SANTA CRUZ MID-COUNTY GROUNDWATER SUSTAINABILITY PLANNING

Advisory Committee Meeting #6

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

Wednesday, April 25, 2018, 6:00 – 9:00 p.m.
Santa Cruz County Sheriff's Office

Welcome and Introductions

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

Meeting Objectives

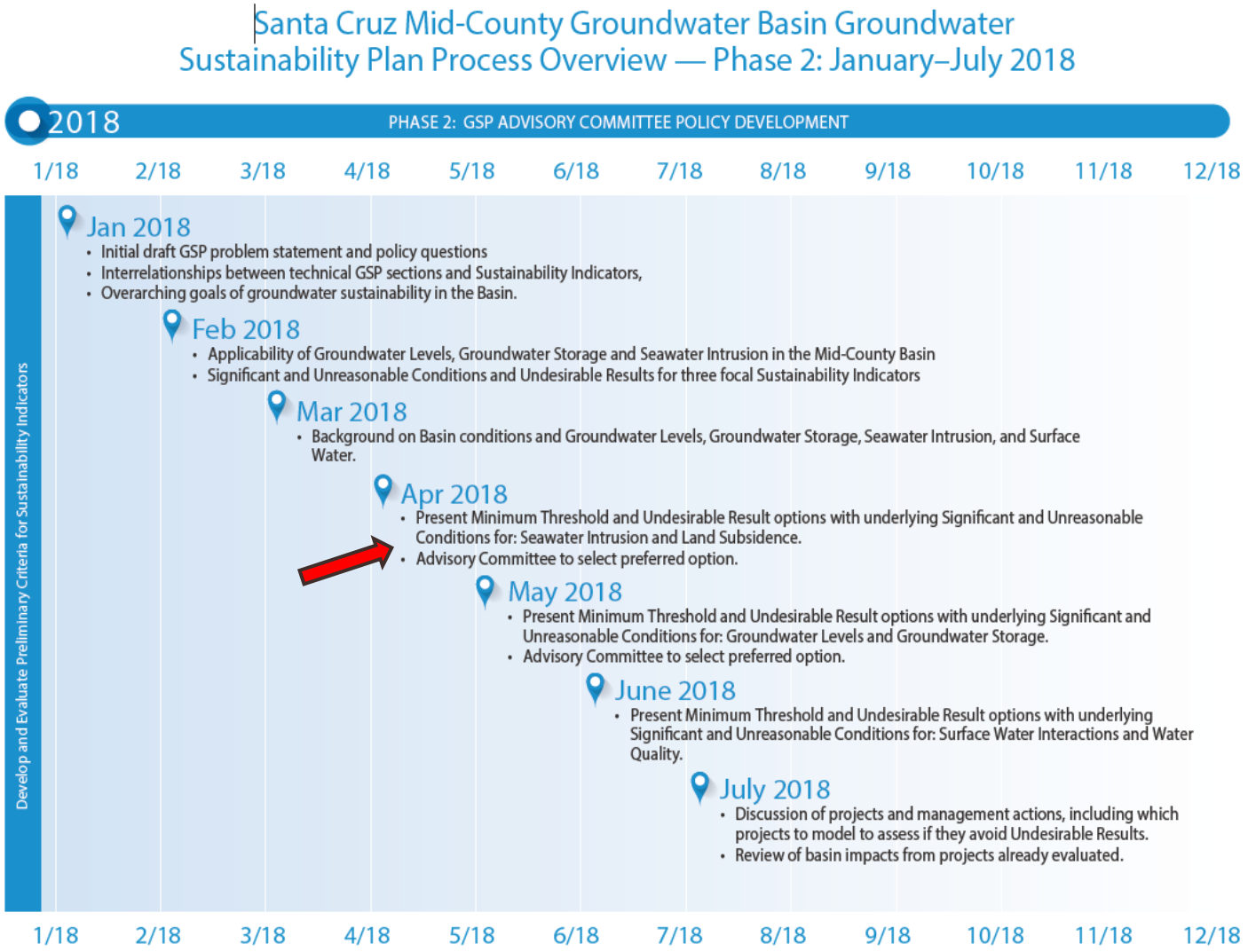
1. Receive additional background information about basin conditions.
2. Share Advisory Committee input on Minimum Threshold and Undesirable Result Options with Underlying Significant and Unreasonable Conditions for the following Sustainability Indicators:
   a. Seawater Intrusion
   b. Subsidence

Agenda

6:00	Welcome, Introductions, Objectives, Agenda, Iterative Decision Process, and GSP Project Timeline Review
6:10	Oral Communications
6:20	Share additional background information: trend data
6:30	*Seawater Intrusion* – Undesirable Results with Underlying Significant and Unreasonable Conditions
7:40	Public Comment
7:50	*Break*
8:05	*Subsidence* – Undesirable Results with Underlying Significant and Unreasonable Conditions
8:40	Public Comment
8:50	Confirm March 28, 2018 Advisory Committee Meeting Summary
8:55	Recap and Next Steps
9:00	*Adjourn*

GSP Project Timeline

GSP Process Timeline – Phase 2



GSP Decision Making Process

(*Iterative*)

