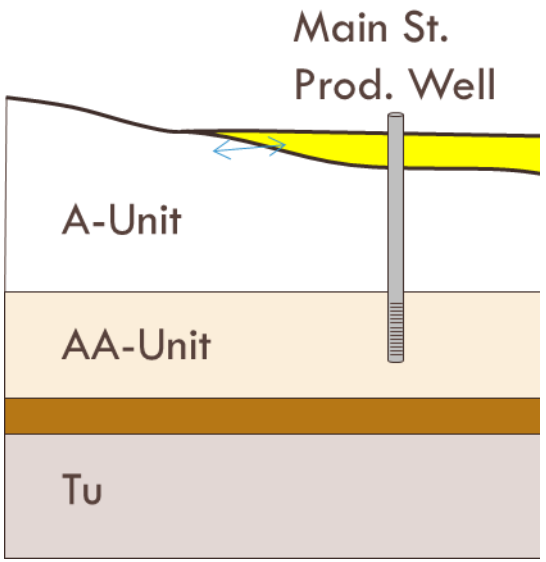




- Effects from nearby nursery pumping and streamflow evident in SC-10A hydrograph
- Increasing groundwater elevation trend when creek Soquel Creek ran dry 1.4 miles downstream ➔ creek drying up is not related to low groundwater levels near SC-10

Main St. Production Well (Purisima AA-unit)





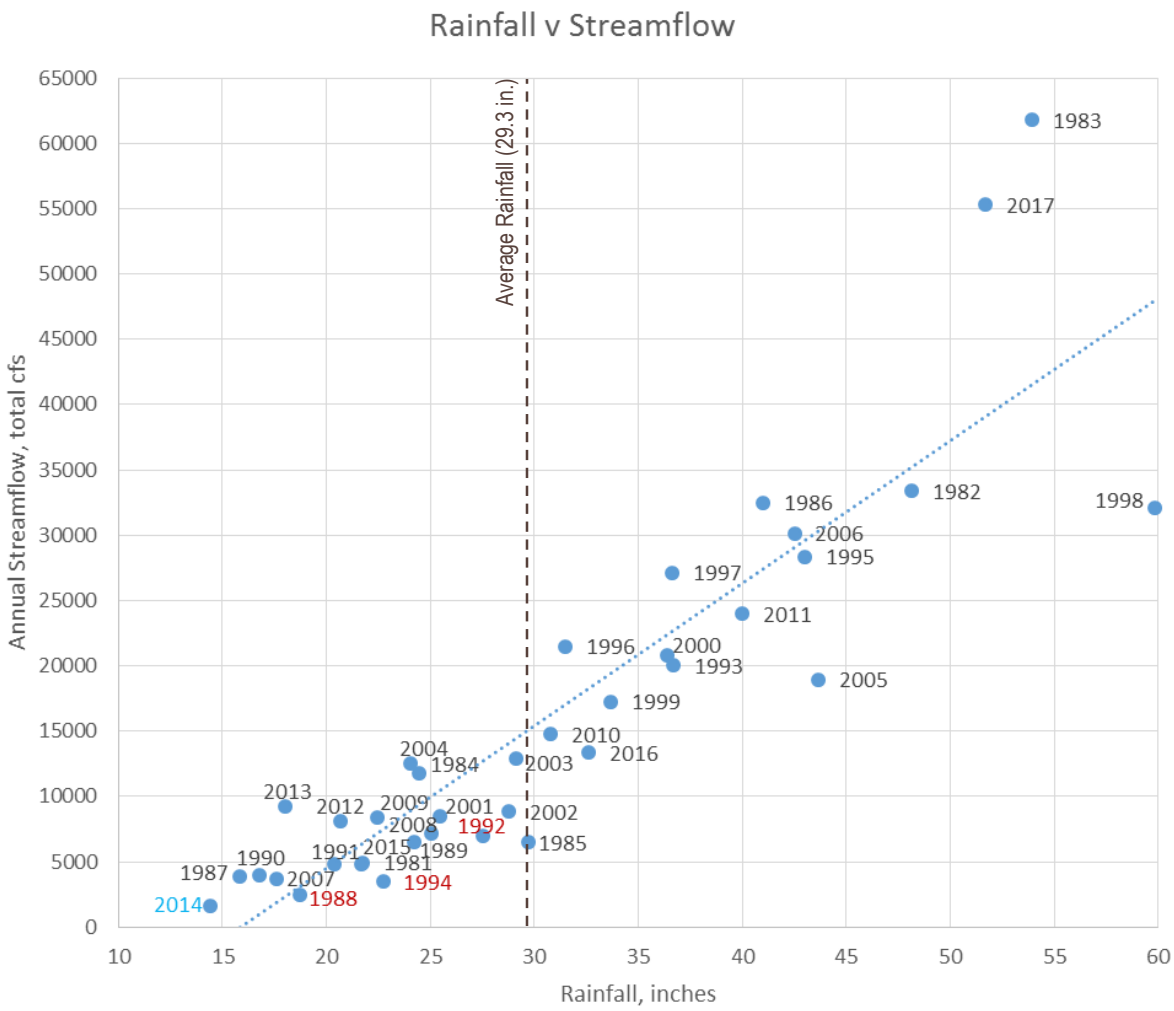
- Historic low groundwater elevations occurred when there was below average rainfall but creek did not dry up
- Higher groundwater elevations measured during years when Soquel Creek dried up ➔ not related to low groundwater levels

Streamflow and Rainfall

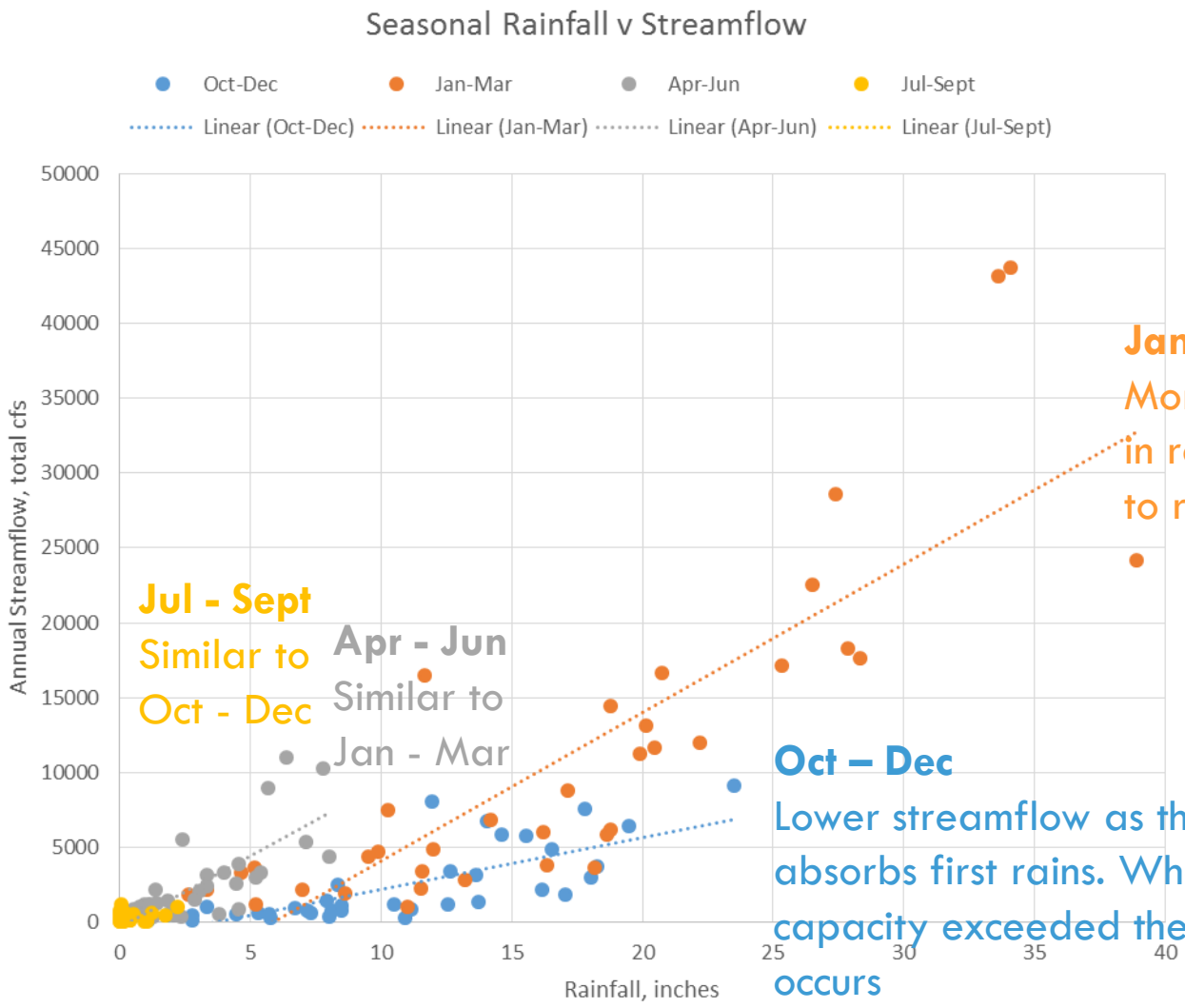
- Red years are years when the creek had zero flow

