Agenda

Santa Cruz Mid-County Groundwater Sustainability Plan (GSP)

Advisory Committee Meeting #7

Wednesday, May 23, 2018, 5:30 – 9:00 p.m.

Santa Cruz County Sheriff's Office, Conference Room, 5200 Soquel Avenue, Santa Cruz

Meeting Objectives

1. Discuss and share Advisory Committee input on Minimum Threshold and Undesirable Result Options with Underlying Significant and Unreasonable Conditions for the following Sustainability Indicators:
    a. Groundwater levels
    b. Subsidence
2. Report back on Technical Staff incorporation of Advisory Committee input from the April 25 meeting.

Agenda

Item No.	Time	Topic	Presenter & Materials
	5:00 p.m.	*Arrivals/Committee members collect food for dinner*	
1	5:30 p.m.	Welcome, Introductions, Meeting Objectives, and Agenda Review • Review project timeline • Share project updates	• John Ricker, County of Santa Cruz • Eric Poncelet, Facilitator (presentation) *Materials:* *1.1 Agenda* *1.2. Updated GSP Process Timeline Graphic* *Refer to PowerPoint Presentation*
2	5:50 p.m.	Oral communications • *Members of the public to comment on non-agenda items*	• All
3	6:00 p.m.	Groundwater Levels – Undesirable Results with Underlying Significant and Unreasonable Conditions • Background information • Discuss staff proposal and Committee to provide input	• Georgina King, HydroMetrics • All *Materials:* *3.1 Proposal: Groundwater Levels Minimum Thresholds* *3.2 PowerPoint Presentation: Groundwater Levels Minimum Thresholds*

Item No.	Time	Topic	Presenter & Materials
4	7:10 p.m.	Public comment • *Focus on meeting agenda items and other Advisory Committee work*	Public
5	*7:20 p.m.*	Break	
6	7:35 p.m.	Subsidence – Undesirable Results with Underlying Significant and Unreasonable Conditions • Background information • Discuss staff proposal and select preferred option	• Georgina King, HydroMetrics *Materials:* *6.1 Proposal: Subsidence Minimum Thresholds* *6.2 PowerPoint Presentation: Subsidence Minimum Thresholds*
7	8:20 p.m.	Public Comment • *Focused on topics discussed in this meeting and other Advisory Committee work.*	Public
8	8:30 p.m.	Confirm: • April 25, 2018 Advisory Committee Meeting Summary • Staff incorporation of Advisory Committee input from April 25 meeting – to inform development of Minimum Thresholds	• All • Eric Poncelet, Facilitator *Materials:* *8.1. Draft Meeting Summary from April 25* *8.2 Proposed Draft Seawater Intrusion Minimum Thresholds* *8.3 PowerPoint Presentation: Proposed Draft Seawater Intrusion Minimum Thresholds*
10	8:55 p.m.	Recap and Next Steps	• Eric Poncelet, Facilitator
	9:00 p.m.	*Adjourn*	

Santa Cruz Mid-County Groundwater Basin Groundwater Sustainability Plan Process Overview — Phase 2: January–July 2018

2018

PHASE 2: GSP ADVISORY COMMITTEE POLICY DEVELOPMENT

1/18 2/18 3/18 4/18 5/18 6/18 7/18 8/18 9/18 10/18 11/18 12/18

Develop and Evaluate Preliminary Criteria for Sustainability Indicators

Jan 2018
- Initial draft GSP problem statement and policy questions
- Interrelationships between technical GSP sections and Sustainability Indicators,
- Overarching goals of groundwater sustainability in the Basin.

Feb 2018
- Applicability of Groundwater Levels, Groundwater Storage and Seawater Intrusion in the Mid-County Basin
- Significant and Unreasonable Conditions and Undesirable Results for three focal Sustainability Indicators

Mar 2018
- Background on Basin conditions and Groundwater Levels, Groundwater Storage, Seawater Intrusion, and Surface Water.

Apr 2018
- Present Minimum Threshold and Undesirable Result options with underlying Significant and Unreasonable Conditions for Seawater Intrusion.
- Advisory Committee to provide input.

May 2018
- Present Minimum Threshold and Undesirable Result options with underlying Significant and Unreasonable Conditions for: Groundwater Levels and Land Subsidence.
- Advisory Committee to provide input.

June 2018
- Present Minimum Threshold and Undesirable Result options with underlying Significant and Unreasonable Conditions for: Surface Water Interactions and Water Quality.
- Advisory Committee to provide input.

July 2018
- Joint MGA/Advisory Committee discussion of projects and management actions, including which projects to model to assess if they avoid Undesirable Results.
- Review of basin impacts from projects already evaluated.
- Discuss data on future trends/demand/supply.

*Groundwater Storage topic will be on a TBD date.

1/18 2/18 3/18 4/18 5/18 6/18 7/18 8/18 9/18 10/18 11/18 12/18

Technical Staff Proposal
Chronic Lowering of Groundwater Levels
Minimum Thresholds

This document is organized into the following three sections:

1. Background – Historical changes in groundwater levels and Representative Monitoring Wells. This section describes the historical fluctuations in groundwater levels in the basin and identifies potential Representative Monitoring Wells.
2. Technical staff proposal for what is considered Significant and Unreasonable chronic lowering of groundwater levels (i.e., groundwater level conditions we want to avoid).
3. Technical staff proposal for what is considered Undesirable Results for chronic lowering of groundwater levels (how we evaluate groundwater levels to avoid significant and unreasonable chronic lowering of groundwater levels).

1. BACKGROUND

HISTORICAL CHANGES IN GROUNDWATER ELEVATIONS

In the area of municipal production wells, the general pattern of groundwater level changes has been:

- Declining groundwater levels as groundwater demand steeply increased through 1988. Note that 1984 – 1992 had below average rainfall.
- Groundwater demand peaked during the period from 1989 - 2004. Also during this period, there was a drought from 1984 through 1992. Together, high demand and drought caused groundwater levels to decline to historic lows measured in 1992/1993.
- In 2005, groundwater demand dropped and stayed fairly constant until 2009. Groundwater recovery started with two consecutive years of above average rainfall in 2005/2006. The economic recession starting around 2008 and further reduced water demand, possibly contributing to recovering groundwater levels during the period of below average rainfall from 2007-2009.
- A further drop in groundwater demand took place in 2010. Since 2010, groundwater demand has been less than previous years. Interestingly, the first two years of the recent drought (2012/2013) had increased demand, which is typical when there is below average rainfall. More recently there has been recovery of groundwater levels from 2014 through 2017. The 2014/2015 drop in demand and

associated increase in groundwater levels corresponds with increased statewide water restrictions due to the 2012-2015 drought.

Operational changes in the basin show that the most influential factor in changing coastal groundwater levels is changing the amount of groundwater pumping in high yield municipal supply wells. Recharge from rainfall and associated increase in groundwater levels generally has a less immediate effect on coastal groundwater levels because those aquifers are confined by less permeable layers, and areas where the aquifers are exposed at the surface and can be directly recharged are limited. Recharge is more noticeable in very wet years, or years of consecutive above average rainfall.

Measurement of groundwater levels in inland private wells through the Santa Cruz County's Groundwater Monitoring Program started in 2008. Generally, these data do not show more than 15 feet of decline over the recent drought, with most wells having a decline of less than 5 feet (Figure 2). There is also no private well in the monitoring program that has a chronic decline in groundwater levels. This implies that the inland private wells are not over-pumping the aquifers used for their water supply (i.e., not pumping more than natural recharge). This may change over time as more private wells are drilled and pumped.

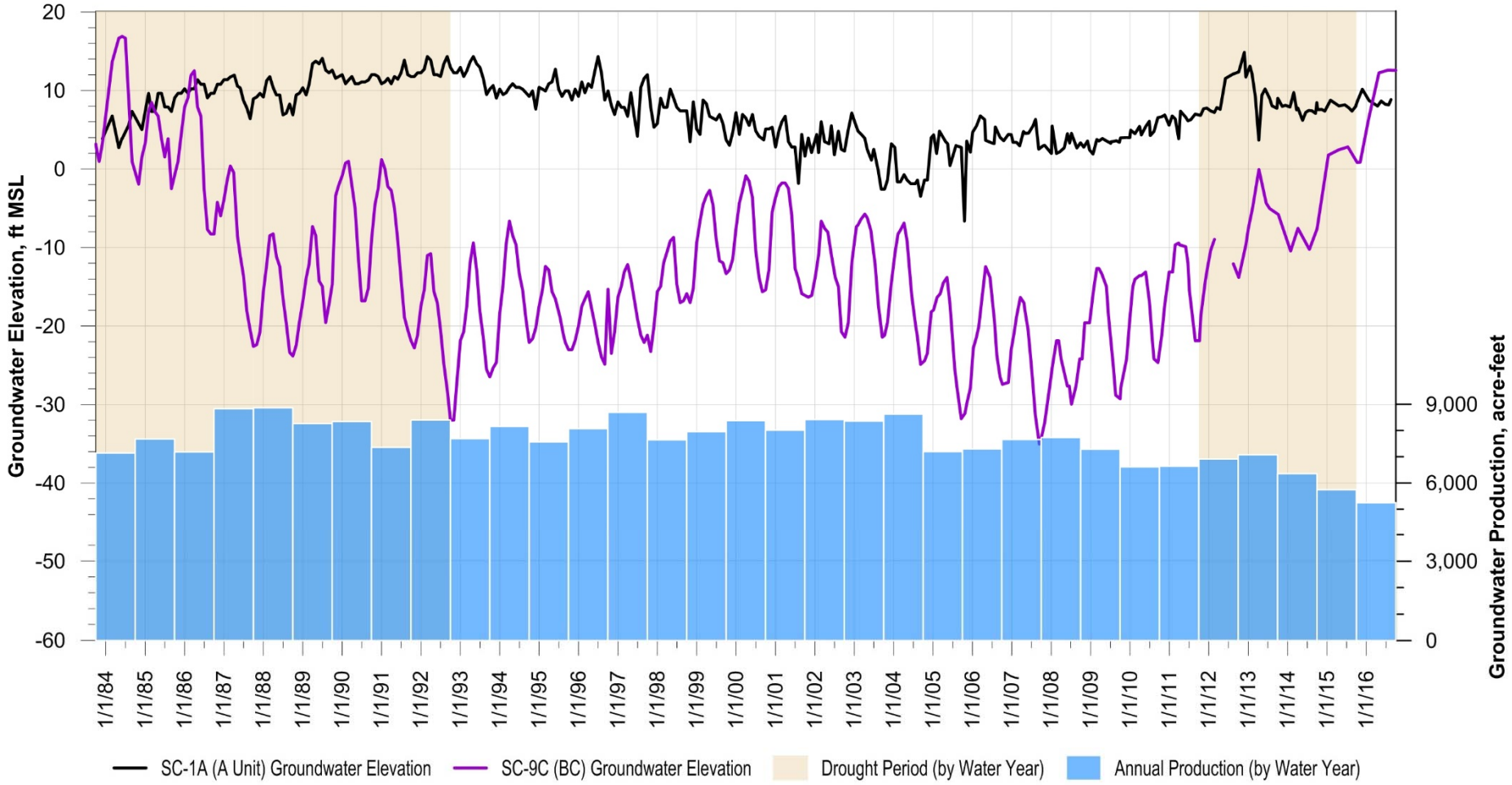


Figure 1: Example of Coastal Hydrographs with Basin Groundwater Pumping

REPRESENTATIVE MONITORING WELLS

Representative Monitoring Wells are defined in the Groundwater Sustainability Plan (GSP) guidance by DWR as "…. representative of the conditions in the area and are used to monitor for undesirable results." The guide adds, "It is anticipated that a GSP monitoring plan will group wells based on geographic and hydrogeologic conditions with one or two wells within each grouping potentially representing the surrounding area."

Potential Representative Monitoring Wells will be selected from wells used in existing monitoring programs. The Santa Cruz Mid-County Basin has a number of monitoring programs implemented already. These are:

- Mid-County Groundwater Agency (MGA) member agency monitoring wells for basin management with groundwater level data that goes back to 1984 for some wells. Many wells have data loggers that continuously measure groundwater levels.
- Santa Cruz County's Groundwater Monitoring Program of private wells that started in 2008. These are measured in the spring and fall of each year.
- Since 2010, new City of Santa Cruz and Soquel Creek Water District production wells have monitoring and mitigation programs (MMP) to monitor effects to nearby private wells from new municipal production wells. This monitoring continues for 10 years after the new municipal production well is commissioned. All wells have data loggers that continuously measure groundwater levels.

Well locations for the different monitoring programs are shown on Figure 3.

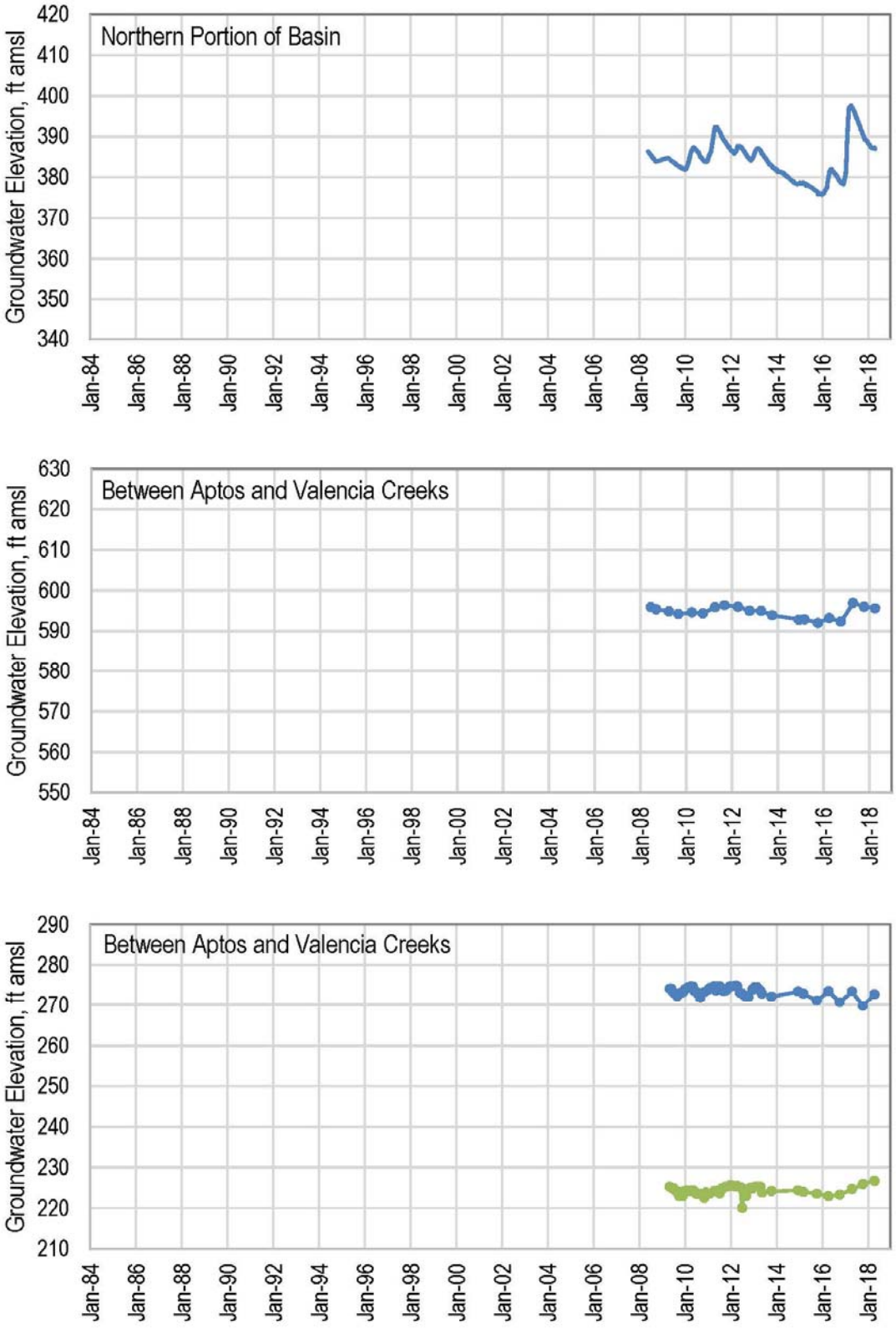


Figure 2: Examples of Private Well Hydrographs

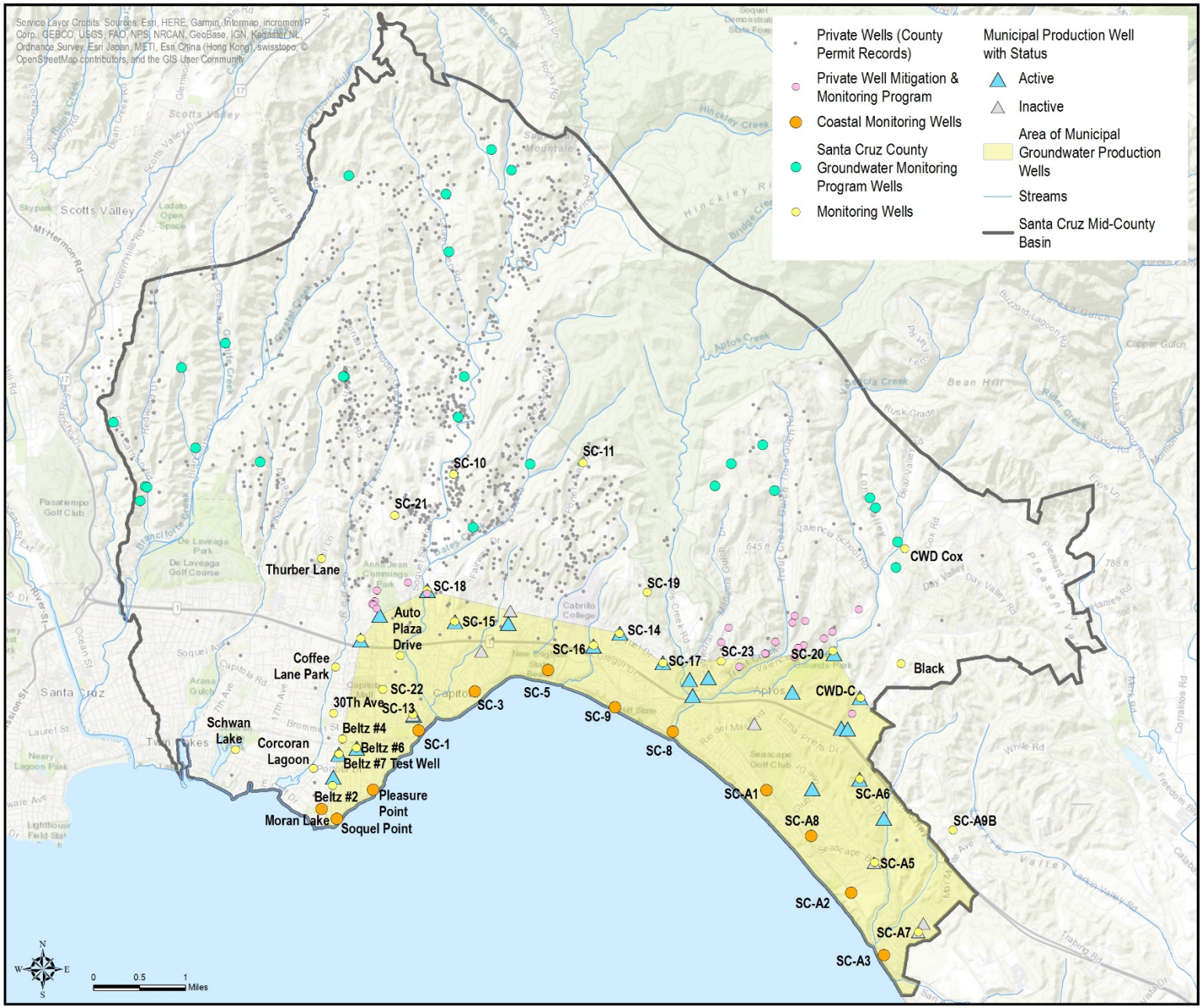


Figure 3: Well Locations in the Santa Cruz Mid-County Basin

It is not ideal to have private domestic wells as Representative Monitoring Wells for groundwater levels as they could be measured when the well is pumping, or the pump could be changed to higher capacity that causes increased drawdown in the well. This will affect the use of groundwater levels in the well and ability to meet Minimum Thresholds set in that well. Private wells that are chosen as Representative Monitoring Wells must be carefully selected. It is preferable to have dedicated monitoring wells, and this may be a recommendation during implementation of the Mid-County GSP. The City of Santa Cruz, Central Water District, and Soquel Creek Water District have a large number of dedicated monitoring wells that will be used where possible, but to cover the entire basin, we will need to supplement with some private wells. The selection of private wells as a Representative Monitoring Wells will require the well to meet certain criteria, such as the well is not being pumped, well construction details are available, and there are at least three years of historical groundwater level measurements.

