# Agenda

## Santa Cruz Mid-County Groundwater Sustainability Plan

### *Advisory Committee Meeting #18*

**Wednesday, April 24, 2019, 5:00 – 8:30 p.m.**
**Simpkins Family Swim Center**
**Room A&B - 979 17th Avenue Santa Cruz CA 95062**

**Meeting Objectives**

- Receive and discuss next round of modeling results and Sustainable Management Criteria for the Surface Water Interaction Sustainability Indicator.
- Introduce the Mid-County sustainability goal.
- Receive and discuss an overview of initial draft GSP recommendations (Section 3 of GSP), including refined Sustainable Management Criteria for all Sustainability Indicators.
- Discuss how the Advisory Committee will be making its recommendations, including sharing levels of support.

**Agenda**

| Item No. | Time[1] | Topic | Presenter & Materials |
|---|---|---|---|
| | *4:30 p.m.* | *Arrivals/Committee members collect food for dinner* | |
| 1. | 5:00 p.m. | Welcome, Introductions, Meeting Objectives, and Agenda Review<br>• Review updated project timeline | • Ron Duncan, Soquel Creek Water District<br>• Eric Poncelet, Facilitator<br>*Materials:*<br>*1.1 Agenda*<br>*1.2 Santa Cruz Mid-County Basin Groundwater Sustainability Plan Process Overview Timeline*<br>*Refer to PowerPoint Presentation* |
| 2. | 5:10 p.m. | Oral Communications<br>• *Members of the public to comment on non-agenda items* | • Public |
| 3. | 5:20 p.m. | Project updates<br>• April 18, 2019 Water Use Forecasting Enrichment Session | • Sierra Ryan, County of Santa Cruz |
| 4. | 5:25 p.m. | Discuss Surface Water Interaction Sustainability Indicator<br>• Outcomes of April 8 Surface Water Interaction working group meeting<br>• Latest modeling results | • Georgina King, Montgomery & Associates<br>• Advisory Committee |

[1] The times allotted on this agenda are approximate and are subject to change.

| Item No. | Time[1] | Topic | Presenter & Materials |
|---|---|---|---|
| | | • Proposed Sustainable Management Criteria | *Materials:*<br>*4.1 Technical Staff Proposal: Depletion of Interconnected Surface Water Sustainable Management Criteria*<br>*Refer to PowerPoint Presentation* |
| 5. | 6:25 p.m. | Introduce Mid-County Sustainability Goal<br>• Purpose<br>• Sources of input and DWR guidance<br>• Initial Advisory Committee feedback | • Darcy Pruitt, RWMF<br>• Advisory Committee<br>*Materials:*<br>*5.1 Administrative Draft Groundwater Sustainability Plan Sustainability Goal and Guidance* |
| 6. | 6:40 p.m. | Public Comment | • Public |
| 7. | *6:50 p.m.* | *Break* | |
| 8. | 7:05 p.m. | Receive and discuss overview of initial draft GSP recommendations (Section 3 of GSP), including refined Sustainable Management Criteria for all Sustainability Indicators | • Georgina King, Montgomery & Associates<br>• Advisory Committee<br>*Materials:*<br>*8.1 Santa Cruz Mid-County Basin Summary of All Sustainable Management Criteria* |
| 9. | 7:50 p.m. | Preview of Advisory Committee deliberations and voting on recommendations to MGA Board | • Eric Poncelet, Facilitator<br>• Advisory Committee<br>*Refer to PowerPoint Presentation* |
| 10. | 8:05 p.m. | Public Comment | • Public |
| 11. | 8:15 p.m. | Confirm:<br>• Draft February 27, 2019 GSP Advisory Committee Meeting Summary<br>• Draft March 27, 2019 GSP Advisory Committee Meeting Summary | • Advisory Committee<br>• Eric Poncelet, Facilitator<br>*Materials:*<br>*11.1 Draft Meeting Summary Groundwater Sustainability Plan Advisory Committee Meeting #16, February 27, 2019*<br>*11.2 Draft Meeting Summary Groundwater Sustainability Plan Advisory Committee Meeting #17, March 27, 2019* |
| 12. | 8:20 p.m. | Recap and Next Steps<br>• Anticipated GSP roll-out process | • Eric Poncelet, Facilitator<br>• Sierra Ryan, County of Santa Cruz |
| | *8:30 p.m.* | *Adjourn* | |

# Santa Cruz Mid-County Basin Groundwater Sustainability Plan (GSP) Process Overview Timeline March – November 2019

2019

3/19 4/19 5/19 6/19 7/19 8/19 9/19 10/19 11/19 12/19

Santa Cruz Mid-County GSP Advisory Committee Objectives for March – November 2019

## Mar 27, 2019
- Discuss modeling results for Reconfigured Aquifer Storage and Recovery and combined projects
- Discuss Sustainable Management Criteria for Groundwater Storage and Seawater Intrusion
- Receive primer and share initial reflections on "who pays for what?" related to projects and rationale behind funding/payment
- Review and confirm representative monitoring wells for each sustainability indicator

***Enrichment Session: Forecasting Water Use from Land Use and Population (April 18)**
- Discuss relationship between population, land use, conservation and forecasting water supply
- Relate these factors to GSP

## Apr 24, 2019
- Introduce Mid-County sustainability goal
- Discuss next round of modeling results for Surface Water Interaction
- Receive and discuss overview of initial draft GSP recommendations (Section 3 of GSP), including refined sustainability indicator management criteria for all sustainability indicators

## May 16, 2019 (Joint MGA/Advisory Committee):
- Discuss Mid-County sustainability goal
- Discuss implementation plan, funding tools and milestones (Section 5 of GSP)
- Discuss draft compilation of recommendations and modeling results for Sustainable Management Criteria (Section 3 of GSP)

## June 19, 2019
- Discuss implementation plan schedule (Section 5 of GSP)
- Refine recommendations for Sustainable Management Criteria
- Discuss level of support for Advisory Committee recommendations to the MGA Board
- End of Advisory Committee process

**Committee work is anticipated to conclude*

## July 2019
- Deliver draft GSP and set of recommendations on Sustainable Management Criteria to MGA Board
- Public/Open House Meeting

## Sep 2019
- MGA Board Report Back on final deliberations related to GSP
- MGA Board final action on GSP

## Nov 2019
- MGA Board Follow-up on final GSP actions as needed

1/19 2/19 3/19 4/19 5/19 6/19 7/19 8/19 9/19 10/19 11/19 12/19



Revised 04/02/2019

# Technical Staff Proposal

# Depletion of Interconnected Surface Water

# Sustainable Management Criteria

This document is organized into the following three sections:

1. Background – This section describes:
   - Information on the Surface Water Working Group.
   - Which aquatic species and other surface water uses are most vulnerable to depletion of surface water interconnected with groundwater?
   - Where surface water is connected to groundwater and potentially influenced by pumping.
   - What we currently know about surface water and groundwater interconnection from the results of analysis of rainfall runoff relationships, initial model analysis, observations of groundwater levels adjacent to the stream, an analysis of streamflow records for Soquel Creek, and relationship of steelhead populations to flow.

2. Technical staff proposal for representative monitoring wells from which to monitor the sustainability indicator through use of groundwater level proxies.

3. Technical staff proposal for what is considered Significant and Unreasonable chronic lowering of groundwater levels (i.e., groundwater level conditions we want to avoid).

4. Technical staff proposal for preliminary minimum thresholds and measurable objectives.

# 1. Background

## SURFACE WATER WORKING GROUP

The Surface Water Working Group was established as an ad-hoc working group of the Groundwater Sustainability Plan (GSP) Advisory Committee to bring experts on wildlife and aquatic ecosystems into the discussion around how groundwater management can and should be used to improve the condition for surface water and dependent species. The Working Group includes staff and representatives from the following entities:

- GSP Advisory Committee
- California Department of Fish and Wildlife
- City of Santa Cruz
- County of Santa Cruz
- Friends of Soquel Creek
- NOAA Fisheries
- PV Water
- Regional Water Management Foundation/MGA
- Resource Conservation District of Santa Cruz County
- The Nature Conservancy
- Environmental Defense Fund
- US Fish and Wildlife Service

The Working Group has met four times over a one-year timespan. Members of the Working Group emphasized the importance of preventing depletion of interconnected surface water that would have significant and unreasonable adverse impacts on beneficial uses of the surface water and the groundwater dependent ecosystems (GDEs) they support. The Working Group discussed the fact that fish populations and streamflow are influenced by many factors, including precipitation, surface diversions, geology, soils, fog, morphology, and evapotranspiration, among others, in addition to groundwater. Additionally, there appear to be a number of locations in the basin where groundwater is not historically connected to streamflow due to geologic conditions in those areas.

Groundwater levels were determined by the technical staff to be an appropriate proxy for measuring effect on interconnected surface water. This idea has been generally supported by the Surface Water Working Group. The consensus of the group is that the Mid-County Groundwater Agency (MGA) should strive to achieve groundwater levels high enough to maintain or increase groundwater contributions to streamflow that protect fish habitat. The GSP Advisory Committee should recommend minimum thresholds that protect against significant and unreasonable impacts to GDEs in the basin that are linked directly to groundwater levels in principle aquifers, and which can be addressed through sustainable groundwater management.

## AQUATIC SPECIES VULNERABLE TO SURFACE WATER DEPLETION

The Sustainable Groundwater Management Act (SGMA) defines an undesirable result as "depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water." In order to address this issue, it is necessary to identify the potentially affected beneficial uses, the aquatic species and habitats that could be adversely affected by lowered groundwater levels in principle aquifers and interconnected surface water depletions, and the degree to which groundwater and surface water depletion is having an impact when accounting for other changes in the system.

Using guidance developed by The Nature Conservancy (https://groundwaterresourcehub.org/), and input from MGA technical staff, the Working Group reviewed information on the distribution of aquatic species throughout the basin and the habitat requirements for those species. Where possible, the potential effect groundwater management could have on habitat was also discussed with the Working Group. The Working Group agreed to the following:

- The assessment should only address impacts to surface water that are directly related to groundwater. There are many factors that affect streamflow including rainfall, evapotranspiration, and surface water diversions, that are beyond the scope of the Groundwater Sustainability Plan (GSP). These factors must still be accounted for in the analysis.
- The Basin supports numerous aquatic species of concern. Steelhead and coho salmon are priority species for evaluating the effects of groundwater management. By managing for their specific habitat requirements in basin streams, the needs of other aquatic species of concern will be met (see Table 1 for occurrences of non-salmonid aquatic species found through the County's monitoring program).
- Maintaining flow for fish will also support other beneficial uses of streams and downstream lagoons, including recreational use and domestic supply, among others. Note that while coho do not appear in the California Natural Diversity Database (Figure 2), they have been seen in the basin though the County's monitoring program. Branciforte, Soquel, and Aptos Creeks are designated as coho recovery streams.
- Similarly, riparian forest that includes native trees like willow and sycamore were identified as a habitat type that should be prioritized for management. For those species, if groundwater levels are maintained at a level to support streamflow for fish, then the groundwater levels should also be high enough to supply the roots of the riparian vegetation.
- Modeling and management should focus on areas of highest groundwater extraction where streams are interconnected with groundwater.

- Linking the basic water needs of the species and habitats of concern, relative to groundwater elevations, is an appropriate way to move forward with the assessment and development of sustainable management criteria to benefit those species.
- Species and habitat types that are found in the basin but would not benefit as directly from groundwater management were removed from future consideration. These include the Santa Cruz Black Salamander, Anderson's Manzanita, Santa Cruz tarplant and Santa Cruz Sedge. See Table 2 for a complete summary of species evaluated in this process.

The Working Group also considered the issue of possible marine ecosystems dependent on freshwater outflow of groundwater into the marine environment. However, after discussions with researchers and further consideration, the Group determined that any possible ecosystem effects would be challenging to evaluate, are likely quite small if they exist at all, and will benefit from the management policies put in place to protect priority aquatic species.

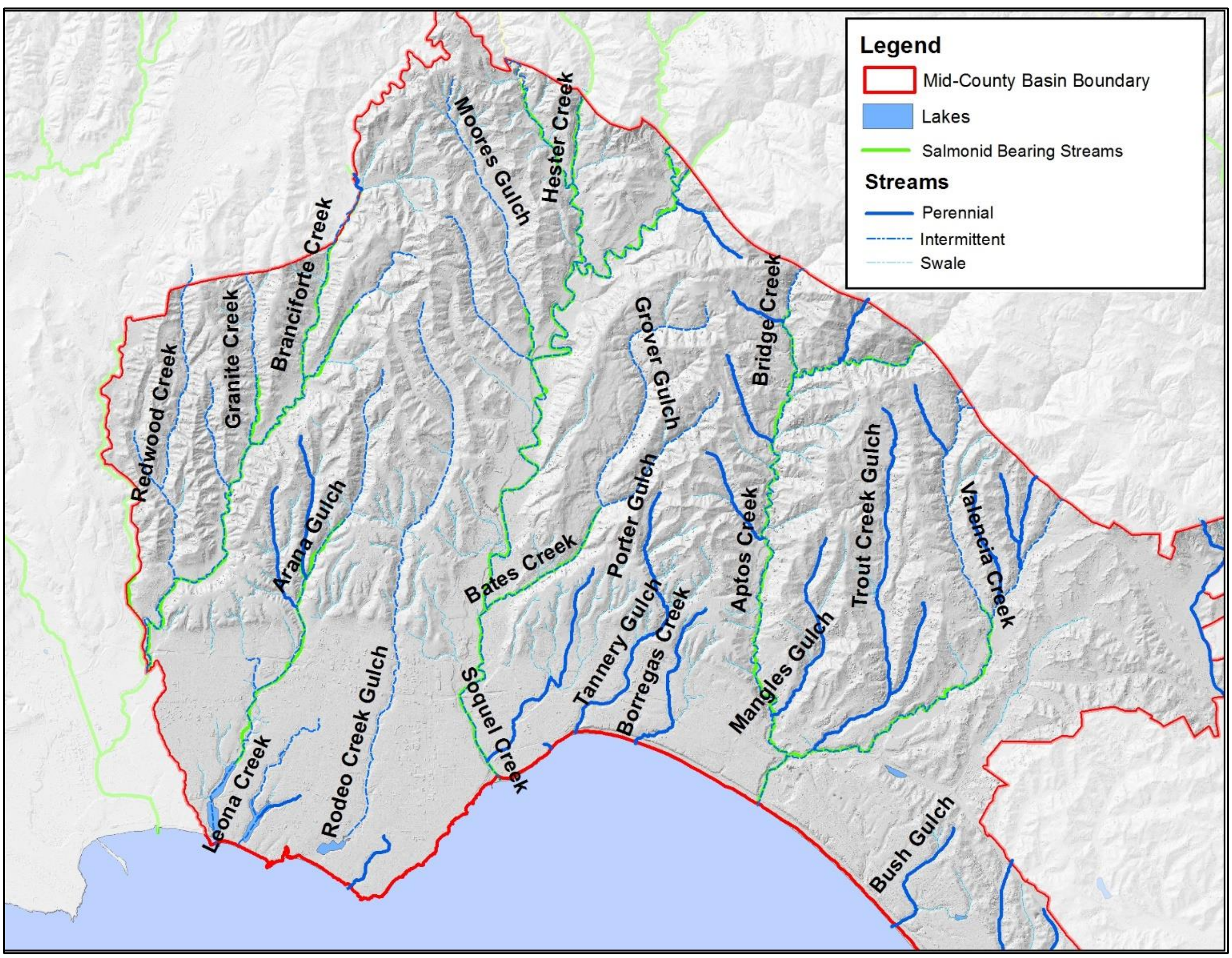



*Figure 1. Stream Habitat in the Mid-County Basin*

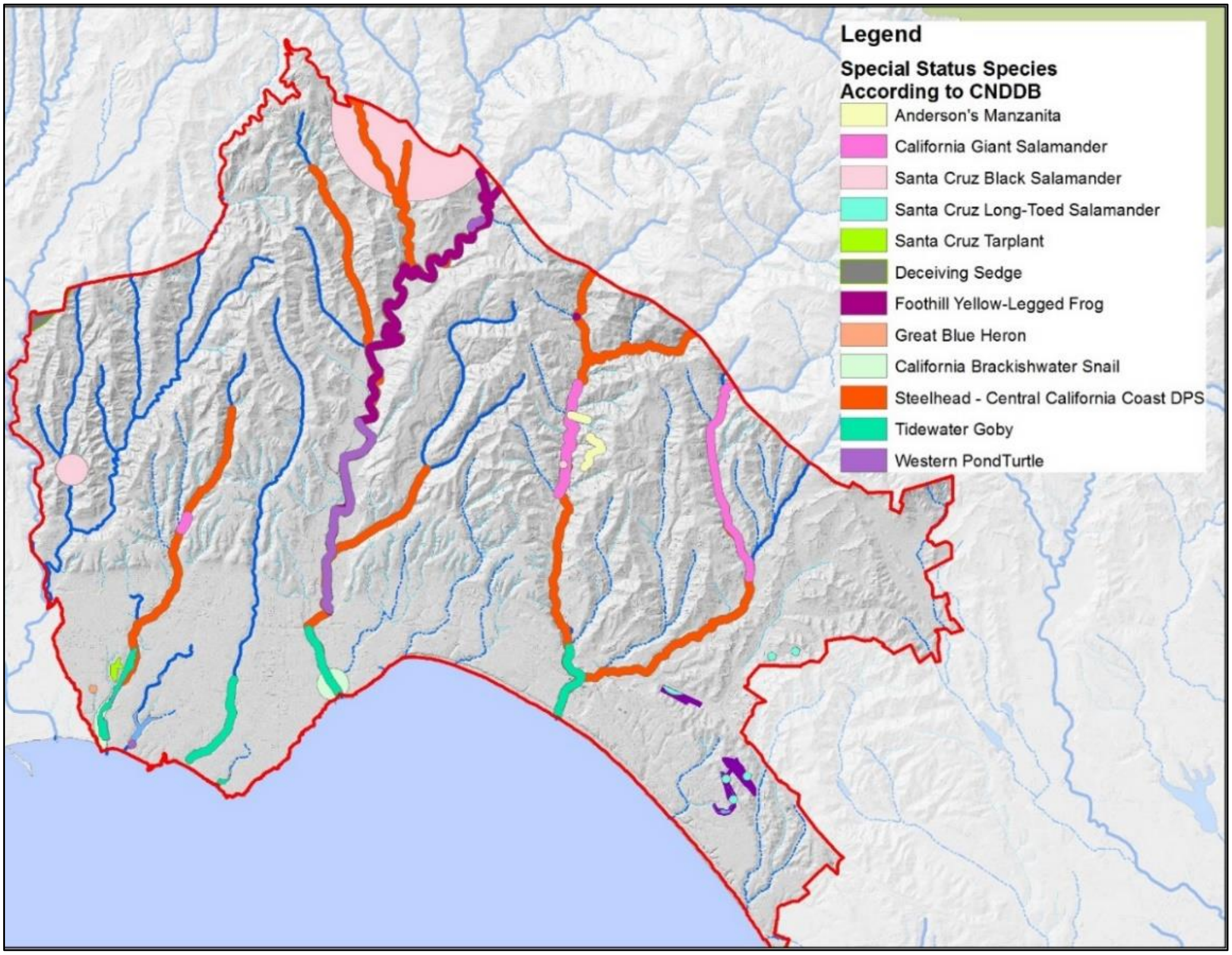



*Figure 2. Distribution of Species throughout the Mid-County Basin according to the California Natural Diversity Database. Several streams support multiple species. Note that due to the layering of species on the map, some species that use the entire stream reach, steelhead for example, may appear only to use part of it.*