= low rainfall

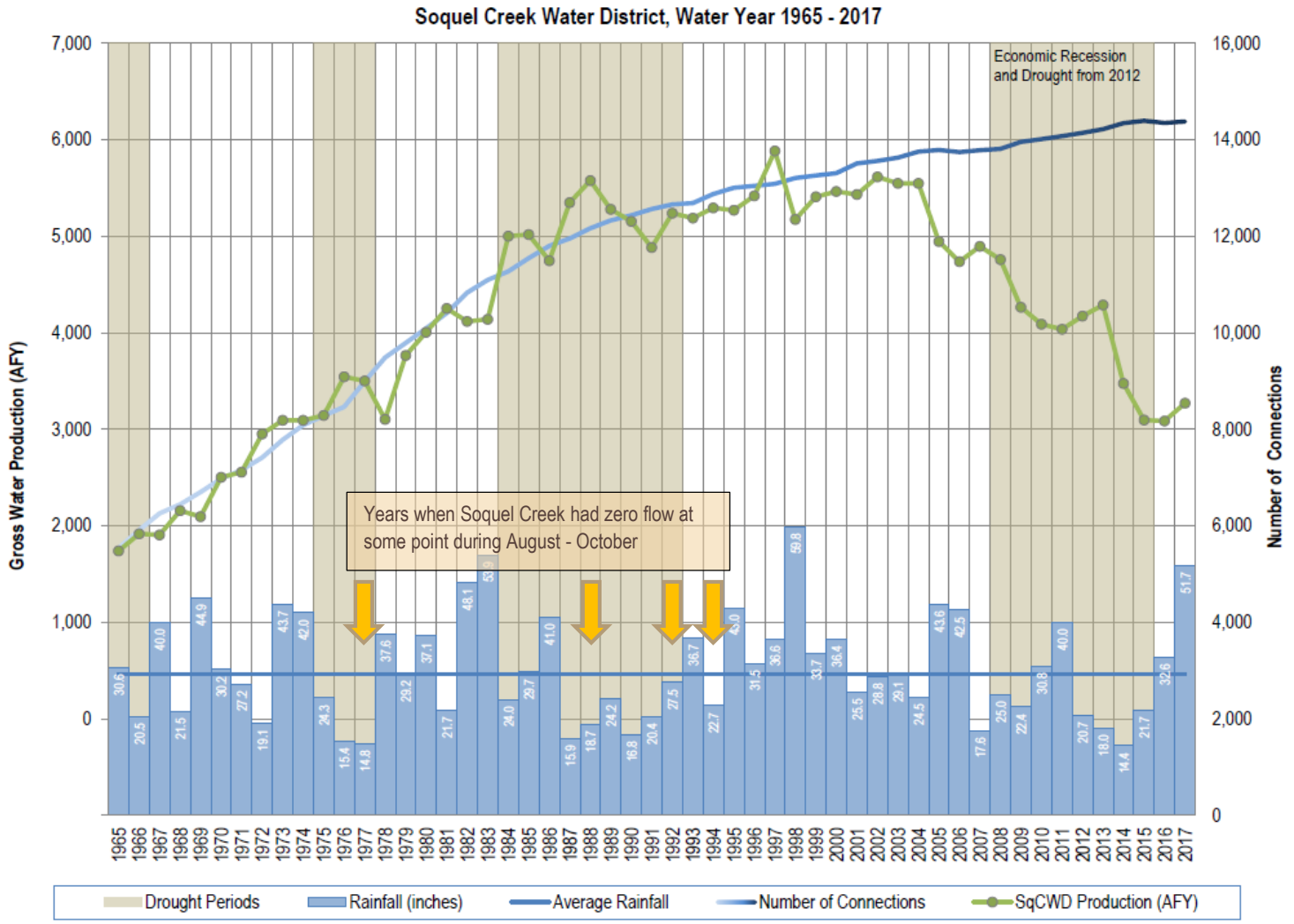
- Blue year was almost record low rainfall but creek did not have zero flow



Streamflow and Rainfall

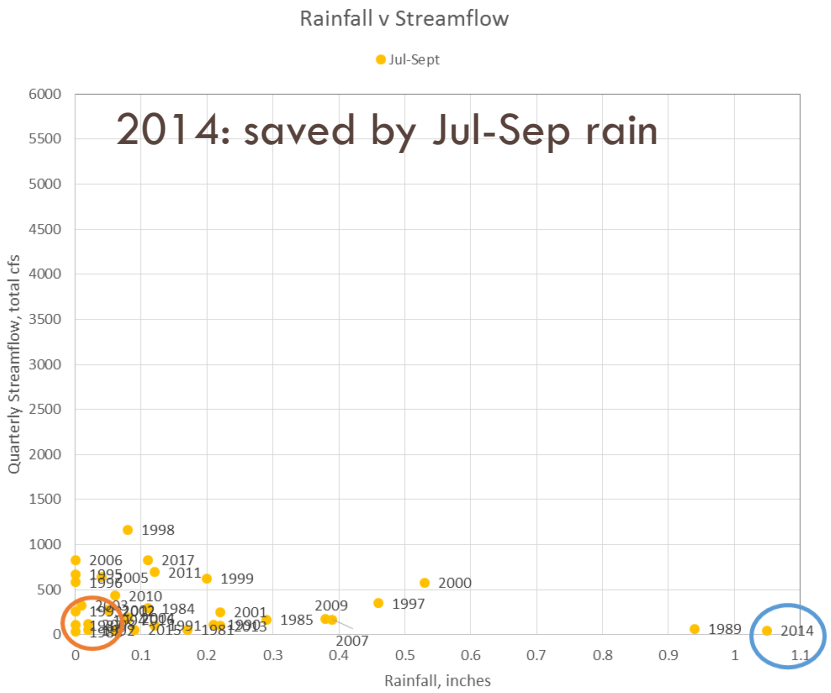


Prior Years had Below Average Rainfall



Why Did the Creek Not Have Zero Flow During the 2012 – 2015 Drought?