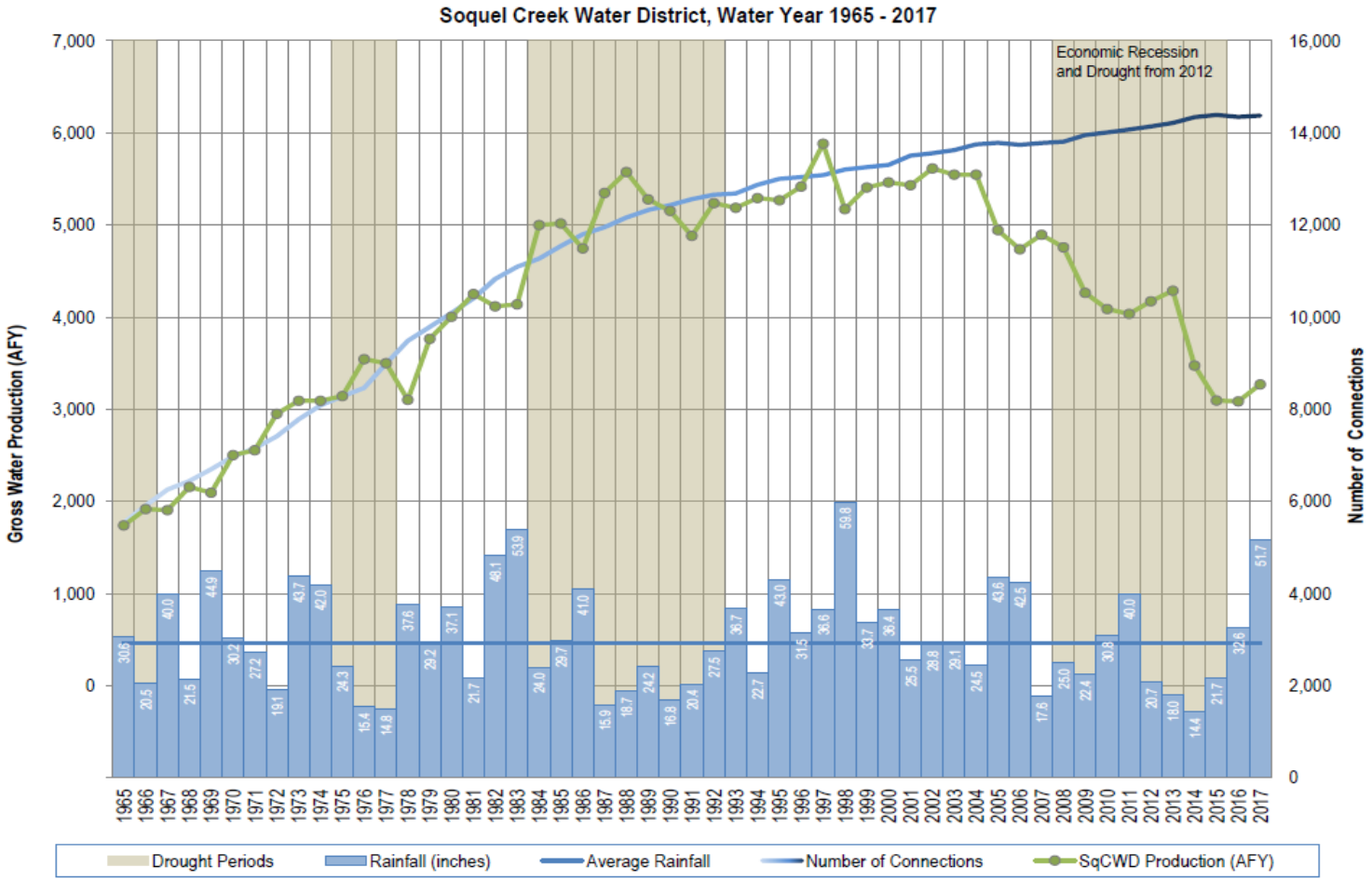
GSP Decision Making Process

Oral Communications

Background

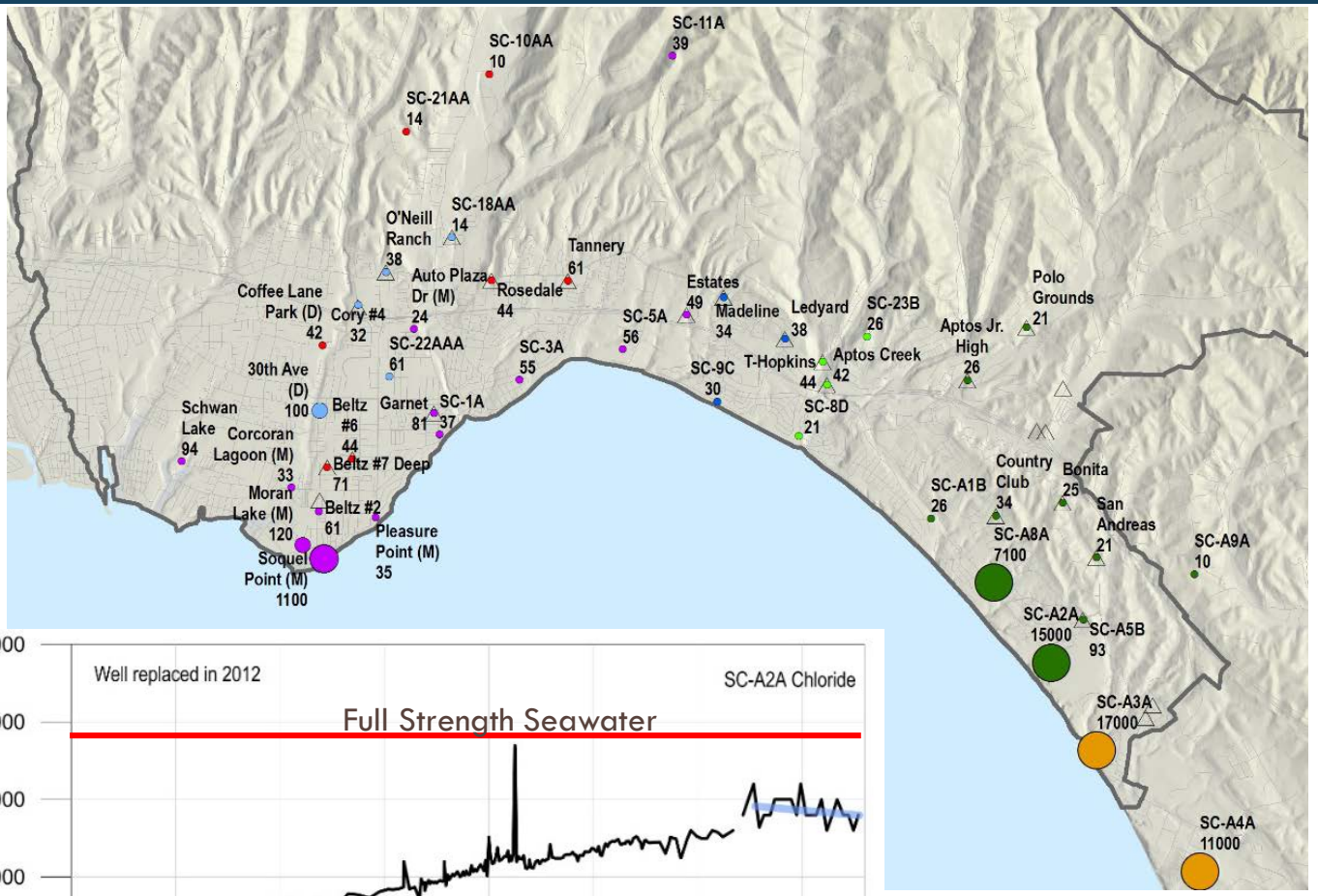
Trend Data Graph
for Soquel Creek Water District

Soquel Creek Water District, 1965 – 2017: Groundwater Pumping, Connections, and Rainfall

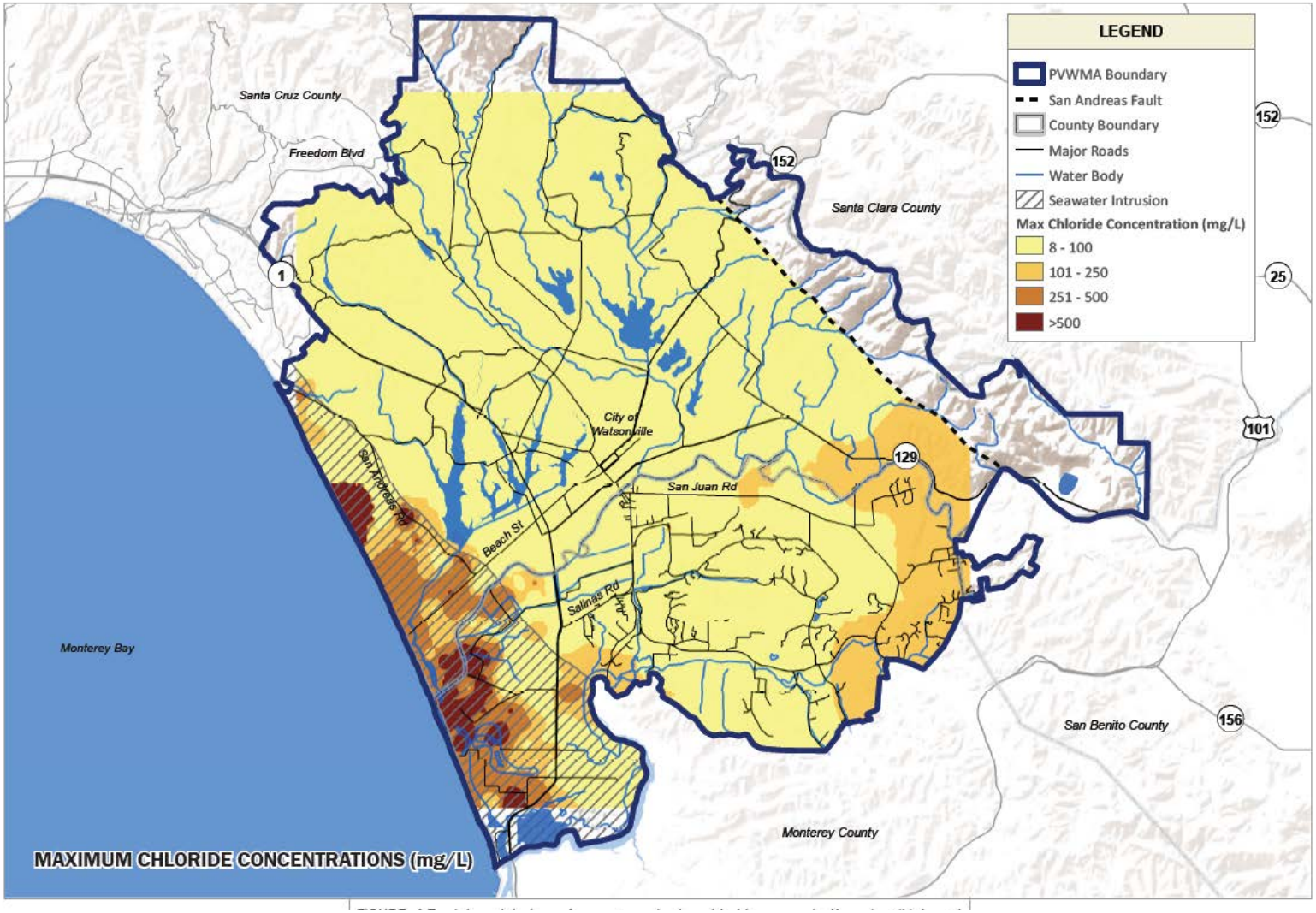


Seawater Intrusion

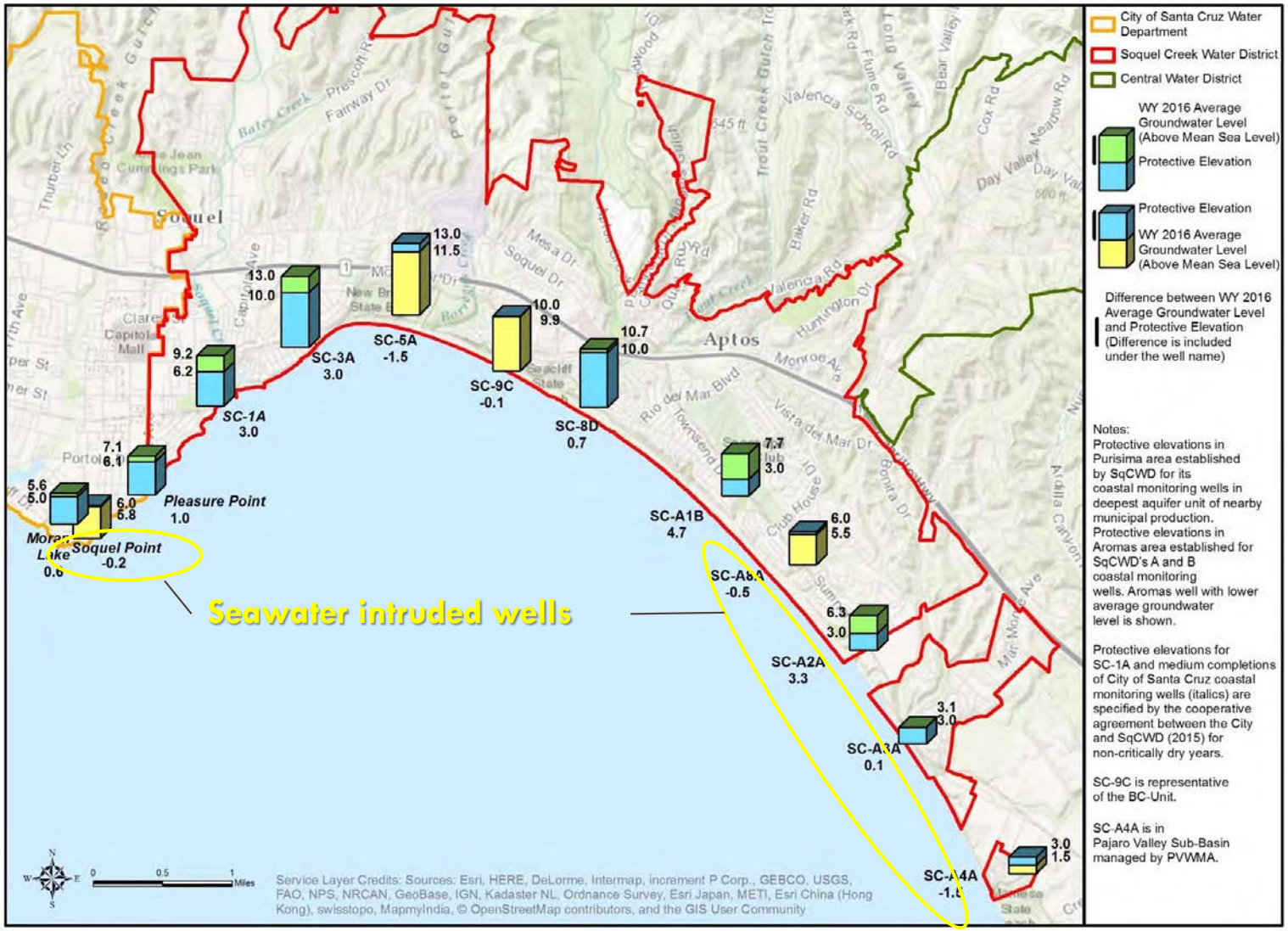
Seawater Intrusion in the Mid-County Basin