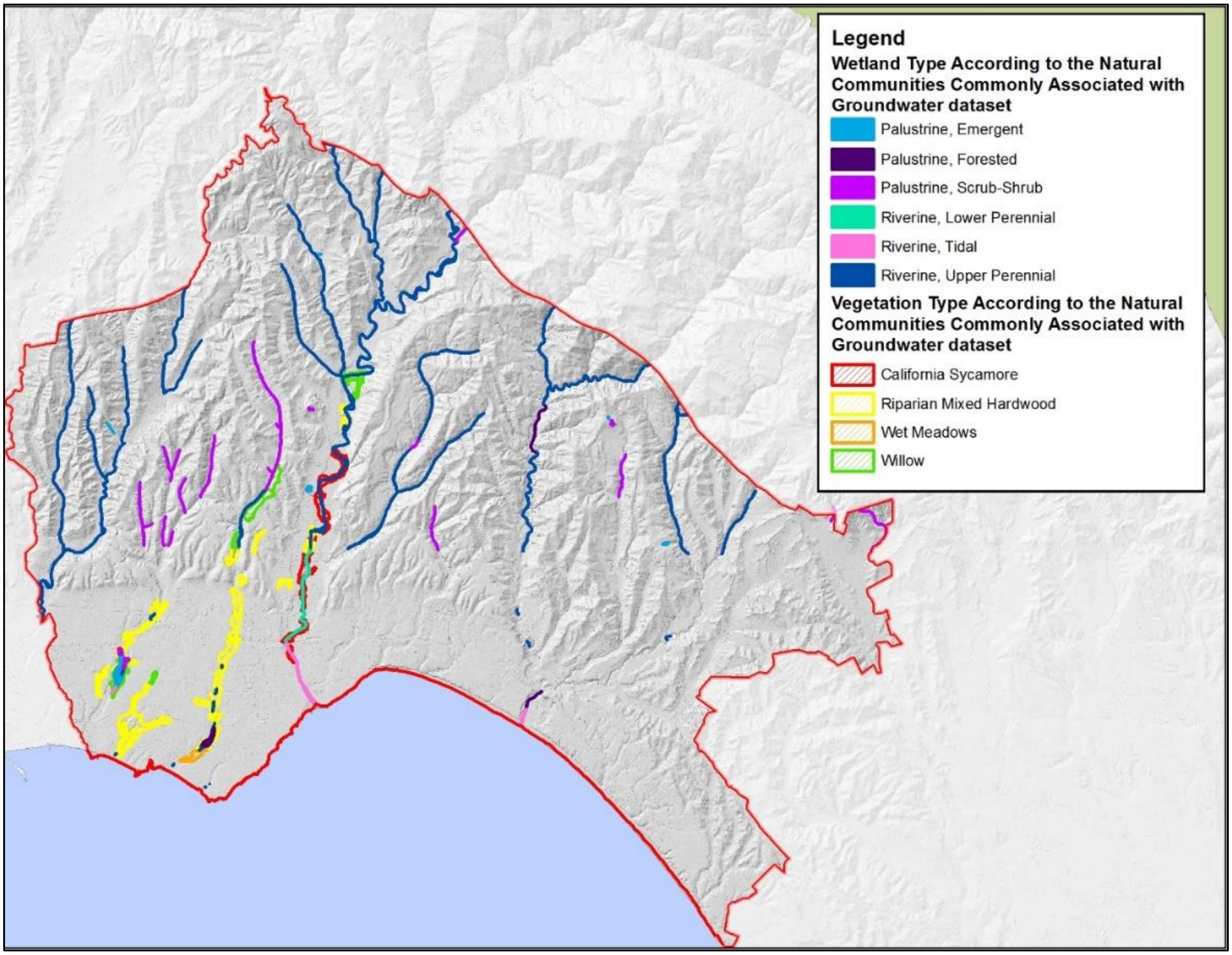



*Figure 3. Wetland and Vegetation Types according to the Natural Communities Commonly Associated with Groundwater Dataset*

*Table 1. Non-salmonid Aquatic Species Identified in Mid-County Streams during Field Sampling Program, 1996-2017. The Sample Count column indicates the number of times over the sampling period that the site was visited. The other Columns show the number of times that specific species were found during those visits.*

| Site | Sample Count | LAMPREY | GIANT SALAMANDER | YELLOWLEGGED FROG | TIDEWATER GOBY | REDLEGGED FROG | WESTERN TURTLE |
|---|---|---|---|---|---|---|---|
| SLR-bran-21a1 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| SLR-bran-21a2 | 15 | 10 | 0 | 0 | 0 | 0 | 0 |
| SLR-bran-21b | 10 | 2 | 0 | 0 | 0 | 0 | 0 |
| SLR-bran-21c | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| SOQ-east-13b | 4 | 0 | 0 | 1 | 0 | 0 | 0 |
| SOQ-main-1 | 20 | 8 | 0 | 1 | 0 | 0 | 0 |
| SOQ-main-2 | 9 | 1 | 0 | 0 | 0 | 0 | 0 |
| SOQ-main-3 | 7 | 1 | 0 | 1 | 0 | 0 | 0 |
| SOQ-main-4 | 21 | 8 | 1 | 14 | 0 | 0 | 0 |
| SOQ-main-5 | 6 | 0 | 0 | 3 | 0 | 0 | 0 |
| SOQ-main-6 | 9 | 1 | 0 | 3 | 0 | 0 | 0 |
| SOQ-main-7 | 6 | 1 | 0 | 2 | 0 | 0 | 0 |
| SOQ-main-8 | 7 | 1 | 0 | 5 | 0 | 0 | 0 |
| SOQ-main-9 | 10 | 2 | 0 | 3 | 0 | 0 | 0 |
| SOQ-main-10 | 22 | 6 | 2 | 10 | 0 | 0 | 0 |
| SOQ-main-11 | 5 | 1 | 0 | 1 | 0 | 0 | 0 |
| SOQ-main-12 | 21 | 10 | 2 | 11 | 0 | 0 | 0 |
| SOQ-east-13a | 22 | 5 | 3 | 9 | 0 | 0 | 0 |
| SOQ-west-19 | 17 | 4 | 3 | 1 | 0 | 0 | 0 |

| Site | Sample Count | LAMPREY | GIANT SALAMANDER | YELLOWLEGGED FROG | TIDEWATER GOBY | REDLEGGED FROG | WESTERN TURTLE |
|---|---|---|---|---|---|---|---|
| SOQ-west-20 | 9 | 0 | 3 | 0 | 0 | 0 | 0 |
| SOQ-east-14 | 10 | 3 | 0 | 5 | 0 | 0 | 0 |
| SOQ-west-21 | 13 | 2 | 9 | 0 | 0 | 0 | 0 |
| APT-apto-3 | 13 | 1 | 1 | 0 | 1 | 0 | 0 |
| APT-apto-4 | 13 | 1 | 3 | 0 | 0 | 0 | 0 |
| APT-vale-2 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| APT-vale-3 | 9 | 0 | 1 | 0 | 0 | 0 | 0 |

*Table 2. Summary of Prioritized Species for GDE Management*

| Species common name | Priority for GDE management | Removed – needs covered by priority species (*), or not impacted by groundwater management |
|---|---|---|
| Steelhead | X | |
| Coho Salmon | X | |
| Riparian forest including willow and sycamore | X | |
| California Brackishwater Snail | | X* |
| Tidewater Goby | | X* |
| Wet Meadows | | X* |
| Lamprey | | X* |
| Santa Cruz Long-Toed Salamander | | X |
| Santa Cruz Black Salamander | | X |
| Foothill Yellow-Legged Frog | | X* |
| California Red-Legged Frog | | X* |
| Western Pond Turtle | | X* |
| Anderson's Manzanita | | X |
| Santa Cruz tarplant | | X |
| Deceiving sedge/Santa Cruz Sedge | | X |

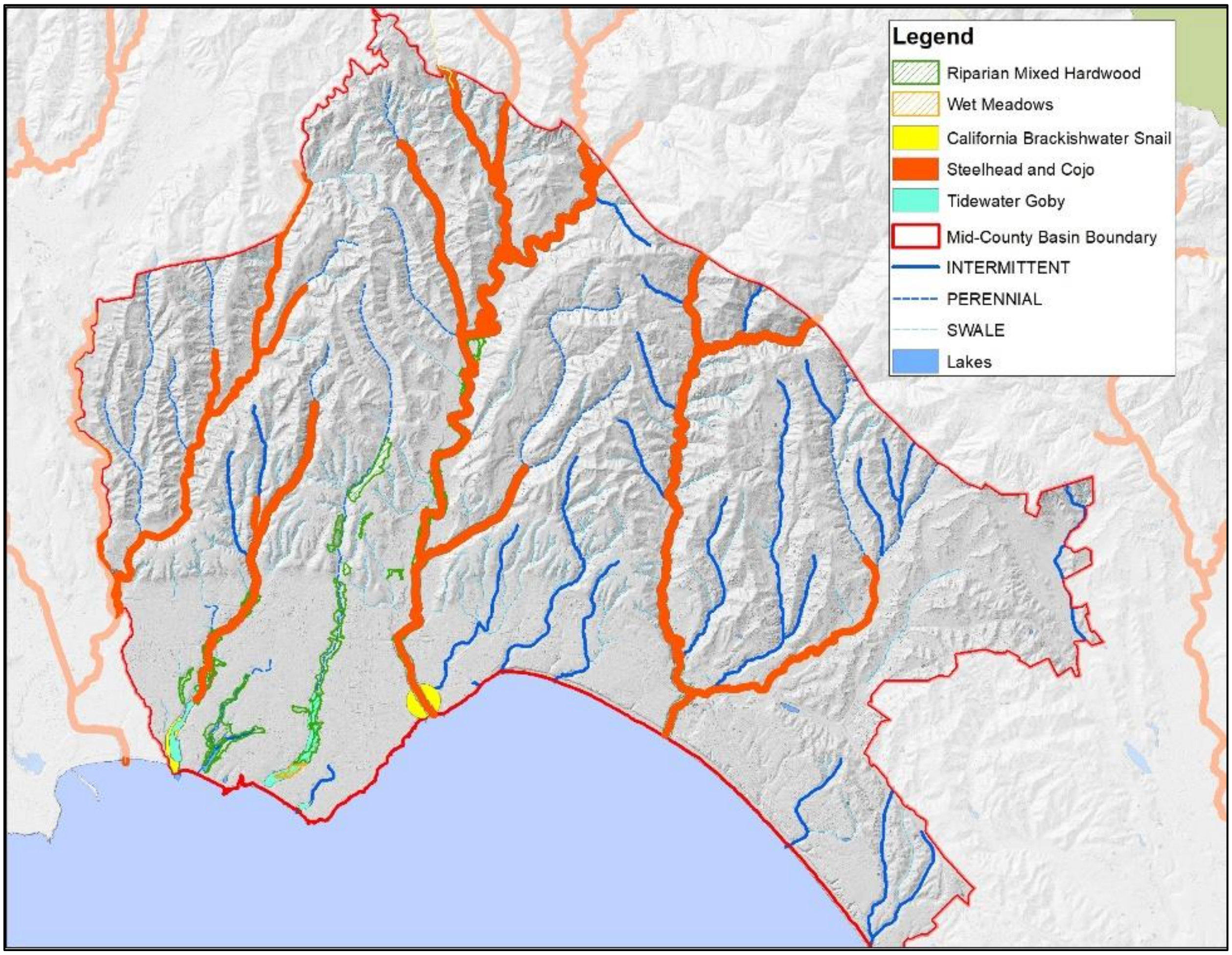



*Figure 4. Final GDEs for Consideration*

## OTHER BENEFICIAL USERS OF SURFACE WATER

There are a number of users of surface water in the Basin that utilize direct diversions of stream water for domestic use, irrigation, or stock watering. The State Water Resources Control Board water rights database shows 31 active surface water diversions in the Soquel Creek watershed, 18 active diversions in the Branciforte Creek watershed, and 2 active diversions in the Aptos Creek watershed. The City of Capitola has an appropriative right for up to 3 cfs at the mouth of Soquel Creek to maintain a lagoon for recreational use and fire-fighting.

Water rights on Soquel Creek were adjudicated in 1977. The adjudication allocated 0.35 cfs to 244 first priority water rights holders (domestic use), 2.37 cfs to 161 second priority rights holders (irrigation and stock watering), and 3.42 cfs to 17 third priority rights holders (appropriative rights, including Capitola). There was no water reserved for maintaining instream flows, public trust benefits, or additional unexercised riparian rights. Despite the overallocation of stream water, recent stream surveys in 2013 and 2014 indicate limited actual diversion of water from Soquel Creek (6 diversions were observed on the mainstem). Gaging of flow indicates relatively limited occurrences of measurable flow reduction from diversions. The groundwater management objective for maintaining groundwater inflow to the creek to support aquatic species should also ensure adequate water availability for stream diverters, although there are ongoing efforts to work with diverters to minimize their impacts on dry season streamflow.

## WHERE SURFACE WATER IS CONNECTED TO GROUNDWATER

Throughout the basin there is spatial variation in the percent of time surface waters are connected to groundwater. Figure 6 shows the spatial connection of groundwater and surface water based on groundwater model output of the percent of time surface water is connected to groundwater between Water Year 1985 and 2015. This information is generally supported by observations of groundwater levels where we currently have monitoring wells. As we proceed with implementation of the GSP, we will be conducting additional monitoring and continuing to refine the groundwater model to improve our understanding of the location and nature of the groundwater-surface water connections on priority streams.

Where streams are disconnected, groundwater levels are well below the bottom of the stream (Figure 7). Although water is typically percolating out of the stream down to the underlying groundwater, the rate of loss is not affected by the elevation of the groundwater. Where streams are connected to groundwater, the stream may be gaining or losing water and the rate of gain or loss is affected by the groundwater level relative to the stream bottom.

- The Eastern side of the basin, specifically upper Valencia Creek, Trout Creek Gulch, as well as a number of ponds, are connected to groundwater less than 5% of the time. This may be a geologic condition of the highly permeable underlying Aromas and Purisima F units, as shown in Figure 6, and/or also may be influenced by the lowered groundwater levels in the adjacent Pajaro Basin.
- Soquel and Branciforte Creeks have the most connection to groundwater. Some reaches in those streams are connected to groundwater more than 95% of the time.
- Most of the rest of the streams in the basin have connection between 30-95% of time.

Developing sustainable management criteria for depletion of interconnected surface water needs to consider not only how often there is connection with groundwater, but also how much that connection influences streamflow, and the location of groundwater pumping that may affect groundwater levels and streamflow (Figure 8). Soquel Creek is the primary stream in the basin where there are major pumping centers and a connection between surface and groundwater (Figure 6Figure 8. Map showing why Different Parts of the Basin were not Prioritized for Data Analysis ). Additional monitoring locations on other streams are proposed in Section 2, in order to verify limited influence of groundwater pumping on other streams (Aptos Creek and Rodeo Gulch).