- Was it because there were increased overall basin groundwater levels?
- Are less surface diversions happening?
- Timing of rainfall

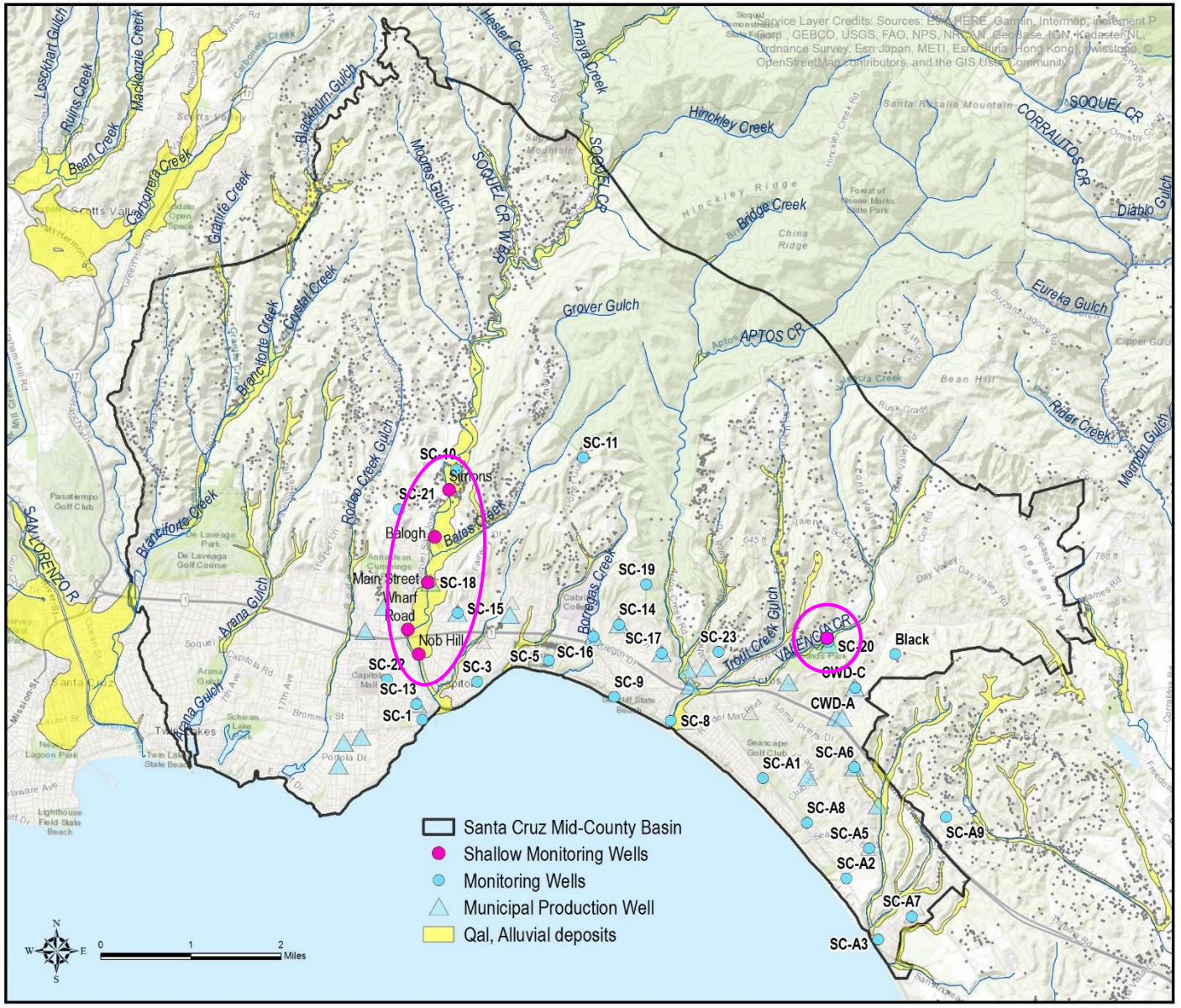


Possible Theory

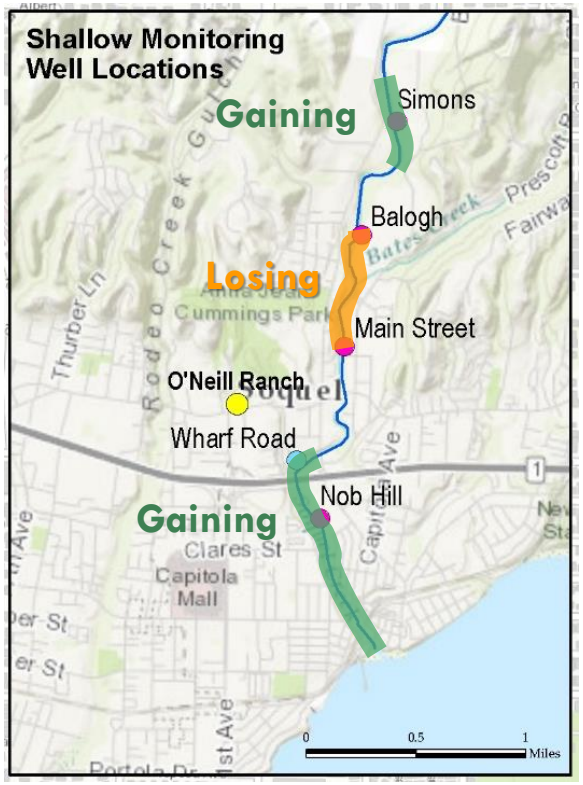
- Forested parts of the watershed acts like a sponge that slowly releases water stored in the vadose zone to streams and underlying aquifers
- If there is not enough rainfall stored because of prior rainfall patterns, less water is released from the vadose zone over the drier months and the likelihood of Soquel Creek drying up are increased
- This has implications as the pattern of rainfall changes due to climate change