Technical staff recommends that one Representative Monitoring Well based on density of County well permits be located in each of the following inland areas of private domestic groundwater use:

- Northern part of the basin: we propose to use the Ricker well or Purisima Water Co. well in the northern part of the basin.
- Between Aptos and Valencia Creeks: there are several wells we could use that are part of the County's monitoring program.

A Representative Monitoring Well should not be located in the western portion where the basin is very shallow (less than 100 feet thick) and most wells are screened in the underlying granite that is not part of the groundwater basin.

The Central portion of the basin can be adequately monitored by Soquel Creek Water District's multi-completion monitoring wells: SC-10 and SC-11.

Within the area of municipal pumping, there are a many dedicated monitoring wells to select as Representative Monitoring Wells. However, similar to use of private wells for Representative Monitoring Wells, we would prefer to have monitoring wells that are not located right next to municipal production wells, which will overwhelmingly influence the groundwater levels instead of being representative of the general basin conditions within the area. Monitoring wells farther away from production wells are given priority over those wells adjacent to production wells.

A preliminary list of potential wells, grouped by aquifer, to use as Representative Monitoring Wells for chronic lowering of groundwater level are:

Aromas – 2 wells (Black, SC-A7C)
Purisima F – 3 wells (SC-23C, Central Water District Cox well, Private well between Aptos and Valencia Creeks)
Purisima DEF – 2 wells (SC-11D, SC-23B)
Purisima BC – 4 wells (SC-11B, SC-19, SC-23A, Cabrillo?)
Purisima A/AA – 4 wells (SC-10A, SC-22, Cabrillo?, Coffee Lane Park)
Purisima AA/Tu – 3 wells (Ricker/Purisima Water Co., SC-10AA, SC-22, Thurber Lane)

The location of the wells are indicated on Figure 4 as yellow large circles.

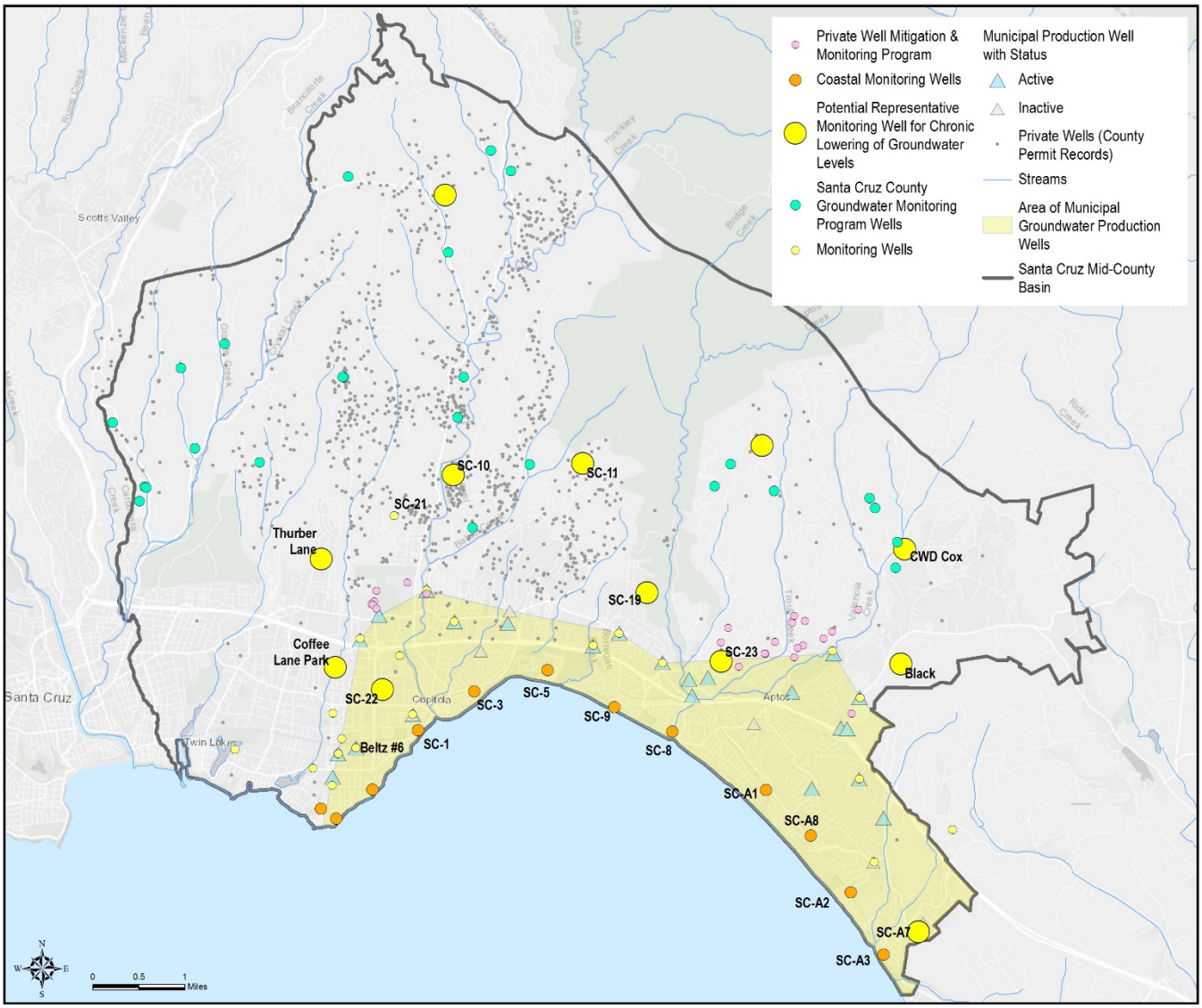


Figure 4: Location of Potential Representative Monitoring Wells for Chronic Lowering of Groundwater Levels

2. **TECHNICAL STAFF PROPOSAL FOR WHAT IS CONSIDERED SIGNIFICANT AND UNREASONABLE LOWERING OF GROUNDWATER LEVELS** (i.e., groundwater level condition we want to avoid)

Advisory Committee Objective: Select a statement that represents what beneficial users of the basin want to avoid happening from chronic lowering of groundwater levels.

Chronic lowering of groundwater levels has potential to impact uses and users by:

1. Inducing seawater intrusion.
2. Reducing stream baseflow that supports groundwater dependent ecosystems (GDEs) and aquatic species by lowering groundwater levels beneath the streambed, or by reducing the hydraulic gradient and the rate of groundwater discharge to the stream.
3. Reducing yield of production wells by causing groundwater levels to drop below well screens or the bottom of wells. Users of groundwater in the basin are agriculture, domestic, and municipal, with a few industrial users.

Lowered groundwater levels below sea level that induce seawater intrusion or deplete surface water by disconnecting streams from groundwater are not considered in this document; those are Significant and Undesirable conditions that will be dealt with separately for those state mandated Sustainability Indicators.

Focusing on the use of wells for groundwater extraction, a good place to start when considering what might be significant and unreasonable is to look at the past history of groundwater levels in the basin. If there has been a time when groundwater levels were so low that they impacted beneficial users of groundwater, this would be considered significant and unreasonable. However, there have been limited reports of private wells going dry during historical low groundwater level periods.

What represents a metric we can use to define a significant impact to a production well? Would the groundwater level need to fall below the bottom of the well, somewhere above the bottom of the well, or the top of the screen? As groundwater levels falls below the top of a well's uppermost screen, the yield of the well has the potential to decline very slightly, this reduction in well yield continues as the aquifer becomes dewatered. Most wells are screened at multiple depths, and a well will continue to produce water while other aquifers are still saturated. The well will eventually go dry if the groundwater level falls below the bottom of the well. Our experience with private wells indicates that many older wells are constructed with the top of the screen right near the groundwater level. This means that when the well is pumping the groundwater level falls below the top of

the screen, and thereby the well's own pumping causes its own potentially restrictive effect.

In general, the upper screens of municipal wells are deeper than the majority of private well depths. Because of this, we should primarily use private wells as the groundwater users we need to protect against chronic lowering of groundwater levels, but also check that municipal wells are not dewatered based on the thresholds set.

Generic Framing of a Significant and Unreasonable Condition regarding lowering of groundwater levels:
Lowering of groundwater levels that cause <percentage> or more of <well use type> groundwater pumping well's to <well condition>.

The words in < > represent variables that change what is considered significant and unreasonable chronic lowering of groundwater levels. If needed, this statement can be revised by adding new variables. Some explanation on the variables is provided below:

<percentage>: this variable is dependent on <well condition>. Groundwater levels falling below top of screens would justify a higher number of wells that can have levels fall below top of screen (e.g., 25% of wells), and if the well condition is that the wells go dry, then fewer wells should be allowed to go dry (e.g., 1% of wells).

<well use type>: Should there be a distinction between user types? (agricultural, domestic, industrial, municipal).

<well condition>: go dry (below bottom of well), a certain distance from the bottom of wells, or fall below top screen?

Technical staff proposal for significant and unreasonable conditions:
Lowering of groundwater levels that cause <u>5%</u> or more of all groundwater pumping well's to fall below <u>20 feet from the bottom of wells</u>.

Technical staff recommendation for an undesirable result is groundwater levels that are 20 feet from the bottom of the well. This condition is clearly significant and unreasonable as groundwater levels falling below this depth will certainly reduce the wells' ability to pump groundwater. Groundwater levels falling below the top of well screens is not significant and unreasonable as it occurs commonly. A low percentage such as 5% covers the population of wells that are very shallow compared to the rest (< 100 feet).

3. **TECHNICAL STAFF PROPOSAL - UNDESIRABLE RESULTS** (i.e., what set of conditions cause significant and unreasonable impacts to occur)

Overarching Advisory Committee Objective: Select a set of conditions for groundwater elevation Minimum Thresholds that if exceeded would cause significant and unreasonable groundwater elevation to occur.

Generic Framing: The <statistic> Representative Monitoring Well groundwater elevation over <time period> falls below the <Minimum Threshold>

<Statistic> options:

- Minimum elevation measured. This absolute number makes it more difficult to stay above the Minimum Threshold and the more difficult it will be to avoid Undesirable Results (less flexibility)
- 75th Percentile elevation measured. This statistic requires three-quarters of the groundwater elevations to be above the Minimum Threshold, making it easier to be above the Minimum Threshold than using the minimum elevation but more stringent than using average groundwater elevations (see following bullet).
- Average elevation measured. This statistic allows for some groundwater levels to go below the Minimum Threshold, making it easier to exceed the threshold (more flexibility)

<time period> options:

- Monthly – there is more data to average and more possibilities that the level falls below the Minimum Threshold. This time period is only possible if the well is equipped with a data logger.
- Quarterly – will need at a minimum monthly groundwater level measurements, which for Representative Monitoring Wells without data loggers is possible.
- One year – will need at a minimum quarterly groundwater level measurements.

<Minimum Threshold>:

- The Minimum Threshold is the level that reflects the lowest acceptable groundwater elevation below which further decline will cause impacts to a significant number of <well use type> wells.
- The metric for measuring the Sustainability Indicator: chronic lowering of groundwater levels, is groundwater elevation in feet above mean sea level (+ is above sea level, and – is below sea level). This numeric value will be set for every well by technical staff, who will look at all wells in the vicinity of Representative Monitoring Wells to set a groundwater elevation that avoids undesirable results.

- The higher the groundwater elevation set for Minimum Thresholds, the more difficult it will be to stay above it and ultimately may cause undesirable results (less flexibility).
- The lower the groundwater elevation set for Minimum Thresholds, the easier it will be to stay above it, but there is a chance other wells may be impacted (more flexibility).
- The aim should be to set the Minimum Threshold at a level that reflects what is considered a chronically lowered groundwater elevation and below which will cause impacts to a significant number of wells.

Note: Minimum Thresholds for chronic lowering of groundwater levels do not need to be set for all Representative Monitoring Wells in the basin, only those that are identified specifically for chronic lowering of groundwater levels.

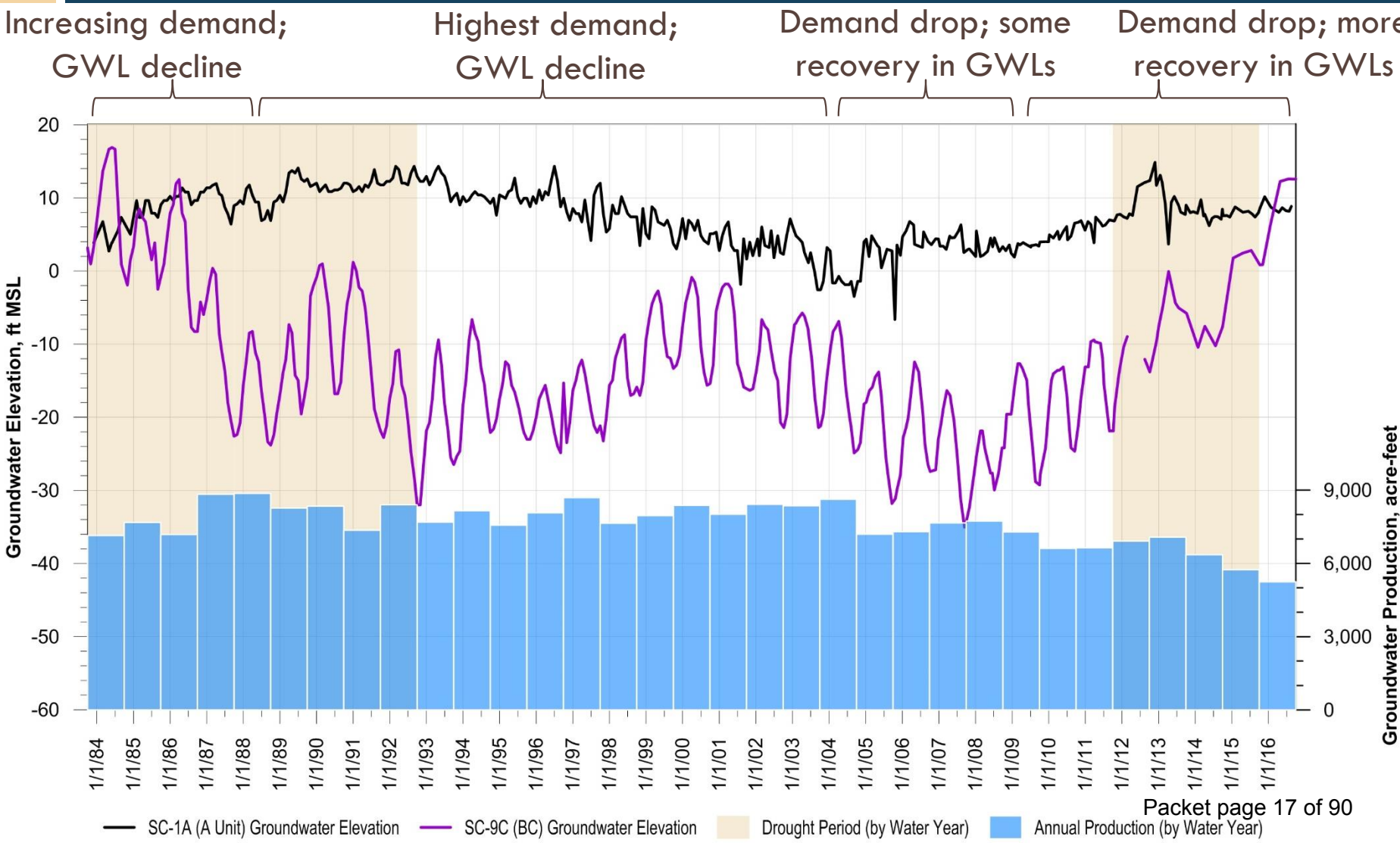
- Coastal monitoring wells with assigned protective groundwater levels Minimum Thresholds do not need chronic lowering of groundwater levels Minimum Thresholds. The assigned protective groundwater elevations will be higher than the groundwater elevation needed to protect against chronic lowering of groundwater levels.
- Similarly, Representative Monitoring Wells will be selected for depletion of interconnected surface water. These wells do not need Minimum Thresholds set for chronic lowering of groundwater levels because groundwater levels set to prevent stream flow depletion will be higher than those needed to prevent chronic lowering of groundwater levels.

Technical staff proposal of undesirable results:
The <u>average</u> Representative Monitoring Well groundwater elevation over <u>one month</u> falls below the <Minimum Threshold>
(provided all Representative Monitoring Wells have data loggers)

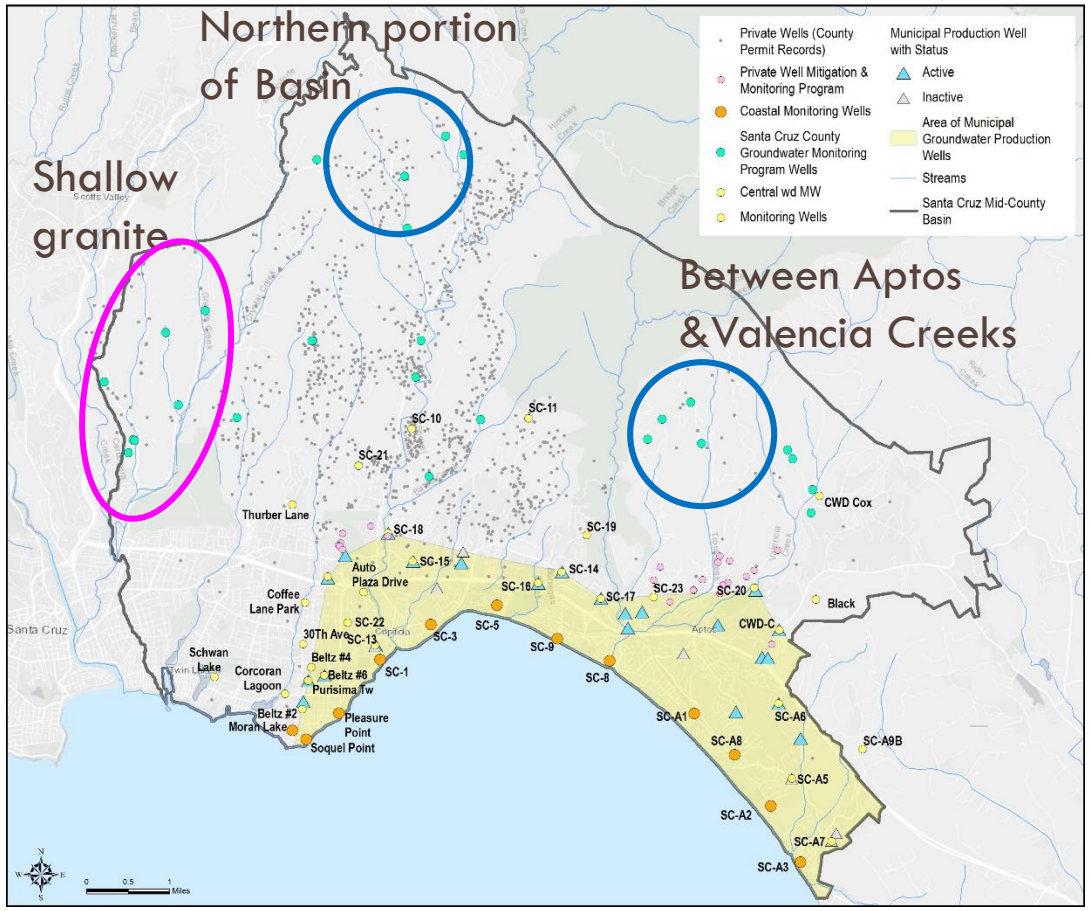
Averaging all the groundwater elevation measurements collected by a data logger (set to record every 15 minutes) over a month ensures that seasonal low groundwater levels are identified. Using a longer period such as annual, may mask seasonal changes. Since current groundwater levels will be higher than Minimum Thresholds set for chronic lowering of groundwater levels, in the unlikely event that levels fall to closer to the Minimum Thresholds, averaging groundwater elevations will provide more flexibility in avoiding undesirable results.