Pajaro Valley Seawater Intrusion

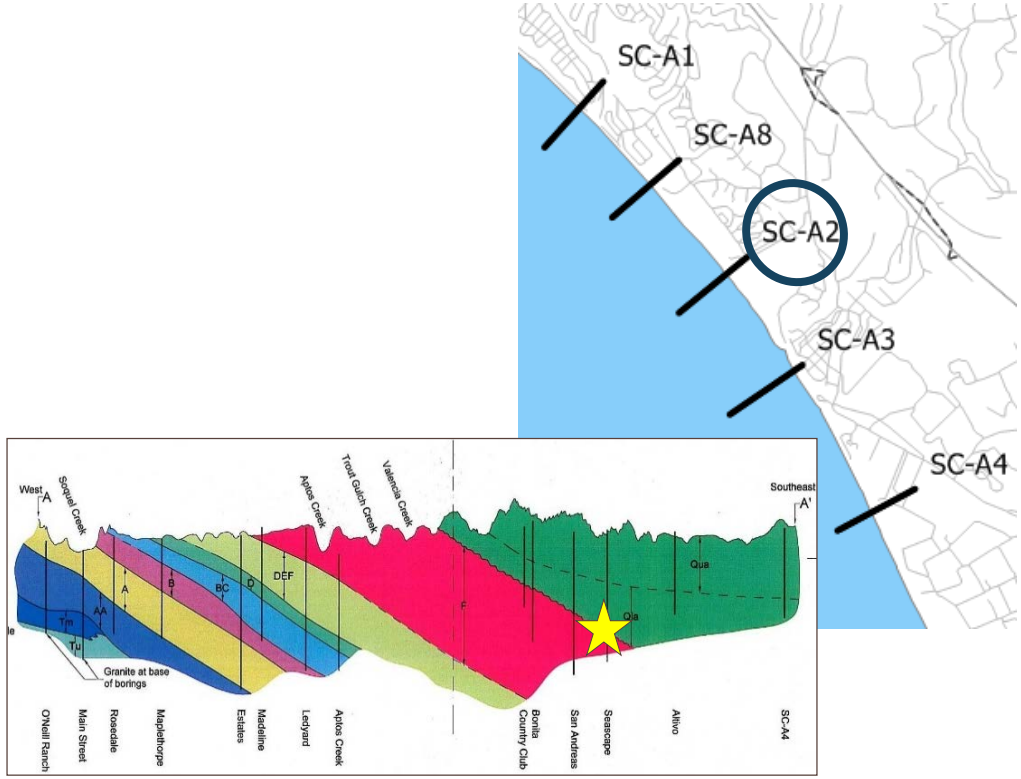


Protective Groundwater Elevations



Aromas Policy Considerations

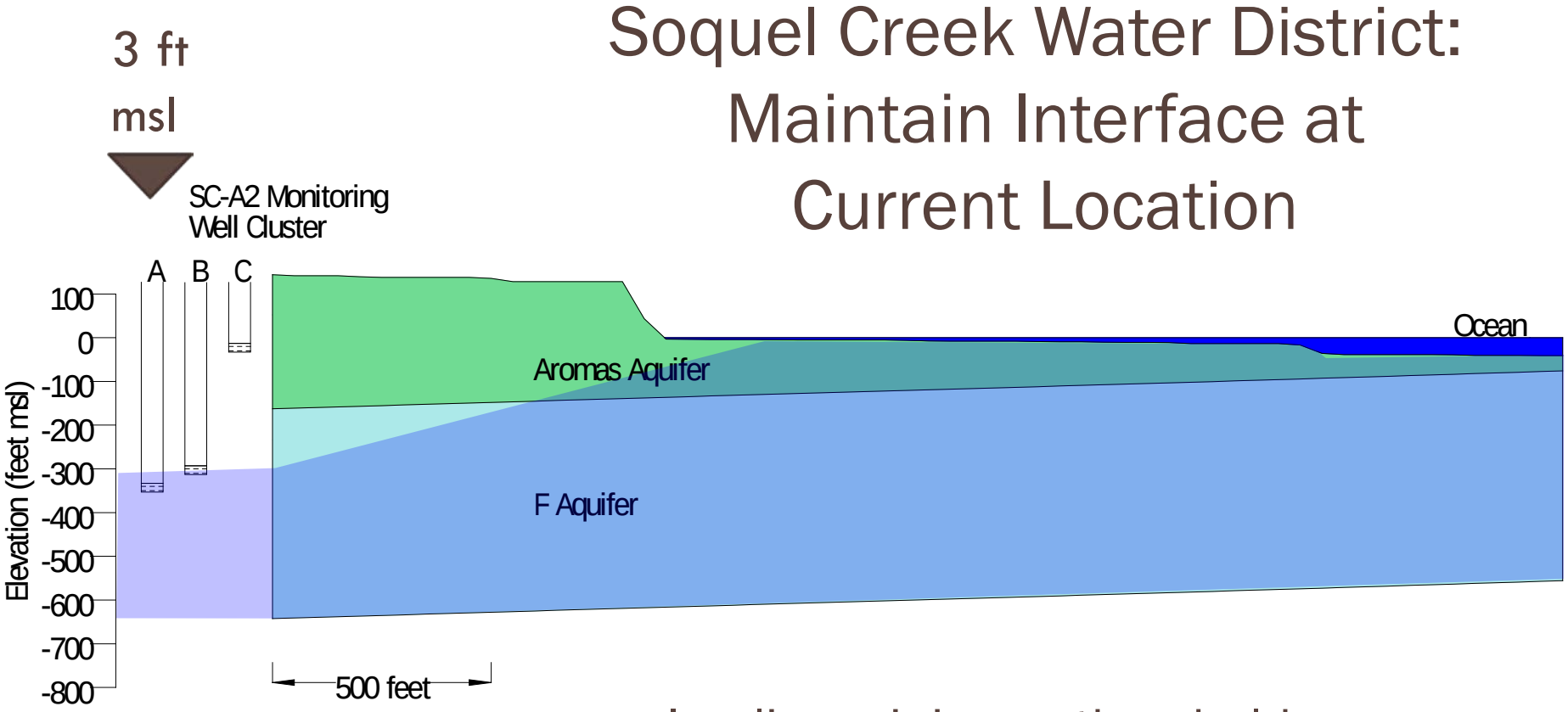
SC-A2A/B



Seawater interface has moved inland of monitoring well over time

Current Policy for Aromas Area

Soquel Creek Water District: Maintain Interface at Current Location

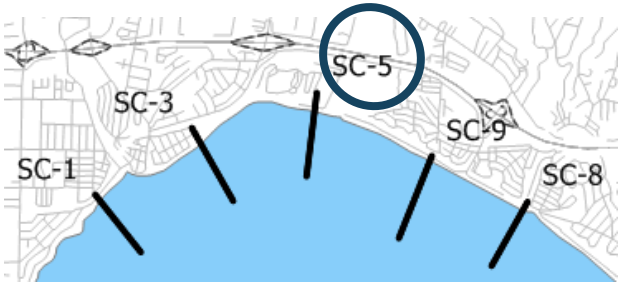


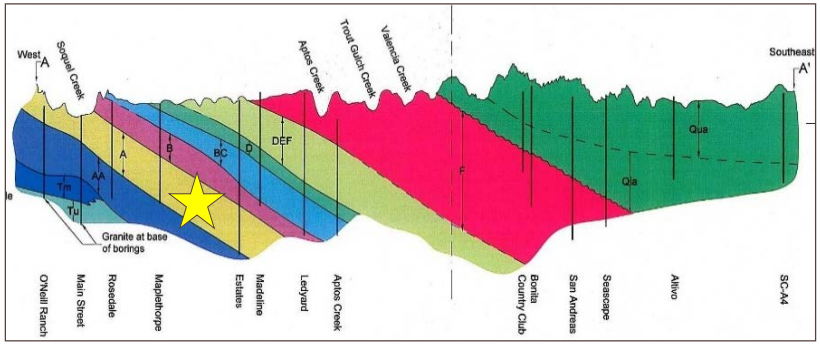
SC-A2

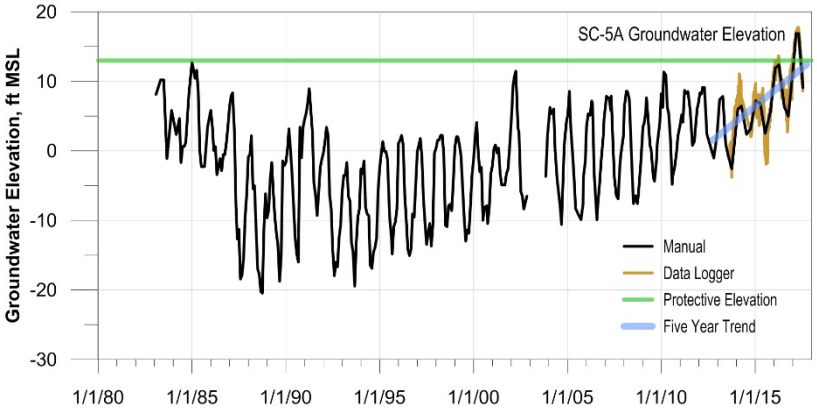
Implies minimum threshold chloride isocontour at well