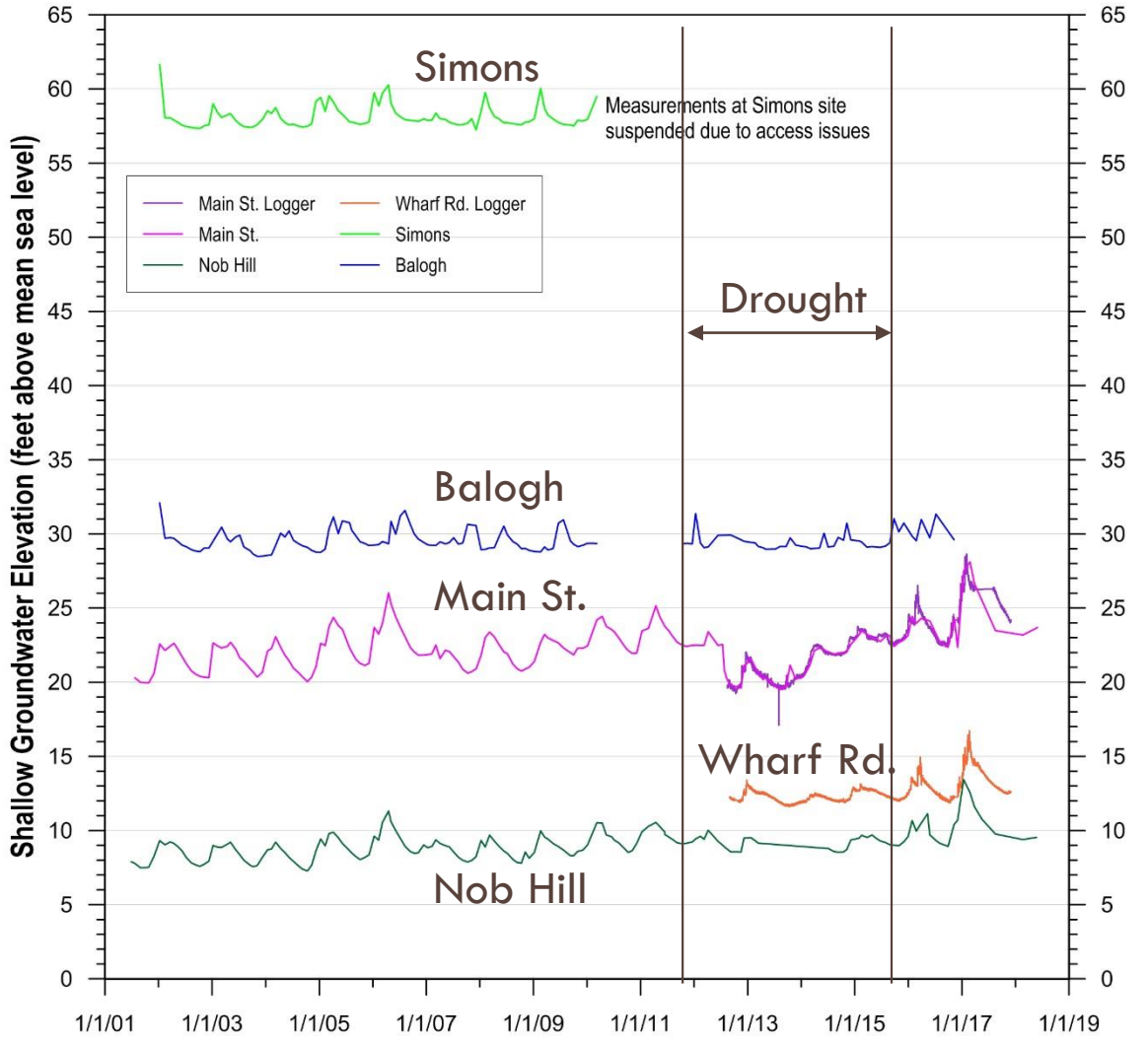
Monitoring Locations

Monitoring Wells in the Basin



Hydrographs of Shallow Monitoring Wells

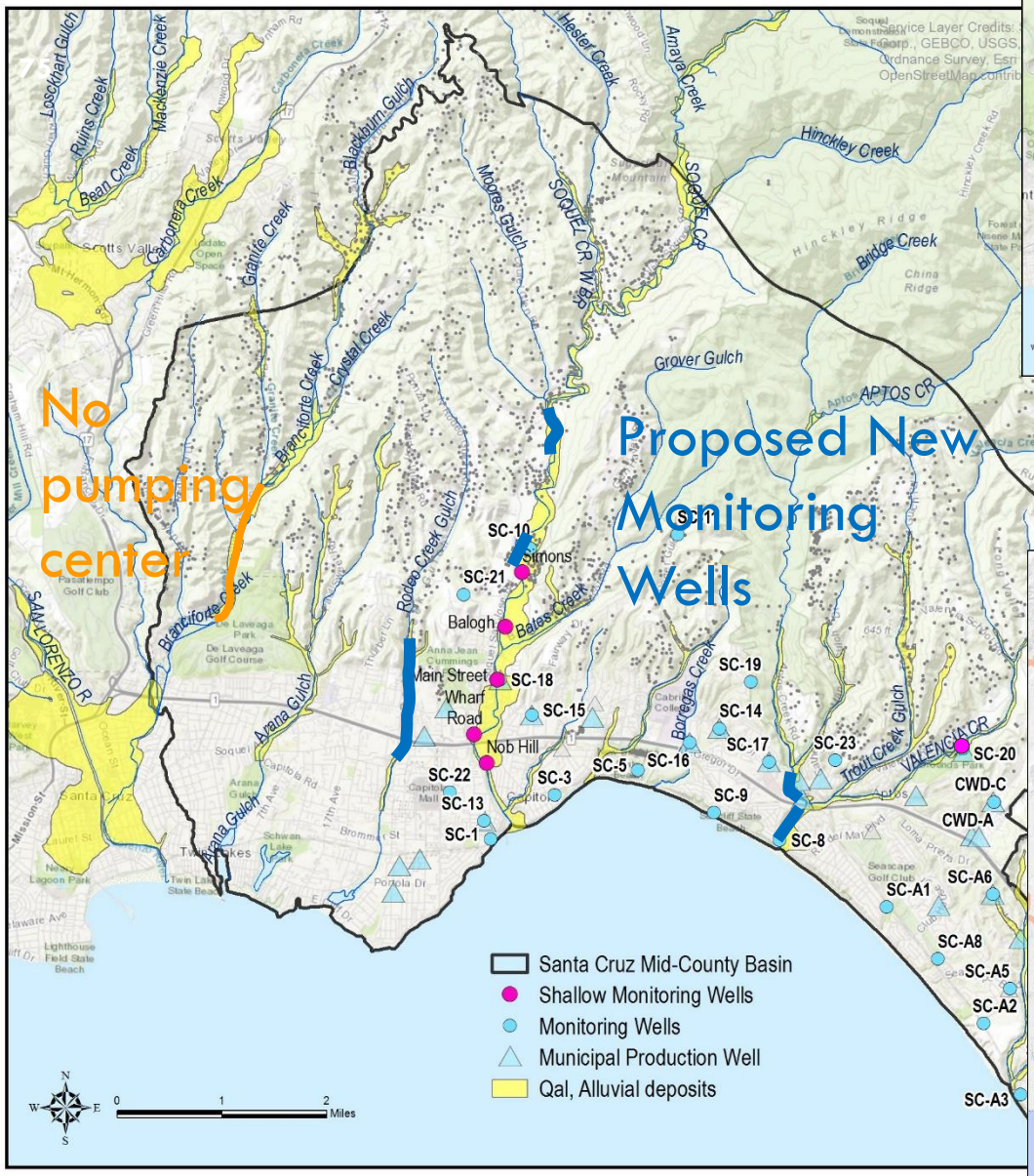


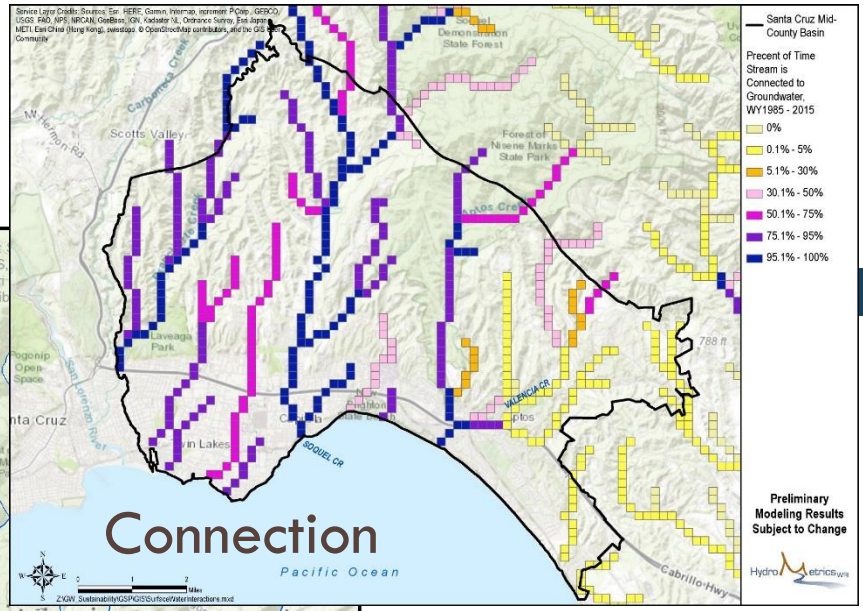


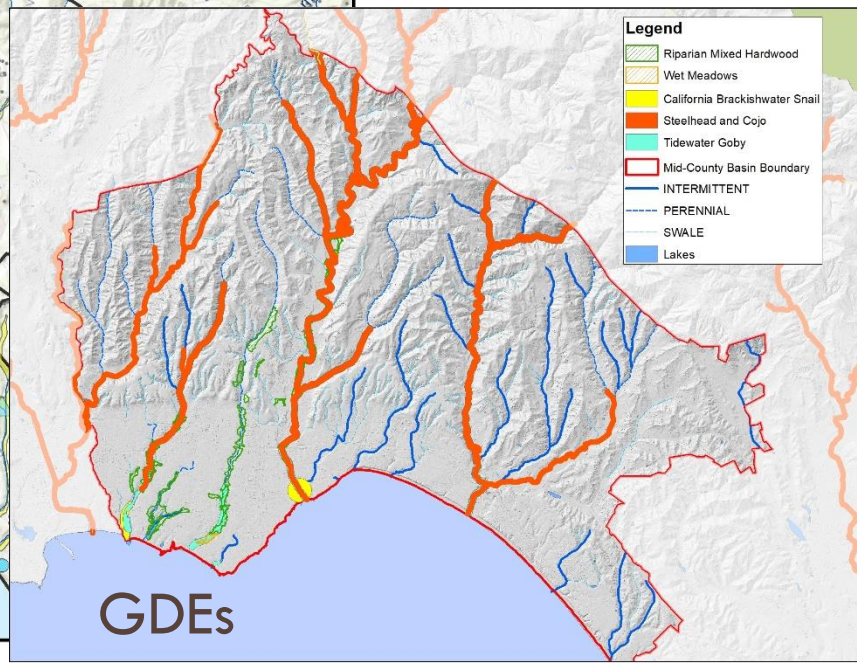
Proposed Monitoring Well Locations

- Criteria for locating a representative monitoring well:
  - Surface water must be connected to groundwater
  - Near pumping centers
  - GDEs have been identified
- Dependent on land availability
  - On Soquel Ck below Moore's Gulch
  - Shallow alluvial well at SC-10
  - Rodeo Creek Gulch
  - Aptos Ck near confluence with Valencia Ck
  - Lower end of Valencia Ck

Proposed Groundwater Monitoring Locations







Data Gaps

- GSP to be developed based on best available science
- Further study needed during GSP implementation to:
  - Understand link between alluvium and unit directly below alluvium
    - Need multi-depth monitoring wells in same location
    - Add shallow monitoring wells at SC-10
  - Understand where creeks are gaining and losing