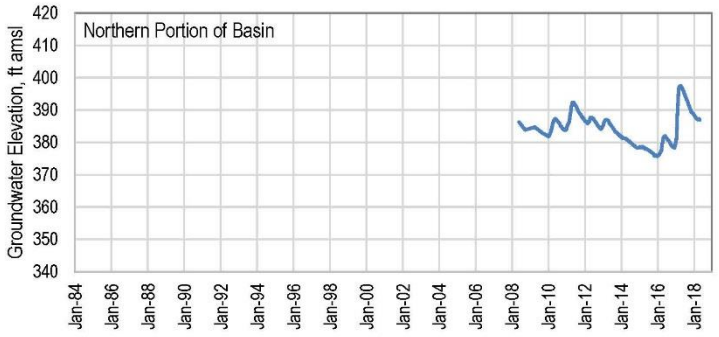
Chronic Lowering of Groundwater Levels

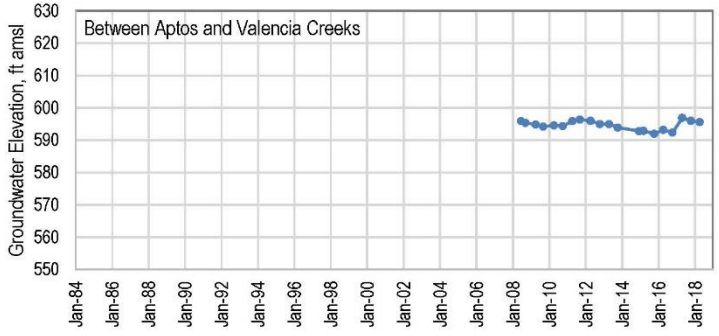
Historical Changes in Coastal Groundwater Elevations

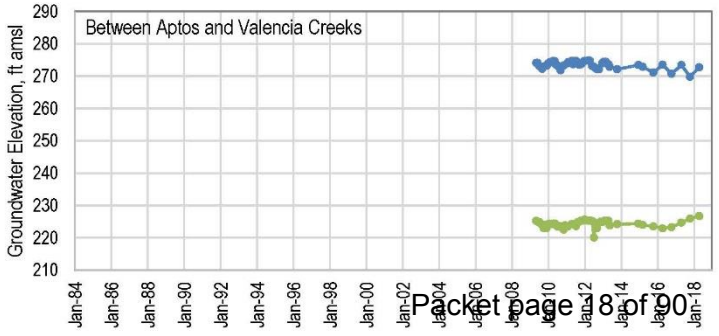


Historical Changes in Private Well Groundwater Elevations

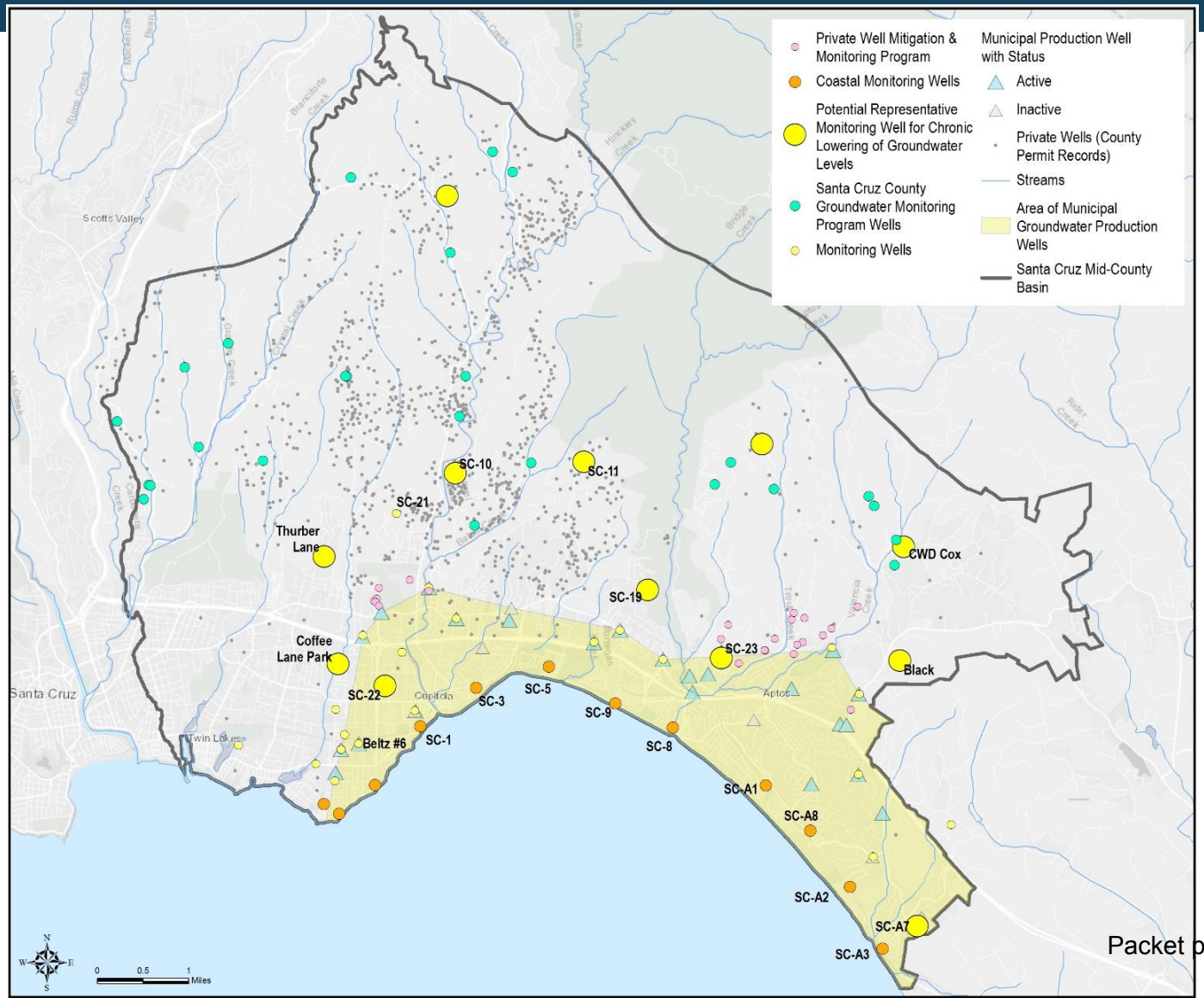








Potential Representative Monitoring Wells



Significant & Unreasonable Conditions

Chronic lowering of groundwater levels has potential to impact uses and users by:

- Inducing seawater intrusion.
- Reducing stream baseflow that supports groundwater dependent ecosystems & aquatic species by lowering groundwater levels beneath the streambed, or by reducing the hydraulic gradient and the rate of groundwater discharge to the stream.
- **Reducing yield of wells by causing groundwater levels to drop below well screens or the bottom of wells. Users of groundwater in the basin are agriculture, domestic, and municipal, with few industrial users.**

Significant & Unreasonable Chronic Lowering of Groundwater Levels

Key Variables: Lowering of groundwater levels that cause <percentage> or more of <well use type> groundwater pumping well's to <well condition>

<percentage>: this variable is dependent on <well condition>.

Fall below top of screen - could be a higher number of wells that can have levels fall below top of screen (e.g., 25% of wells)

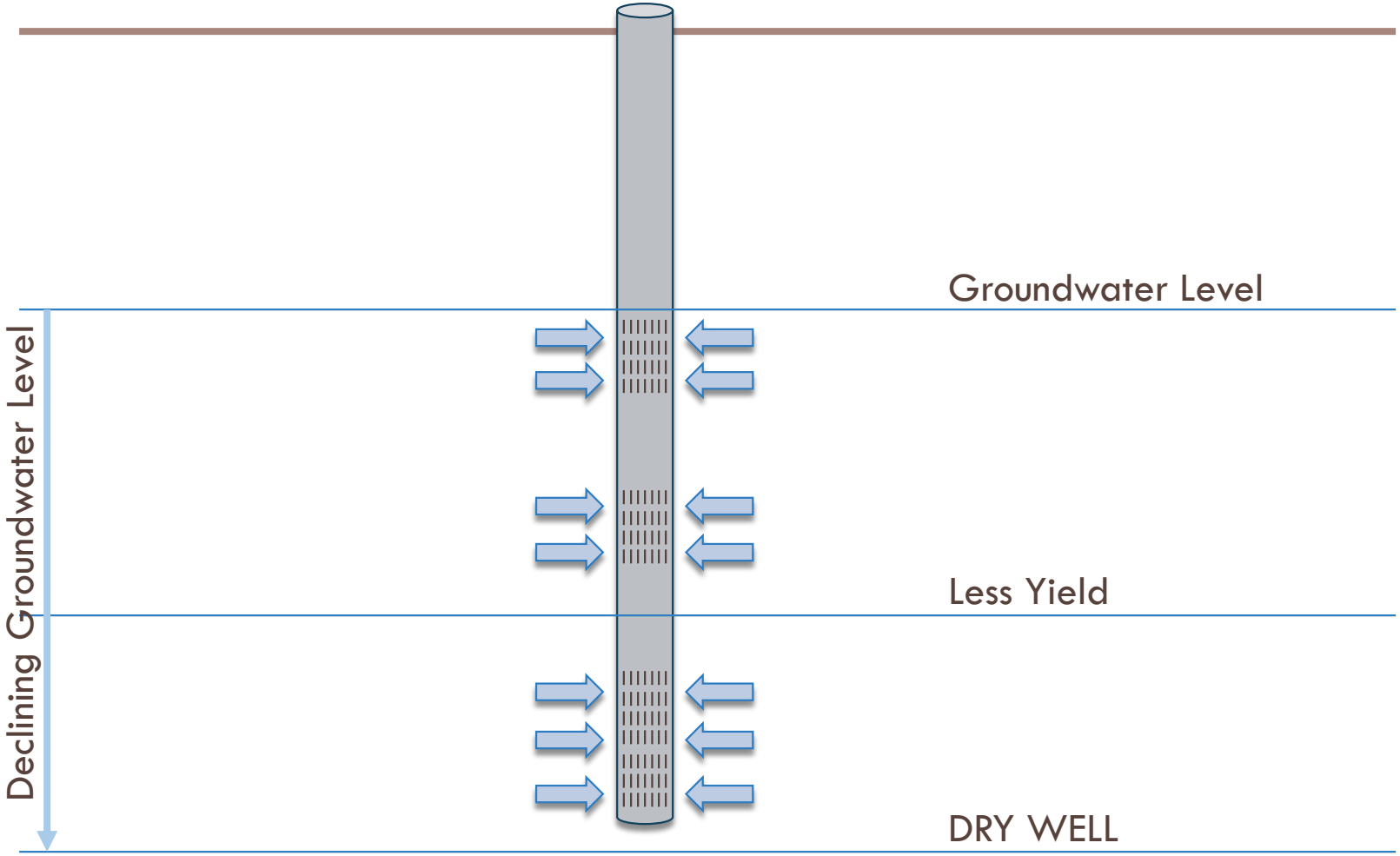
Certain distance from bottom of well – e.g., 20 feet allows for some production capacity (e.g., 5% of wells, excludes very shallow wells)

Go dry – fewer wells should be allowed to go dry (e.g., 1% of wells)

<well use type>: Should there be a distinction between user types? (agricultural, domestic, industrial, municipal).

<well condition>: go dry (below bottom of well), a certain distance from the bottom of the well, or fall below top screen?

Impacts of Lowered Groundwater Levels on Wells



Significant & Unreasonable

Chronic lowering of groundwater we want to avoid

Technical staff proposal:

Lowering of groundwater levels that cause 5% or more of all groundwater pumping well's to fall below 20 feet from the bottom of wells

RATIONALE: having groundwater levels fall below 20 feet from the bottom of a well is clearly significant and unreasonable. Groundwater levels falling below this depth will certainly reduce the wells' ability to pump groundwater. Groundwater levels falling below the top of well screens is not significant and unreasonable as it occurs commonly. A low percentage such as 5% covers the population of wells that are very shallow (< 100 feet).

Discussion

and

Selection of Significant & Unreasonable Chronic Lowering of Groundwater Level Conditions

Significant & Unreasonable Chronic Lowering of Groundwater Levels

Key Variables: Lowering of groundwater levels that cause <percentage> or more of <well use type> groundwater pumping well's to <well condition>

<percentage>: this variable is dependent on <well condition>.

Fall below top of screen - could be a higher number of wells that can have levels fall below top of screen (e.g., 25% of wells)

Certain distance from bottom of well – e.g., 20 feet allows for some production capacity (e.g., 5% of wells excludes very shallow wells)

Go dry – fewer wells should be allowed to go dry (e.g., 1% of wells)

<well use type>: Should there be a distinction between user types? (agricultural, domestic, industrial, municipal).

<well condition>: go dry (below bottom of well), a certain distance from the bottom of the well, or fall below top screen?

Undesirable Results for Chronic Lowering of Groundwater Elevations

What set of conditions are significant & unreasonable

Key Variables: The <statistic> Representative Monitoring Well groundwater elevation over <time period> falls below the <Minimum Threshold>

What happens when you change <variables>?

- <statistic>
  - **Minimum** elevation measured. This absolute number makes it more difficult to stay above the Minimum Threshold and the more difficult it will be to avoid Undesirable Results (less flexibility)
  - **75th Percentile** elevation measured. This statistic requires three-quarters of the groundwater elevations to be above the Minimum Threshold, making it easier to be above the Minimum Threshold than using the minimum but more stringent than using average groundwater elevations
  - **Average** elevation measured. This statistic allows for some groundwater levels to go below the Minimum Threshold, making it easier to exceed the threshold (more flexibility)

What happens when you change <variables>?

- <time period>
  - Monthly ⇨ data logger needed. More data to average
  - Quarterly ⇨ data needs to be collected at least monthly
  - One year ⇨ data needs to be collected at least quarterly

What happens when you change <variables>?

- <Minimum Threshold>
  - Numeric value set for every Representative Monitoring Well by technical staff
  - The aim is to set the Minimum Threshold at a level that reflects what is considered a chronically lowered groundwater elevation. Levels below this level will cause impacts to a significant number of wells
  - The lower the groundwater elevation set for Minimum Thresholds, the easier it will be to stay above the threshold, but there is a chance other wells may be impacted (more flexibility)
  - The higher the groundwater elevation set for Minimum Thresholds, the more difficult it will be to stay above it and ultimately may cause undesirable results (less flexibility)

Undesirable Results
Technical Staff Proposal

- The average Representative Monitoring Well groundwater elevation over one month falls below the <Minimum Threshold>

Rationale: monthly average will identify seasonal low levels

More flexibility in avoiding Undesirable Results: average elevation over one year

Less flexibility in avoiding Undesirable Results: 75th percentile elevation over one month

Discussion
and
Selection of Undesirable Results
for
Chronic Lowering of
Groundwater Levels

Technical Staff Proposal
Land Subsidence Minimum Thresholds

This document is organized into the following sections:

1. Background – land subsidence susceptibility in the Mid-County Basin
2. Guidance - Use Groundwater Levels as a Proxy for Land Subsidence Minimum Thresholds
3. Technical staff proposal for what would represent a Significant and Unreasonable condition (what we want to avoid)
4. Technical Staff Proposal - Undesirable Results in Purisima A, BC, and DEF units, using groundwater levels as a proxy for subsidence
5. Technical Staff Proposal - Undesirable Results in Purisima AA/Tu unit, using ground surface elevations as the numeric

1. Background - Land Subsidence Susceptibility in the Mid-County Basin

Conditions you need for land subsidence to occur:

- Drainage and decomposition of organic soils,
- Underground mining, oil and gas extraction, hydrocompaction, natural compaction, sinkholes, and thawing permafrost, or
- Aquifer-system compaction

There are no known organic soils in the Mid-County Basin. The depositional environments of the sediments comprising the basin's aquifers are not conducive to deposition of organics.

There is no underground mining, oil and gas extraction, hydrocompaction, natural compaction, sinkholes, and thawing permafrost occurring in the basin.

Because there have historically been declines in groundwater levels (greater than 50 feet), the possibility of aquifer-system compaction does exist. Susceptibility to land subsidence from groundwater level declines requires aquitards (fine-grained silts and clays) above- or within-which preconsolidation-stress thresholds are exceeded. There are aquitards in the Mid-County Basin between the aquifer units. However, in areas with pumping, the bottom elevations of aquitards are generally more than 100 feet below sea level, which is deeper than typical groundwater levels. This means that the aquitards do not get dewatered, but may still be subjected to changes in preconsolidation stresses.