Purisima Policy Considerations

SC-5A



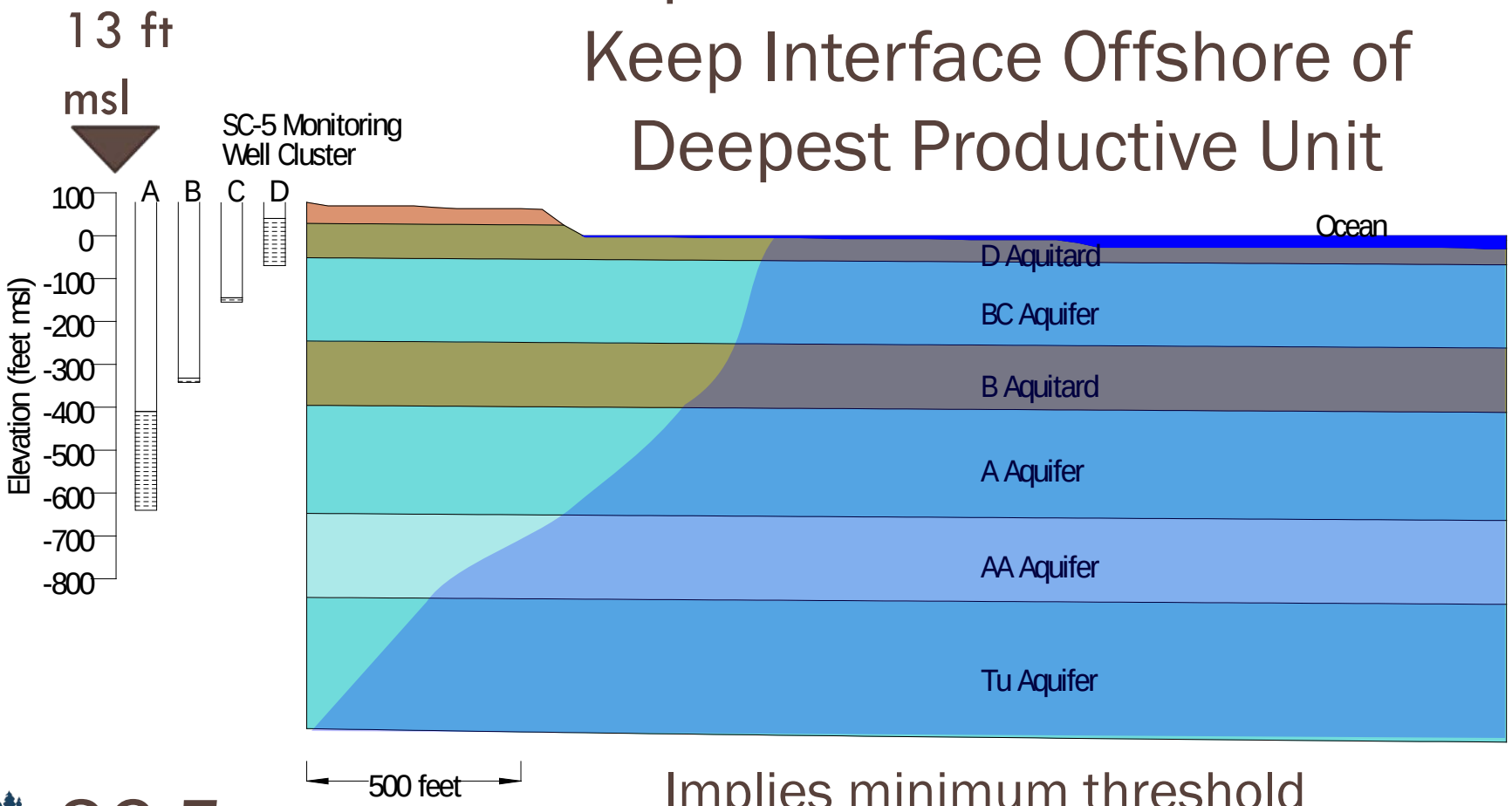




No seawater intrusion detected despite low groundwater levels historically

Current Policy for Purisima Area

Soquel Creek Water District: Keep Interface Offshore of Deepest Productive Unit

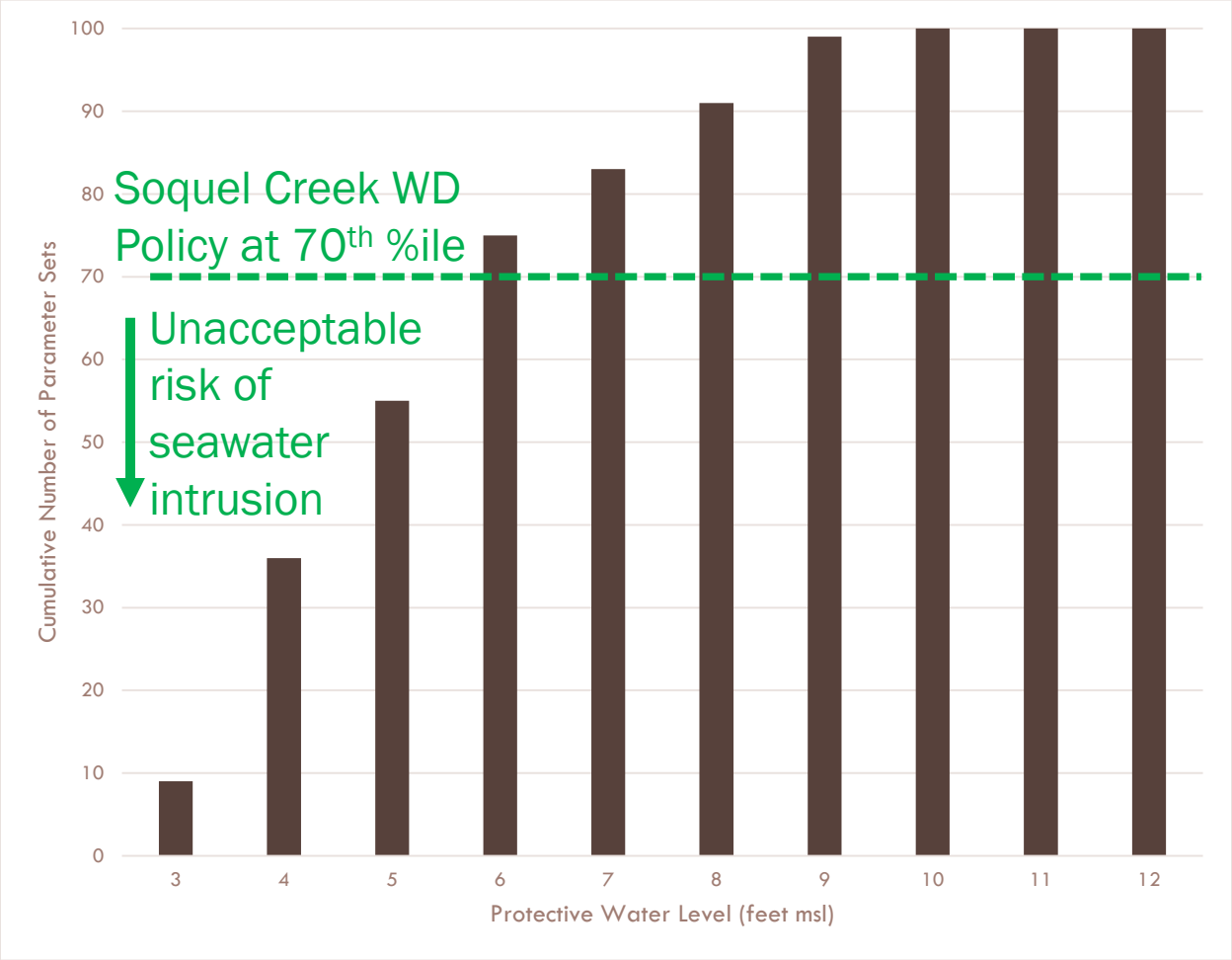


SC-5

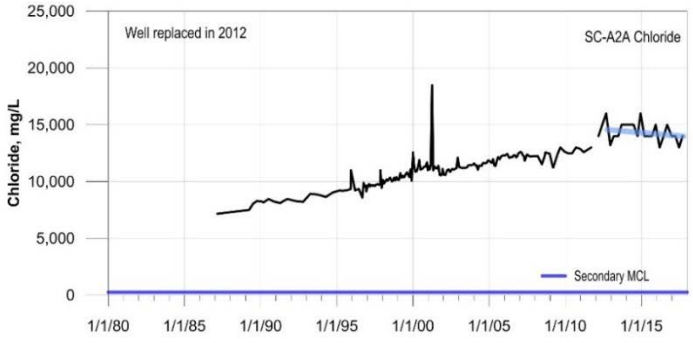
Implies minimum threshold chloride isocontour at coast

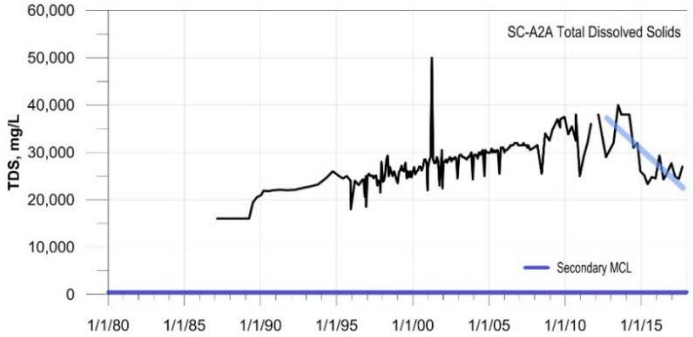
Policy Based on Risk Analysis

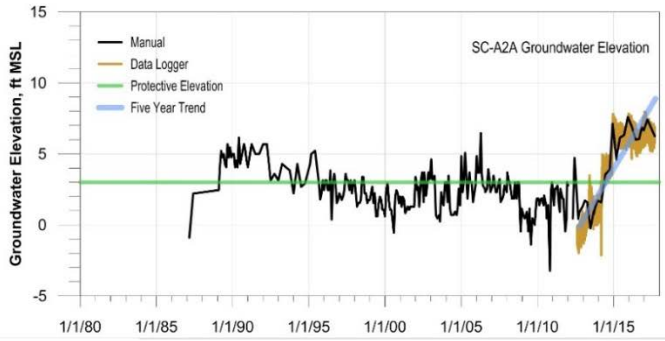
Aquifer and aquitard unit parameters varied within published ranges