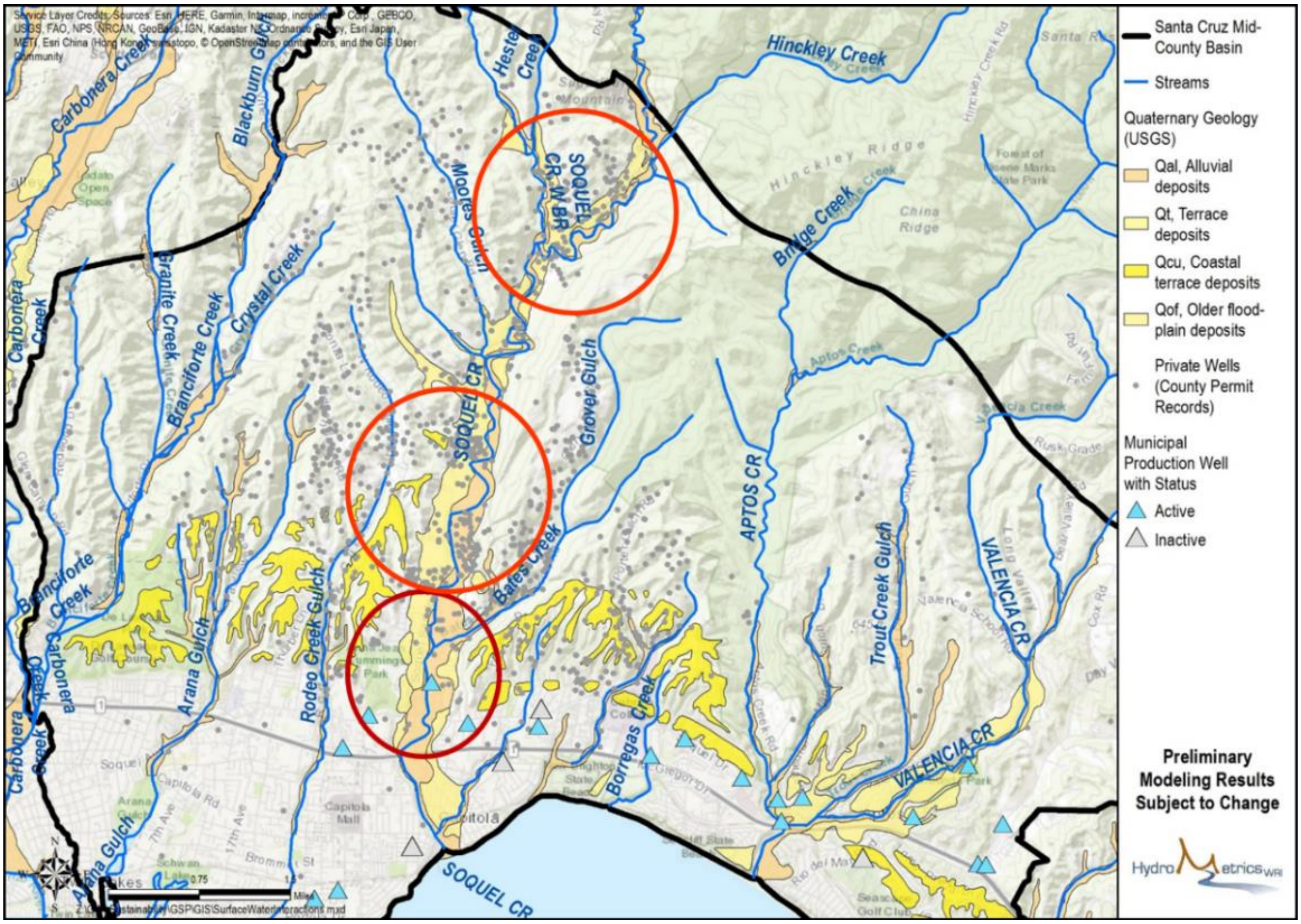



*Figure 5. Areas of Concentrated Groundwater Pumping along Soquel Creek*

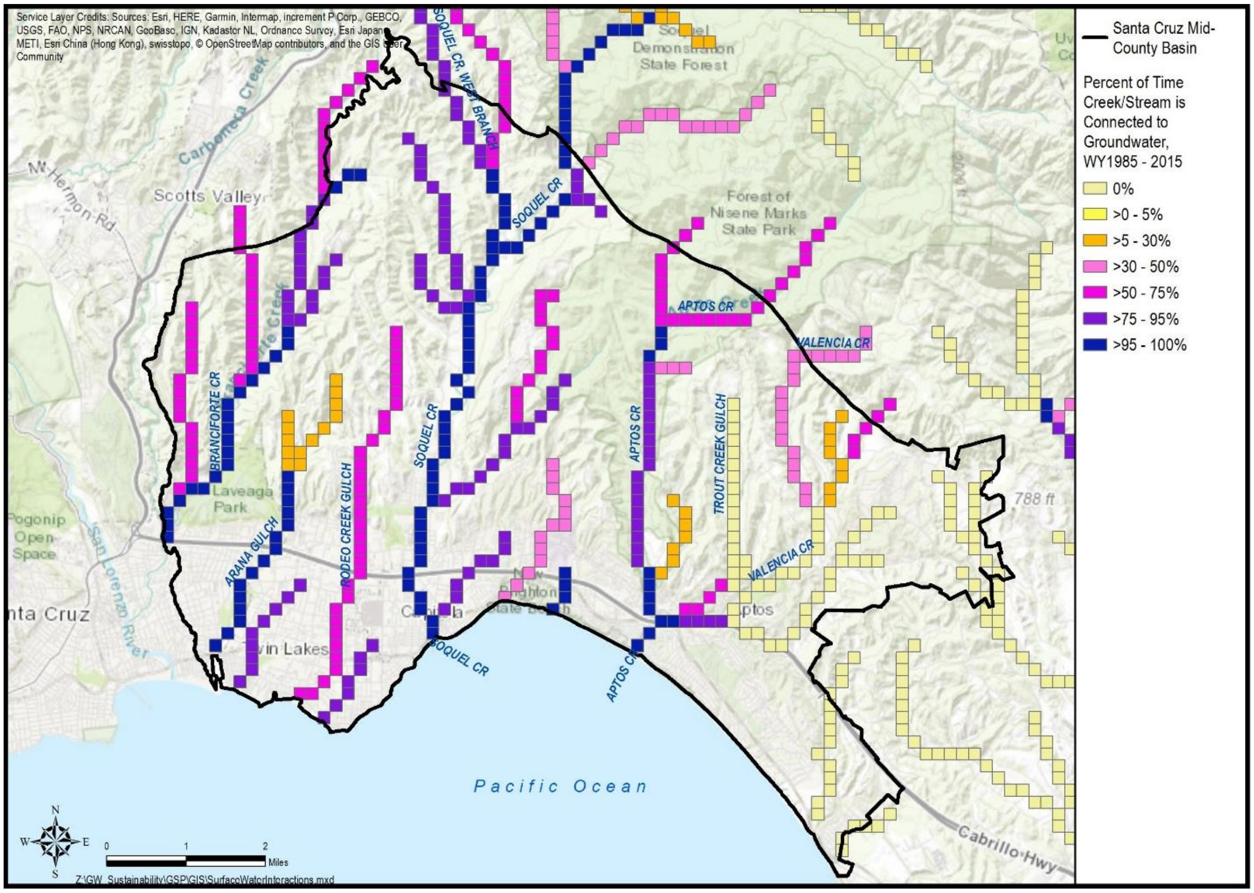



*Figure 6. Percent of Time Streams are Connected to Groundwater (WY 1985 – 2015)*

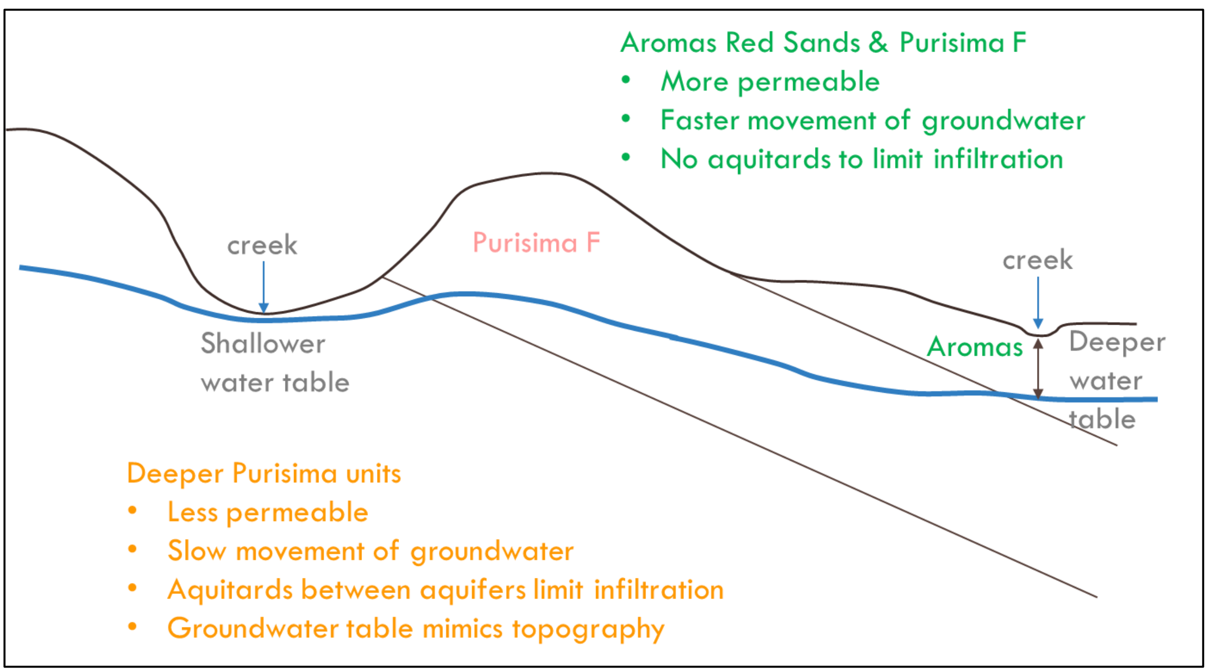



*Figure 7. Schematic Illustrating the Difference between Purisima and Aromas Connection to Groundwater*

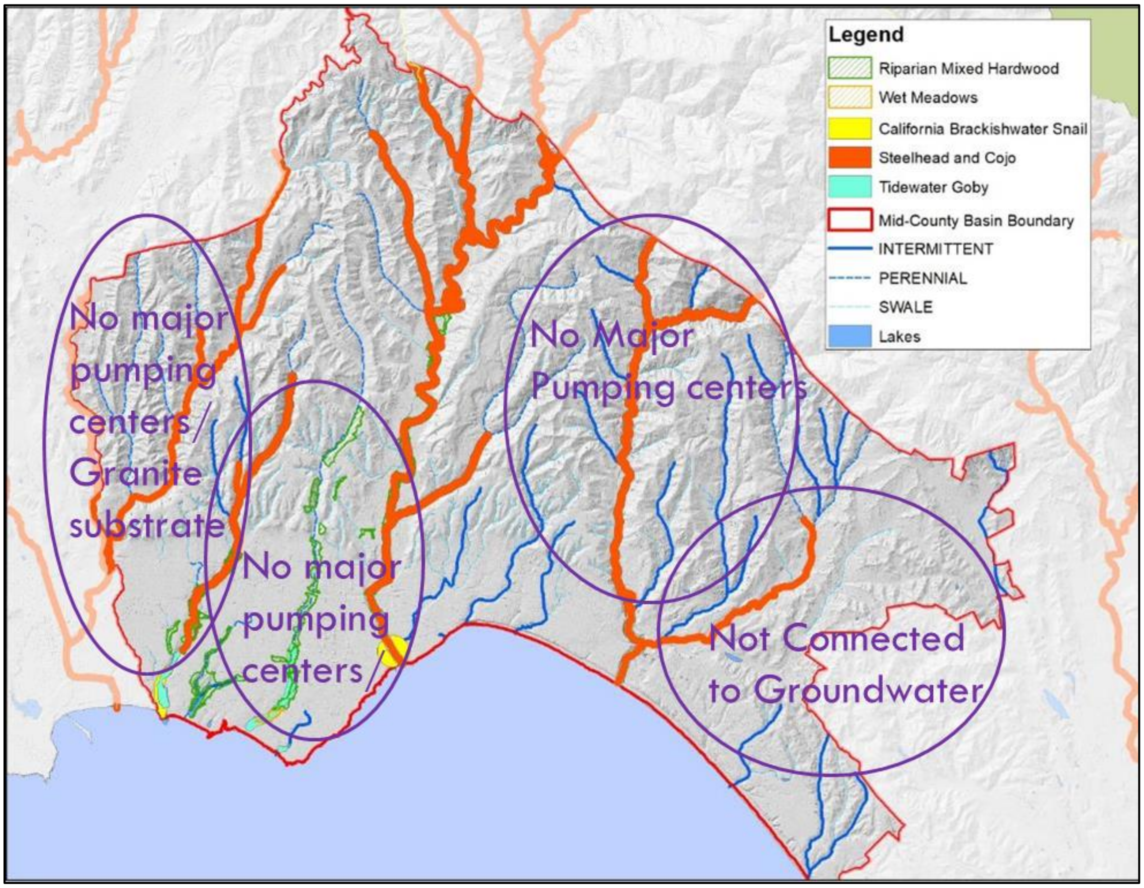



*Figure 8. Map showing why Different Parts of the Basin were not Prioritized for Data Analysis*

## SIMULATED GROUNDWATER - SURFACE WATER INTERACTIONS

Our current understanding of surface water and groundwater interactions are being informed by both direct monitoring of streamflow and groundwater levels, and by simulating surface and groundwater flow using an integrated surface water/groundwater model. The interactions are simulated through several components of flow using the surface portion of the model, called the Precipitation-Runoff Modeling System (PRMS). Figure 9 illustrates the surface processes that are simulated by the integrated model. In particular, interactions with surface water (stream) occur through surface runoff, interflow, and groundwater. Figure 10 through Figure 12 show output from the calibrated groundwater model for groundwater contribution to streamflow compared to runoff and interflow (surface/near-surface) contributions and total streamflow during the month with lowest streamflow for each water year. Figure 10 and Figure 11 show results for the two modeled stream segments, Simons to Balogh and Main Street to Nob Hill, where there are shallow groundwater data from which to calibrate, stream-aquifer interactions are high relative to the model as a whole, and are near municipal pumping. Figure 10 and Figure 11 show that groundwater only contributes a small amount of flow (< 0.5 cfs) to each of these segments of Soquel Creek in the months with lowest flows, but the groundwater contributions for the segments are greater than surface/near-surface contributions in those months as most of the streamflow comes from higher up in the watershed. Figure 12 shows what the model simulates for relative contribution of groundwater versus surface/near-surface flows for the entire watershed in minimum streamflow months. For the entire watershed, surface/near-surface contribution is simulated as greater than groundwater contribution and drives the inter-annual variability in streamflow. The groundwater contribution is simulated as approximately 1 cfs.

Given the uncertainty in the groundwater modeling, and recognizing the possible importance of even small amounts of groundwater flow contributions or additional flow depletions during low flow periods, we intend to improve monitoring and our understanding over time and revisit these estimates as new information is developed.

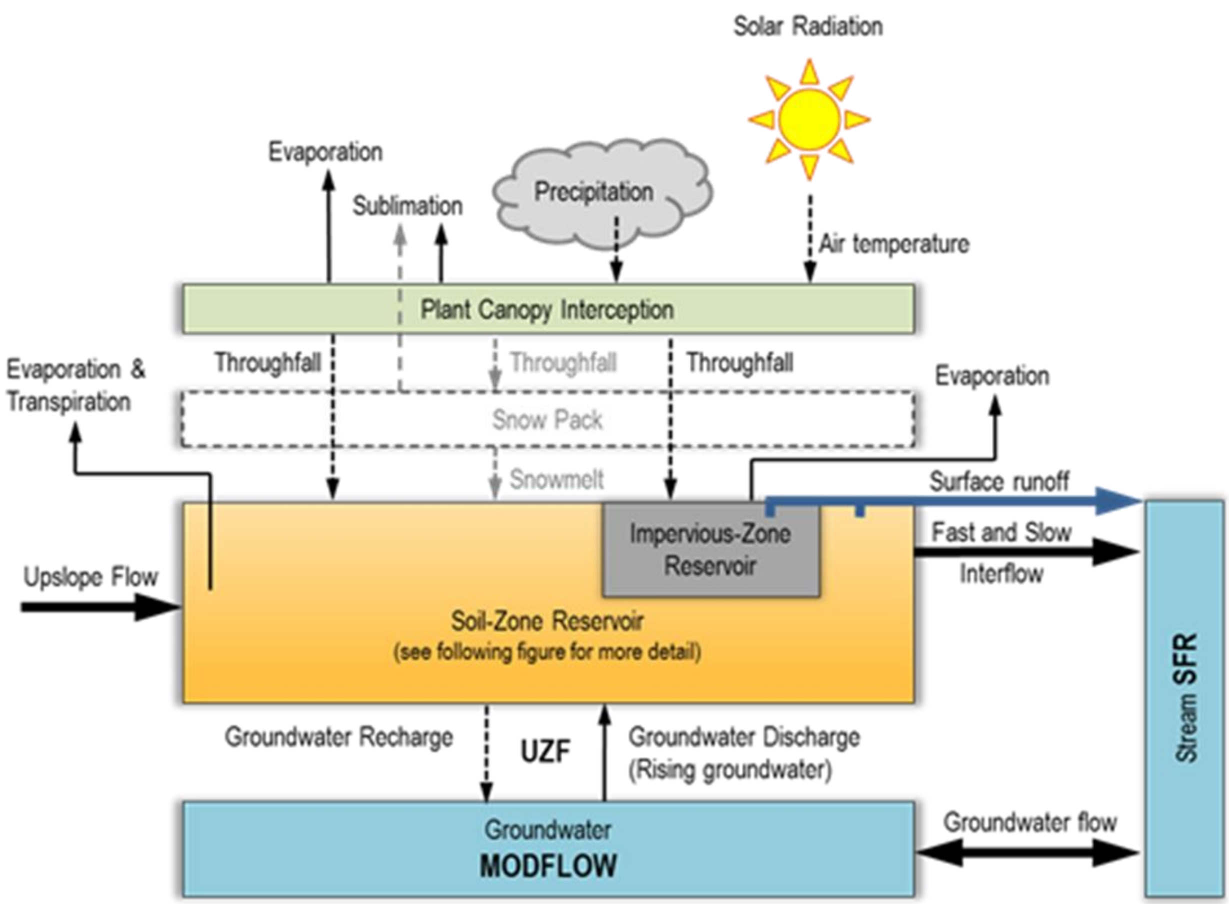



*Figure 9. Hydrologic Process Simulated by the Precipitation-Runoff Modeling Systems*