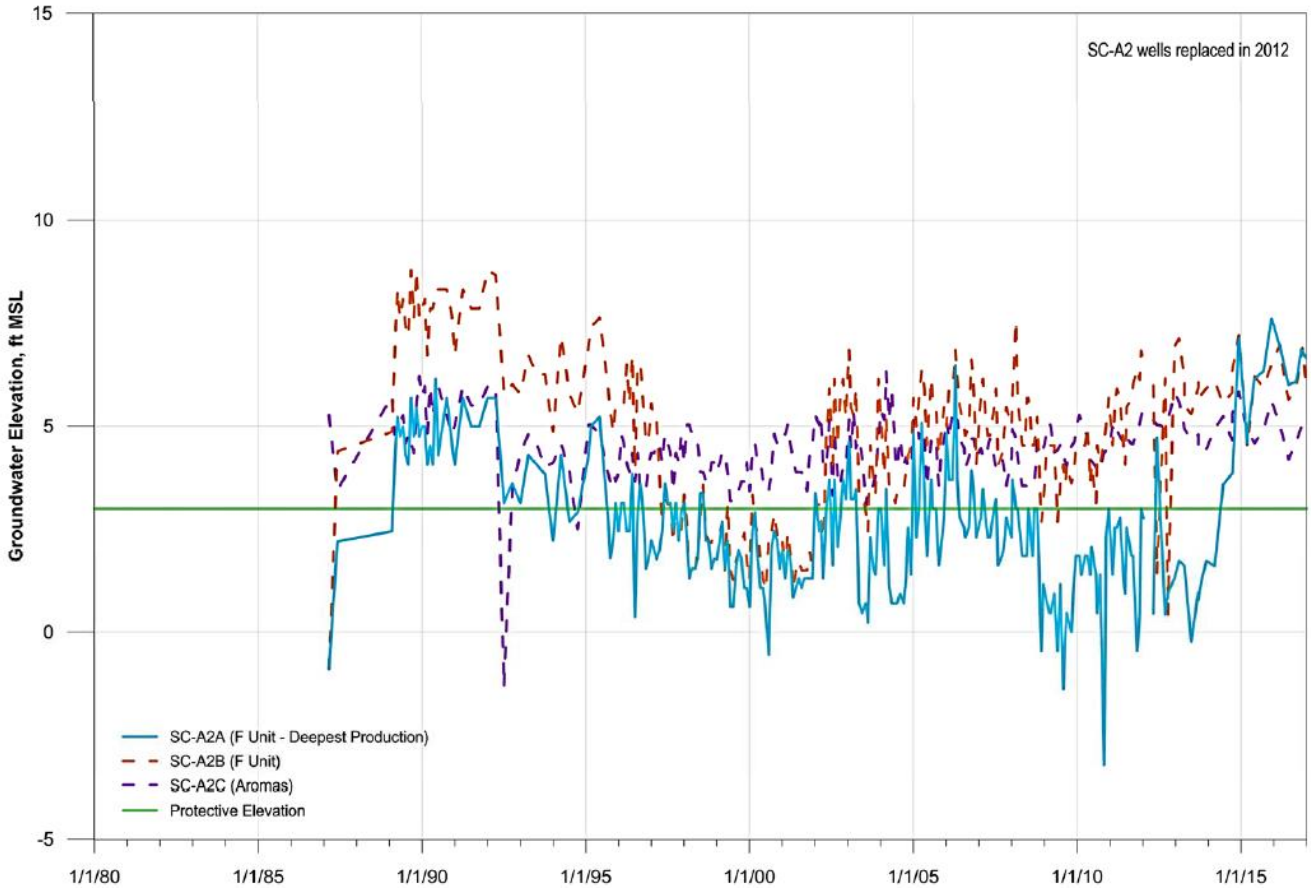
HAS ANY SUBSIDENCE OCCURRED DURING HISTORIC LOW GROUNDWATER LEVELS?

The greatest groundwater level declines since recording levels started in 1984 are in the Purisima BC units where declines in the order of 140 feet historically occurred. The Purisima A and DEF units have also had significant historical declines that led to historic low levels, which have since recovered. The table below summarizes the maximum declines for each aquifer and lists the associated hydrograph.

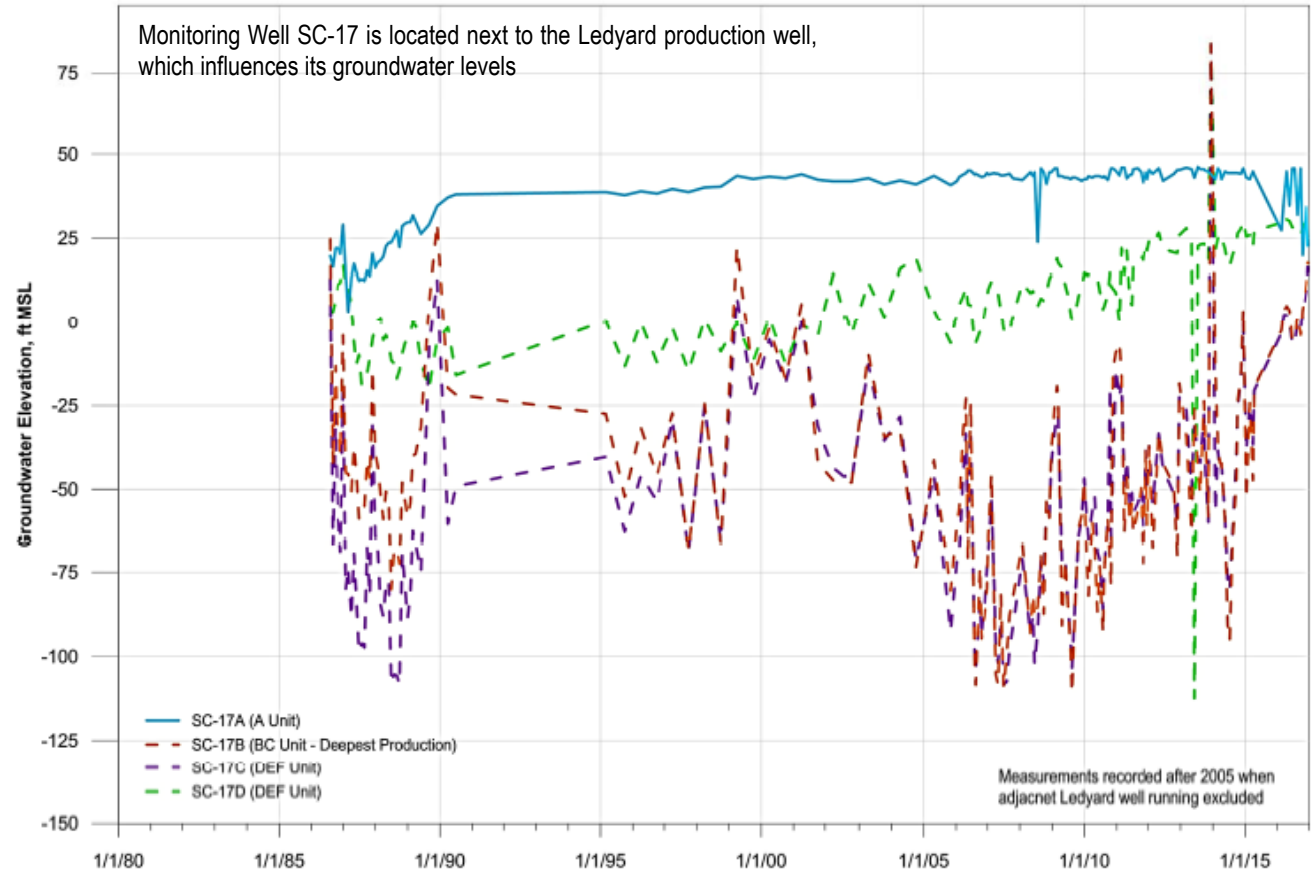
Years of historic low groundwater levels:

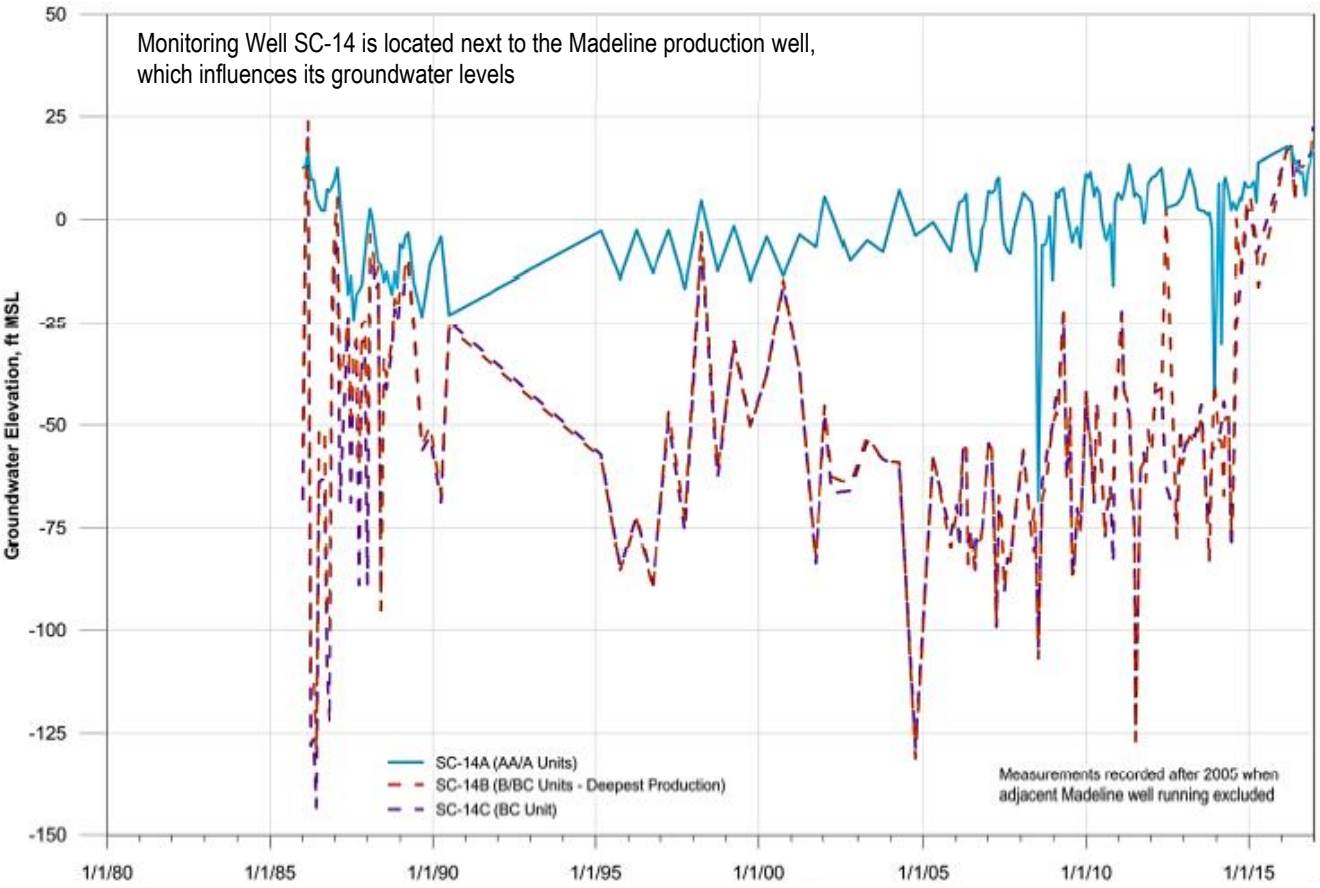
Unit	Maximum Decline, feet	Year of Historic Low
Aromas/Purisima F	5 (SC-A2A)	2000
Purisima DEF	100 (SC-17C)	1988
Purisima BC	140 (SC-14B)	1986
Purisima A	80 (SC-16A)	1988
Purisima AA/Tu	35 (SC-22AAA)	2017

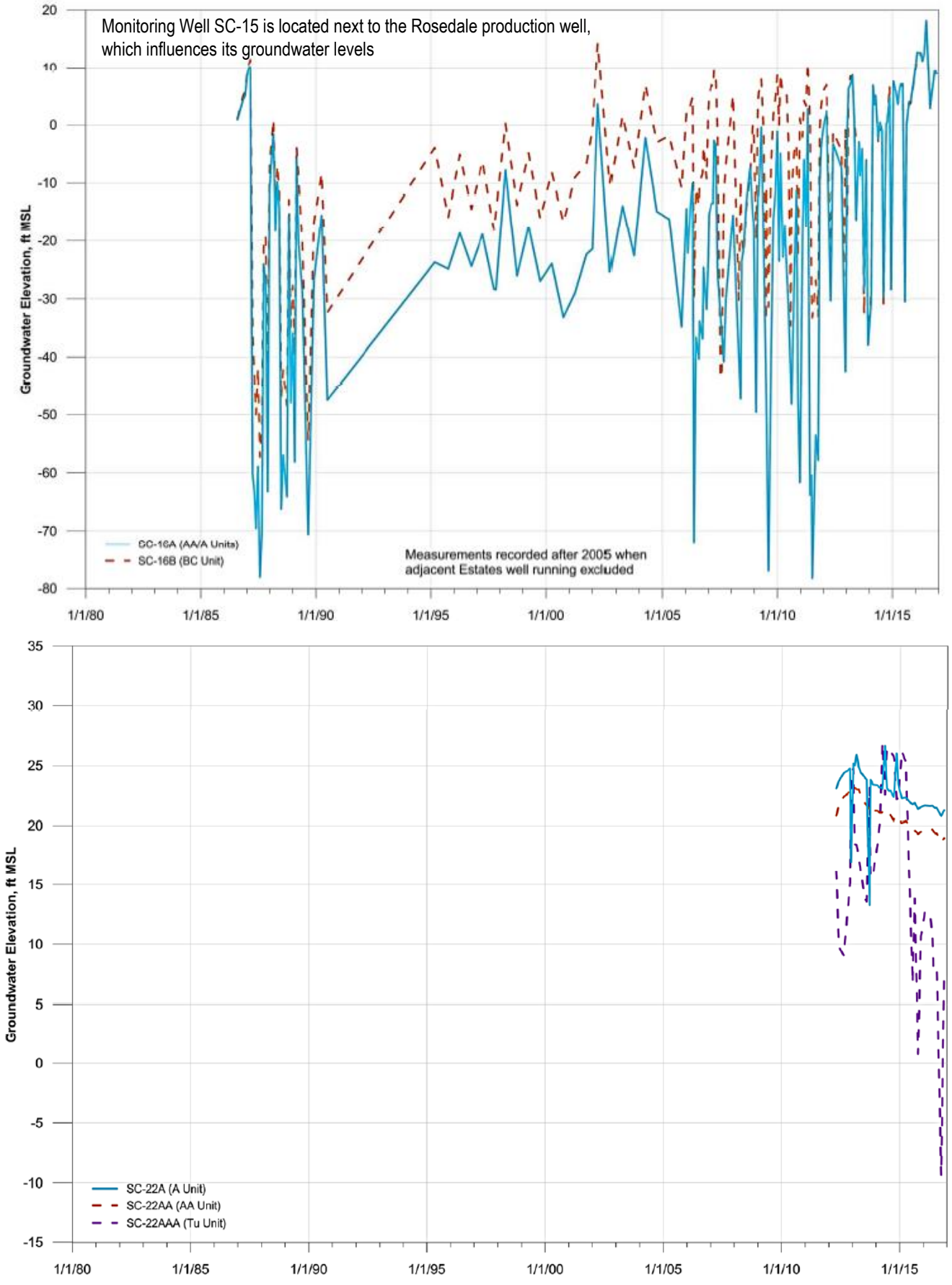
Hydrographs of wells with greatest declines are shown below. A map showing locations of the wells is included after the last hydrograph.



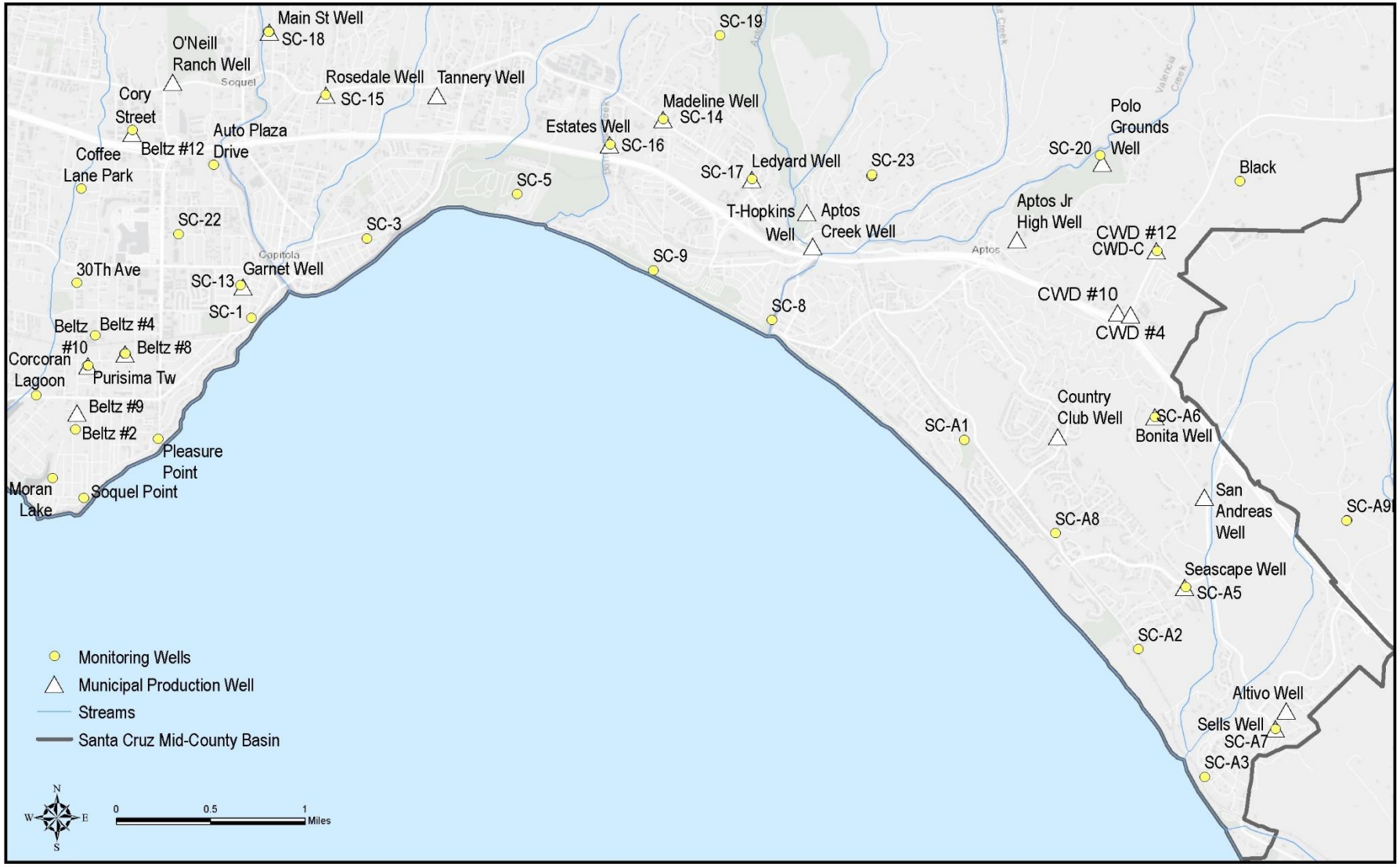
Proposal for Subsidence Minimum Thresholds


Monitoring Well SC-17 is located next to the Ledyard production well, which influences its groundwater levels
Groundwater Elevation, ft MSL
75
50
25
0
-25
-50
-75
-100
-125
-150
1/1/80
1/1/85
1/1/90
1/1/95
1/1/00
1/1/05
1/1/10
1/1/15
SC-17A (A Unit)
SC-17B (BC Unit - Deepest Production)
SC-17C (DEF Unit)
SC-17D (DEF Unit)
Measurements recorded after 2005 when adjacnet Ledyard well running excluded


Monitoring Well SC-14 is located next to the Madeline production well, which influences its groundwater levels
Groundwater Elevation, ft MSL
50
25
0
-25
-50
-75
-100
-125
-150
1/1/80
1/1/85
1/1/90
1/1/95
1/1/00
1/1/05
1/1/10
1/1/15
SC-14A (AA/A Units)
SC-14B (B/BC Units - Deepest Production)
SC-14C (BC Unit)
Measurements recorded after 2005 when adjacent Madeline well running excluded



Proposal for Subsidence Minimum Thresholds


Main St Well
SC-18
SC-19
O'Neill
Ranch Well
Soquel
Rosedale Well
SC-15
Tannery Well
Cory
Street
Madeline Well
SC-14
Estates Well
SC-16
Auto Plaza
Drive
Beltz #12
Coffee
Lane Park
SC-17
Ledyard Well
SC-23
SC-5
Polo
Grounds
Well
SC-20
Black
SC-22
SC-3
T-Hopkins
Well
Aptos
Creek Well
Aptos Jr
High Well
CWD #12
CWD-C
Capitola
Aptos
30Th Ave
Garnet Well
SC-13
SC-9
SC-1
SC-8
CWD #10
CWD #4
Beltz
#10
Beltz #4
Beltz #8
Corcoran
Lagoon
Purisima Tw
Country
Club Well
SC-A6
Bonita Well
Beltz #9
Beltz #2
SC-A1
Pleasure
Point
Moran
Lake
Soquel Point
San
Andreas
Well
SC-A9
SC-A8
Seascape Well
SC-A5
SC-A2
Altivo Well
Sells Well
SC-A7
SC-A3
Monitoring Wells
Municipal Production Well
Streams
Santa Cruz Mid-County Basin
N
W
E
S
0
0.5
1
Miles

For all groundwater elevation declines in the basin there is no reported evidence of the typical manifestations of land subsidence on manmade infrastructure or natural systems (described below) either during or after the documented historic low periods. Groundwater elevation declines in the Purisima AA/Tu unit are too recent to evaluate for any long-term effects, but have shown none of the typical manifestations of land subsidence to date.