Use Long-Term Average GW Elevations



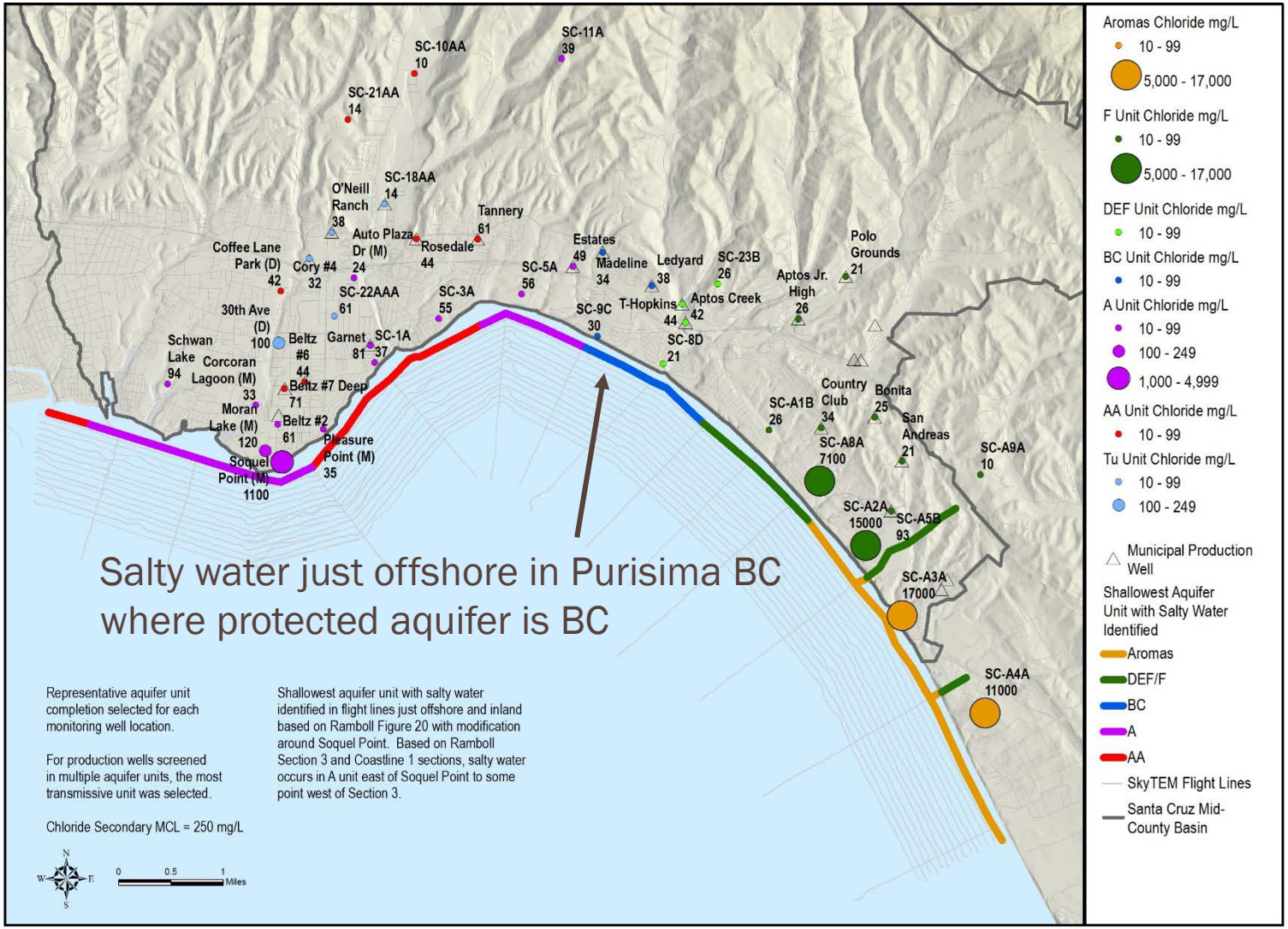




- Need long-term groundwater elevations to be above protective elevations for there to be improvement in chloride concentrations

SkyTEM Offshore Data

No Protective Elevations for Purisima AA/Tu where salty water detected



Significant & Unreasonable - Proposal

Seawater intrusion conditions we want to avoid

- Aromas aquifer – seawater intrusion found at depths shallower than those currently observed in impacted Coastal monitoring wells is significant and unreasonable (i.e., existing seawater intrusion is acceptable baseline condition)
- Purisima aquifer - in currently unintruded areas, seawater intrusion moving inland from the coast is significant and unreasonable. Seawater intrusion found at depths shallower than those observed in currently impacted Purisima A unit area is also significant and unreasonable (i.e., existing seawater intrusion is acceptable baseline condition)

RATIONALE: HOLDING SEAWATER INTRUSION TO ITS CURRENT EXTENT IS A REASONABLE BASIN MANAGEMENT APPROACH

Significant & Unreasonable - Options

Seawater intrusion conditions we want to avoid

Less protective:

- Seawater intrusion affecting production wells. Intrusion allowed to progress farther inland than it is now, but not farther than the closest private, Ag or municipal production well. (i.e., more intrusion than current is ok).
- Seawater intrusion affecting monitoring wells. Intrusion allowed to progress farther inland than it is now, but not farther than Coastal monitoring wells, presumed to be between coast and municipal production wells (i.e., more intrusion than current is ok).

More protective:

- Seawater intrusion farther inland than the coastline for each aquifer (i.e., any intrusion is not ok)

Note: Consider allowing intrusion into some aquifers but not others

Discussion

and

Selection of Significant & Unreasonable Seawater Intrusion Conditions

Undesirable Results - Topics

- Undesirable Results for Chloride Concentrations
  1. Intruded Coastal Monitoring Wells
  2. Unintruded Coastal Monitoring Wells and Inland Monitoring Wells

- Undesirable Results for Protective Groundwater Elevations

Undesirable Results

What set of conditions are significant & unreasonable?

Key Variables: If any representative monitoring well has a chloride concentration above <threshold concentration> mg/L in <number of samples> over a <period>

- Intruded Coastal Monitoring Wells
- Unintruded Coastal Monitoring Wells and Inland Monitoring Wells

What happens when you change <variables>?

- <Concentration>
  - Lower concentration ⇨ more difficult to meet threshold
  - Higher concentration ⇨ easier to meet threshold, but then greater risk of seawater intrusion (SWI)
- <Number of samples>
  - Fewer samples that exceed threshold ⇨ more difficult to avoid undesirable result
  - More samples that exceed threshold ⇨ easier to avoid undesirable result
- <Period>
  - Shorter period ⇨ fewer samples to use to determine if threshold is being met – decreased confidence this is due to SWI
  - Longer period ⇨ more samples to use to determine if threshold is being met – increased confidence this is due to SWI

Undesirable Result in Intruded Coastal Monitoring Wells

Technical Staff's Proposal:

- A chloride concentration above its 2013 – 2017 average chloride concentration. This concentration must be exceeded in more than 6 (75%) of the last 8 consecutive samples (quarterly sampled wells) to be an Undesirable Result

Rationale: 5-year average takes into account recent concentration fluctuations. Number of samples and time period allow for some outliers over a 2-year period.

More or less flexibility in avoiding Undesirable Results?

Undesirable Result in Intruded Coastal Monitoring Wells

More flexibility

- A chloride increase above its historical maximum chloride concentration. This concentration must be exceeded in 100% of the last 8 consecutive samples

Less flexibility

- A chloride increase above its 2013 – 2017 average chloride concentration. This concentration must be exceeded in more than 2 (50%) of the last 4 consecutive samples

Discussion
and
Selection of Undesirable Results
for
Intruded Coastal Monitoring Wells

Undesirable Result in Unintruded Coastal & Inland Monitoring Wells

Technical Staff's Proposal:

- A chloride concentration above 250 mg/L. This concentration must be exceeded in more than 2 (50%) of the last 4 consecutive samples

More or less flexibility in avoiding Undesirable Results?

Rationale: 250 mg/L is basin water quality objective and recommended secondary MCL. Coastal monitoring wells are sampled quarterly, and inland wells twice a year. Inland wells are evaluated over a 2-year period, and the early warning Coastal wells are evaluated over a one year period.

Undesirable Result in Unintruded Coastal & Inland Monitoring Wells

More flexibility

- A chloride concentration above 500 mg/L (upper range of secondary maximum contaminant level). This concentration must be exceeded in all of (100%) the last 4 consecutive samples

Less flexibility

- A chloride concentration above 125 mg/L. This concentration must be exceeded in more than 2 (50%) of the last 4 consecutive samples

Discussion
and
Selection of Undesirable Results
for
Unintruded Coastal Monitoring Wells & Inland Monitoring Wells

Undesirable Results for Protective Elevations

What set of conditions are significant & unreasonable

Key variables: <Period of time for averaging groundwater elevations> average groundwater elevation below protective groundwater elevations in Coastal Monitoring Wells for <number of wells>

Recommend using long-term average groundwater elevations in assessment of whether protective elevations are being met

What happens when you change <variables>?

- < Period of time for averaging groundwater elevations >
  - Long period ⇨ easier it will be to be above protective elevations
  - Shorter period ⇨ more difficult to be above protective elevations

- <Number of wells>
  - Fewer wells below protective elevations ⇨ lower risk of SWI
  - More wells below protective elevations ⇨ higher risk of SWI

Undesirable Results for Protective Groundwater Elevations

Technical Staff's Proposal:

- Five-year average groundwater elevations below protective groundwater elevations in Coastal Monitoring Wells for any well

More or less flexibility in avoiding Undesirable Results?

Rationale: 5-year average groundwater elevation provides some flexibility in avoiding Undesirable Results.
The current policy is to have groundwater elevations in all Coastal Monitoring wells above protective elevations.

Undesirable Results for Protective Groundwater Elevations

More flexibility

- Ten-year average groundwater elevations below protective groundwater elevations in Coastal Monitoring Wells in more than 1 of the 13 wells

Less flexibility

- Three-year average groundwater elevations below protective groundwater elevations in Coastal Monitoring Wells for any well

Discussion
and
Selection of Undesirable Results
for
Protective Groundwater Elevations