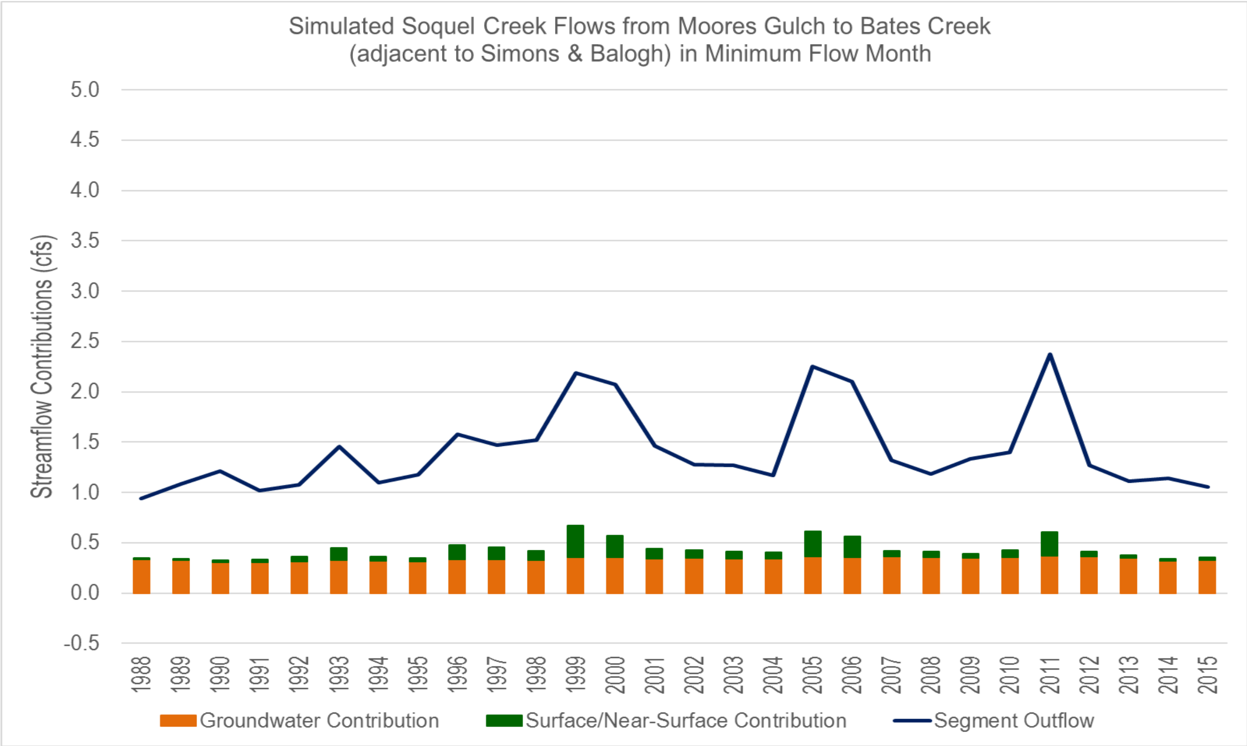



*Figure 10. Simulated Minimum Monthly Flows from Moores Gulch to Bates Creek*

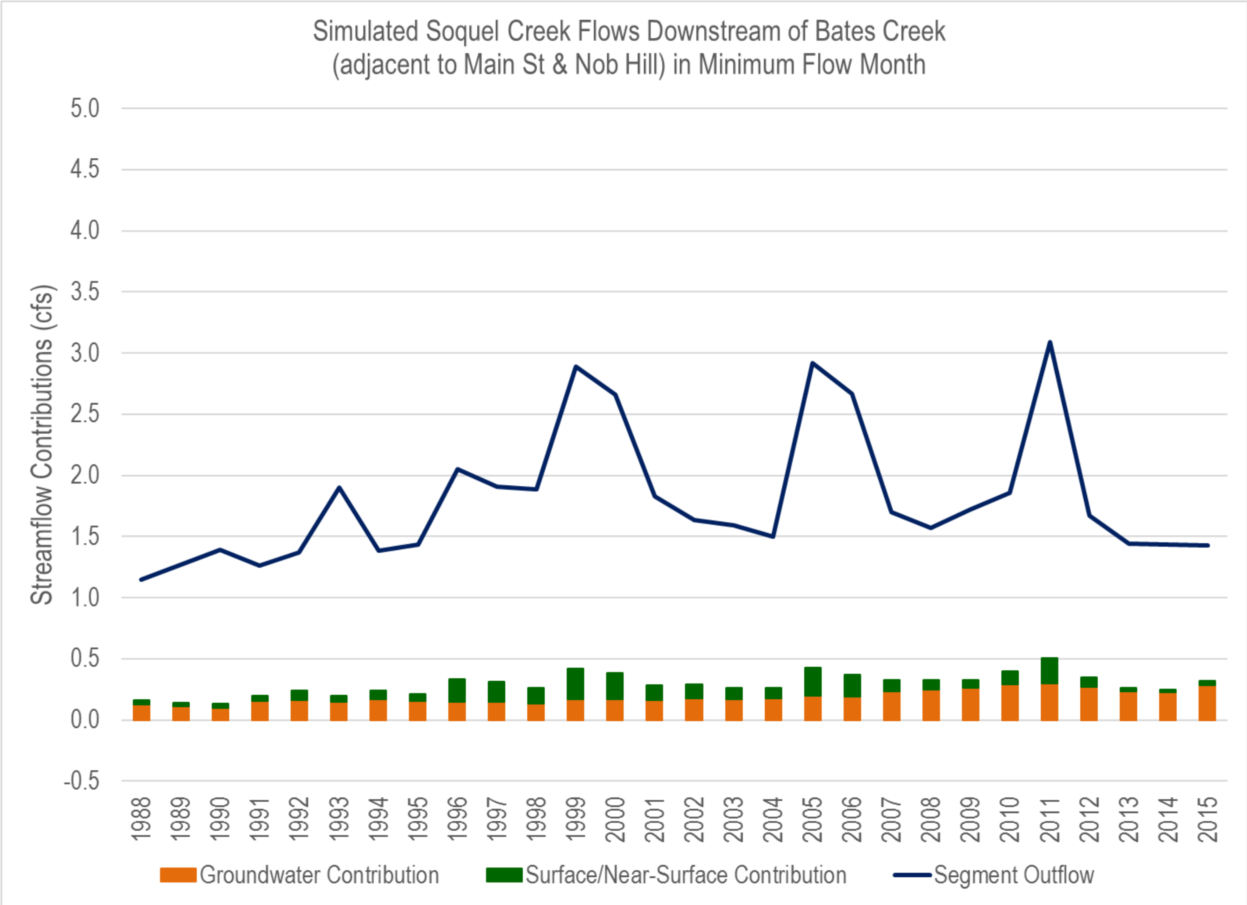



*Figure 11. Simulated Minimum Monthly Flows Downstream from Bates Creek*

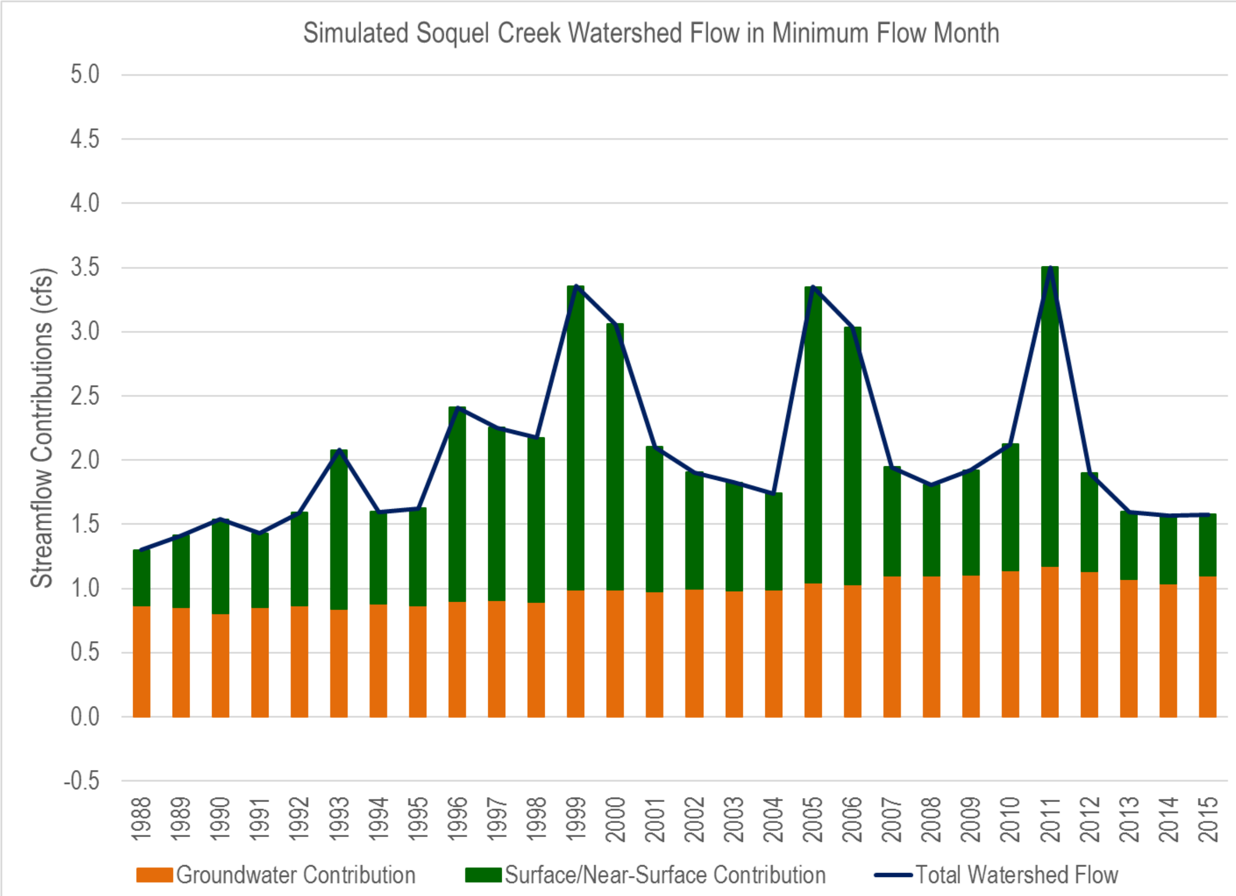



*Figure 12. Simulated minimum monthly flows for the entire Soquel Creek Watershed*

## SURFACE WATER AND GROUNDWATER CONNECTION IN THE PURISIMA AQUIFER

Fortunately, Soquel Creek Water District has been monitoring surface water interactions near the Main Street municipal well and monitoring well network for almost 20 years. Annual reports evaluating the connection between Main Street and other nearby municipal wells to Soquel Creek have been prepared since 2015. These reports have shown no direct measurable connection to creek flow or stage in response to pumping starting and stopping in the Main Street municipal well, which is screened in the Purisima AA-unit and Tu (as shown on Figure 13). The hydrographs on Figure 14 for monitoring well SC-18A (screened in Purisima AA-unit) and the Main Street shallow monitoring well (screened in alluvium and top of the Purisima A-unit) are plotted together with streamflow at the USGS Soquel Creek at Soquel gauge located adjacent to the Main Street wells, precipitation recorded at the Main Street site (since January 2012), and monthly pumping at the Main Street municipal well.

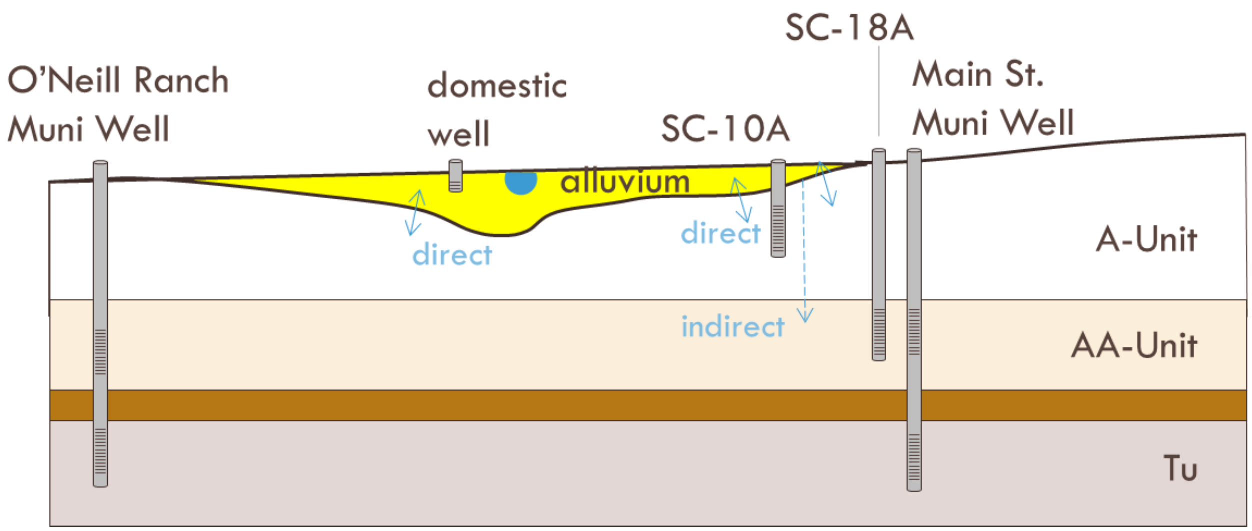



*Figure 13. Conceptual Connections between Soquel Creek, Alluvium, and Underlying Aquifers*

Evaluation of the relationships between measurements shown on Figure 14 indicate:

- Shallow groundwater levels fluctuate in response to both pumping and rainfall.
- Shallow groundwater levels rose during the period between April 2014 and April 2015 when the Main Street municipal well was offline. The increase occurred even though it was the middle of the recent drought and groundwater levels were below average.
- There is a 1-2 foot increase in shallow groundwater levels in the Main Street shallow well that corresponds to the increase in Purisima AA-unit groundwater levels in SC-18A (it also corresponds to rainfall). However, record high groundwater levels in SC-18A are not matched by record high shallow groundwater levels.

The above information suggests that the alluvium, and hence the creek, is connected to underlying aquifers. That connection appears to be more direct with the Purisima A-unit, and indirect with aquifers deeper than the Purisima A-unit.

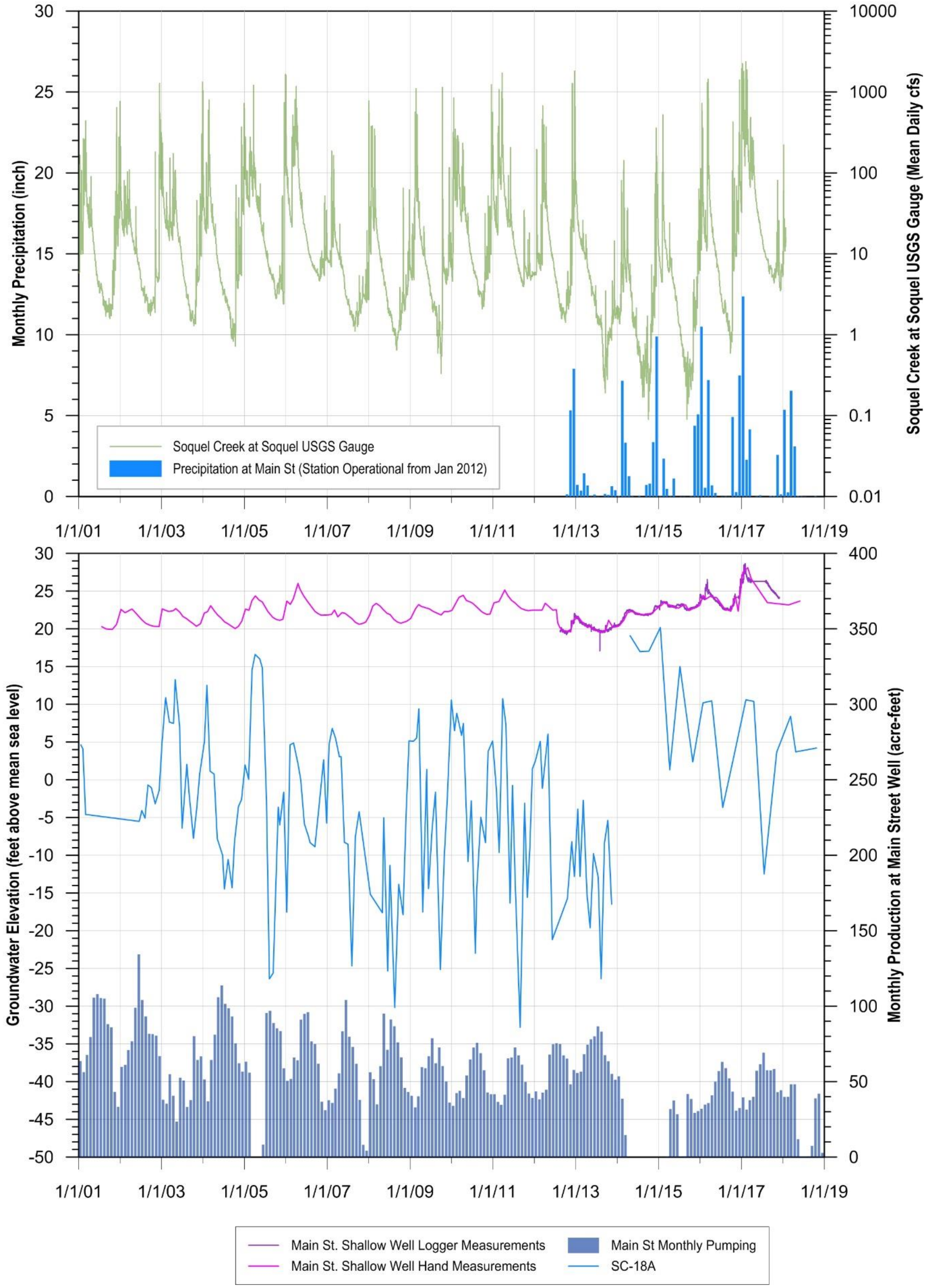



*Figure 14. Hydrographs for Main Street Monitoring Wells Compared to Monthly Main Street Pumping, Creek Flow and Precipitation*

## HISTORICAL SOQUEL CREEK ZERO FLOW

There was zero flow in Soquel Creek in 1977, 1988, 1992 (for 29 days), and 1994 (for 49 days) typically in September, October, and occasionally in November. In 2015 there was 15 minutes of zero recorded flow and several days of very low flow. These correspond to consecutive years of below average rainfall (Figure 15). In 2007 and 2008 there were also consecutive years of less severe below average rainfall without zero flow at the Soquel Creek gauge at Soquel. Even though 2014 had the lowest annual recorded flow in Soquel Creek and lowest rainfall, it did not go dry. This is because of rainfall that occurred in July – September, as will be shown below. Additionally, flows were likely not as low in 2014-15 as they were in 1992 because groundwater levels had recovered to some extent, with a reduced loss of streamflow in the mainstem.

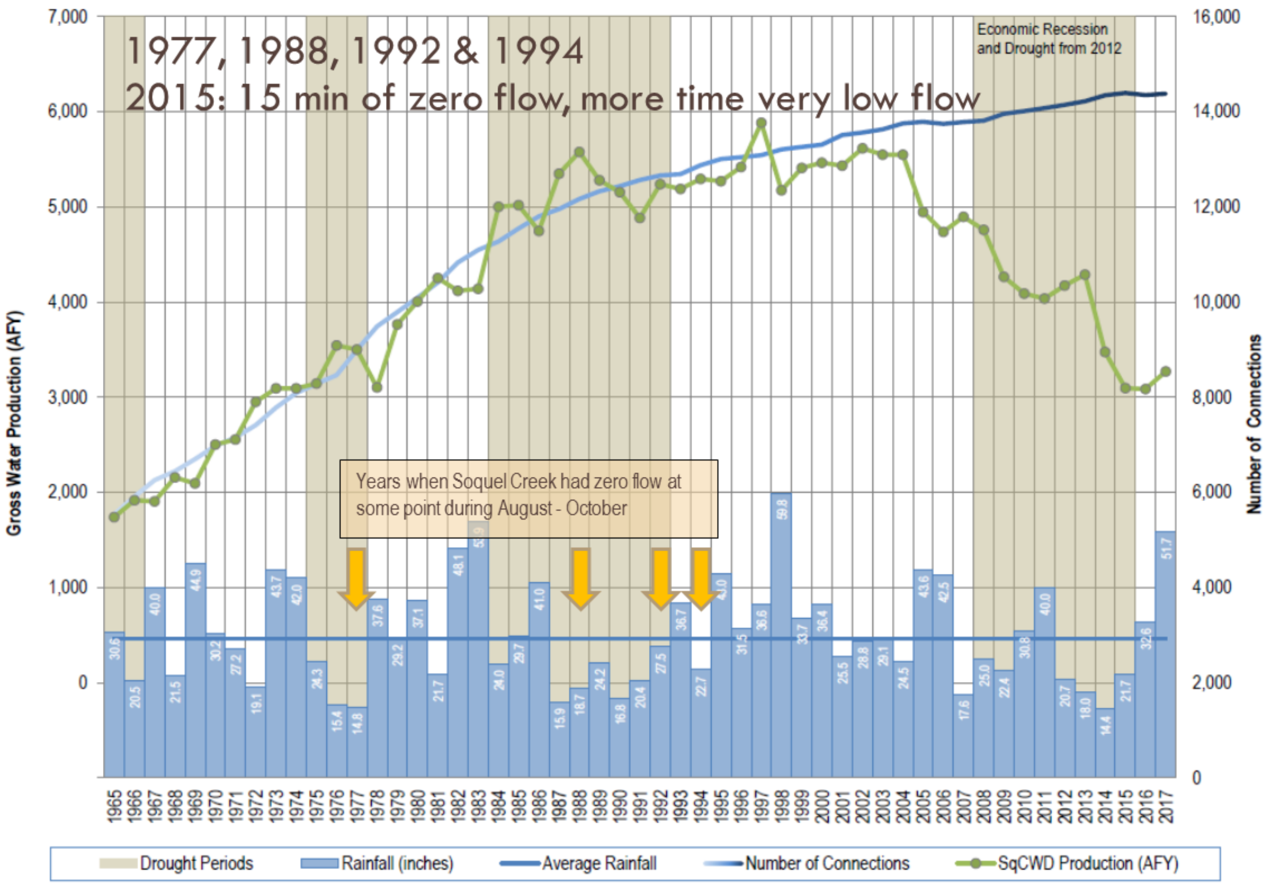



*Figure 15. Annual Rainfall with Periods of Zero Flow at the USGS Soquel Creek gauge near Soquel*

In an attempt to correlate periods when the Soquel Creek had zero flow, available groundwater level data near Soquel Creek were compared to those periods of zero flow at the gauge:

- The closest monitoring well to the USGS Soquel Creek gauge is SC-18A next to the Main Street municipal well. This well, although located in the alluvial valley, is screened in the Purisima AA-unit, which is below the Purisima A-unit that directly underlies alluvium (Figure 13). Because of this there is no direct connection of the monitored aquifer to the alluvium and it is not possible to correlate periods when the creek dried up to low groundwater levels. Although the well was only installed in 1999 which is after the years when the creek ran dry, late summer/fall in 2015 when the creek had 15 minutes of zero flow and more days with very low flow can be compared to shallow groundwater levels. Monitoring well SC-18A's hydrograph on Figure 14 shows that this period on the hydrograph corresponds to a period when Main Street shallow groundwater levels were slowly increasing, possibly in response to the year of Main Street municipal well being offline. This indicates that shallow groundwater levels in the area of the Main Street are not correlated with very low flows in the creek.