    - Measure groundwater levels in private alluvial wells and compare against creek levels
    - May need stream flow measuring devices

Sustainable Management Criteria

Significant & Unreasonable

Minimum Thresholds

Measurable Objectives

Significant & Unreasonable

Lowering of groundwater levels adjacent to interconnected streams supporting special status species, due to groundwater extraction, that results in a significant decrease in stream baseflow during the period from June – ~~October~~ November

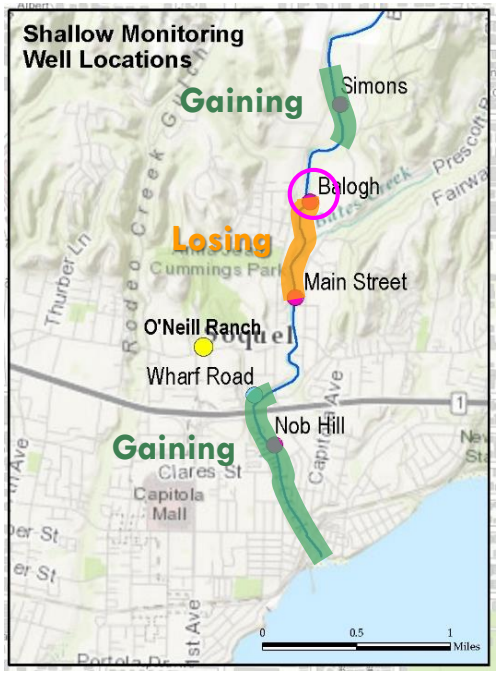
Minimum Threshold Approach

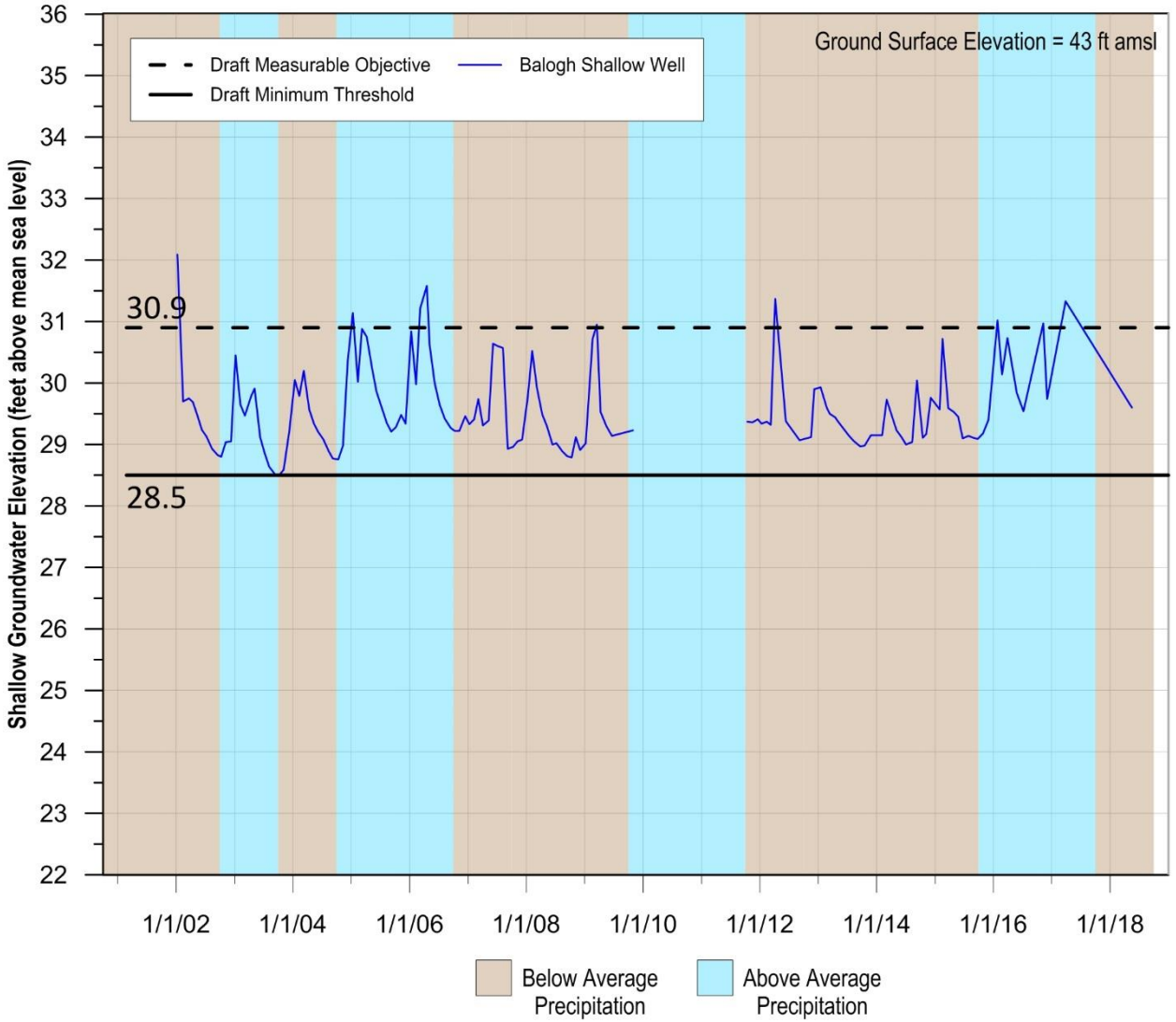
- Level below which significant and unreasonable conditions occur
- Use groundwater levels as a proxy for surface water depletion
- Shallow well data do not go back far enough to correlate with when Soquel Creek had zero flow, but do cover recent drought period
  - Except for Main St. Shallow Well, there was little response to the drought
- Provided creek did not have zero flow or other adverse effects did not occur, minimum shallow groundwater level over period of record (2001 – 2018)