Public Comment

Break

15 Minutes

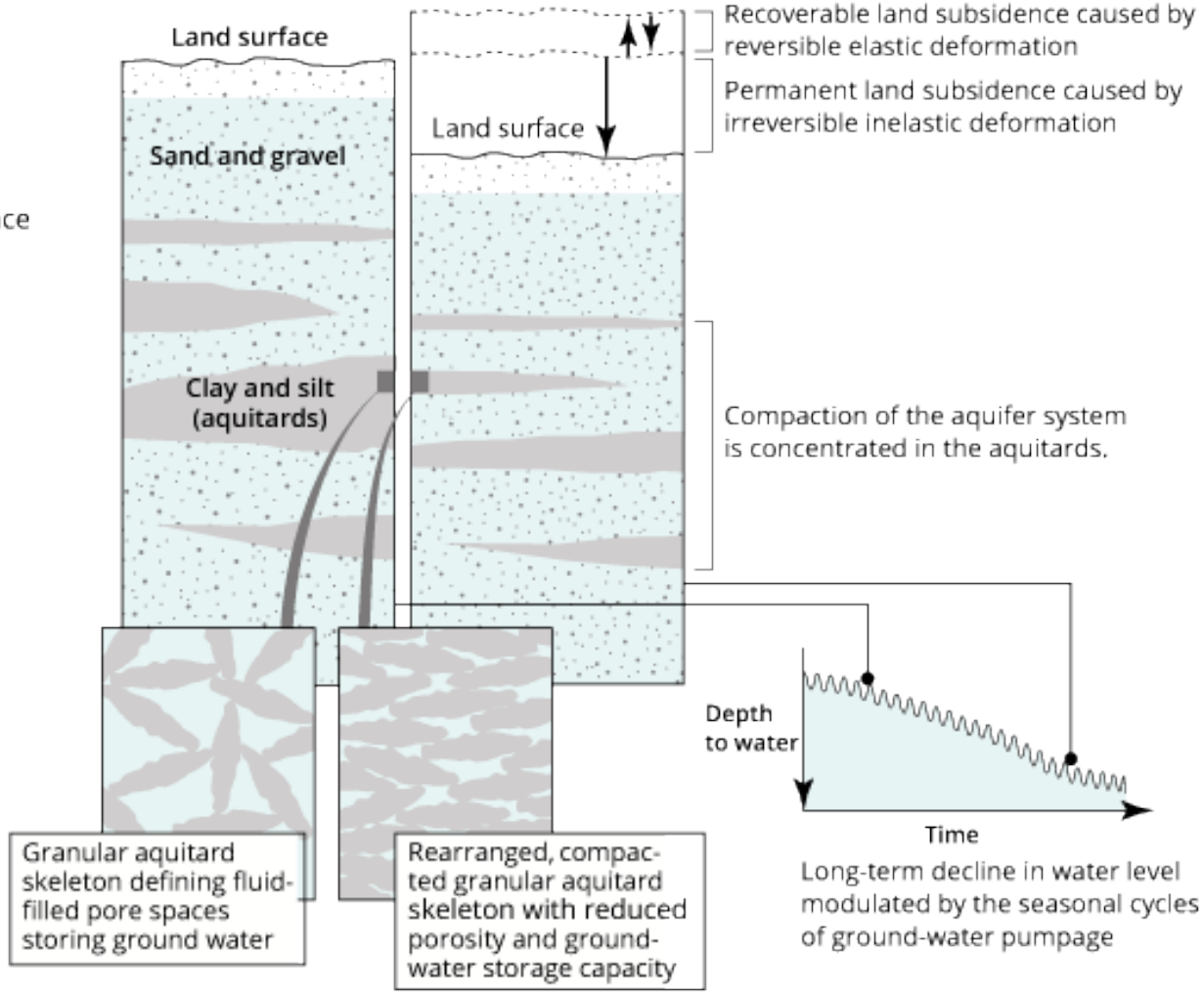
Land Subsidence

What is Land Subsidence

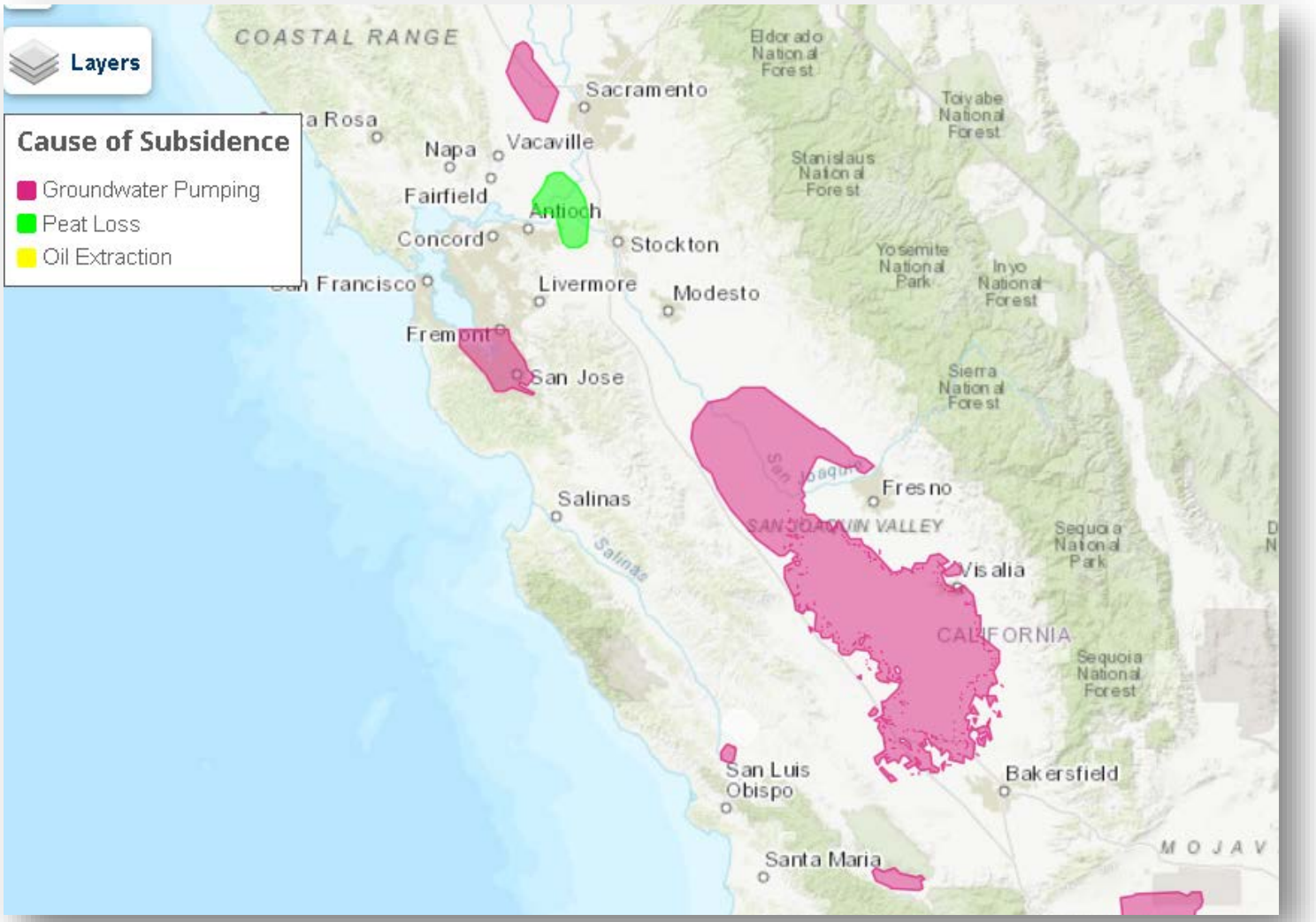
- Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials.
- The principal causes are:
  - Aquifer-system compaction,
  - Drainage and decomposition of organic soils
  - Underground mining, oil and gas extraction, hydrocompaction, natural compaction, sinkholes, and thawing permafrost

Aquifer-System Compaction

When long-term pumping lowers groundwater levels and raises stresses on the aquitards beyond the preconsolidation-stress thresholds, the aquitards compact adn the land surface subsides permanently.

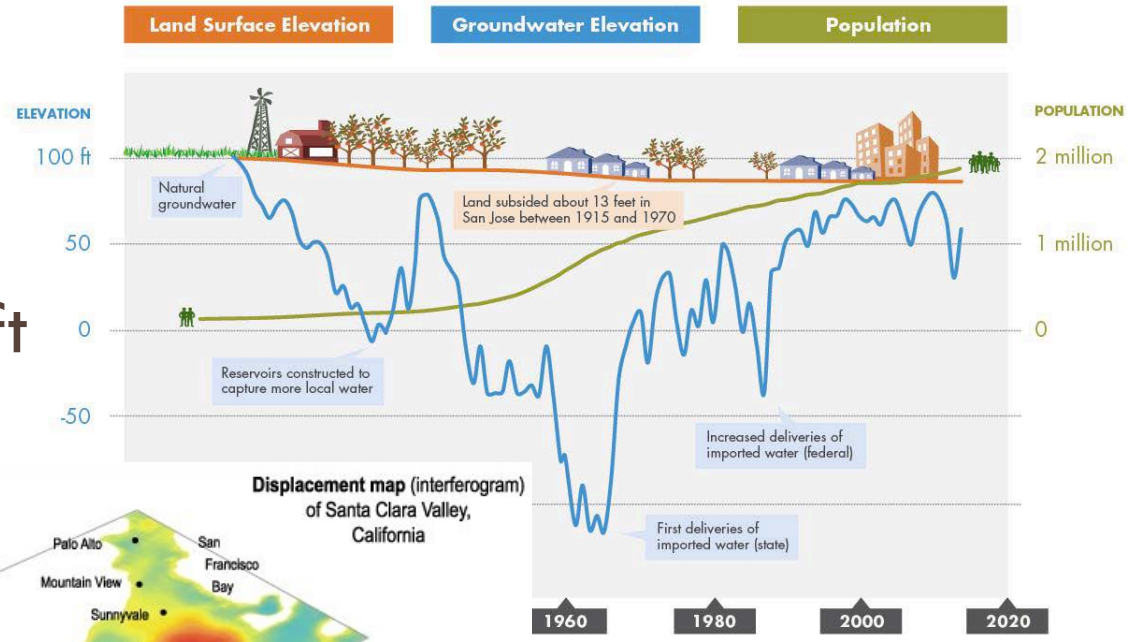


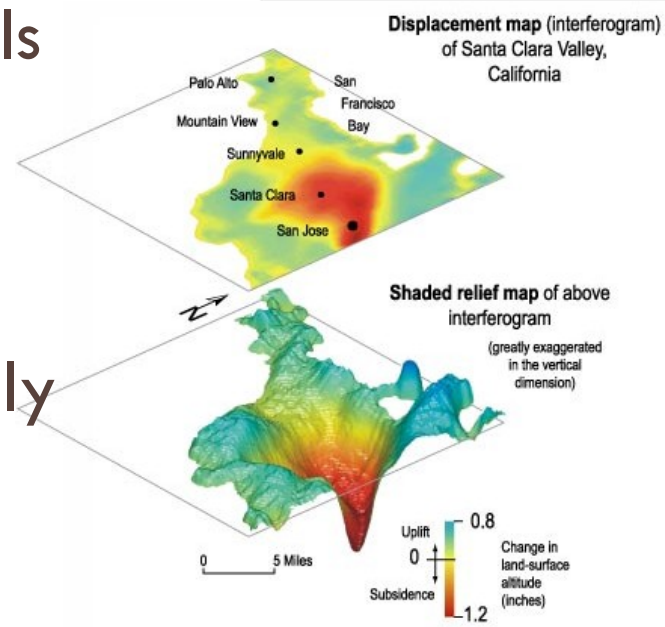
Nearby Documented Land Subsidence



Santa Clara Valley Land Subsidence

- Started in 1933
- Up to 8 feet of subsidence
- After 1992 some uplift occurred as groundwater levels recovered
- Currently, elastic subsidence that recovers seasonally





San Joaquin Valley Land Subsidence

Impacted area = 5,200 mi^2

Monitoring Land Subsidence

- Level surveying tied to known stable benchmarks;
- Borehole extensometers;
- Continuous GPS tracking; or
- Satellite derived Interferometric Synthetic Aperture Radar (InSAR) data

NONE OF THESE ARE CURRENTLY DONE IN THE BASIN

Effects of Land Subsidence

Manmade Infrastructure

- Changes to gradients of water conveyance structures causing reductions in designed flow capacity
- Damage to roads & railways
- Damage to bridges & buildings
- Damage to pipelines & wells