- Figure 14 shows a hydrograph for the Main Street well, screened in the Purisima AA-unit underlying the Purisima A-unit, which is beneath alluvium (Figure 13). There is no correlation between years when the creek has zero flow and low groundwater levels in the production well. The lowest groundwater levels in the Main Street municipal well are in the fall of 2004; this was a below average rainfall year and the creek had no zero flow recorded. Additionally, after several years of monitoring, the Monitoring and Adaptive Management Plan (MAMP) demonstrates that the Main Street municipal well has no measurable influence on streamflow.

- Monitoring well SC-10A is located about 1.4 miles upstream from the USGS Soquel Creek gauge. The shallowest completion in this well cluster is in the Purisima A/AA-unit which is in contact with the alluvium at this location. Low groundwater levels in the well do not correlate with periods there was zero recorded flow at the Soquel Creek at Soquel gauge (Figure 15). Groundwater levels in SC-10A during the period of zero flow were increasing.

Most municipal production wells are pumping from deeper confined aquifers not directly connected to streams or stream alluvium. It is likely that only wells completed at shallow depth in either the alluvium or aquifer units immediately beneath the alluvium can directly influence streamflows. However, the deeper pumping can have an indirect effect on shallow groundwater levels, as indicated by the increase in deep and shallow groundwater that has taken place in response to reduced pumping, beginning in 2004 and continuing through the 2012-15 drought (Figure 14 through Figure 16).

The relationship between streamflows and rainfall in the years when there was zero flow in Soquel Creek in 1988, 1992, and 1994 was examined in an attempt to show the relationship between Soquel Creek streamflow and rainfall, and why, if there were not very low groundwater levels causing flow from the creek to lose water to the aquifers, did Soquel Creek have zero recorded flow in certain years. The following series of charts show that the creek has zero or very low flow recorded in years where there was simply very little rainfall, often combined with prior years of below average rainfall, which resulted in little runoff to the creek.

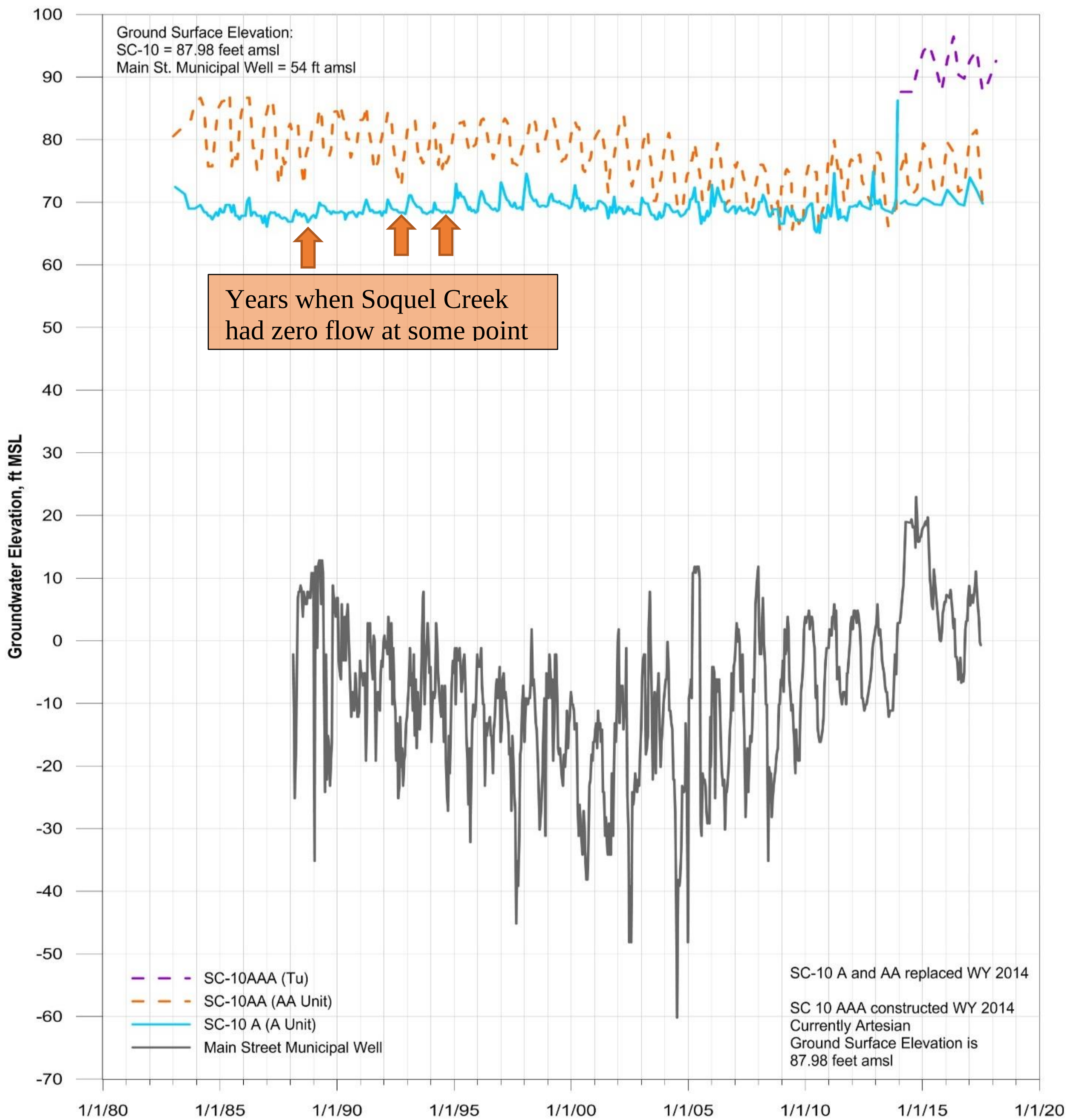



*Figure 16. SC-10 Monitoring Wells and Main Street Municipal Well Hydrographs*

The years of zero flow are labeled in red and 2014, representing a year with almost record low rainfall which should have resulted in zero flow, is in blue on Figure 17 and Figure 19. Further breaking the data up by quarter reveals further relationships. Figure 18 shows that the beginning of the rainy season (Oct-Dec) has less streamflow generated from rainfall (a shallower slope of the best fit line). This is because the watershed absorbs the first rains and only when the infiltration capacity of the soils are exceeded does more runoff occur to the creeks (see the steeper best fit line for Jan-Mar). The Apr-June best fit line is similar to the Jan-Mar line indicating the rainfall/runoff relationship is similar for those quarters.

Figure 19 includes separate charts for each quarter and it shows that years when July – September rainfall were extremely low correlate with the years when the creek had zero flow. The earlier quarters for years when the creek had zero flow usually also had low rainfall and streamflow, but it is likely mostly driven by no to minimal rainfall in July – September. In the late summer/fall of 2014 after almost record low rainfall, the Soquel Creek might have been expected to have had zero flow but because of just over a combined 1 inch of rain in July and September, Soquel Creek had recordable flow.

The periods of zero flow in 1992 and 1994 coincided with both multiple low rainfall years and low groundwater levels. Although 2014-15, had similar multi-year low rainfall, groundwater levels had come up and may have helped prevent the stream from having zero flow for an extended period of time.

Given the data presented above and study of recession curves (how streamflow recedes in the summer and fall months), our conceptual understanding of baseflow to Soquel Creek is that the forested areas of the catchment act like a sponge that slowly releases stored rainwater and fog drip into the creeks through interflow (the unsaturated root zone above the groundwater table) and to underlying aquifers. If there is not enough water stored because of prior low rainfall years, less water is released from the vadose zone over the drier months and the likelihood of Soquel Creek having zero recorded flow are increased. This has implications as the pattern of rainfall changes because of climate change.

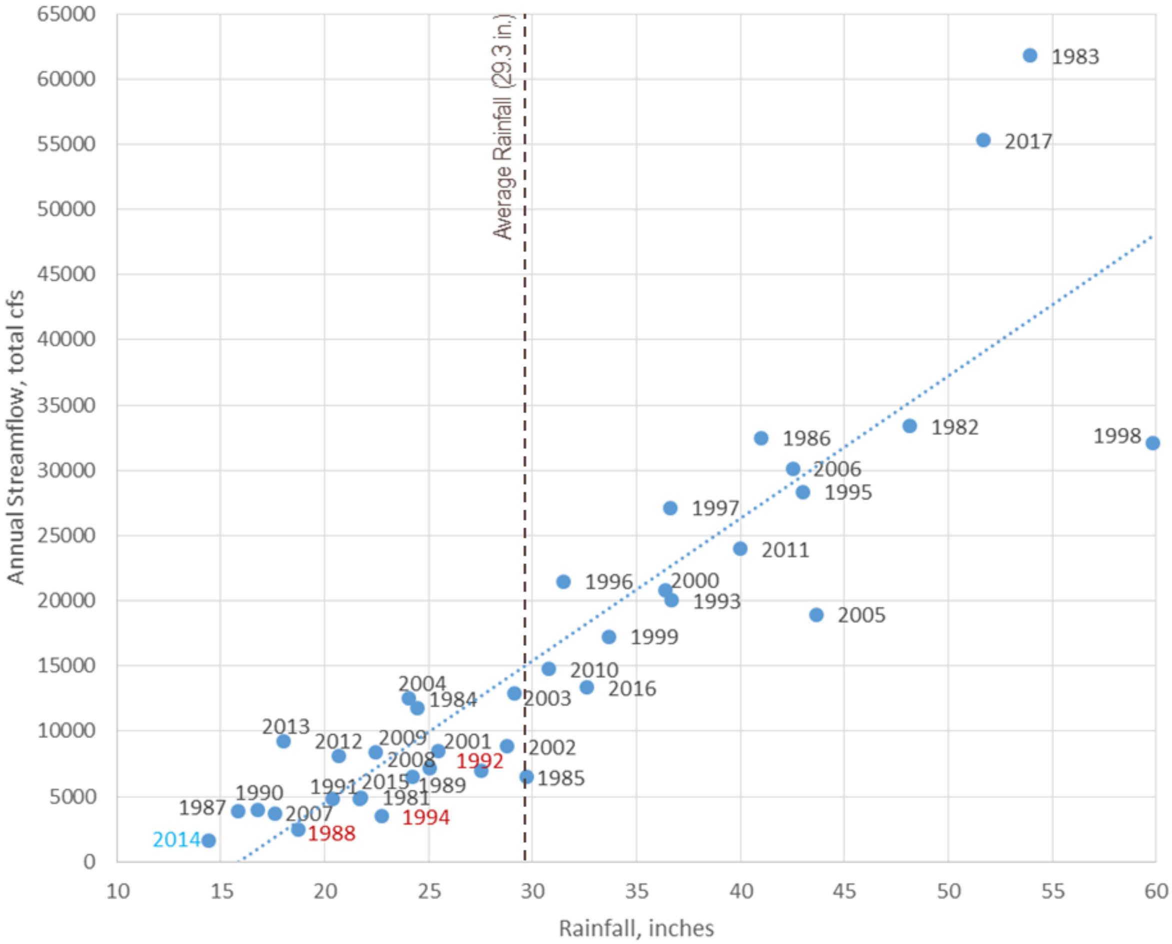



*Figure 17. Annual Rainfall versus Flow at the Soquel Creek Gauge*

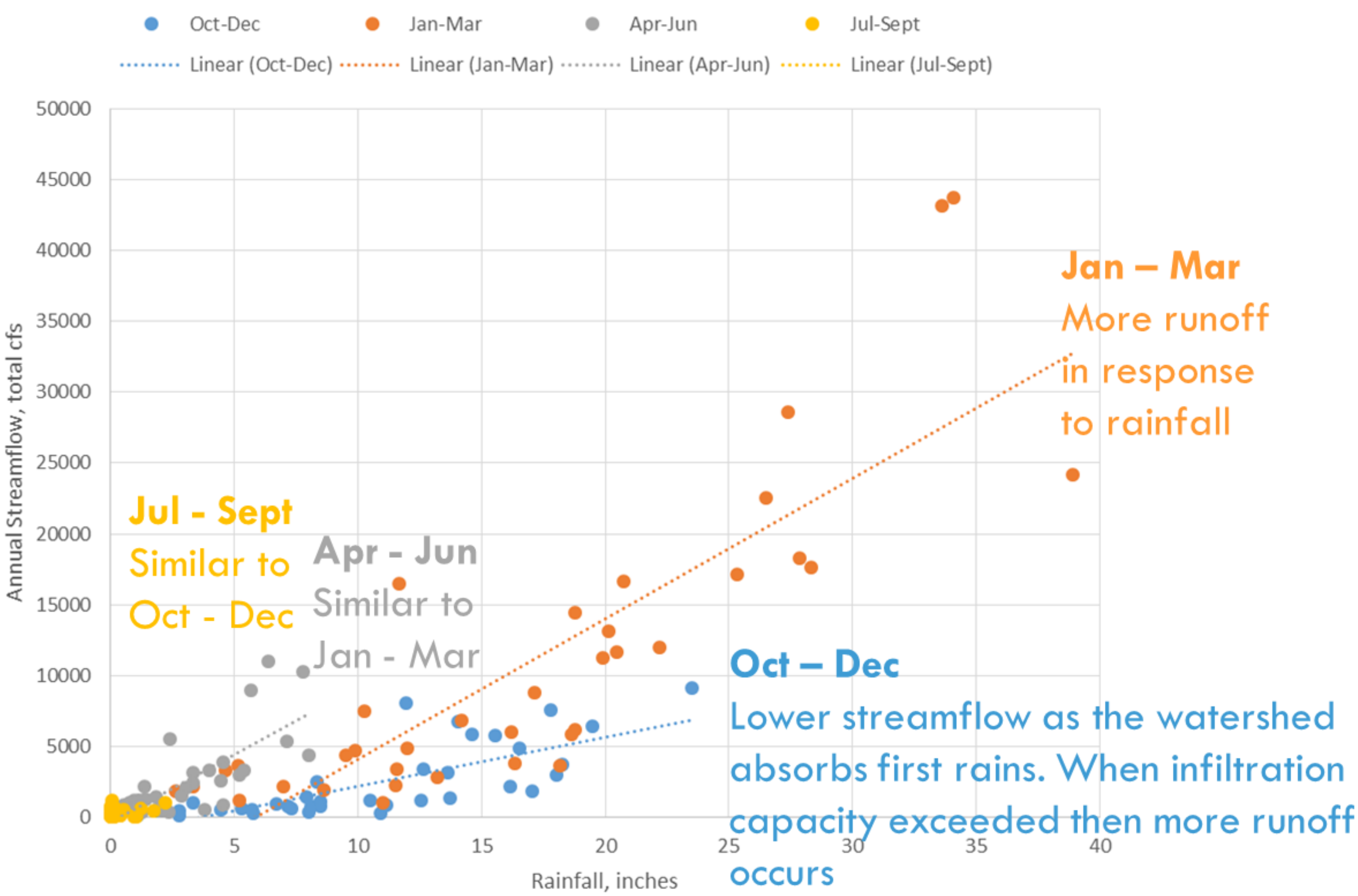



*Figure 18. Seasonal Rainfall versus Streamflow Relationships at Soquel Creek Gauge*

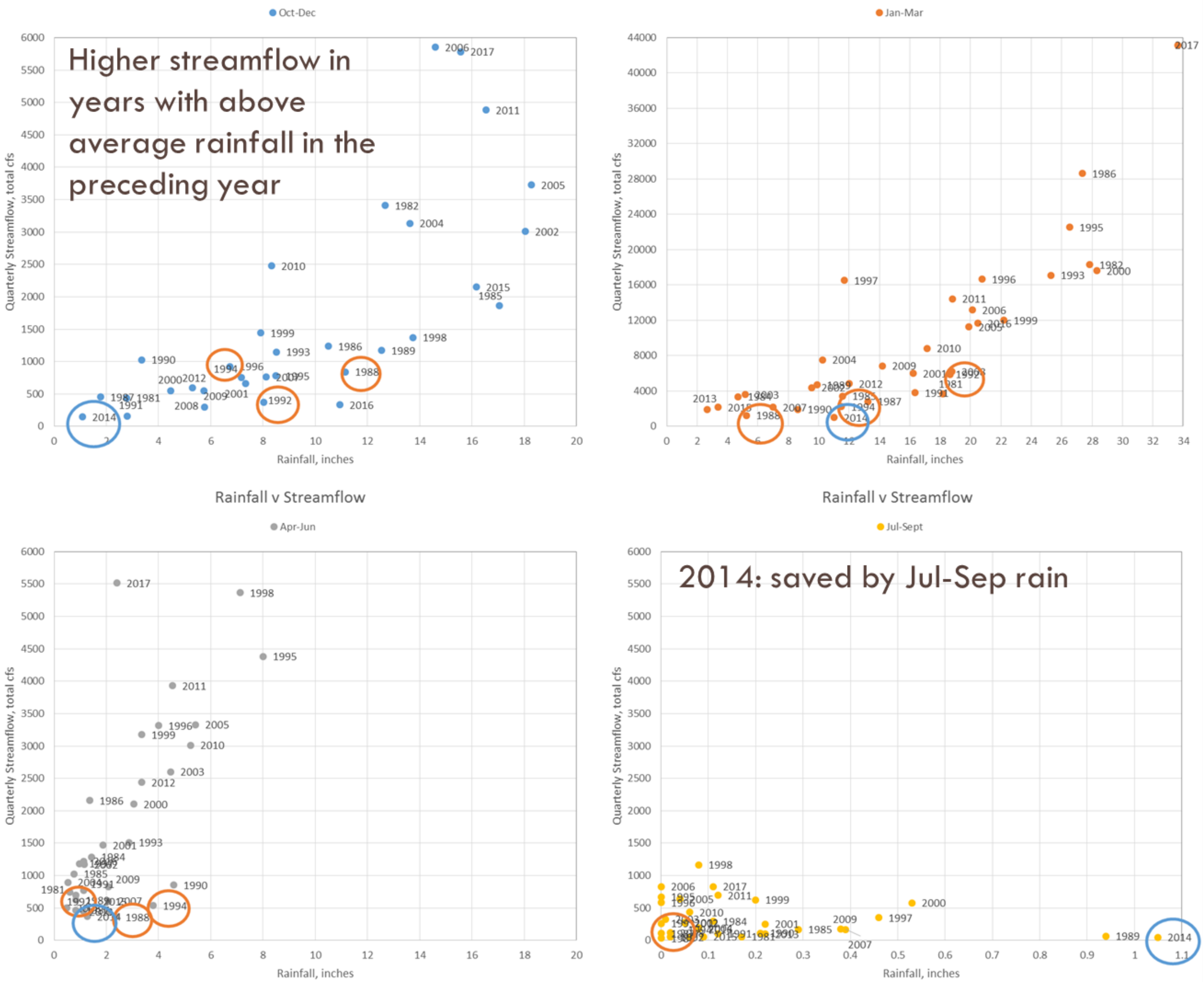



*Figure 19. Seasonal Rainfall versus Streamflow Relationships at the Soquel Creek Gauge by Season*

## SHALLOW GROUNDWATER LEVEL RESPONSE TO THE RECENT DROUGHT

The shallow groundwater level data available adjacent to the creeks does not go back as far as the 1980's and 1990's when Soquel Creek at Soquel had four separate years of zero flow. The shallow well data do however, cover the recent drought as shown in Figure 20. These hydrographs, with the exception of the Main Street shallow well, do not show late summer/fall shallow groundwater levels falling below non-drought years. Groundwater levels in wells with groundwater levels below creek levels (such as Balogh) are likely controlled by the creek, and the overall basin showed some recovery of groundwater levels during the drought.