Measurable Objective Approach

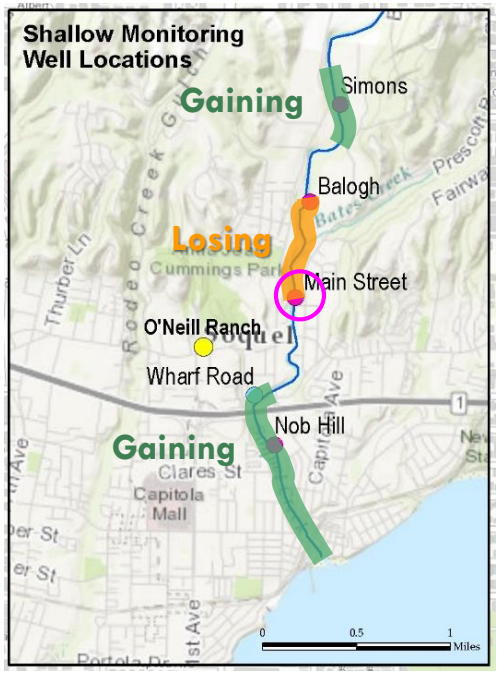
- Not expecting similar conditions to last 18 years because of climate change
- Use maximum winter/spring groundwater levels in below average rainfall years
- Will evaluate maximum annual minimum groundwater level over period of record