Examples of subsidence effects on manmade infrastructures which have not been observed in the Mid-County Basin:

- Changes to gradients of water conveyance structures (e.g., canals, pipelines) causing reductions in designed flow capacity (Central Valley),
- Damage to roads and railways,
- Damage to bridges and buildings, and
- Damage to pipelines and wells.

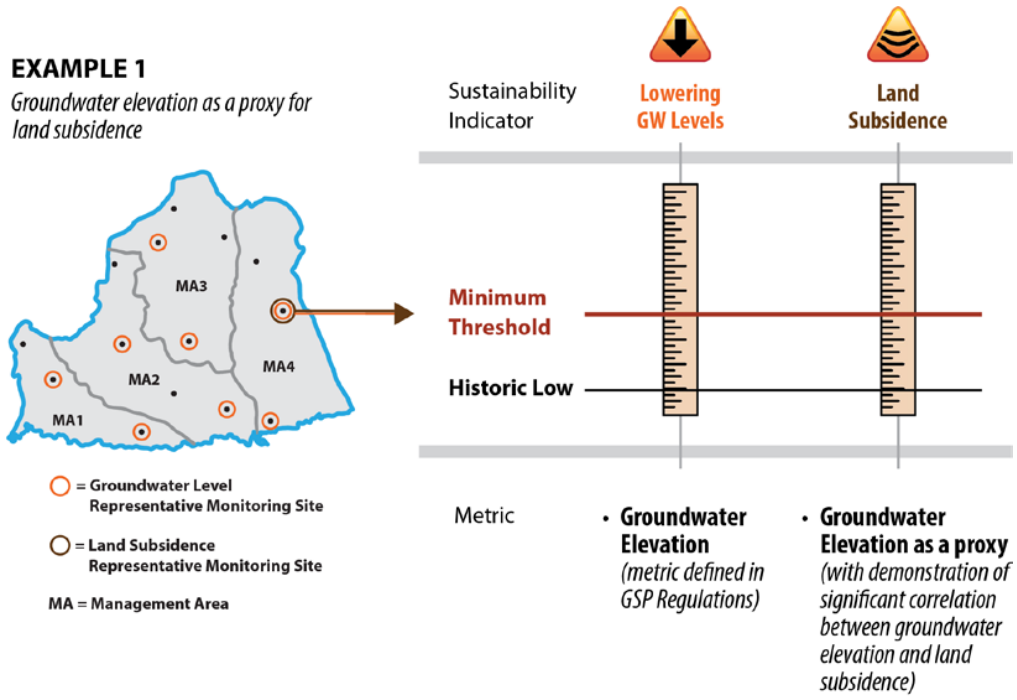
Example of subsidence effects on natural systems which have not been observed in the Mid-County Basin:

- Permanently decreased capacity to store groundwater in affected parts of a basin,
- If topography of the land changes by varying amounts in different places, the low areas, such as wetlands, will change size and shape, migrate to lower elevations, or even disappear, and
- Rivers changing course or erosion/deposition patterns changing to reach a new equilibrium.

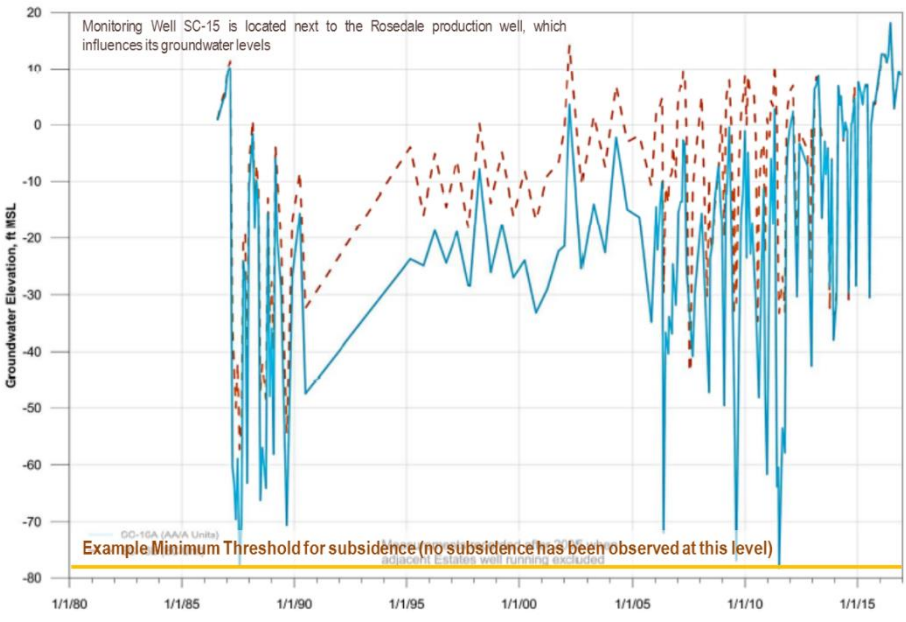
2. GUIDANCE - USE GROUNDWATER LEVELS AS A PROXY FOR LAND SUBSIDENCE MINIMUM THRESHOLDS

DWR will allow groundwater levels to act as a proxy for land subsidence Minimum Thresholds if the following applies: the GSA must establish and document that subsidence has not/will not occur if groundwater levels are maintained above minimum historic levels, then any Minimum Threshold for groundwater levels that is higher than historic low groundwater levels would avoid land subsidence as well.

This approach results in applying the same numeric definition (groundwater levels) to two Undesirable Results – chronic lowering of groundwater and land subsidence (see following figure).



Proposed direction from technical staff: Because there has been no known subsidence during periods of historic low groundwater levels in the basin, we recommend groundwater levels be used as a proxy for land subsidence minimum thresholds in all aquifers, except in the Purisima AA/Tu unit. Representative Monitoring Wells for this sustainability indicator will be monitoring wells that are located close to areas where the largest fluctuations in groundwater levels are expected to occur, which is typically adjacent to municipal production wells.



The Purisima AA/Tu unit has too recent of a decline in groundwater levels to determine if historic low levels would be protective against subsidence or not. Purisima AA/Tu unit Minimum Thresholds will need to be based on measured land surface elevation changes, instead of groundwater levels like the other aquifers.

Proposal for Subsidence Minimum Thresholds

3. TECHNICAL STAFF PROPOSAL FOR WHAT WOULD REPRESENT A SIGNIFICANT AND UNREASONABLE CONDITION (what we want to avoid)

Advisory Committee Objective: Select or adapt a statement of what represents significant and unreasonable subsidence conditions in the basin.

Rationale:
There is a very low likelihood that subsidence will occur in the basin, even more so with groundwater being managed. Making sure no subsidence occurs will not be difficult to achieve since historically it has not happened.

Technical staff's proposal:

Any land subsidence occurring

A less protective option:

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

4. TECHNICAL STAFF PROPOSAL - UNDESIRABLE RESULTS IN AROMAS, PURISIMA A, BC, AND DEF UNITS, USING GROUNDWATER LEVELS AS A PROXY FOR SUBSIDENCE (what set of conditions would cause significant and unreasonable subsidence impacts to occur)

Advisory Committee Objective: Select a set of groundwater levels conditions that if exceeded would cause significant and unreasonable impacts to occur.

Generic Framing: <Number of wells > Representative Monitoring Wells in the Aromas and Purisima A, BC, and DEF units with <statistic> <time period> groundwater elevations below their <Minimum Threshold> in <extent>

The words in < > represent variables that change how easily we can meet the threshold of historic low groundwater elevations in Representative monitoring wells, if we conservatively assume that land subsidence may occur if groundwater levels fall below their historical lows.

<Number of Wells> options

- the more wells that have groundwater elevations below the <Minimum Threshold>, the easier it is to avoid undesirable results but higher risk of potential subsidence
- the less wells that have groundwater elevations below the <Minimum Threshold>, the more difficult it might be to avoid undesirable results but there is a lower risk of potential subsidence

<statistic> options

- average groundwater elevations: groundwater levels need to be below the <Minimum Threshold> for extended periods of time for there to be a risk of potential subsidence
- certain percentile: the more often a groundwater level is below the <Minimum Threshold>, the greater the risk of potential subsidence. The percentile selected needs to represent either a majority or minority of groundwater elevations being below the <Minimum Threshold> depending on how much flexibility in avoiding undesirable results is acceptable. A majority of elevations within the selected <time period> below the threshold will mean a greater risk of potential subsidence, and a minority of elevations within the selected <time period> will mean a greater risk of potential subsidence.

<time period> options

- Quarterly – shorter period over which to analyze <statistic>, allows for less flexibility
- Annual – longer period over which to analyze <statistic>, allows for more flexibility

<Minimum Threshold> options

- Historic low – this can be used if there is no evidence of subsidence when groundwater was at these levels
- An elevation either higher or lower than historic low

<Extent> must be the area of subsidence concern

Technical staff's proposal of an Undesirable Result in the Aromas and Purisima A, BC, and DEF units:

<u>Any</u> representative monitoring well in the Aromas and Purisima A, BC, and DEF units with <u>average annual</u> groundwater elevations below their <u>historic lows</u> in <u>any part of the basin</u>

Rationale:
Based on the proposed statement of significant and unreasonable, any representative monitoring wells, in any part of the basin, with a groundwater levels lower than its historic low for extended periods of time could potentially have a higher risk of subsidence. Averaging groundwater elevations over a year indicates what the typical groundwater elevation was and provides more flexibility in avoiding undesirable

5. **TECHNICAL STAFF PROPOSAL - UNDESIRABLE RESULTS IN PURISIMA AA/TU UNIT, USING GROUND SURFACE ELEVATIONS AS THE METRIC** (what set of conditions would cause significant and unreasonable subsidence impacts to occur from pumping the Purisima AA/Tu unit)

Advisory Committee Objective: Select a combination of subsidence rates and extent that if exceeded would cause significant and unreasonable impacts to occur.

If a groundwater level proxy cannot be used for subsidence, the metrics for subsidence as an indicator of sustainability are rate and extent of subsidence. Note that there is no subsidence monitoring infrastructure or subsidence studies conducted to date in the basin because there have been no reports of subsidence.

This metric can only be set for areas with land surface elevation monitoring to check if the No subsidence occurred threshold rate of subsidence is being exceeded. In this case, monitoring infrastructure will need to be established in areas where there are large groundwater declines in the Purisima AA/Tu unit.

Generic Framing: <Rate of subsidence, inches per year> occurring in <extent >

The words in < > represent variables that change how easily we can meet the subsidence threshold. If we demonstrate that we are able to avoid Undesirable Results within 20 years then the State views the basin as sustainable. Below are examples to show how changing the variables makes it easier or more difficult to avoid Undesirable Results.

Rate of subsidence:

- the lower the subsidence rate, the more difficult it might be to remain below that threshold if you have known subsidence and the more difficult it will be to avoid Undesirable Results (less flexibility)
- the higher the subsidence rate, the easier it will be to meet the threshold if you have known subsidence and the easier it will be to avoid Undesirable Results (more flexibility) but there is a greater risk of damage if you have inelastic subsidence
- Example of local subsidence: Santa Clara Valley has a tolerable rate of 0.01 feet (0.12 inches) per year to prevent inelastic subsidence

Extent:

- limiting the threshold area to developed areas only and allowing undeveloped areas to subside may make it easier to avoid Undesirable Results in subsidence prone areas (more flexible) if that aligns with what you consider Significant and Unreasonable basin conditions

Technical staff's proposal of an Undesirable Result in the Purisima AA/Tu unit:

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

Rationale:
The absence of known subsidence in the basin and low susceptibility for it occurring in the future.

It is possible to include in the GSP that subsidence monitoring and/or InSAR (using satellites to measure very small changes in surface elevation over time) will be established after the GSP due date (Jan 2020). We can use data collected from this monitoring to determine if very small changes in land surface have occurred historically (even though no reports of subsidence were reported) and to fine-tune the Minimum Thresholds for the Purisima AA/Tu unit subsidence rates.

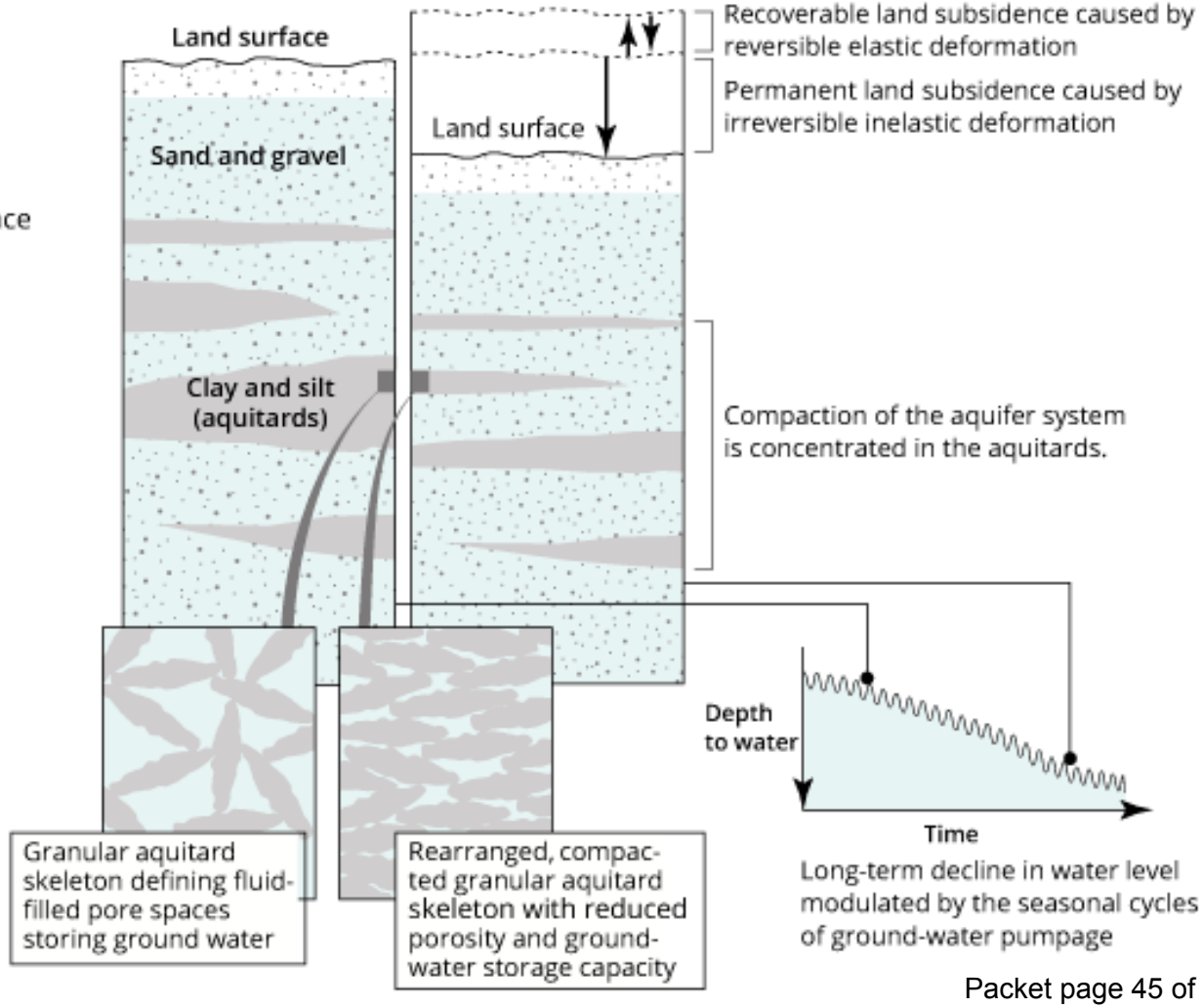
Land Subsidence

What is Land Subsidence

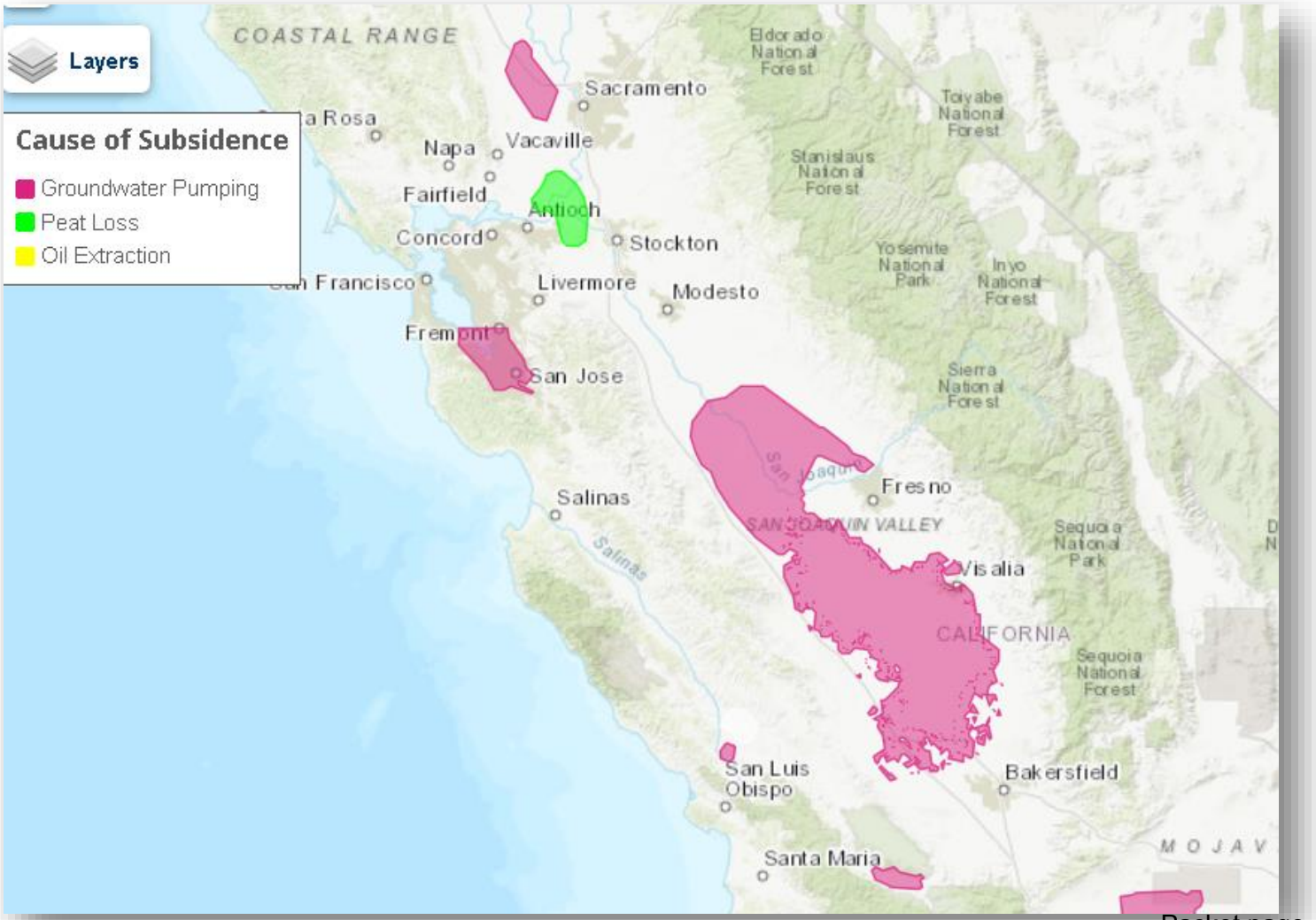
- Land subsidence is a gradual settling or sudden sinking of the Earth's surface owing to subsurface movement of earth materials.
- The principal causes are:
  - Aquifer-system compaction,
  - Drainage and decomposition of organic soils
  - Underground mining, oil and gas extraction, hydrocompaction,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