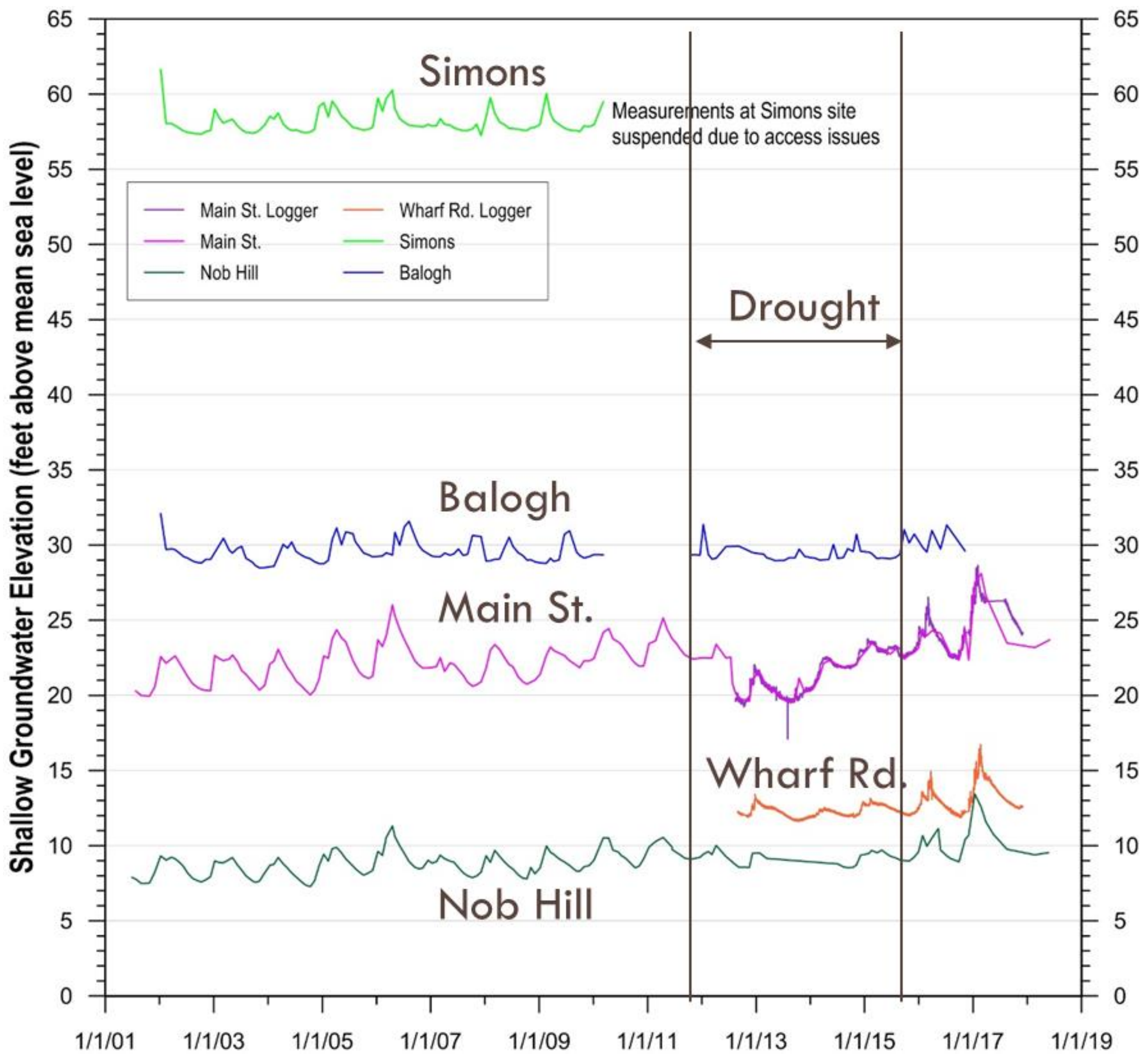



*Figure 20. Shallow Groundwater Elevations along Soquel Creek*

## ADDITIONAL OBSERVATIONS REGARDING THE EFFECT OF GROUNDWATER AND OTHER FACTORS AFFECTING STREAMFLOW IN SOQUEL CREEK

The following discussion was prepared by County staff, based on an analysis of streamflow records upstream and downstream of the USGS gage, work conducted by prior investigators (primarily Balance Hydrologics), current flow studies being conducted by Trout Unlimited, and an analysis of fish monitoring data collected by DW Alley and Associates.

Factors Influencing Flow

Streamflow in the mainstem of Soquel Creek between the forks and the USGS gage is influenced by many factors, as described below, along with the relative effect of these factors upon late summer flow in the mainstem. For reference, the median late September flow at the USGS gage is 2.1 cubic feet per second (cfs). See
Table 3 for a summary.

1. Annual rainfall and prior year(s) rainfall directly influences flow, contributing 1-5 cfs in September. As an example of prior year effect, 2012 was dry, but still had high summer baseflow after wet year 2011).
2. Upper watershed discharge from outside the groundwater basin contributes 1-4 cfs to the mainstem in September. This includes much of the rainfall contribution described above.
3. Temperature and evapotranspiration of riparian vegetation causes flow fluctuations of 0.7 cfs on a daily cycle, with a 1.4 cfs variation from cool summer days to hot summer days. This effect increases downstream (Figure 21).
4. Groundwater discharge of 0.5-0.7 cfs contributes to mainstem in summer (based on model results, Figures 9 and 10); This contribution may have increased by an estimated 0.2 cfs from 1992 to 2015 (based on both observed increase in baseflow under similar antecedent rainfall and model results).
5. Build-up of coarse bed material in the stream channel (aggradation) may force flow underground and result in less surface flow to be measured or available for aquatic life, potentially reducing flow by 0.2-0.5 cfs. (This occurred in 1994).
6. Stream diversions seem to currently be limited as indicated by stream surveys but may occur intermittently, as indicated by summer flow monitoring by Trout Unlimited (0.2 cfs = 100gpm).

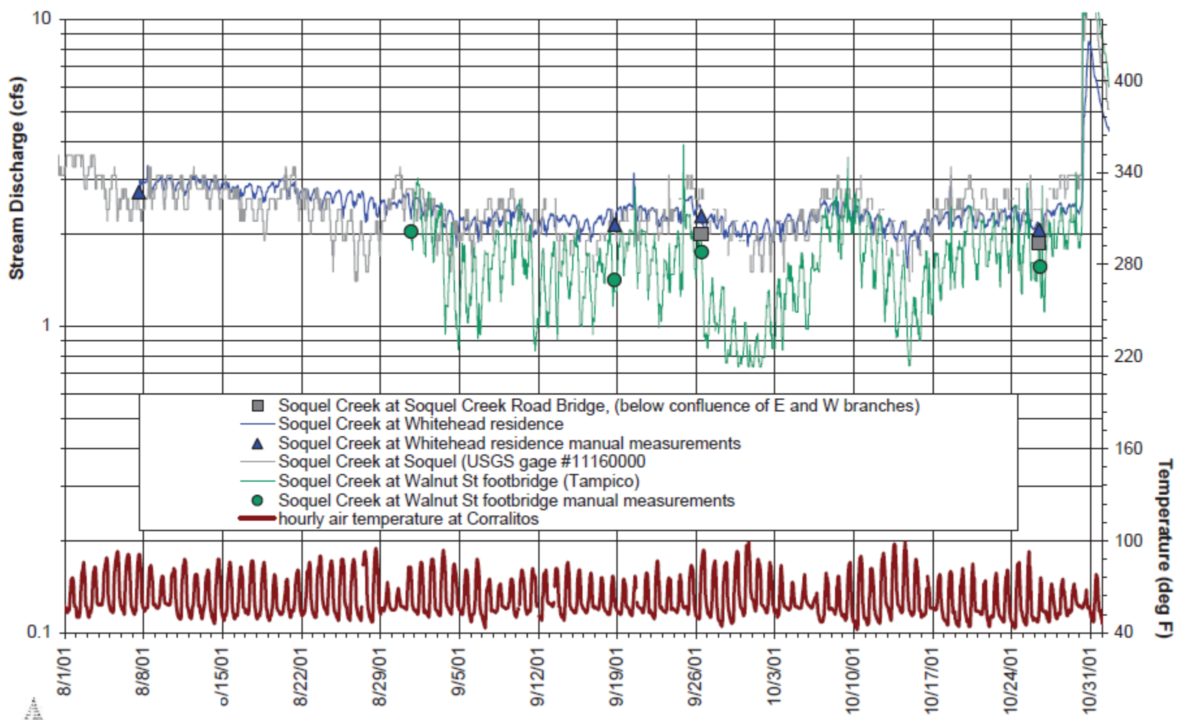
*Table 3. Factors Affecting Summer Baseflow in Mainstem Soquel Creek*

| | |
|---|---|
| Rainfall | +1-5 cfs |
| Flow from Upper Watershed | +1-4 cfs |
| Temperature/Evapotranspiration | (0.7-1.4 cfs) |
| Groundwater Discharge to Mainstem | +0.5-0.7 cfs |
| Streambed Aggradation (Underflow) | (0.2-0.5 cfs) |
| Surface Diversions | (0-0.4 cfs) |
| Median September Flow at USGS Gage = 2.1 cfs | |
| 90% September Flow =5.4 cfs | |
| 10% September Flow = 0.3 cfs | |
| 5% September Flow = 0.2 cfs | |

<u>Observations Relative to Flow and Groundwater</u>:

1. Soquel mainstem is connected to groundwater, and thus flow is influenced to some extent by groundwater levels relative to the creek (Figure 6).
2. Soquel mainstem gains flow in spring and during wet years (15-35%) (Figure 22, Table 4).
3. Soquel mainstem loses flow in dry summers (0.3-0.8 cfs, 30-100%); (Figure 22, Table 4).
4. East Branch Soquel loses flow in the lower mile most years (0.5 cfs) and goes dry in dry years (Table 4).
5. Dry flow conditions in 1994 at the USGS gauge may have been an anomaly due to the significant aggradation of the bed (1994 bed was 0.8 ft higher than 1992); (Figure 15 and Figure 23).
6. Flow in Soquel Creek was much lower in 1992, after six low rainfall years than in 2015 after four low rainfall years (Figure 17).
7. The decrease in Soquel Creek flow relative to San Lorenzo River flow (departure from a double mass plot) was much more pronounced in the 1987-92 drought than the 2012-15 drought (Figure 24).
8. The increased Soquel Creek flow in 2015 relative to 1992 may be related to increased groundwater levels and increased groundwater contribution.
9. Groundwater elevations at SC-10 and SC-18 increased from 2010 to 2017, during the drought (Figure 16).
10. Total municipal groundwater production peaked in 1997-2004 and then declined sharply (Figure 15).
11. The historic low groundwater level at Main Street occurred in 2004 (Figure 16).

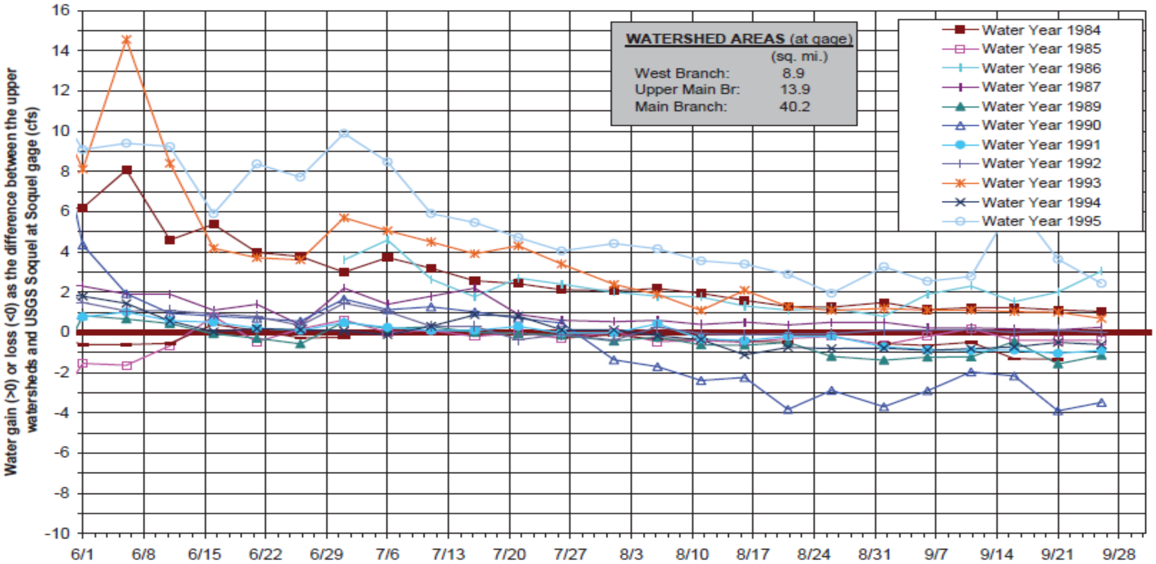
12. Pumping at Main Street well was about 1000 acre-feet/year (1.4 cfs) in 2000 and 2004, and has recently been 600 acre-feet/year (0.8 cfs). The well was offline with no pumping from April of 2014 until April of 2015 (Figure 14).
13. In the 1950's only 2% of June-September daily flows were less than 2 cfs. In all other decades through 2000, 34-40% of June-September flows were less than 2 cfs (Figure 25).




Balance Hydrologics, Inc.

**Figure H-7: Comparison of low flow along the Main Branch of Soquel Creek, Summer 2001, Santa Cruz County, California.** Flow generally decreases with distance downstream. Flow is also dependent on air tempature, an effect that is magnified at the downstream stations.

*Figure 21. Variation in Soquel Creek Flow as related to Temperature (primarily related to Evapotranspiration)*




Balance Hydrologics, Inc.

**Figure H-6: Surplus and deficit of baseflow between the Upper and Lower Soquel Creek Watershed.** Net streamflow gain or loss is calculated as the mean daily flow on the Lower Main Branch (USGS station 11164000) minus the sum of the upper branches. The upper branches were gaged at two stations, one on the West Branch and one on the Main Upper Branch, by Linsley, Kraeger Associates as reported for the Soquel Creek Water District (Linsley, Kraeger Associates, 1993, 1994, 1997). A complete set of data are not available for water year 1988.