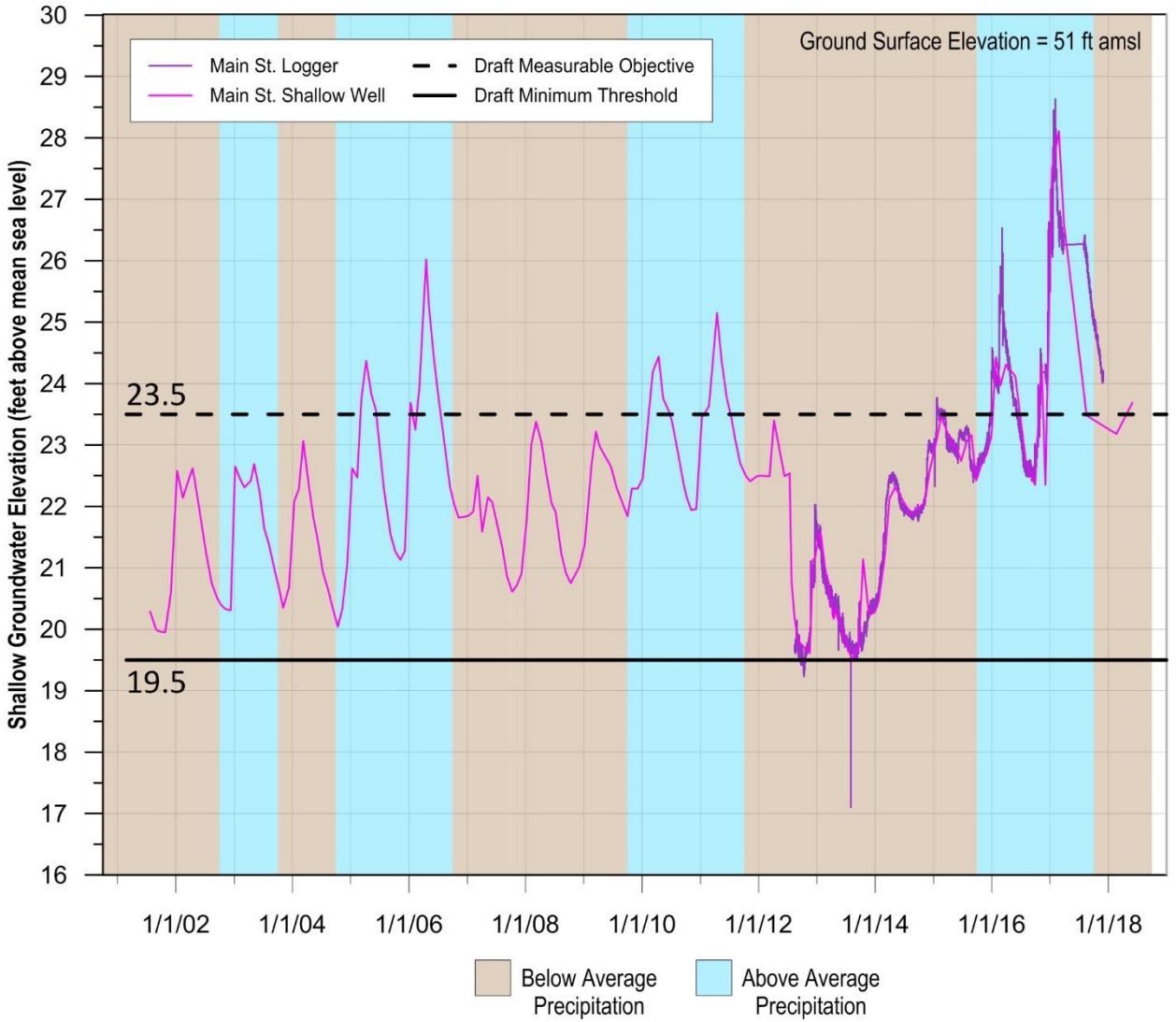
Balogh Shallow Well



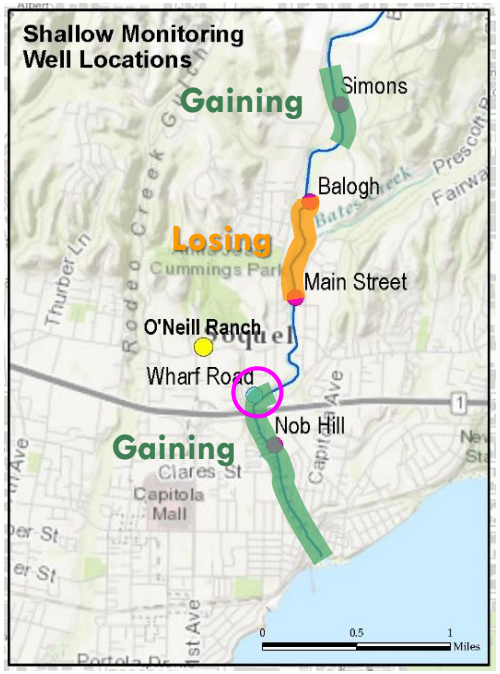


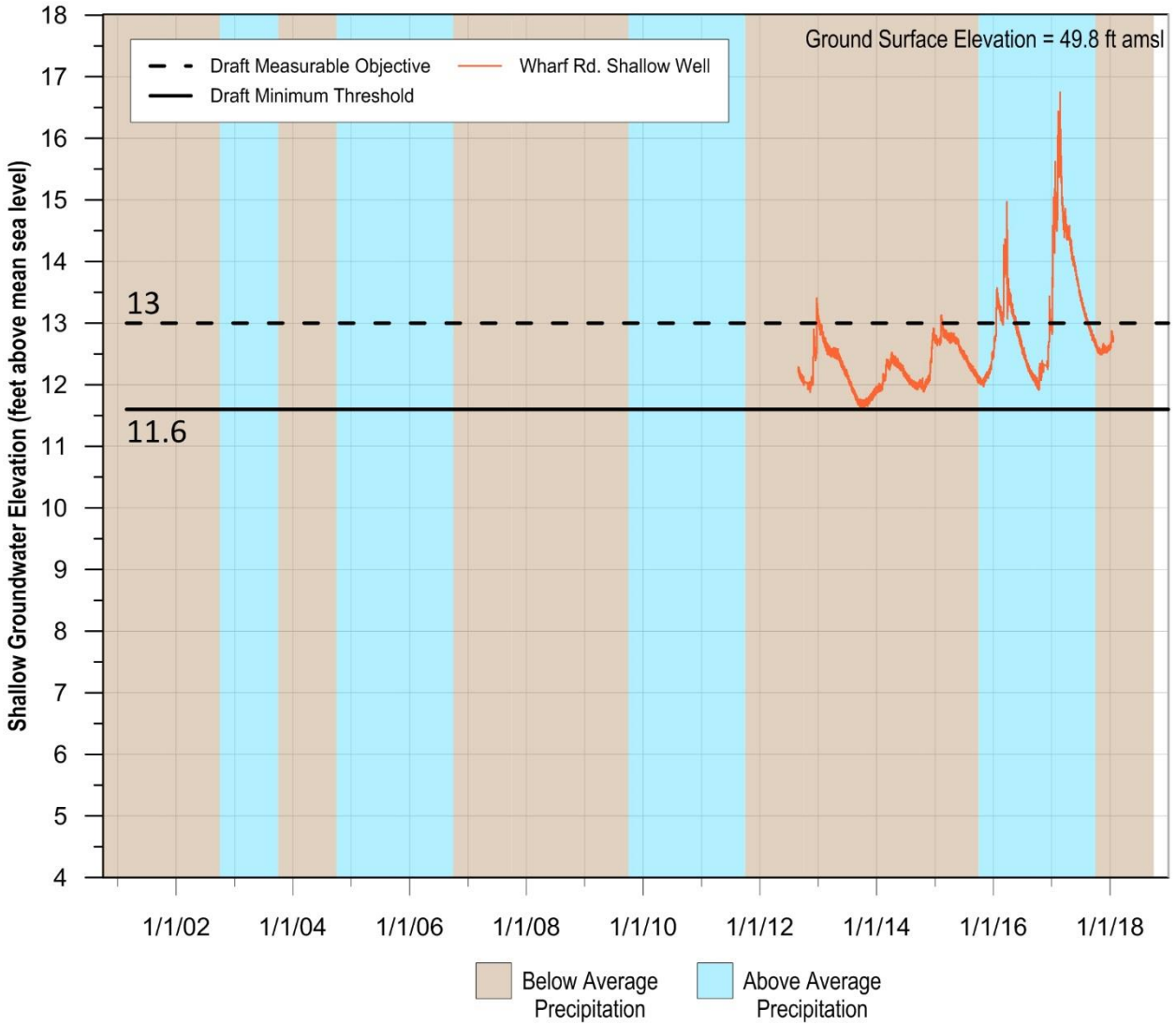
Main Street Shallow Well



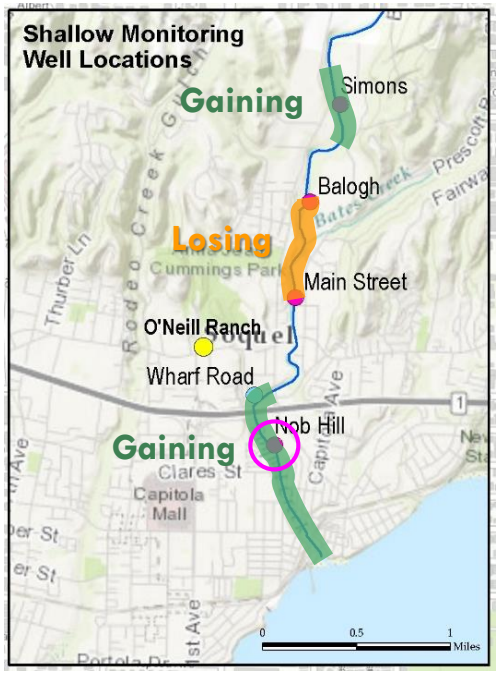


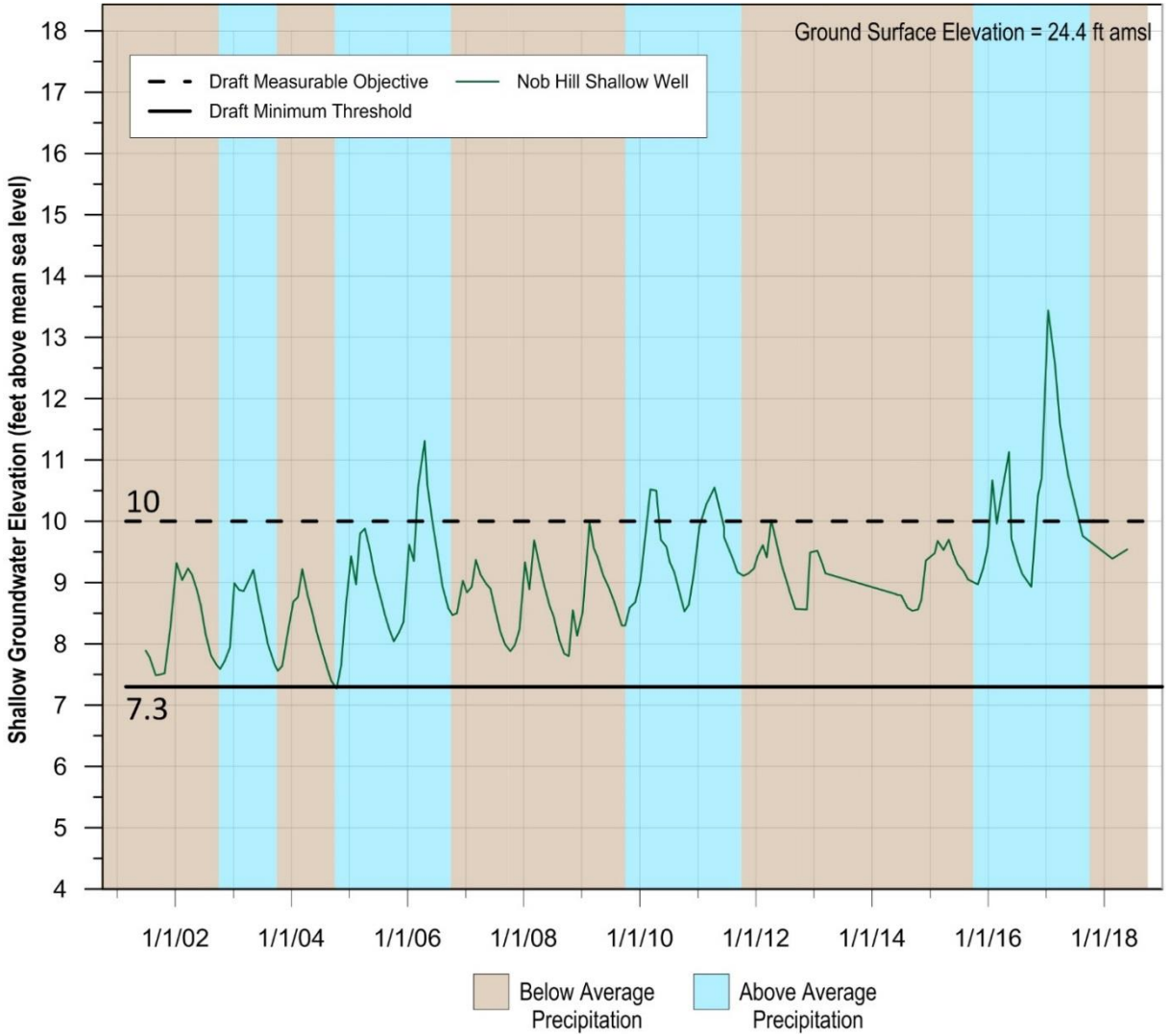
Wharf Rd. Shallow Well





Nob Hill Shallow Well





Questions

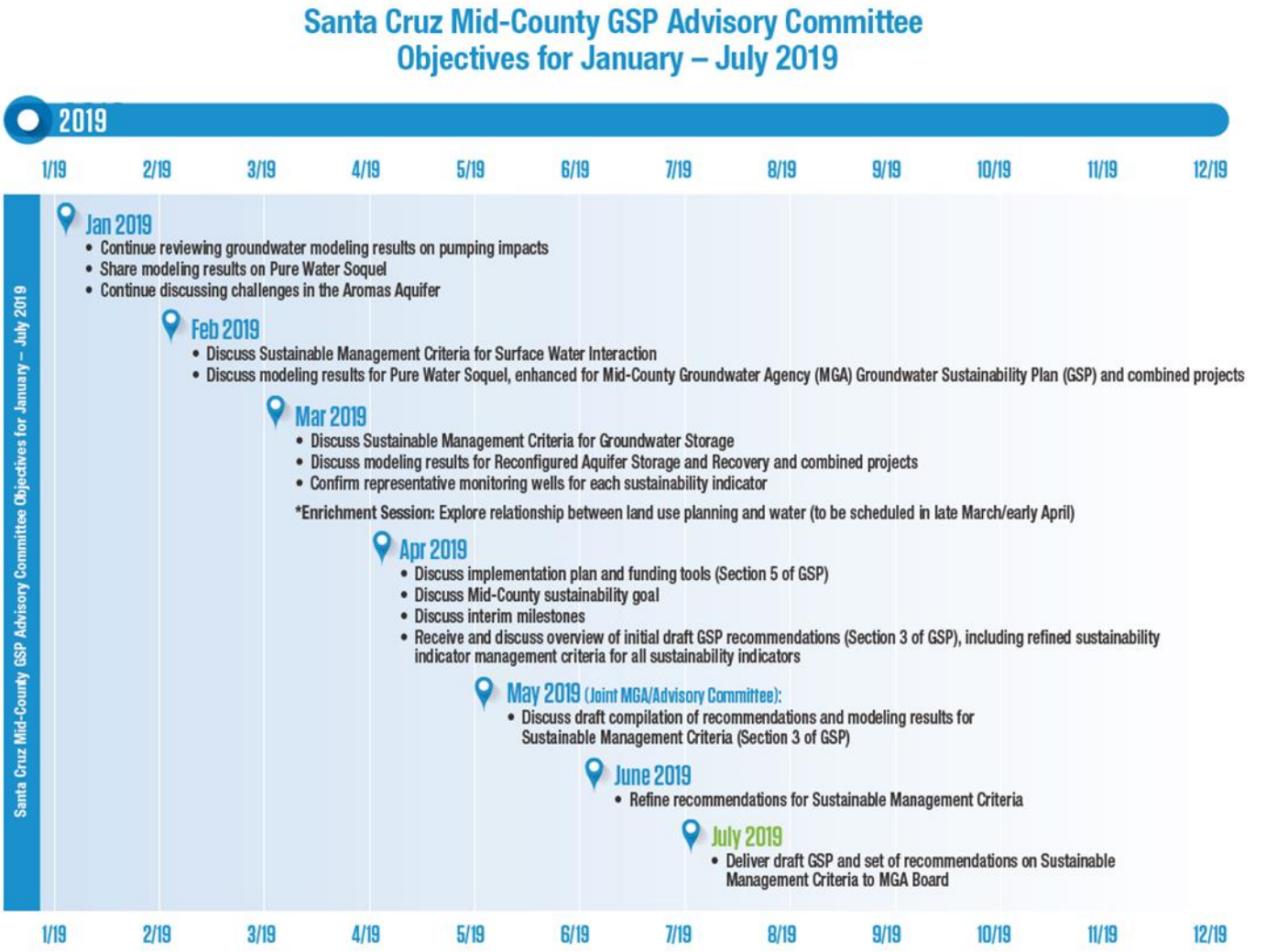
Public Comment

Confirm

January 23, 2019 GSP Advisory Committee Meeting Summary

Recap and Next Steps

GSP 2019 Project Timeline



Next Steps: Meetings 17, 18 and 19

- **March 27, 2019 Meeting (#17)**
  - Discuss Sustainable Management Criteria for Groundwater Storage
  - Discuss modeling results for Reconfigured Aquifer Storage and Recovery and combined projects
  - Confirm representative monitoring wells for each sustainability indicator

March/April: ***Enrichment Session (or equiv) on Land Use Planning & Water***

- **April 24, 2019 Meeting (#18)**
  - Discuss implementation plan and funding tools (Section 5 of GSP)
  - Discuss Mid-County sustainability goal
  - Discuss interim milestones
  - Receive and discuss overview of initial draft GSP recommendations (Section 3 of GSP), including refined sustainability indicator management criteria for all sustainability indicators
- **May 22, 2019 (Joint MGA/Advisory Committee) Meeting (#19)**
  - Discuss draft compilation of recommendations and modeling results for Sustainable Management Criteria (Section 3 of GSP)

THANK YOU!

FOR ANY QUESTIONS, PLEASE CONTACT:
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SANTA CRUZ MID-COUNTY
GROUNDWATER AGENCY

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