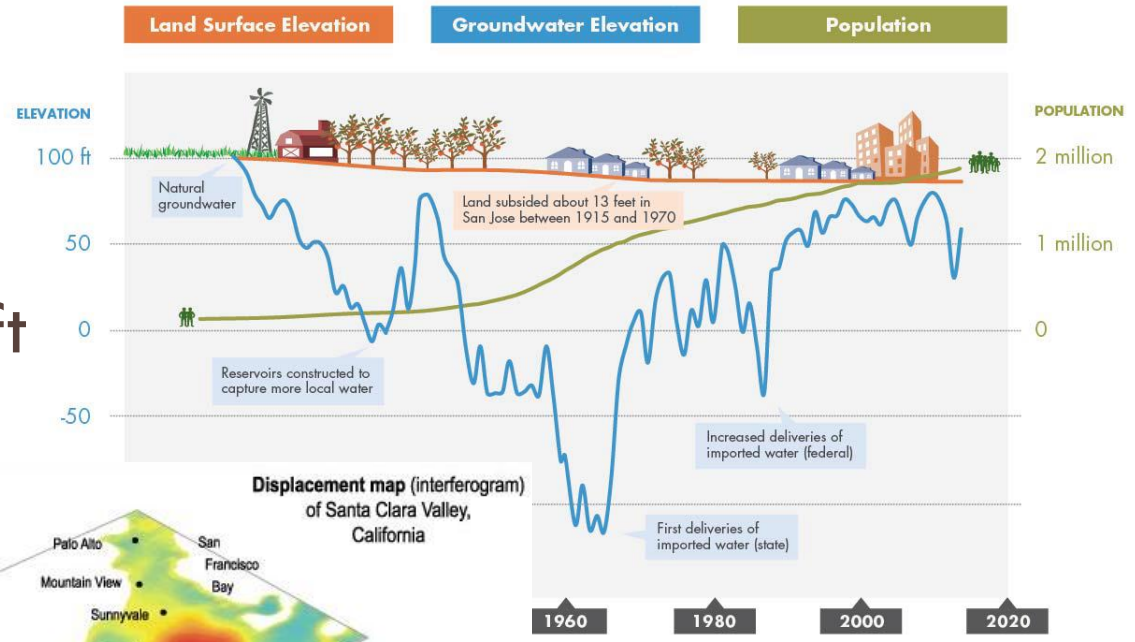


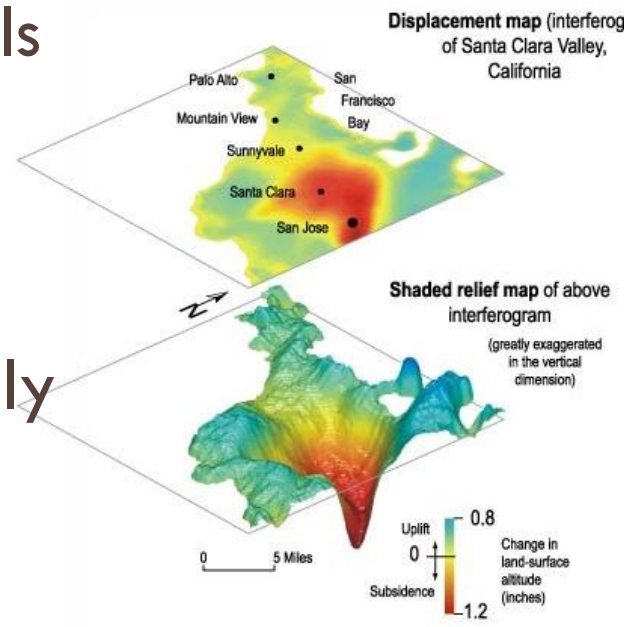
Nearby Documented Land Subsidence



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

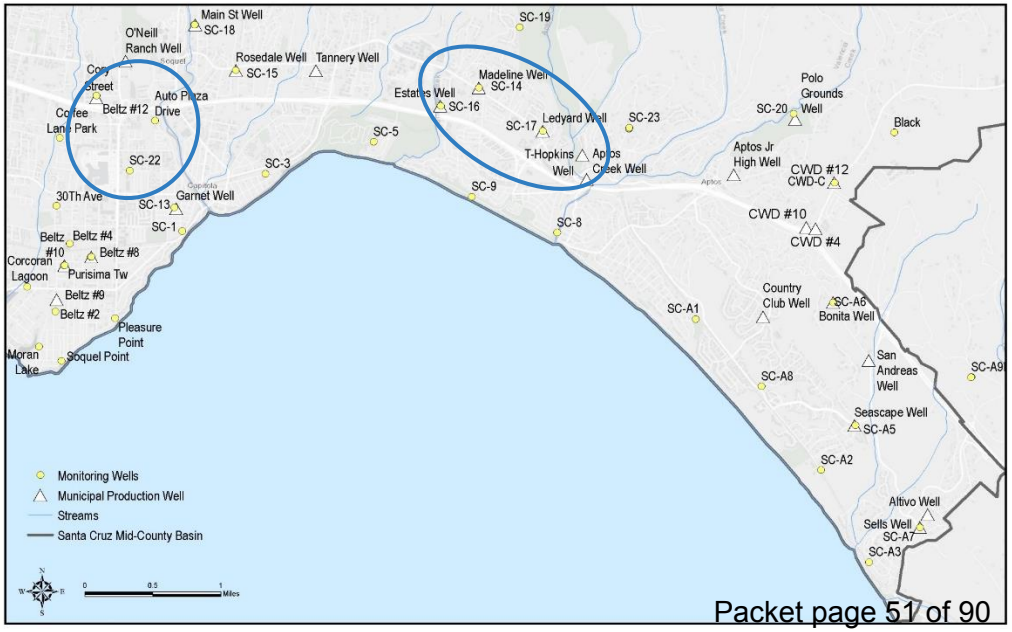
Natural Systems

- 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?

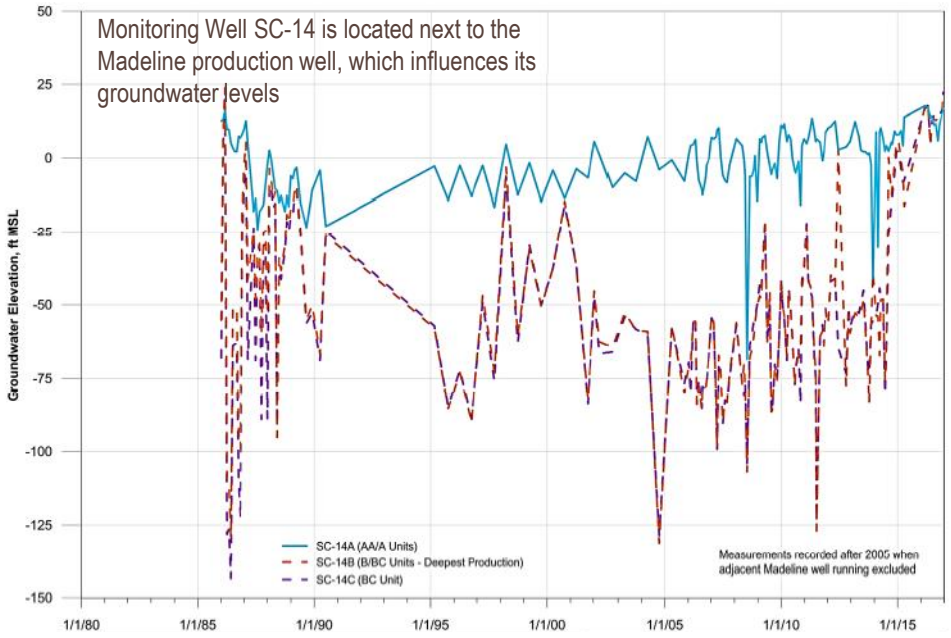
Unit	Maximum Decline, feet	Year of Historic Low
Aromas/Purisima F	5 (SC-A2A)	2000
Purisima DEF	100 (SC-17C)	1988
Purisima BC	140 (SC-14B)	1986
Purisima A	80 (SC-16A)	1988
Purisima AA/Tu	35 (SC-22AAA)	2017

Areas of historic low groundwater levels > 50 feet



Historic Low Groundwater Levels

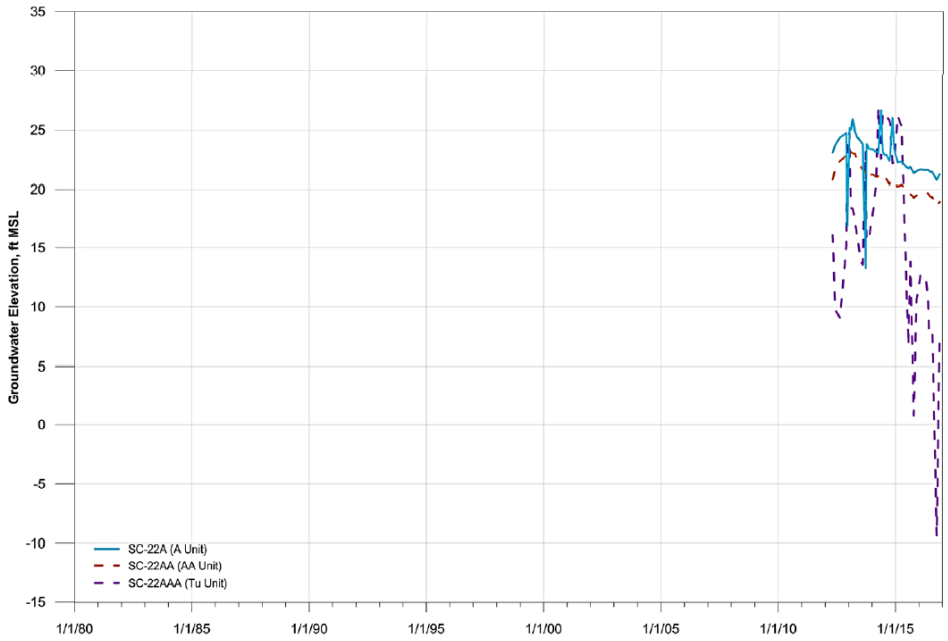
Purisima Aquifer



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

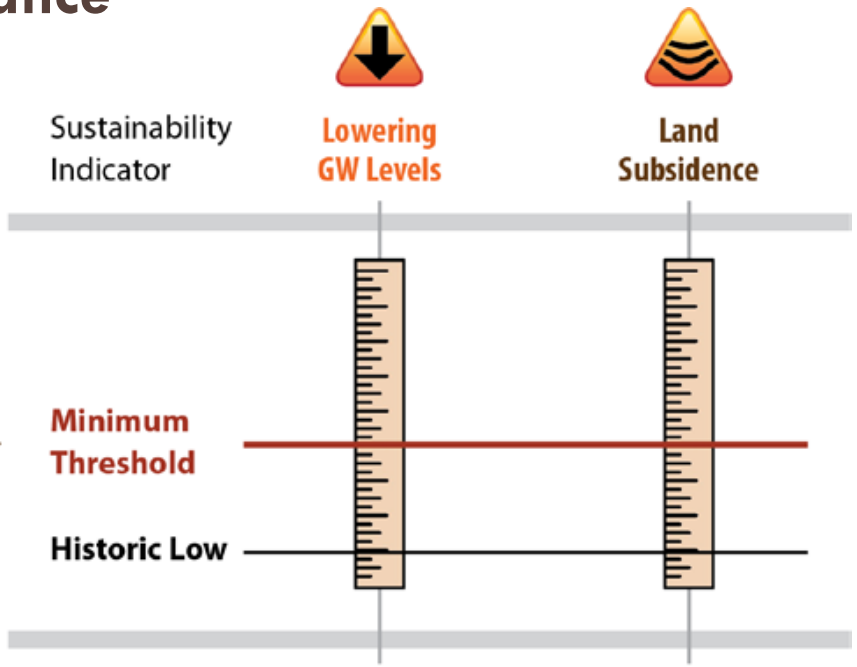
EXAMPLE 1

Groundwater elevation as a proxy for land subsidence

○ = Groundwater Level Representative Monitoring Site

○ = Land Subsidence Representative Monitoring Site

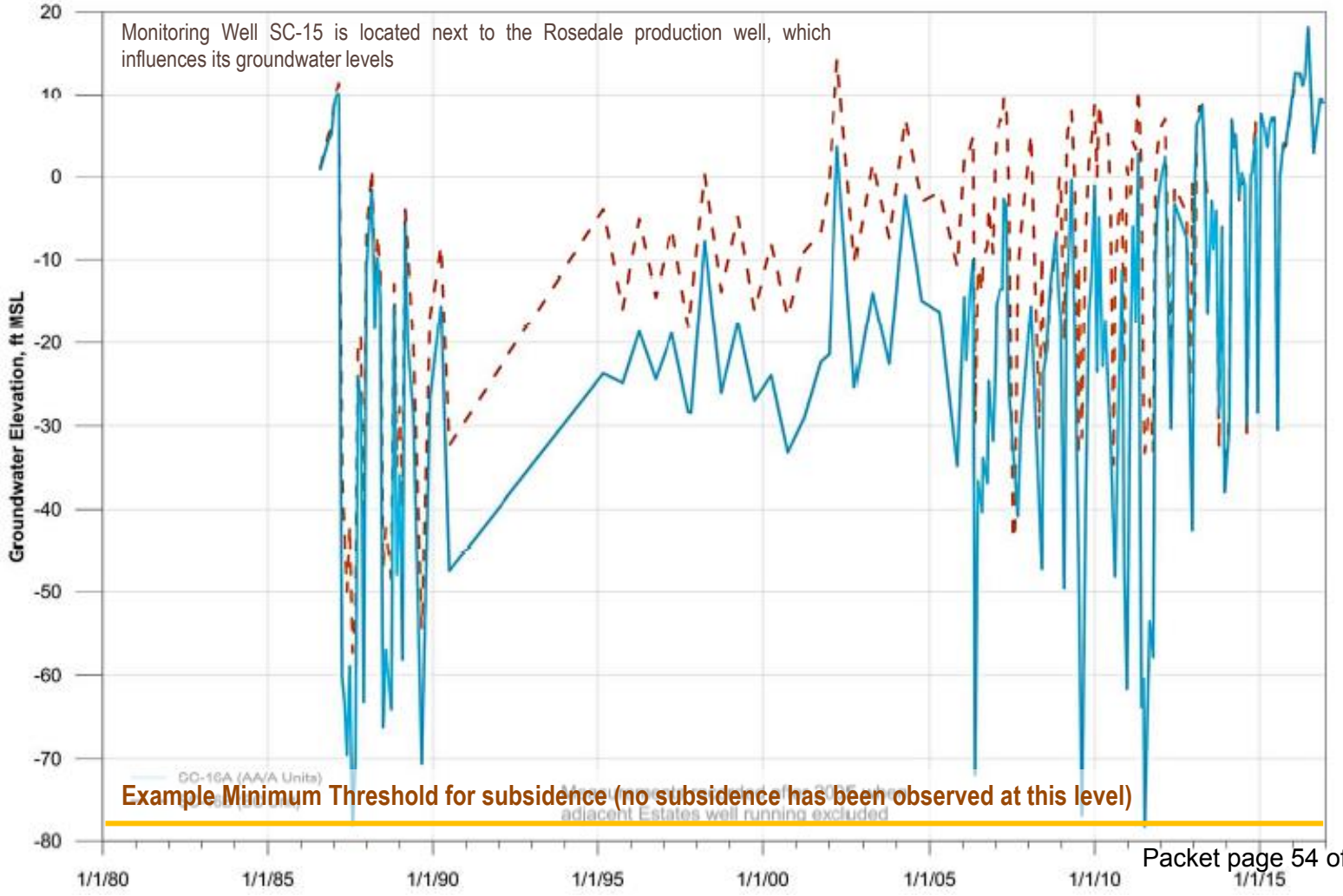
MA = Management Area



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

Allow Some Subsidence

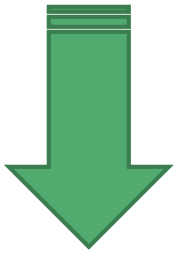
- Land subsidence occurring in developed areas only (ok if it occurs in undeveloped areas)

Note: Undeveloped areas are not likely to have changes in groundwater levels which could potentially cause subsidence

Discussion
and
Selection of Significant & Unreasonable Land Subsidence Conditions

Undesirable Results
Proposed Metrics for Different Aquifers

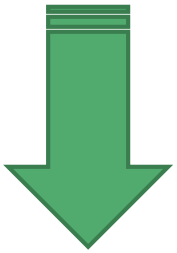
Aromas
Purisima A, BC, DEF



Groundwater Levels

Use groundwater levels as a proxy for Subsidence

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

Use historic low groundwater levels at Representative Monitoring Wells in areas of greatest groundwater level fluctuations

Key Variables: <Number of wells > Representative Monitoring Wells in the Aromas and Purisima A, BC, and DEF units with <statistic> <time period> groundwater elevations below their <Minimum Threshold> in <extent>

What happens when you change <variables>?

- <Number of wells>
  - More wells ⇨ easier to avoid Undesirable Results but higher risk of potential subsidence
  - Less wells ⇨ less flexibility in avoiding Undesirable Results but lower risk of potential subsidence
- <statistic>
  - Average – groundwater levels need to be below the <Minimum Threshold> for extended periods of time for there to be a risk of potential subsidence
  - Certain percentile – the more often a groundwater level is below the <Minimum Threshold> the greater the risk of potential subsidence

What happens when you change <variables>?

- <time period>
  - Quarterly
  - Annual
- <Minimum Threshold>
  - Historic low
  - An elevation either higher or lower than the historic low
- <Extent>
  - This represents 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 average annual groundwater elevations 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

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

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

Groundwater is a vital resource, together let's protect it.

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Draft Meeting Summary

Santa Cruz Mid-County Groundwater Sustainability Planning (GSP) Advisory Committee Meeting #6

April 25, 2018, 6:00 – 9:00 pm

This meeting was the sixth convening of the Groundwater Sustainability Planning (GSP) Advisory Committee. It took place on April 25, 2018 from 6:00-9:00 p.m. at the Santa Cruz County Sheriff's Office. This document summarizes a presentation to the Advisory Committee and discussion focused on Seawater Intrusion[1]. It also captures additional information provided on trend data; presentation of a technical staff proposal and options covering Seawater Intrusion Minimum Thresholds; Advisory Committee general consensus on SGMA risk factors for Seawater Intrusion under various scenarios; Committee perspectives on Significant and Unreasonable Conditions and Undesirable Results related to Seawater Intrusion under various scenarios; action items; and an overview of public comment received. It is not intended to serve as a detailed transcript of the meeting.