NONE OF THESE HAVE BEEN REPORTED IN THE BASIN

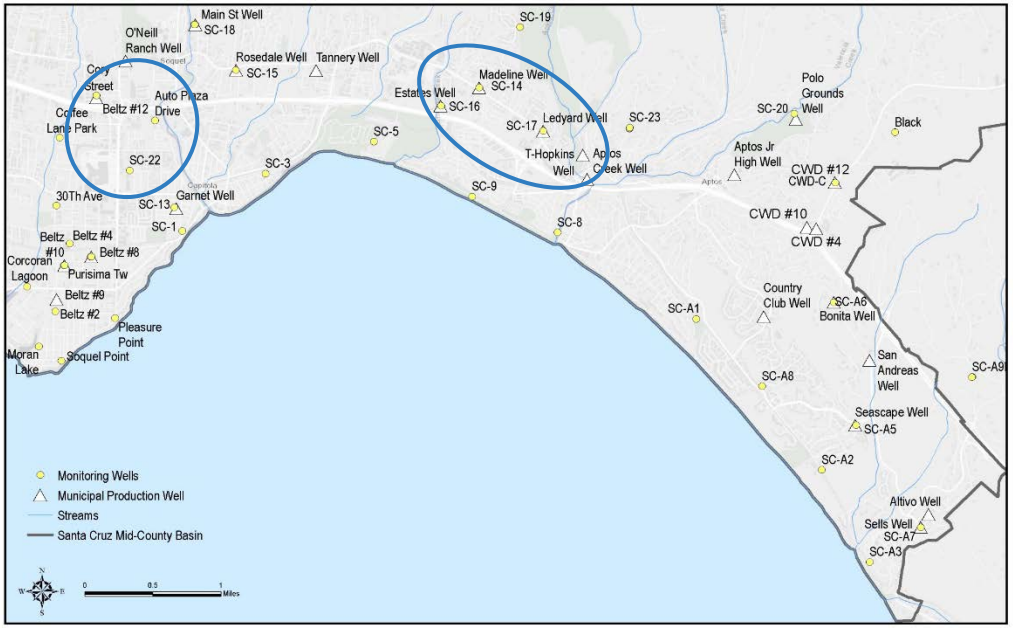
Natural Systems

- Permanently decreased capacity to store groundwater
- Topography changes, causing low areas, such as wetlands, to change size and shape, migrate to lower elevations, or disappear
- Rivers changing course or erosion/deposition patterns changing to reach a new equilibrium

Has any Subsidence Occurred during Historic Low Groundwater Levels?

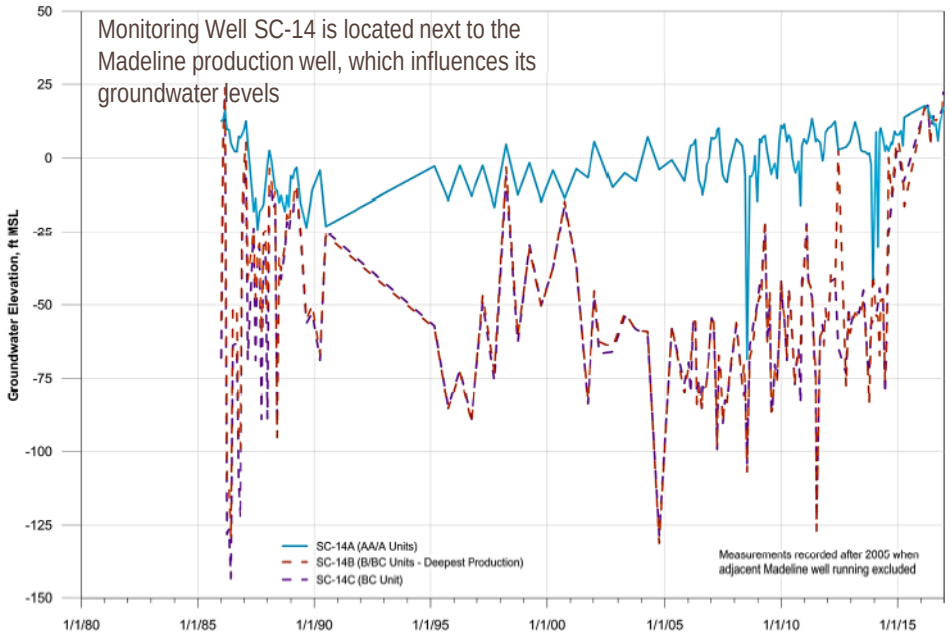
Unit	Maximum Decline, feet	Year of Historic Low
Aromas/Purisima F	5 (SC-A2A)	2000
Purisima DEF	100 (SC-17C)	1988
Purisima BC	140 (SC-14B)	1986
Purisima A	80 (SC-16A)	1988
Purisima AA/Tu	35 (SC-22AAA)	2017