*Figure 22. Plot of Gaining and Losing Streamflow Conditions in Mainstem Soquel Creek from 1984-1995*

*Table 4. Measured Gain/Loss of late Summer Flow in Mainstem of Soquel Creek, 1979-2018 Data from County of Santa Cruz*

| Year | East Branch Flow (cfs) | West Branch Flow (cfs) | Upper Mainstem Flow (cfs) | USGS Gage | Gain/Loss (cfs) | Percent Change |
|---|---|---|---|---|---|---|
| **1979** | 0.6 | 0.8 | 1.4 | 1.3 | -0.1 | -7% |
| **1992** | 0.1 | 0.8 | 0.9 | 0.1 | -0.8 | -89% |
| **1993** | 0.8 | 1.1 | 1.9 | 2.2 | 0.3 | 16% |
| **1994** | 0.0 | 0.7 | 0.7 | 0.0 | -0.7 | -100% |
| **2007** | 1.0 | 1.7 | 2.8 | 1.9 | -0.8 | -30% |
| **2010** | 1.6 | 1.7 | 3.3 | 3.4 | 0.2 | 6% |
| **2011** | 2.7 | 3.0 | 5.6 | 5.8 | 0.1 | 2% |
| **2012** | 0.4 | 1.2 | 1.6 | 2.0 | 0.4 | 24% |
| **2013** | 0.2 | 0.9 | 1.1 | 0.3 | -0.7 | -65% |
| **2014** | 0.0 | 0.8 | 0.8 | 0.3 | -0.6 | -76% |
| **2015** | 0.0 | 0.6 | 0.6 | 0.6 | -0.3 | -43% |
| **2017** | 4.1 | 3.8 | 7.9 | 10.8 | 2.9 | 36% |
| **2018** | 0.5 | 1.4 | 1.9 | 2.0 | 0.1 | 5% |

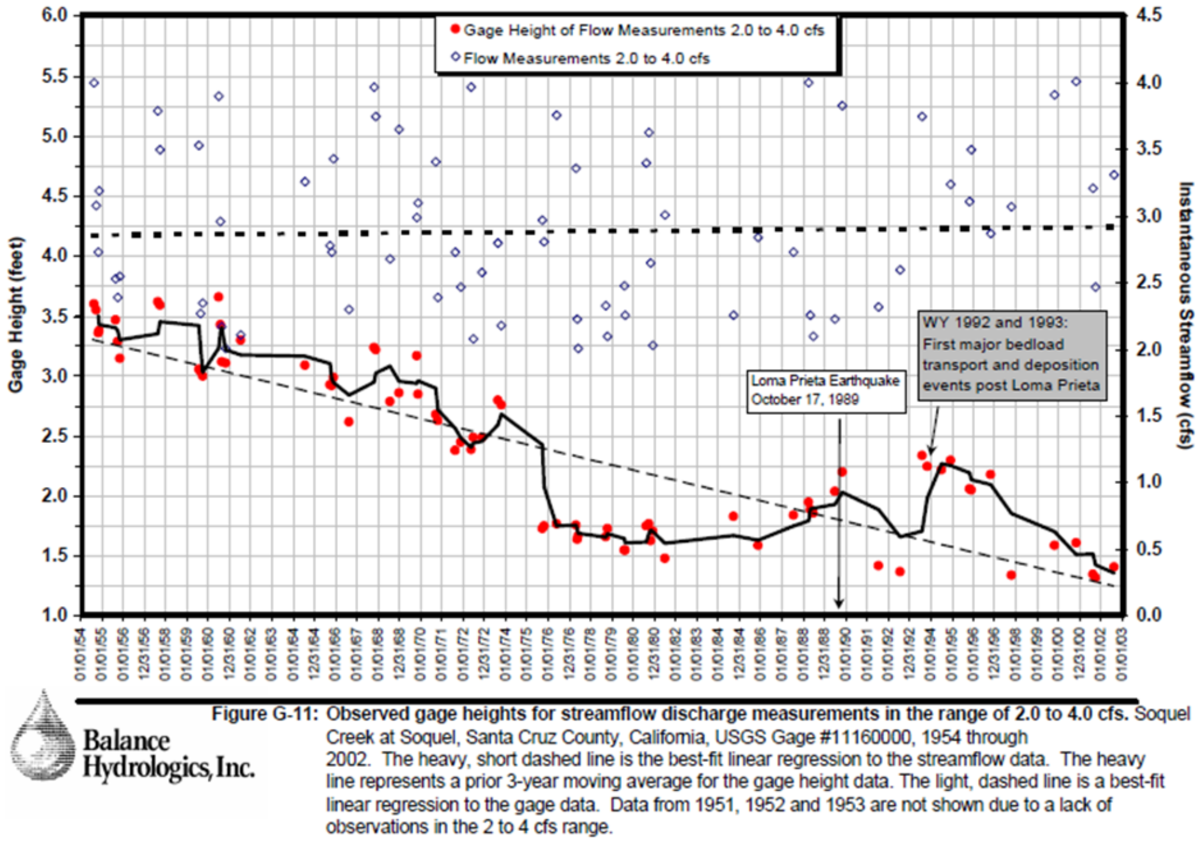



**Figure G-11: Observed gage heights for streamflow discharge measurements in the range of 2.0 to 4.0 cfs.** Soquel Creek at Soquel, Santa Cruz County, California, USGS Gage #11160000, 1954 through 2002. The heavy, short dashed line is the best-fit linear regression to the streamflow data. The heavy line represents a prior 3-year moving average for the gage height data. The light, dashed line is a best-fit linear regression to the gage data. Data from 1951, 1952 and 1953 are not shown due to a lack of observations in the 2 to 4 cfs range.

*Figure 23. Plot indicating Stream Bed Aggradation in Soquel Creek at the USGS gage. Note the significant increase in bed elevation in 1994.*

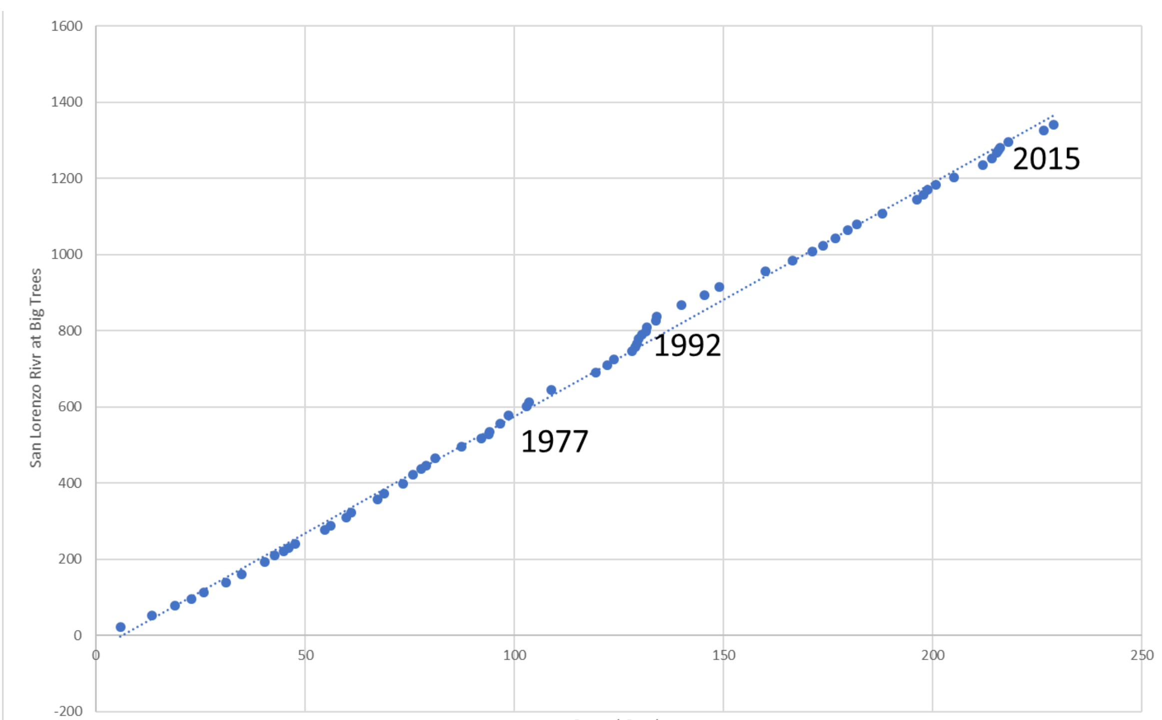
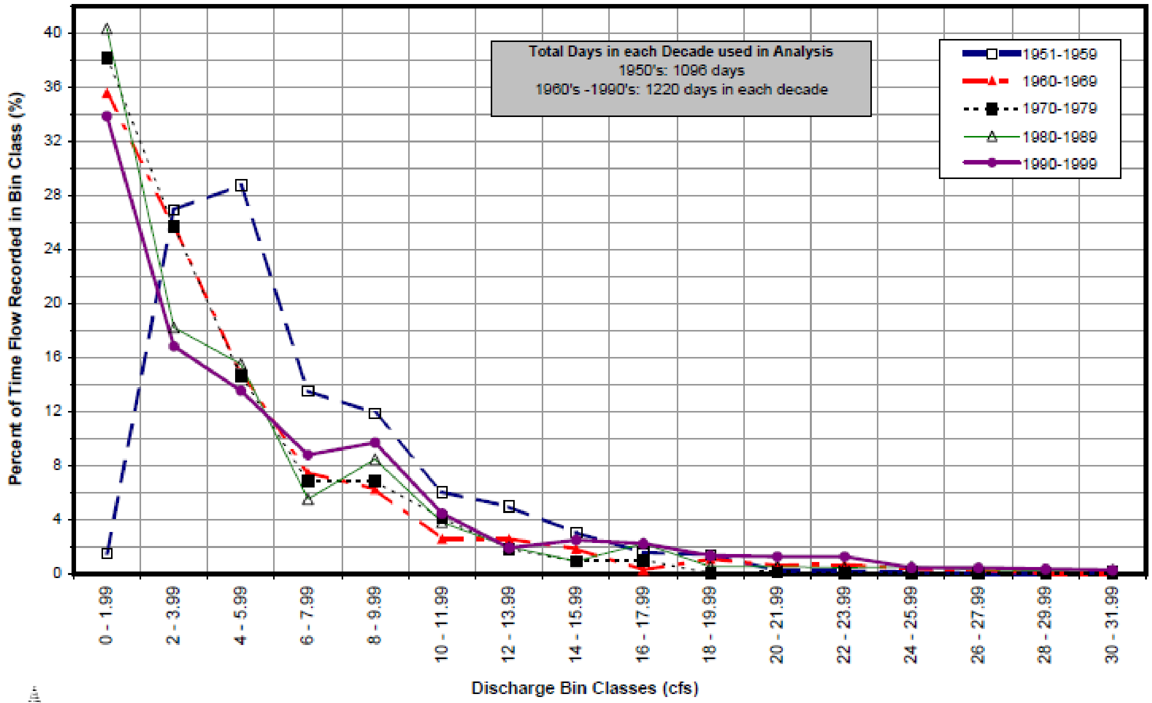



*Figure 24. Double mass plot showing relationship of August mean August flow between Soquel Creek and San Lorenzo River. Note the greatly diminished flow in Soquel Creek during the 1987-92 drought compared to the 1976-77 and 2012-15 droughts*




Balance Hydrologics, Inc.

**Figure H-8:** **Flow duration statistics for the months June through September by decade for the decades 1951 through 1999, Soquel at Soquel, USGS Gage # 11160000.** Flow duration statistics were derived from flow bins of 2 cfs over the range 0 to 61.99 cfs for months June through September. September 20th and 21st were omitted from 1959 data due to their large mean flow values (316 and 119 cfs, respectively)

*Figure 25. Flow Duration Statistics for June through September from 1951 - 1999*

## RELATIONSHIP OF FLOW TO FISH HABITAT AND FISH PRODUCTION

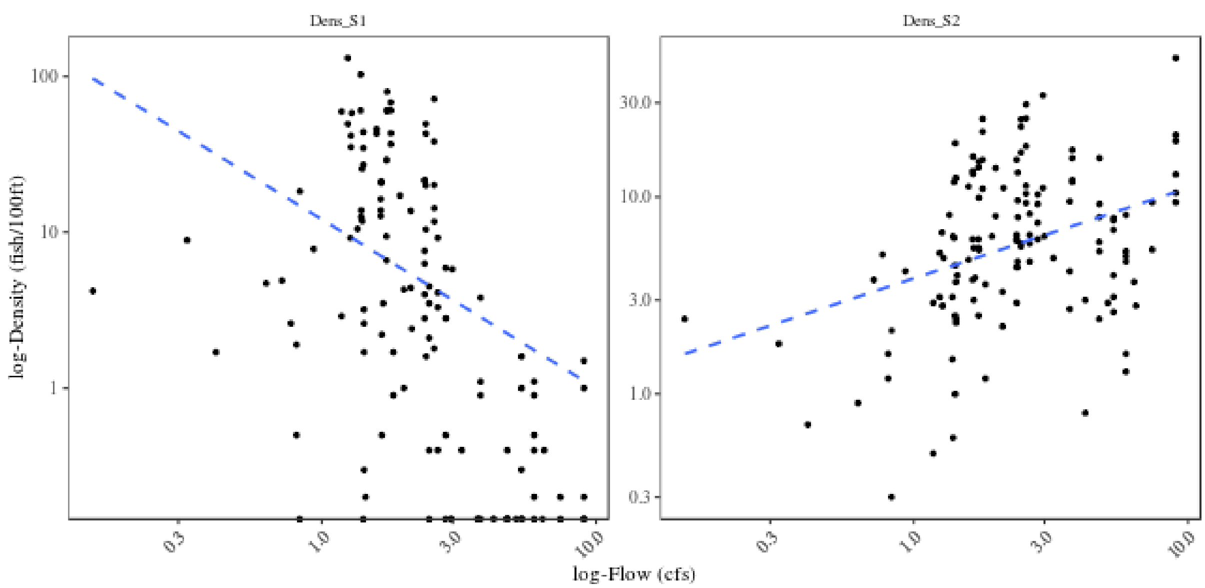
The County and the water agencies have been monitoring juvenile steelhead numbers and habitat conditions in late summer in Soquel Creek (and other county streams) since 1994. More information about the Juvenile Steelhead and Stream Habitat Monitoring Program can be found at http://scceh.com/steelhead.aspx. Data collected through that program includes:

- Density and measurements of juvenile steelhead at key sites throughout the watershed;
- Habitat quality including specific habitat types within ½-mile stream segments throughout the watersheds; and
- Presence of additional aquatic species encountered during sampling.

We are currently in the process of analyzing trends in fish numbers relative to trends in habitat conditions. A preliminary analysis of fish numbers relative to September flows in the mainstem of Soquel Creek is presented for two different sampling locations (Figure 26 through Figure 28). Fish production is measured by the density of Size Class 1 fish (likely young of the year - those that hatched as a result of spawning that year), and Size Class 2 fish (yearlings that have survived in the stream for more than a year or young of the year that have been able to grow rapidly due to good habitat conditions.). Production of Size Class 2 fish is critical for producing fish that are large enough to survive ocean conditions. The plots show a trend related to flow but the strong influence of many other factors.

While groundwater contribution influences the amount of late summer stream baseflow and availability of habitat in the stream, there are many other factors that affect the number of fish measured in the stream in late summer:

- Habitat condition: sedimentation, depth of pools, shading, cover, etc.
- Spawning success and survival of eggs and juveniles the previous two winters .
- Refuge and survival in high flows the previous winter for yearlings.
- Ocean conditions affecting number of adults entering the stream.
- Winter flow and migration conditions.




| | Dependent variable: | |
|---|---|---|
| | Density (fish/100ft) | |
| | S1 | S2 |
| | (1) | (2) |
| log10(1 + flo) | -1.743*** | 0.468*** |
| | (0.224) | (0.127) |
| Constant | 1.681*** | 0.596*** |
| | (0.130) | (0.073) |
| Observations | 136 | 136 |
| $R^2$ | 0.312 | 0.093 |
| Adjusted $R^2$ | 0.307 | 0.086 |
| Residual Std. Error (df = 134) | 0.526 | 0.298 |
| F Statistic (df = 1; 134) | 60.698*** | 13.681*** |
| *Note:* | *p<0.1; **p<0.05; ***p<0.01 | |

*Figure 26. Juvenile Steelhead Density (/100 ft) in Mainstem Soquel Creek in September compared to flow, 1997-2017. Dens_S1 is young of the year density, Dens_S2 is Size Class 2 density. The trendlines are statistically significant but with low R2.*

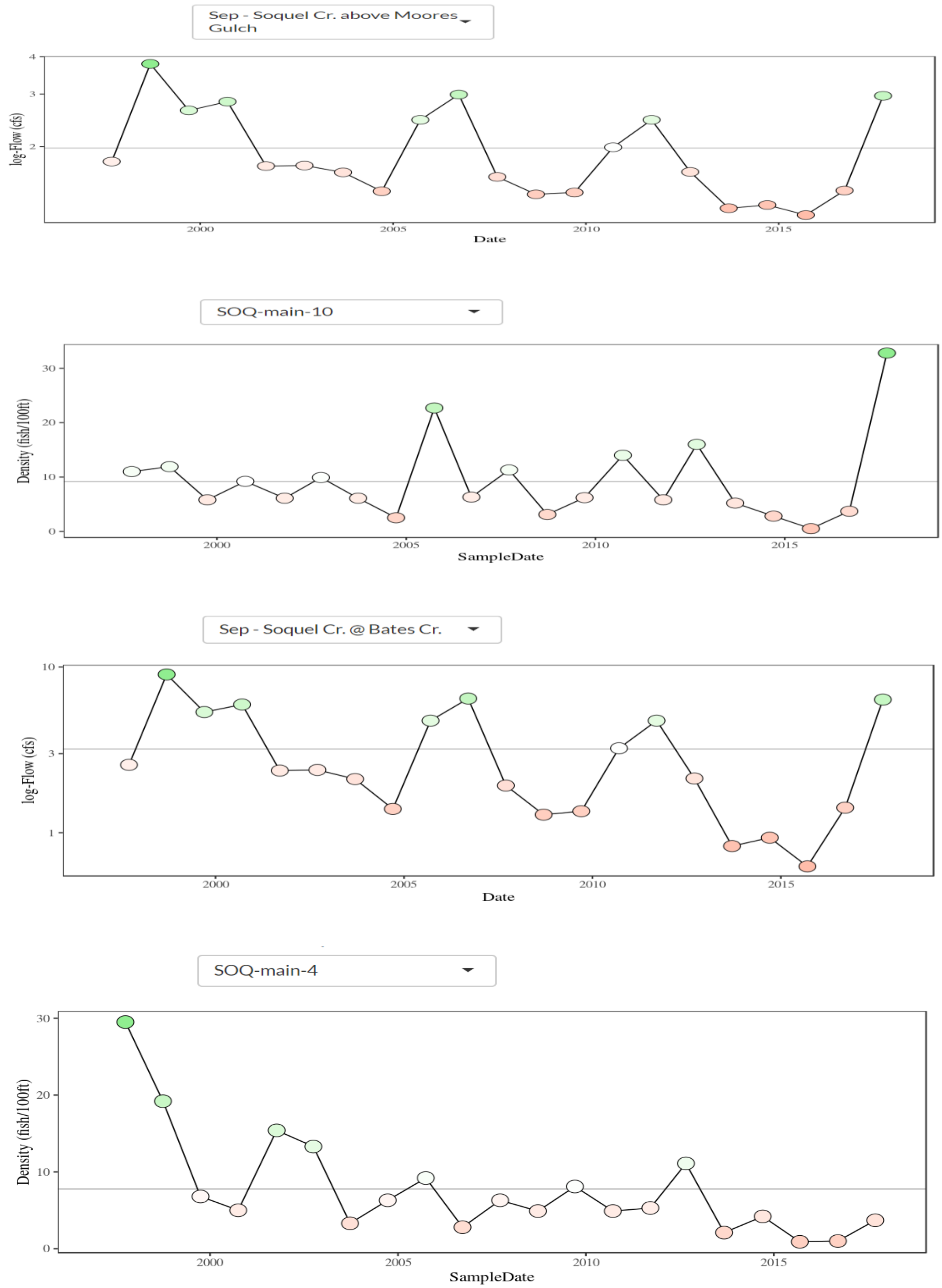
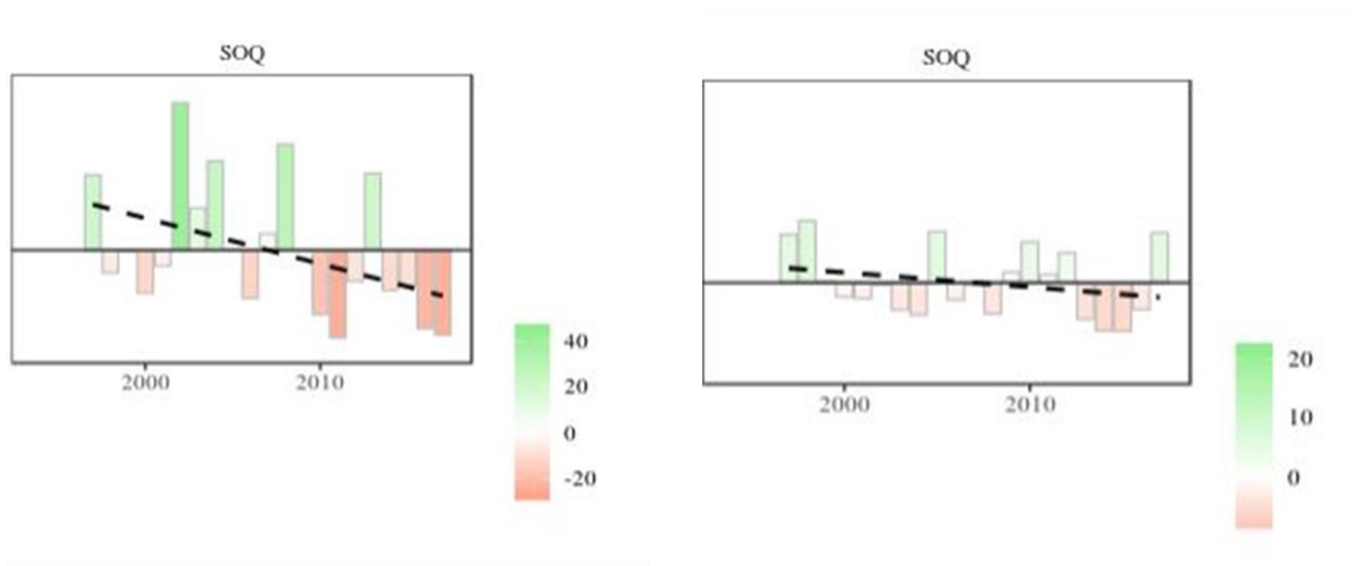



*Figure 27. Flow and Fish Density at two locations on the Soquel mainstem. The first plot is the September flow at the indicated location, followed by a plot of juvenile steelhead yearling density.*

While a direct link between steelhead and flow in Soquel Creek is tenuous, it is still important that the MGA continue consider the species in the ongoing management and monitoring for the GSP. Salmonid numbers in Soquel Creek have been declining since 1994, so any efforts to try to improve the conditions for these species are valuable (Figure 28).