Meeting Objectives

The objectives for the meeting were to:

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

Action Items

Key action items from the meeting include the following:

Background Information:

- Staff to follow up with Jon Kennedy for feedback on the trend data (*Soquel Creek Water District, 1965 – 2017: Groundwater Pumping, Connections, and Rainfall)* presented.

[1] Both Seawater Intrusion and Subsidence were on the agenda for discussion, but due to time constraints, the Committee and staff were only able to cover Seawater Intrusion. Subsidence will be covered at the May 23 Advisory Committee meeting.

Seawater Intrusion Presentation/Proposal

- Technical staff provide further explanation regarding how Soquel Creek Water District determined/chose the 70% threshold to represent their terms/policy of risk for Seawater Intrusion.
- Technical staff to present additional information on differences in Seawater Intrusion at all the intruded wells, and a comparison of historical maximum and the last five years of intrusion levels.
- Technical staff to confirm whether bifurcating the Seawater Intrusion standards for coastal vs. inland monitoring wells would make better sense or be necessary in selecting Significant and Unreasonable Seawater Intrusion conditions.

General

- Staff to explore options for Advisory Committee field trip of the Mid-County Basin.
- Staff to consider using a document sharing platform to store GSP/Advisory Committee-related documents and establishing public-facing email addresses for Advisory Committee members.

Meeting attendance

Committee members in attendance included:

1. Kate Anderton, Environmental Representative
2. John Bargetto, Agricultural Representative
3. Rich Casale, Small Water System Management
4. Keith Gudger, At-Large Representative
5. Dana Katofsky McCarthy, Water Utility Rate Payer
6. Jonathan Lear, At-Large Representative
7. Douglas P. Ley, Business Representative
8. Marco Romanini, Central Water District
9. Allyson Violante, County of Santa Cruz
10. Thomas Wyner for Cabrillo College, Institutional Representative

Committee members who were absent included:

1. David Baskin, City of Santa Cruz
2. Bruce Jaffe, Soquel Creek Water District
3. Jon Kennedy, Private Well Representative
4. Charlie Rous, At-Large Representative

Meeting Key Outcomes (linked to agenda items)

1. Introduction and Discussion of GSP Process Timeline and Framework

Rosemary Menard, City of Santa Cruz, opened the meeting and welcomed participants. Ms. Menard then asked MGA Executive Team, staff and the consultant support team around the room to introduce themselves. She then addressed members of the public in attendance and asked them for self-introductions.

Eric Poncelet, Facilitator, reviewed the agenda, meeting objectives, the updated GSP process timeline, and ground rules and asked Ms. Menard to provide her overview of the GSP process framework.

Ms. Menard referred to the GSP process slide (spiral), explaining the iterative nature of the GSP process, involves various rounds of discussions on proposals presented on each of the six Sustainability Indicators and other GSP-related issues. She added that each round of discussion, as such, would result in technical staff-developed models based on input from Advisory Committee members, which would then be returned to the Committee for further feedback and additional refinement by technical staff. Ms. Menard stressed that this process will be repeated until the Committee feels comfortable with its recommendations. Ms. Menard emphasized that the group is currently at the launching point and as it works through the process (spiral), staff is hopeful that Committee members will feel more confident in discussing the issues and proposals and providing input and recommendations on the GSP components.

2. Oral Communications (for items *not* on the agenda)

Members of the public provided comments on non-agenda items during this session.

The first participant shared handouts on Water for Santa Cruz County's proposal/option on water issues and transfers and requested time at the next MGA Board meeting to present this information in detail.

The second participant requested confirmation on the prediction published in the Santa Cruz Sentinel that Seawater Intrusion can permanently impact monitoring wells in the Basin in two years. If so, the speaker urged the Committee and staff to expeditiously take action to prevent this impact.

3. Additional Background Information

- **Chloride Level Changes from 1987 to 2017**

  Marco Romanini, Central Water District shared data on Chloride levels for a sample set of wells with Committee members, staff and meeting participants. The data showed the difference in Chloride level trend for 1987 and 2017 as the approximate change in such levels during that 30-

year period, by computing and graphing the annual average of Chloride levels. (*This informational item was not originally on the agenda*.)

- **Trend Data for Soquel Creek Water District, 1965 – 2017: Groundwater Pumping, Connections, and Rainfall.**

  Georgina King, HydroMetrics presented trend data for Groundwater pumping, connections and rainfall in Soquel Creek Water District from 1965 – 2017. Ms. King prepared this data chart showing how Soquel Creek Water District has managed its Groundwater production, in response to a request from an Advisory Committee member.

  The group discussed the following key points following Ms. King's presentation:

  - In general, this trend data is helpful and additional layers (e.g., Groundwater Levels, change in Groundwater Storage) could be added as requested by Committee members.
  - The trend data graph shows that Soquel Creek Water District has managed water consumption well, and this is a direct correlation with the water conservation program that it has instituted.
  - This data mostly represents residential water consumption for the Soquel Creek aquifer.

4. Seawater Intrusion – Undesirable Results with Underlying Significant and Unreasonable Conditions.

Cameron Tana, HydroMetrics presented a technical staff proposals and options on Seawater Intrusion Minimum Thresholds, which included requests for Advisory Committee members to determine: 1) what the they want to avoid for the Basin (what is considered Significant and Unreasonable Condition); and 2) what set of conditions they see would cause significant and unreasonable impacts for the Basin (Undesirable Results). Prior to soliciting Committee input on the proposals, Mr. Tana provided the Committee with some background on current Seawater Intrusion Management for the Aromas and Purisima Areas, including risk policy goals that have been previously established.

The Advisory Committee then offered provisional policy statements on SGMA risk factors for Seawater Intrusion below and were polled after each category of risk factors. A synthesis of the Advisory Committee selected options will be prepared by HydroMetrics and shared with the Advisory Committee for review.

<u>General Committee Consensus</u>

The general feeling of the group was that the goal should be to recover the basin and improve water supply reliability and environmental quality overall. However, the committee also understands that groundwater management at the southern end of the basin may be difficult to control because of

geological and jurisdictional constraints. The committee expressed an interest in setting a realistic minimum threshold baseline that protects the basin from seawater intrusion. They are also concerned about state intervention in basin management if they set the minimum threshold at a level that is adequately protective, but can also be met if another severe drought were to occur before supplemental supply projects could be approved/implemented.

Committee Perspective on Significant and Unreasonable Conditions - Seawater Intrusion

"Significant and Unreasonable Conditions" are the conditions we want to avoid related to seawater intrusion in our groundwater basin. Generally, the committee felt that the staff proposal (restated below) which keeps saltwater intrusion at its current extent (or its historical maximum to provide a little more management flexibility) was the committee's provisional recommendation. The committee doesn't want seawater intrusion to get measurably worse.

Aromas aquifer – Where seawater intrusion exists, keep seawater intrusion confined to its current extent. Seawater intrusion at depths shallower than those currently observed in intruded Coastal monitoring wells is not acceptable (i.e., existing seawater intrusion is acceptable baseline condition).

Purisima aquifer – Where seawater intrusion does not exist, keep seawater intrusion from moving inland from the coast (i.e., no measurable onshore seawater intrusion is acceptable).

Purisima aquifer – Where seawater intrusion exists, keep seawater intrusion confined to its current extent. Seawater intrusion found at depths shallower than those observed in currently intruded Purisima A unit Coastal monitoring wells is not acceptable (Soquel Point (Med))(i.e., existing seawater intrusion is acceptable baseline condition).

Committee Perspective on Undesirable Results – Seawater Intrusion and chloride concentrations

"Undesirable Results" are the set of conditions that would cause significant and unreasonable impacts to occur related to seawater intrusion as measured by chloride concentrations in our groundwater basin. Generally, the committee felt that the staff proposal (restated below) which measures chloride concentrations quarterly and assesses those measurements against a running 5-year average with a 25% sample variance standard (to allow for some management flexibility) was the committee's provisional recommendation. The committee doesn't want chloride concentrations to get measurably worse or to exceed their historical maximum. The committee also discussed but did not make a recommendation on whether the chloride concentration threshold of 250 mg/L should be reduced in monitoring wells where seawater intrusion did not currently exist.

Undesirable Results for Coastal Monitoring wells where seawater intrusion exists, An undesirable result occurs if any coastal monitoring well with current seawater intrusion has a chloride concentration above

its running 5-year average chloride concentration. This chloride concentration must be exceeded in more than 75% of the last 8 consecutive samples (quarterly sampled wells).

Undesirable Results for Inland and Coastal Monitoring Wells where seawater intrusion does not exist: An undesirable result occurs if any Inland Representative Monitoring or Coastal Monitoring Well where seawater intrusion does not exist has a chloride concentration above 250 mg/L. This concentration must be exceeded in more than 2 (50%) of the last 4 consecutive samples.

Committee Perspective on Undesirable Results – Seawater Intrusion and use of Protective Elevations as an ongoing Assessment Tool

"Undesirable Results" are the set of conditions that would cause significant and unreasonable impacts to occur related to seawater intrusion as measured by protective elevations in our groundwater basin. Generally, the committee felt that the staff proposal (restated below) which measures protective elevations at our coastal monitoring network was a good measure for seawater intrusion. All of the committee members present at the end of the meeting approved continuing to use "protective elevations" as an ongoing management criteria, even though not required by the GSP guidelines. Several committee members suggested linkages to the measurement and success criteria of chloride concentrations, but all felt that the use of protective elevations is a useful assessment tool to manage seawater intrusion in the basin.

Undesirable Results for Protective Groundwater Elevations in Coastal Monitoring wells: Five-year average groundwater elevations below protective groundwater elevations in Coastal Monitoring Wells for any well would be unacceptable.

5. Public Comments (focused on meeting agenda items and other Advisory Committee work).

During this segment, Mr. Poncelet asked members of the public to limit comments to those related to Seawater Intrusion and any Advisory Committee work. The participants made the following comments:

- One of the participants cautioned the Advisory Committee and staff on the possible public misconception of the term "less protective" used to evaluation Seawater Intrusion conditions in the Basin.
- Another participant asked a question regarding the Advisory Committee's outlook on how it would determine success and failure of its GSP-related decisions and how they would relate this outlook to success as framed in the Charter.
- A participant requested HydroMetrics address two questions:

  1) What assumptions are you making in the model regarding the amount of annual pumping of out Soquel Creek wells?

2) Have or could you model the influx of water in large quantities into the basin from elsewhere (e.g., surface water transfers from the City of Santa Cruz) so that groundwater pumping levels were reduced?

- The last speaker expressed disappointment in the opportunities offered for public comment at the meetings and requested more access to Advisory Committee members outside of the meeting (e.g., via email, telephone). This speaker also requested that a DWR representative attend and have a more active role at each Advisory Committee meeting and suggested inviting representatives from neighboring basins to speak at future meetings. Last, the speaker encouraged the Advisory Committee to consider future concerns (and not just current concerns) of all those concerned in the basins, including agriculture and the cannabis industry.

6. Subsidence - Undesirable Results with Underlying Significant and Unreasonable Conditions

This proposal was not discussed at this meeting and was deferred for discussion at the May 23, 2018 meeting.

7. Confirm March 28, 2018 Advisory Committee Meeting Summary

The Advisory Committee members did not have any edits or comments on the March 28, 2018 Advisory Committee meeting summary. Mr. Poncelet confirmed it for submission to the MGA Board.

8. Next Steps

In closing, Mr. Poncelet reviewed the anticipated meeting objectives for the May and June Advisory Committee meetings, and confirmed that the joint MGA and Advisory Committee meeting will be held on July 19. The group also discussed the possibility of a field trip of the Basin, and setting up document sharing and email addresses for Advisory Committee members. Executive staff members closed the meeting by thanking the attendees for their participation.

Santa Cruz Mid-County Basin
Proposed Draft Seawater Intrusion Minimum Thresholds

This document is a proposed draft that documents preliminary development of some of the Sustainable Management Criteria to be included in the Groundwater Sustainability Plan (GSP). Specifically, the Sustainable Management Criteria included in this document are:

- Seawater intrusion conditions which are considered significant and unreasonable,
- The set of conditions that cause undesirable results which will lead to significant and unreasonable seawater intrusion, and
- Minimum thresholds, which are the metrics included as part of the set of conditions for undesirable results.

The format of the document is:

1. Recap the initial staff proposal presented at the April 25 Advisory Committee meeting.
2. Provide a summary of Committee input during the meeting.
3. Based on Committee input, provide revised technical recommendations to original staff proposals, with a rationale for each specific recommendation.

The recommendations are used to develop proposed draft minimum thresholds needed as metrics against which to evaluate future projects and management actions using the groundwater model.

Seawater Intrusion Significant and Unreasonable Conditions

Staff Proposal at Discussed at April 25, 2018 Advisory Committee Meeting (reworded slightly to avoid confusion caused by statements framed in the negative)

Aromas area – seawater intrusion found at depths shallower than those observed in intruded coastal monitoring wells is significant and unreasonable (i.e., no further seawater intrusion allowed)

and

Purisima aquifer - in currently unintruded areas, seawater intrusion moving inland from the coast (i.e., no onshore seawater intrusion allowed), and seawater intrusion found at depths shallower than those observed in currently intruded Purisima A unit area is significant and unreasonable (Soquel Point (Med))(i.e., no further seawater intrusion allowed)

Summary of Advisory Committee Discussion

The Advisory Committee, in general, supported the technical staff proposal but a few indicated that something less protective than the staff proposal would be acceptable as long as municipal, private or agricultural production wells are still protected. After staff discussions with some of the AC members following the meeting, staff has come to the understanding that the AC members interviewed who were leaning slightly towards something less protective do not want more seawater intrusion but confused the term "less protective" with "more flexible" which is used to set groundwater management evaluation criteria needed to assess and avoid the occurrence of undesirable results.

Revised Statement of Significant and Unreasonable Conditions

Seawater moving farther inland than has been observed in the past five years.

Rationale: This statement reflects the major consensus of Advisory Committee members not wanting to see seawater intrusion advancing. The statement is also much simpler than the original proposed statement but has the same intent. The period of five years is included because although there has not been much recent change in the distribution of seawater intrusion, there has been one seawater intruded well that has experienced decreased chloride concentrations which are now below 250 mg/L. By specifying the past five years, we ensure that we do not allow intrusion back into this area, whereas if we used the historical maximum concentration we would allow concentrations to increase to 700 mg/L (see Table 1 for averages and maximum concentrations for the full record and the past five years).

Table 1: Summary of Intruded Coastal Monitoring Well Chloride Concentrations in mg/L

Monitoring Well Name	Shallowest Intruded Unit	Historical Maximum Chloride	Historical Maximum Year	2013-2017 Average Chloride	2013-2017 Maximum Chloride	Current Chloride	Threshold Chloride Concentration
Moran Lake Med	Purisima A	700	2005	147	230	78	230
Soquel Point Med	Purisima A	1,300	2005	1,104	1,200	1,000	1,200
SC-A8A	Purisima F	8,000	2015	7,258	8,000	7,200	8,000
SC-A2RA	Purisima F	18,480	2001	14,259	16,000	14,000	16,000
SC-A3A	Aromas	22,000	2010	17,955	20,000	17,000	20,000

Seawater Intrusion Undesirable Results

1. Undesirable Results for Intruded Coastal Monitoring Wells

Staff Proposal at April Advisory Committee Meeting

Any coastal monitoring well with current intrusion has 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)

Summary of Advisory Committee Discussion

In general, the Committee was in support of the staff proposal. Some additional thoughts were:

- Members wanted to see what the differences between historical maximum chloride concentrations and the 2013 - 2017 average concentrations are.
- Some members were okay with chloride concentrations in coastal monitoring wells increasing slightly provided pumping wells were not impacted.
- Consider factors that cannot be controlled by the MGA and that could affect chloride concentrations. For example, the southern part of the basin in the Aromas area is of particular concern where the MGA may not have complete control over all pumping since there are a lot of agricultural wells in this area and it is adjacent to the Pajaro Valley subbasin.
- More flexibility could be built-in by increasing the number of consecutive samples to 8 of 8 that need to exceed the selected chloride concentration.
- More flexibility could be built in by exempting one well from meeting the set of conditions for an undesirable result to address concerns about lack of MGA control in the southern part of the basin.

Revised Technical Recommendation: Undesirable Results for Intruded Coastal Monitoring Wells

Any coastal monitoring well with current intrusion has a chloride concentration above its ~~2013 – 2017 average~~ past five year maximum chloride concentration. This concentration must be exceeded in ~~more than 6~~ 2 or more of the last ~~8~~ 4 consecutive samples (quarterly sampled wells).

Rationale: if seawater intrusion had not been reported in wells inland of the coastal monitoring wells when chloride concentrations in the coastal monitoring wells were at their historic high, the likelihood of seawater intruding them in the future if coastal monitoring well concentrations increased back that level again is low. Using the past

five year's historical maximum chloride concentration provides greater flexibility in avoiding undesirable results than using the past five-year's average and is more protective than using the historical maximum, which is mostly higher than the maximum concentration over the past five years.

The number of chloride concentration exceedances should be set at 2 per year to account for occasional fluctuations not related to seawater intrusion. Three or four samples exceeding the recent historical maximum indicates that seawater intrusion has advanced farther inland, which would be considered significant and unreasonable.

Table 1 above includes a list of historical maximum chloride values versus 2013 - 2017 average and 2013 – 2017 maximum chloride concentrations for coastal monitoring wells that have had or have seawater intrusion. A proposed threshold concentration for each intruded well is provided based on its past five year maximum concentration. Note that Moran Lake was previously impacted by seawater (700 mg/L) and its chloride concentration has now decreased to below 250 mg/L.

2. Undesirable Results for Unintruded Coastal Monitoring Wells, and Inland Monitoring and Production Wells

Technical Staff Proposal at April Advisory Committee Meeting

Any Inland Representative Monitoring or Unintruded Coastal Monitoring Well has a chloride concentration above 250 mg/L. This concentration must be exceeded in more than 2 (50%) of the last 4 consecutive samples.

Summary of Advisory Committee Discussion

In general, the Committee was in support of the staff proposal. Some additional thoughts were:

- Pumping wells need lower concentrations but monitoring wells between the coast and the pumping wells can have higher concentrations than the pumping wells if we are certain those levels will protect the pumping wells.
- Consider lower chloride concentrations for inland wells.

Revised Technical Recommendations: Undesirable Results for Unintruded Coastal Monitoring Wells, and Inland Monitoring and Production Wells

The main revision to the technical staff proposal is to include production wells that are closest to the coast as inland monitoring points, together with inland dedicated

monitoring wells. Statements of what is considered undesirable results are broken down by well type/location:

A. Unintruded coastal monitoring wells
B. Unintruded inland monitoring wells (which includes municipal production wells closest to the coast and other non-coastal monitoring wells).

A. Any Unintruded Coastal Monitoring Well has a chloride concentration above 250 mg/L. This concentration must be exceeded in ~~more than 2~~ 2 or more of the last 4 consecutive samples (quarterly sampled wells).

Rationale: Coastal monitoring wells are the basin's early warning system and first line of defense against seawater intrusion, if their chloride concentrations increase to 250 mg/L this is a clear indication that seawater is advancing onshore father than it is today. Water with more than 250 mg/L chloride has a salty taste but is still drinkable to 500 mg/L, which is the state's upper maximum contaminant level. To make sure we have confidence that tested water sample concentrations are not anomalies, at least half of the samples in a year must exceed this 250mg/L concentration to be undesirable.