Areas of historic low groundwater levels > 50 feet



Historic Low Groundwater Levels

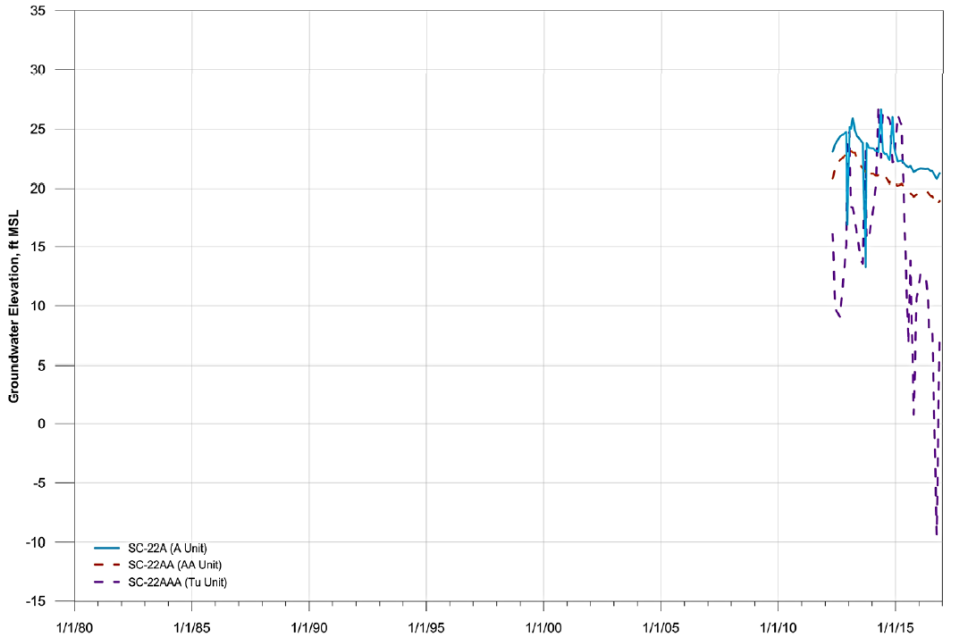
Purisima Aquifer



More historical declines in groundwater levels

NO SUBSIDENCE EFFECTS OBSERVED

Tu Aquifer



More recent declines in groundwater levels

TOO SOON TO OBSERVE SUBSIDENCE EFFECTS

Groundwater Levels as a Proxy for Land Subsidence Minimum Thresholds

DWR Guidance

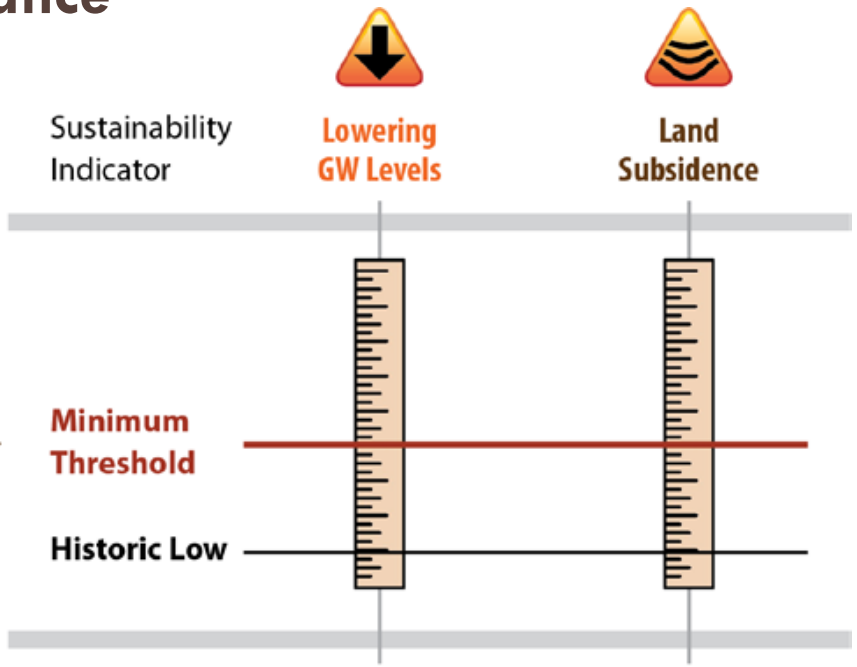
EXAMPLE 1

Groundwater elevation as a proxy for land subsidence

○ = Groundwater Level Representative Monitoring Site

○ = Land Subsidence Representative Monitoring Site

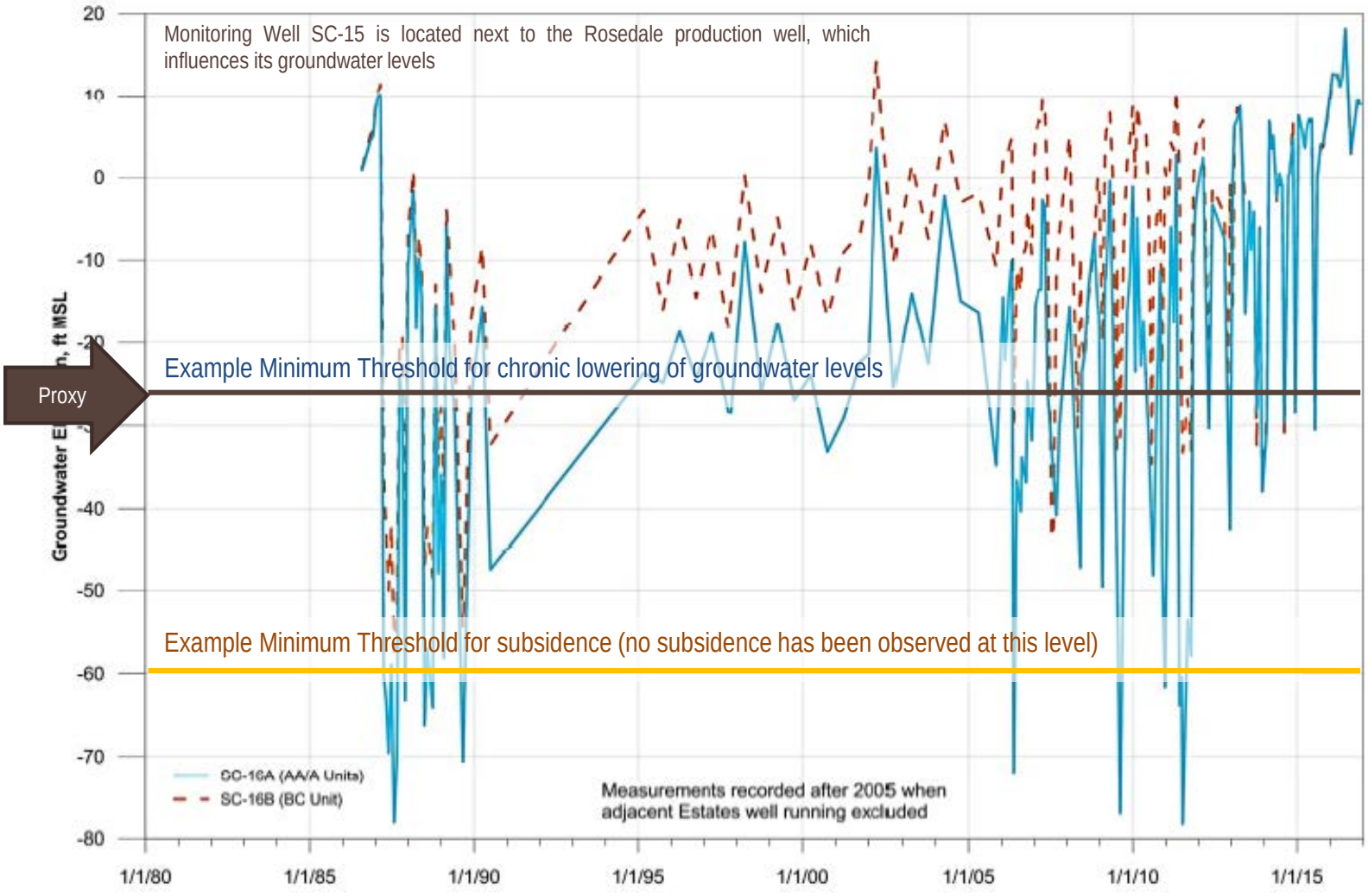
MA = Management Area



Metric

- **Groundwater Elevation** *(metric defined in GSP Regulations)*
- **Groundwater Elevation as a proxy** *(with demonstration of significant correlation between groundwater elevation and land subsidence)*

Groundwater Levels as a Proxy for Land Subsidence Minimum Thresholds



Significant & Unreasonable

Subsidence conditions we want to avoid having

Technical staff's proposal

- Any land subsidence occurring

Rationale: Based on historical lack of subsidence

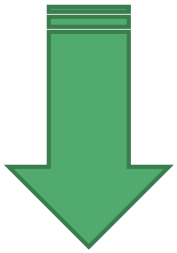
Less Protective

- Land subsidence occurring in developed areas only (ok if it occurs in undeveloped areas)

Discussion
and
Selection of Significant & Unreasonable Land Subsidence Conditions

Undesirable Results
Proposed Metrics for Different Aquifers

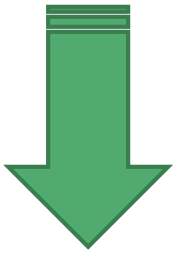
Aromas
Purisima A, BC, DEF



Groundwater Levels

Use Chronic Lowering of Groundwater Minimum Threshold

Purisima AA/Tu



Groundwater Surface Elevation

Use rate of change of land surface (inches/year)

Undesirable Results – Land Subsidence

What set of conditions are significant & unreasonable?

Aromas, and Purisima A, BC, DEF Units

Using historic low groundwater levels

Key Variables: <Number of wells > representative monitoring wells in the Aromas and Purisima A, BC, and DEF units with groundwater levels below their historic lows in <extent>

What happens when you change <variables>?

- <Number of wells>
  - More wells ⇨ easier to avoid Undesirable Results but higher risk of subsidence
  - Less wells ⇨ less flexibility in avoiding Undesirable Results but lower risk of subsidence

- <Extent>
  - This should represent the area of subsidence concern

Undesirable Results in Aromas, Purisima A, BC, and DEF Units

Technical Staff's Proposal:

- Any representative monitoring well in the Aromas and Purisima A, BC, and DEF units with groundwater levels below their historic lows in any part of the basin

Rationale: no subsidence occurred at historical lows. Staying above those lows will ensure land subsidence does not happen in the future

THESE LEVELS WILL ALL BE BELOW MINIMUM THRESHOLDS FOR CHRONIC LOWERING OF GROUNDWATER LEVELS

Use Minimum Thresholds for chronic lowering of groundwater levels as a Proxy for Land Subsidence

Discussion of

Use of Groundwater Level Proxy for Subsidence

Selection of Undesirable Results for Land Subsidence in Aromas, Purisima A, BC and DEF units

Undesirable Results – Land Subsidence

What set of conditions are significant & unreasonable?

Purisima AA/Tu Units

Using Land Surface Elevation as the metric

Key Variables: <Rate of subsidence, inches per year> occurring in <extent>

What happens when you change <variables>?

- <Rate of subsidence>
  - Higher rate ⇨ easier to avoid Undesirable Results but higher risk of subsidence
  - Lower rate ⇨ less flexibility in avoiding Undesirable Results but lower risk of subsidence

- <Extent>
  - This should represent the area of subsidence concern

Undesirable Results in Purisima AA/Tu

Using Land Surface Elevation as the metric

Technical Staff's Proposal:

- Any land subsidence occurring in the area where the Purisima AA/Tu unit is being pumped or injected into

More flexibility:

- Land subsidence exceeding threshold rates that are higher in undeveloped areas than in developed areas

Discussion
and
Selection of Undesirable Results
for Land Subsidence in
Purisima AA/Tu unit
Subsidence Rate Metric

Public Comment

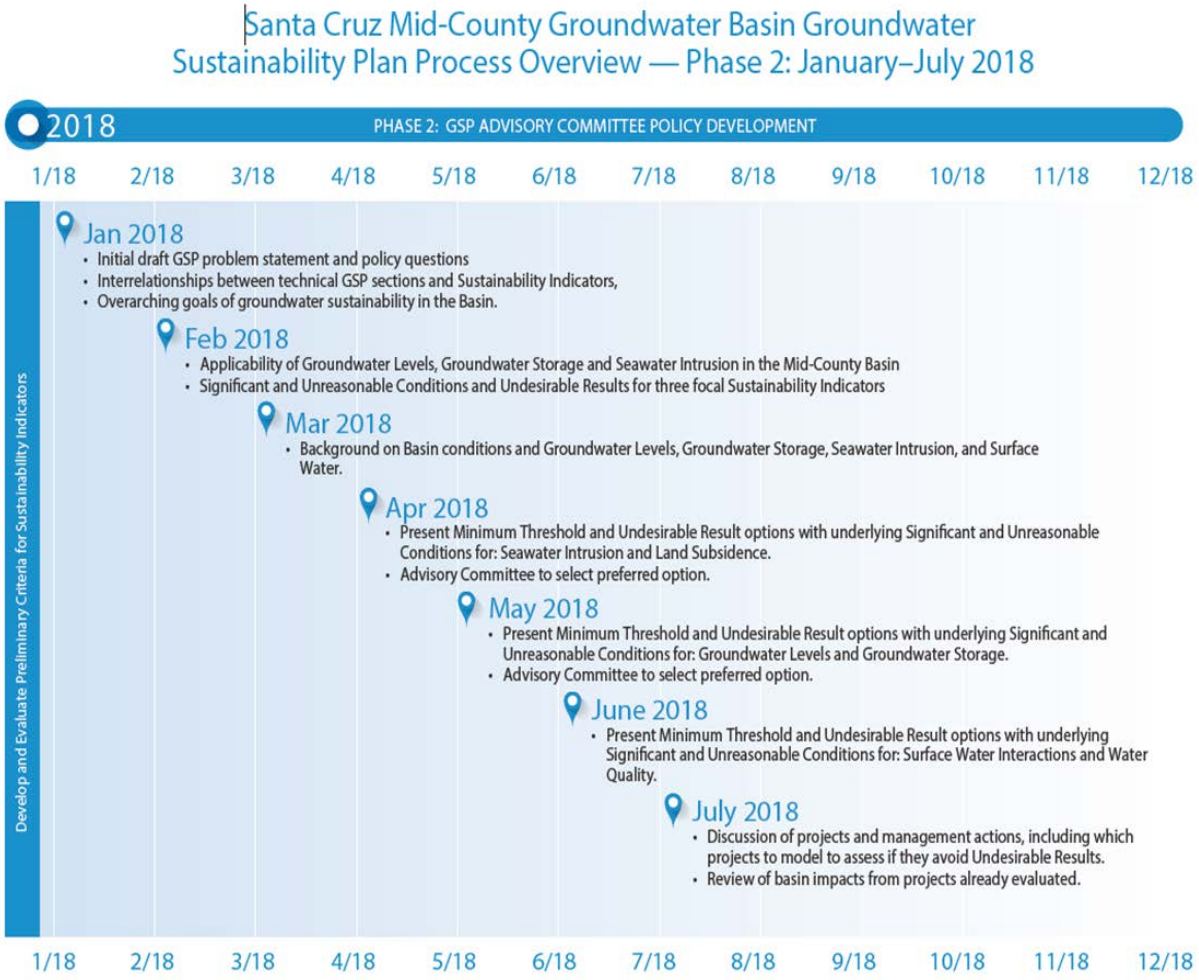
Confirm

March 28, 2018

GSP Advisory Committee Meeting Summary

Recap and Next Steps

GSP Project Timeline



Next Steps – Meetings 7, 8 & 9

- **Meetings 7 & 8 (May & June)**
  - Present Minimum Threshold and Undesirable Result Options with Underlying Significant and Unreasonable Conditions for four remaining Sustainability Indicators.
  - Advisory Committee to select preferred options.
- **Meeting 9 (July)**
  - Begin discussing projects and management actions; which projects to model if they avoid Undesirable Results.
  - Review Basin impacts from projects already evaluated.

THANK YOU!

FOR ANY QUESTIONS, PLEASE CONTACT:

DARCY PRUITT, Senior Planner
831.662.2052
dpruitt@cfscc.org

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

www.midcountygroundwater.org