Table 2: Summary of Unintruded Coastal Monitoring Well Chloride Concentrations in mg/L

Monitoring Well Name	Deepest Unintruded Unit	Historical Maximum Chloride	Historical Maximum Year	2013-2017 Average Chloride	Current Chloride	Threshold Chloride Concentration
Pleasure Point Med	Purisima A	38	2012	34	35	250
SC-1A	Purisima A	51	2013	41	35	250
SC-3A	Purisima A/AA	66	1984	39	55	250
SC-5A	Purisima A	94	2001	55	51	250
SC-9C	Purisima BC	63	1984	28	36	250
SC-8B	Purisima BC	32	2003	14	17	250
SC-8D	Purisima DEF	65	2016	28	21	250

B. Any Unintruded Inland Monitoring Well (which includes municipal production wells closest to the coast and other non-coastal monitoring wells) has a chloride concentration above 150 mg/L. This concentration must be exceeded in 2 or more of the last 4 consecutive quarterly samples.

All wells used as data points to develop the chloride isocontour should have TDS and chloride tested on a quarterly schedule, the same as the coastal monitoring well network. Additionally, seawater must be the cause of the chloride increase and not some other source, such as a localized chemical spill.

Rationale: In the City of Santa Cruz and Soquel Creek Water District's current Cooperative Monitoring/Adaptive Management Agreement, a conservative chloride concentration above 150 mg/L is used together with an increasing chloride trend for production wells closest to the coast to indicate possible seawater intrusion. To ensure seawater does not move farther into the basin and since native chloride concentrations are very low in unintruded wells (generally less than 100 mg/L), monitoring wells inland of the coastal monitoring wells are considered in the early stages of seawater intrusion if their concentrations exceed 150 mg/L. It is possible that inland monitoring wells could have concentrations of 150 mg/L or above, while the coastal monitoring wells still have concentrations below 250 mg/L. In this case, the exceedance of 150 mg/L chloride alerts the MGA that there is a possibility that increases in chloride concentrations may imminently be observed at coastal monitoring wells or that the seawater may have bypassed the coastal monitoring well and threaten production wells.

Ag and Chloride
Chloride moves readily within soil and water and is taken up by the roots of plants. It is then transported to the stems and leaves. Sensitive berries and avocado rootstocks can tolerate only up to 120 mg/L of chloride, while grapes can tolerate up to 700 mg/L or more. (University of California Agriculture and Natural Resources, http://anrcatalog.ucanr.edu/pdf/8066.pdf).

Table 3 lists potential inland wells that could be used to monitor for exceedances of threshold concentrations. The table includes chloride historical maximums and the average chloride concentrations over the past five years. Note there is one inland Aromas monitoring well (SC-A5A) which is already intruded by seawater. We therefore propose to set a threshold concentration of the past five year maximum for that well (this was in 2015 and is the same as the historical maximum), based on the same rationale used for setting the thresholds for intruded coastal monitoring wells.

Table 3: Summary of Inland Monitoring Well Chloride Concentrations in mg/L

Well Name and Type	Aquifer Unit Screened	Historical Maximum Chloride	Historical Maximum Year	2013-2017 Average Chloride	Current Chloride	Threshold Chloride Concentration
Altivo (PW)	Aromas	25	1997	19	25	150
SC-A5A (MW)	Purisima F	9,800	2015	8,575	7,600	9,800
San Andreas (PW)	Purisima F	79	2011	21	20	150
Seascape (PW) (next to SC-A5)	Purisima F	29	1996	20	15	150
Country Club (PW)	Purisima F	40	2003	34	36	150
Aptos Creek (PW)	Purisima DEF & BC	50	1986	41	42	150
T. Hopkins (PW)	Purisima DEF	71	2011	46	44	150
Estates (PW)	Purisima BC & A	63	1990	45	49	150
SC-17A (MW)	Purisima A	27	1985	NA	20	150
Garnet (PW) (next to SC-13)	Purisima A	90	2009	81	81	150
Corcoran Lagoon Deep (MW)	Purisima AA	120	2011	20	20	150
Schwan Lake (MW)	Purisima AA	97	2008	91	94	150
Beltz#2 (MW)	Purisima	97	2008	63	61	150
Beltz#8 (PW)	Purisima A/AA	56	2012	51	52	150
Beltz#9 (PW)	Purisima A	75	2011	50	46	150

3. Undesirable Results for Protective Groundwater Elevations

Technical Staff Proposal at April Advisory Committee Meeting`

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

Summary of Advisory Committee Discussion

In general, the Committee was in support of the staff proposal. Some additional thoughts were:

- Desire to know more about risk associated with protective levels currently being used and what that means for basin management.
- Some members thought that using a 10-year average would provide more flexibility in avoiding Undesirable Results.

Revised Technical Recommendation: Undesirable Results for Protective Groundwater Elevations

~~Five~~ Ten-year average groundwater elevations below protective groundwater elevations in Coastal Monitoring Wells for any Coastal Monitoring Well.

Rationale: It is expected that as the GSP is implemented from 2020 to 2040, projects and management actions will improve basin conditions and groundwater elevations will increase over time. Having a five-year groundwater elevation average will make it easier to avoid undesirable results. However, as it is only after 2040 that we need to show we have groundwater levels higher than protective elevations to be sustainable, having a longer averaging period will provide more flexibility to meet protective elevations and prove sustainability.

The ten-year groundwater elevation average is appropriate to show a path to sustainability in the years prior to 2040 if projects and management actions are able to consistently keep groundwater elevations above protective level basin prior to 2030. The revised technical recommendation is to extend the period for averaging groundwater elevations to ten-years provides more flexibility to avoid undesirable results after 2040.

Minimum Thresholds for Seawater Intrusion

Minimum thresholds are numeric values for each sustainability indicator used to define undesirable results. The chloride concentrations included in the undesirable results recommendations are the minimum thresholds for seawater intrusion monitoring wells. Per the DRAFT Sustainable Management Criteria Best Management Practices (BMP) document, the minimum threshold metric for seawater intrusion is the location of a chloride isocontour on a map. Contrary to the general rule for setting minimum thresholds, the seawater intrusion minimum threshold does not have to be set at individual monitoring sites. Rather, the minimum threshold is set along an isocontour line in a basin or management area. However, with the way undesirable results need to be defined and how the observed isocontour is evaluated based on monitoring wells, for practical purposes, we recommend setting thresholds of 250 mg/L and 150 mg/L at selected monitoring wells used to define the isocontour.

In addition to the chloride isocontour minimum threshold, we will use protective groundwater elevations at coastal monitoring wells as a proxy for seawater intrusion. Protective groundwater elevations are easier to measure and manage with respect to controlling seawater intrusion, compared to chloride concentrations.

Chloride Isocontour

The revised technical recommendations in the preceding sections, based on GSP Advisory Committee input, included undesirable results with chloride concentration metrics at specific wells. These concentrations are used to determine the location of the chloride isocontour representing a minimum threshold for seawater intrusion.

To provide for more locational certainty of the chloride isocontour, we propose to anchor the isocontour, where possible, at coastal monitoring wells, which are located along the coast in the area of municipal production. All but two of the 12 coastal monitoring wells in the basin are within 1,000 feet of the coast. Anchoring the isocontour at coastal monitoring wells allows us to definitively ascertain if concentrations at a data point on the isocontour (coastal monitoring well) have increased beyond the concentration set for the isocontour, i.e., that point on the isocontour is represented by a monitoring well from which concentration data can be obtained and no interpolation is needed.

Additionally, because our statement of significant and unreasonable seawater intrusion conditions is based on historical observations at monitoring wells, it is appropriate to use the same monitoring wells to gauge changes to the location of the isocontour in the

future. It is difficult to monitor the chloride isocontour if it is set at the coast, as there is no data point on the coast from which to obtain concentration data to know if that concentration has been exceeded or not.

Figure 1 presents proposed draft minimum thresholds for seawater intrusion in both the Aromas and Purisima aquifers, represented by the 250 mg/L chloride isocontour. A chloride concentration of 250 mg/L is selected for the minimum threshold for the Santa Cruz Mid-County Basin because native chloride concentrations in groundwater are generally below 100 mg/L. Thus an increase up to the basin water quality objective of 250 mg/L is considered significant. Note that a chloride isocontour of 250 mg/L is relatively low and likely represents some seawater mixed in with native groundwater. Full strength seawater has a chloride concentration of 19,000 mg/L.

If chloride concentrations range between current concentrations and the threshold proposed, we feel confident that seawater is not advancing. If chloride concentrations in wells inland of the isocontour increase to above the threshold levels we have proposed, this will indicate that seawater is moving inland and management actions to remedy it need to take place to ensure that by 2040, chloride concentrations inland of the 250 mg/L isocontour remain below 250 mg/L.

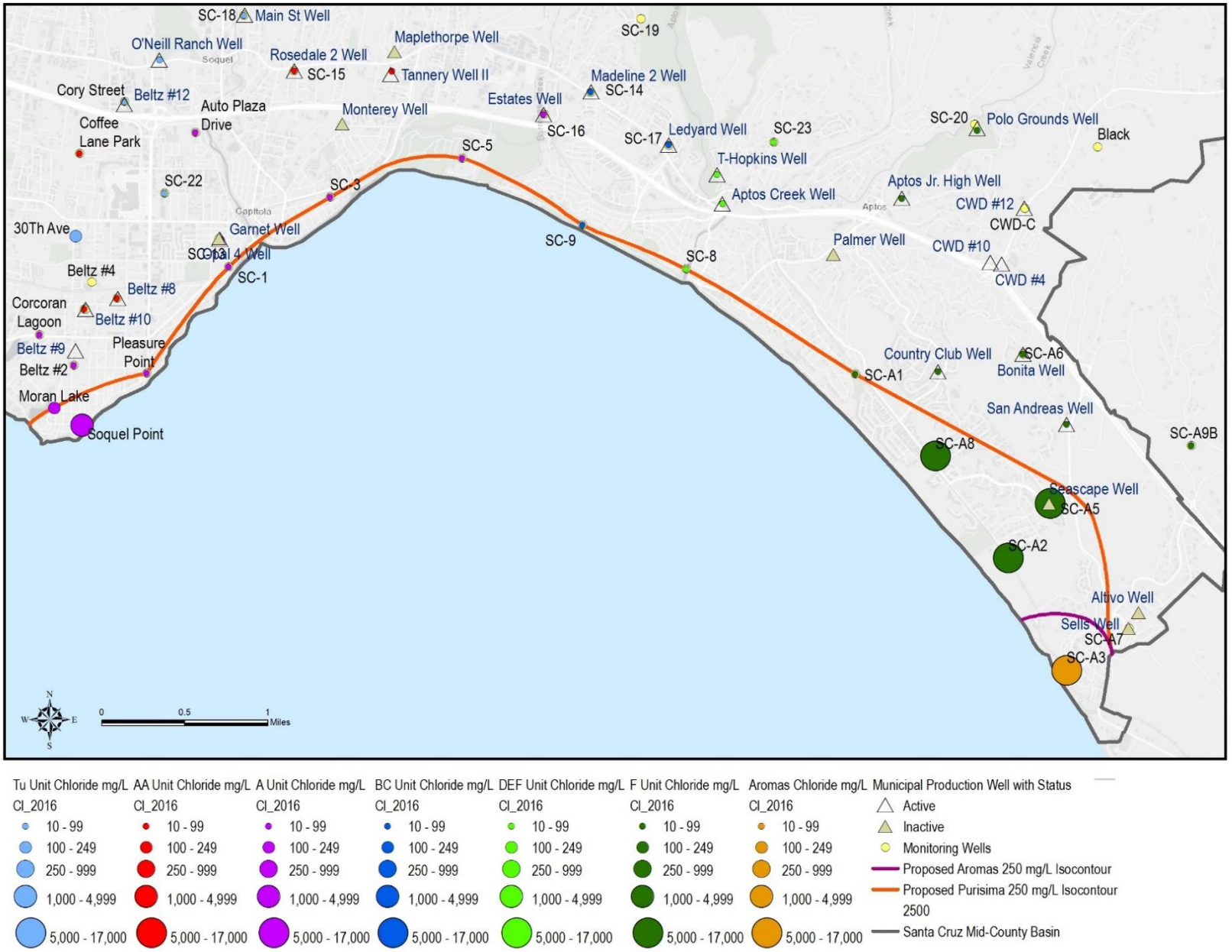


Figure 1: Proposed Draft 250 mg/L Chloride Isocontours for the Aromas and Purisima Aquifers

Protective Elevations

Current protective elevations for coastal monitoring wells are listed in Table 4. These groundwater elevations will be used as proxies for additional minimum thresholds for seawater intrusion. If any new protective elevations are established in the future for the deeper Purisima AA/Tu aquifers, these will also be added as minimum thresholds.

Table 4: Current Protective Elevations to be Used as Proxies for Minimum Thresholds at Coastal Monitoring Wells

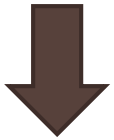
Coastal Monitoring Well	Protective Elevation (feet mean seal level)
Moran Lake Medium	5
Soquel Point Medium	6
Pleasure Point Medium	6.1
SC-1A	6.2
SC-3A	10
SC-5A	13
SC-9C	10
SC-8D	10
SC-A1B	3
SC-A8A	6
SC-A2A	3
SC-A3A	3

Proposed Draft

Seawater Intrusion Minimum Thresholds

Proposed Draft Document format

- Recap the initial staff proposal
- Provide a summary of Committee input
- Provide revised technical recommendations to original staff proposals, with a rationale for each specific recommendation



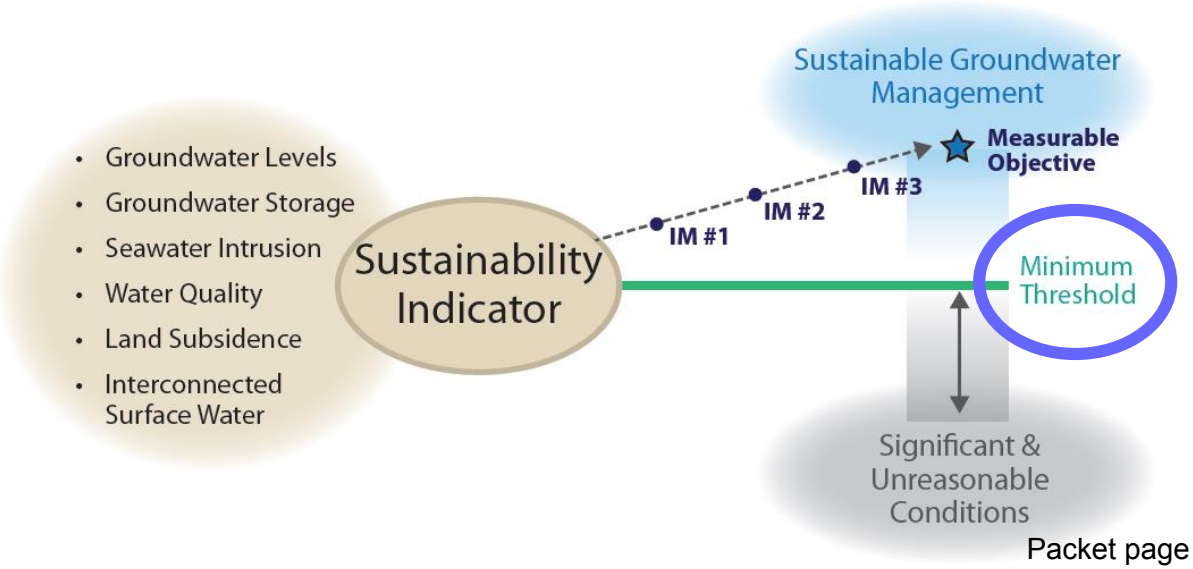
- Minimum Thresholds

Preliminary Development of Sustainable Management Criteria for GSP

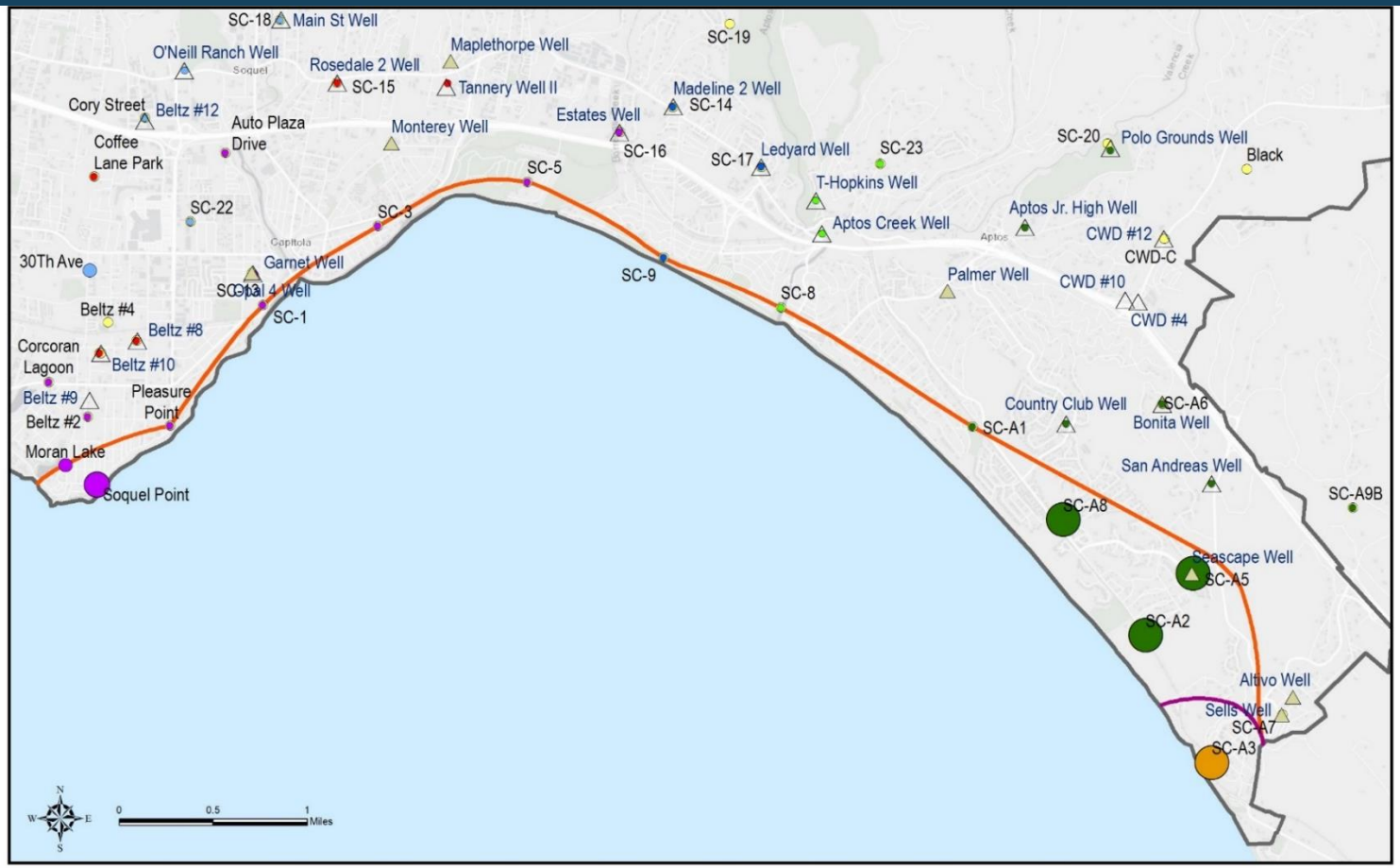
- Statement of Significant and Unreasonable
- Undesirable Results

metrics

- Minimum Thresholds



Chloride Isocontours



Protective Elevations as a Proxy for Seawater Intrusion

Coastal Monitoring Well	Protective Elevation (feet mean seal level)
Moran Lake Medium	5
Soquel Point Medium	6
Pleasure Point Medium	6.1
SC-1A	6.2
SC-3A	10
SC-5A	13
SC-9C	10
SC-8D	10
SC-A1B	3
SC-A8A	6
SC-A2A	3
SC-A3A	3