Size Class 1

Size Class 2

*Figure 28. Trends of Juvenile Steelhead Densities for Soquel Creek Sites 1994 - 2017*

## 2. Technical Staff Proposal for Representative Monitoring Points from which to Monitor the Sustainability Indicator Through Use of Groundwater Level Proxies

### EXISTING MONITORING WELL AND STREAM GAUGE LOCATIONS

There are several existing shallow monitoring wells adjacent to creeks in the Basin. Figure 29 shows five existing shallow monitoring wells along Soquel Creek and one next to Valencia Creek. The five monitoring wells along Soquel Creek are part of an existing groundwater/surface water monitoring program called the Monitoring and Adaptive Management Plan (MAMP) that monitors the effects of municipal pumping on Soquel Creek. Figure 30 shows the elevation of the shallow groundwater in relation to the Soquel Creek level adjacent to each monitoring well. The data show that Soquel Creek is mostly a gaining stream (because groundwater levels are higher than the creek level, the creek is gaining water from groundwater), except between the Balogh and Main Street sites. More recently this losing stretch, where groundwater levels are lower than the creek level, have experienced increased shallow groundwater levels, with occasional gaining conditions during the wet months. Historically the losing reach likely extended further upstream during dry years.

There are currently five stream gauges in Soquel Creek. The USGS has maintained a stream gauge since 1951 on the Mainstem near the Main Street shallow monitoring well. Trout Unlimited and the Resource Conservation District have maintained four stream gauges since 2017, on one the mainstem above Bates Creek (downstream of the Balogh well), one on each of the West Branch and East Branch right above the confluence, and one on the East Branch near Olive Springs. The Soquel Creek Water District has maintained gages on the east and west branches further upstream. As shown on Figure 29, only the USGS gauge is in the same location as a shallow monitoring well.

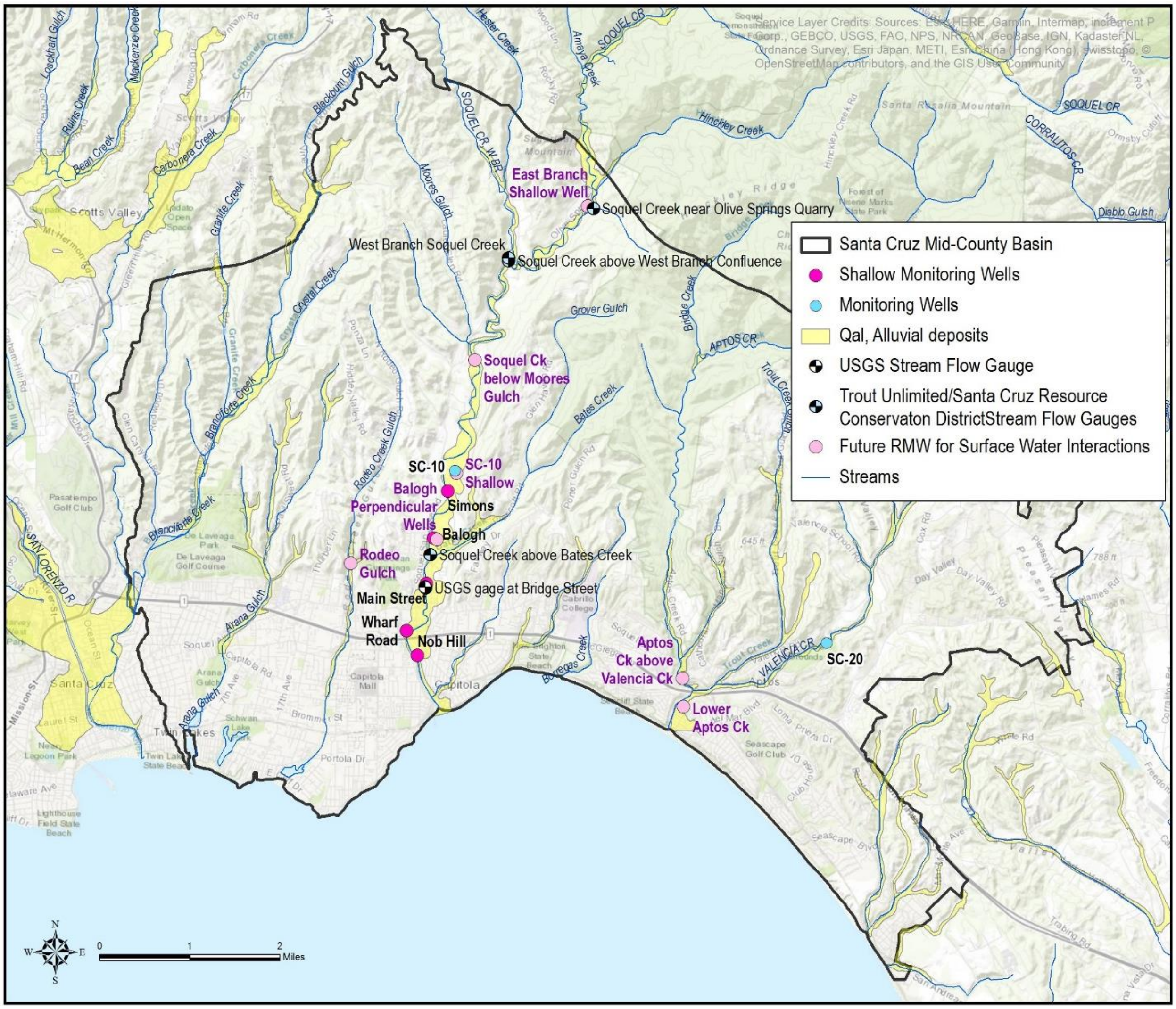



*Figure 29. Proposed Representative Monitoring Points for Surface Water Depletions in the Santa Cruz Mid-County Basin*

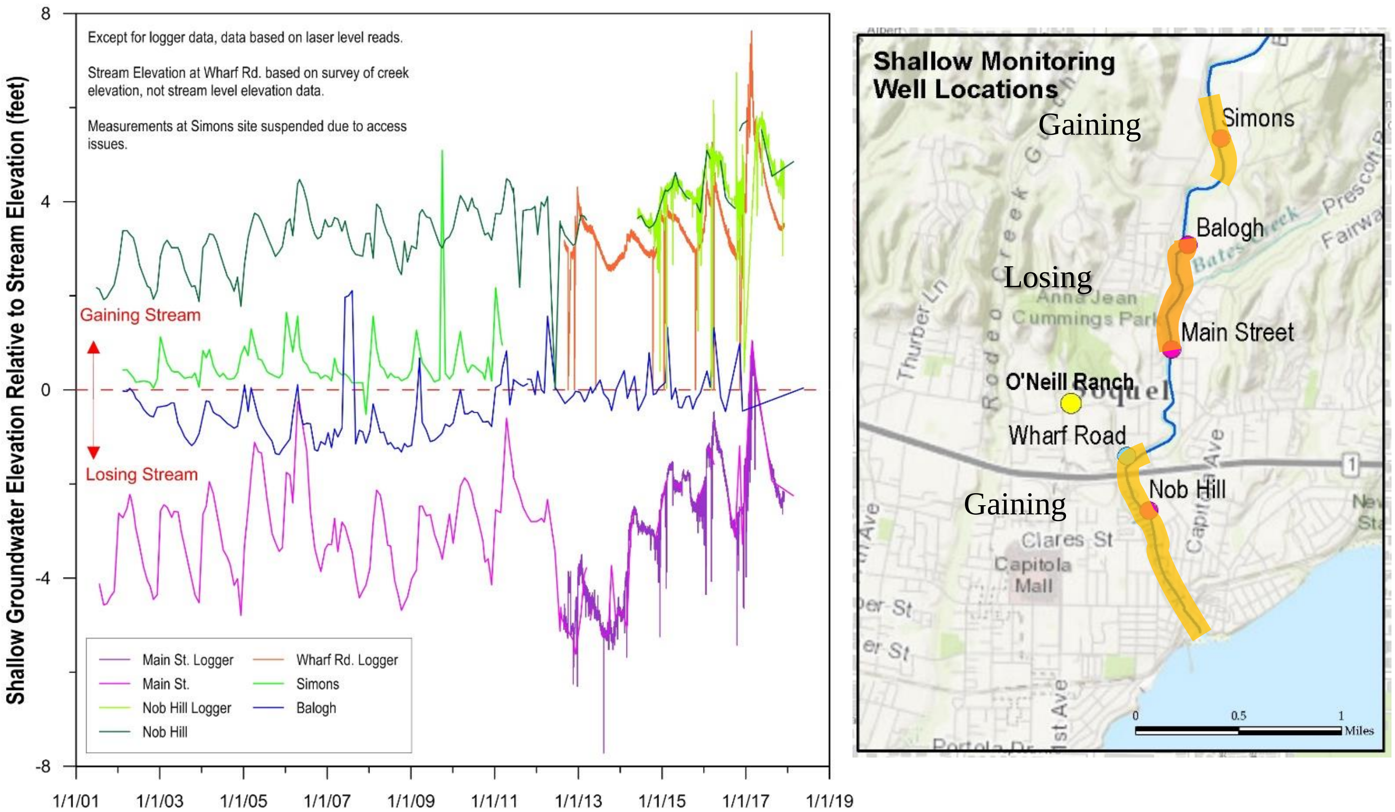



*Figure 30. Shallow Groundwater Levels Relative to Adjacent Soquel Creek Levels*

## CRITERIA FOR LOCATING REPRESENTATIVE MONITORING WELLS

1. Surface water must be connected to groundwater.
2. Near municipal or private domestic well pumping centers.
3. GDEs have been identified.
4. Groundwater is being extracted from the aquifers in the groundwater basin and not granite which forms the official base of the basin (which is the case in Branciforte Creek).

Dependent on land availability, the following sites are proposed for new representative monitoring wells to supplement the existing shallow well network (Figure 29):

- Next to Soquel Creek below Moore's Gulch
- Add a shallow alluvial well at SC-10 to complete the cluster of multi-depth monitoring wells from alluvium down to the Tu-unit, which is the lowermost Basin aquifer.
- Add a shallow well on the East Branch of Soquel near the gauged location (Soquel Creek near Olive Springs Quarry) that frequently goes dry.
- A series of shallow wells located perpendicular to Soquel Creek at the Balogh shallow well site to determine the groundwater gradient towards the creek. Up to two new shallow wells will be required to supplement the existing Balogh shallow well.
- On a stretch of Rodeo Creek Gulch
- Aptos Creek near the confluence with Valencia Creek
- At the lower end of Valencia Creek

Although GDE's are identified on Branciforte Creek and surface water is connected to groundwater, this portion of the Basin does not meet the criteria above that the monitoring well must be near municipal or private domestic well pumping centers, and sourced from the basin, so is not included as a proposed location at this time.

## STREAM GAUGING AND ADDITIONAL MONITORING

To help further refine the link between streamflow and groundwater elevation, additional stream gauging is required. Where those gauges are currently absent, the MGA will install gauges and collect data to compare with shallow groundwater levels. The Trout Unlimited/RCD gage locations should be maintained, with the possible addition of another stream gage near Moore's gulch.

With the emphasis the Working Group has placed in the impacts of depletion on special status species, it is important to note that the MGA partners also continue to participate in annual monitoring of salmonids in all the fish bearing streams in the Basin. Since the project was not developed with the purpose of identifying the contributions of groundwater to fish habitat, it is possible that some additional fish sampling sites near monitoring wells and stream gauges should be considered.

The Nature Conservancy has provided a new tool called GDE Pulse (https://gde.codefornature.org/#/map) which is a web-based mapping and data visualization platform that summarizes 35 years of remotely sensed satellite data from NASA's Landsat program for all NC Dataset polygons in the state. This tool will be used to show trends in riparian vegetation and change over time, which can be useful for measuring changes in riparian habitat health.

## DATA GAPS

Recognizing that GSPs are to be developed based on best available science, the following actions should be incorporated into the GSP as future work to be carried out to improve understanding of surface water and groundwater interactions in the Basin.

- Further study will be needed during GSP implementation to:
  - Understand link between alluvium and unit directly below alluvium
    - Need multi-depth monitoring wells in same location
    - Add shallow monitoring well at SC-10 perpendicular to Soquel Creek, similar to monitoring wells at Main Street
  - Understand where creeks are gaining and losing
    - Measure groundwater levels in private alluvial wells and compare against creek levels
    - More streamflow measuring devices need to be installed

## 3. TECHNICAL STAFF PROPOSAL FOR WHAT IS CONSIDERED A SIGNIFICANT AND UNREASONABLE SURFACE WATER DEPLETION DUE TO LOWERED GROUNDWATER LEVELS

Surface water depletion due to groundwater extraction in interconnected streams supporting priority species, greater than that experienced during the highest seasonal-low elevation in below-average rainfall years, over the period from the start of monitoring through 2015, would be a significant and unreasonable depletion of surface water.

## 4. TECHNICAL STAFF PROPOSAL FOR PRELIMINARY MINIMUM THRESHOLDS AND MEASURABLE OBJECTIVES.

### USE OF GROUNDWATER LEVELS AS A PROXY

The metric for depletion of interconnected surface water is a volume or rate of surface water depletion. This is a very difficult metric to quantify in the Basin since the depletion of interconnected surface water by groundwater extraction is very small and not possible to directly measure through changes in streamflow. Fortunately, the GSP regulations allow for the use of groundwater elevations as a proxy for volume or rate of surface water depletion. To use a groundwater elevations proxy there must be significant correlation between groundwater elevations and the sustainability indicators for which groundwater elevation measurements are to serve as a proxy.

Throughout the four meeting of the Surface Water Working Group, the group agreed that use of groundwater levels as a proxy was reasonable. The Environmental Defense Fund (EDF) has also proposed an approach to address surface water depletion conditions required by SGMA that is based on groundwater level proxies. In summary, the approach seeks to maintain a groundwater gradient near the stream by controlling groundwater levels next to the stream. The approach includes the flowing:

1. Assume stream elevation levels are the same in the future as in the past;
2. Set minimum threshold for groundwater levels in the vicinity of streams;
3. Conduct modeling to assess trajectory of levels;
4. Use monitoring data (if available) and modeling to develop best estimates of threshold levels in the vicinity of the streams;
5. Develop management plan to maintain levels near stream at or above thresholds; and
6. Install appropriate monitoring wells -- monitor and adjust actions to maintain threshold levels.

EDF's rationale to this approach is summarized as:

- It achieves the intent of the law.
- It avoids difficult issue of actually quantifying stream depletion.
- It tends to manage to groundwater levels.
- It maintains management flexibility at distance from stream.
- It simplifies communication/discussion – consistent with "zone" concept.

Advantages to their approach:

- Avoids problem of inaccuracies in depletion estimation
- Allows management flexibility
    - Groundwater levels distant from stream can vary more widely
    - Wide range of actions available for maintaining groundwater levels
- Analogous to salt water intrusion approaches and strategies

EDF's full document can be accessed at:

https://www.edf.org/ecosystems/california-groundwater-management-resources

In order to use groundwater level proxies for minimum thresholds as proposed, a relationship of those groundwater level proxies with streamflow depletion from pumping need to be demonstrated. For this purpose, we use groundwater model results to estimate the relationship between groundwater level proxies and streamflow depletion, but recognize that the modeling estimates of stream depletion are highly uncertain due to lack of widespread measured shallow groundwater levels and insufficient characterization of the subsurface geology in the vicinity of the stream. Accordingly, we propose to use groundwater levels as a proxy for stream depletion. Due to uncertainty of the estimates of streamflow depletion and difficulty in measuring streamflow depletion from pumping, achieving groundwater level proxies for minimum thresholds and measurable objectives can more reliably achieve the streamflow depletion relative to historical conditions that reflects what the MGA considers sustainable and provides operational flexibility.

## DRAFT MINIMUM THRESHOLDS

The proposed approach for developing minimum thresholds for the depletion of interconnected surface water sustainability indicator is to select groundwater elevations in shallow monitoring wells below which significant and unreasonable depletions of surface water due to groundwater extractions would occur.

Based on shallow groundwater level data available, over the period of record from 2001 onwards, there is no evidence that significant and unreasonable conditions have occurred in Soquel Creek due to municipal groundwater extractions. There may have been significant and unreasonable depletions of surface water from groundwater extraction in the early 1990s when there was a prolonged drought and groundwater extraction in the Basin was 3,000 acre-feet per year more than it is currently, but no shallow groundwater elevation data are available from that time to verify this condition. Evidence that the Working Group considered during the discussion about whether there have been significant and unreasonable conditions occurring in Soquel Creek due to municipal groundwater extractions since 2001 include:

1. The Monitoring and Adaptive Management Plan (MAMP) demonstrates that pumping from the Main Street and other nearby municipal wells, which are screened in the deeper Purisima A-, AA-, and Tu units has no immediate measurable influence on Soquel Creek flow. Additional data collected for the SGMA process has also not been able to identify a direct quantifiable causal relationship between groundwater pumping and immediate streamflow depletion. The general lowering of deep groundwater levels has likely had some impact on shallow groundwater levels and streamflow, as indicated by less severe impacts in the recent drought as a result of increasing groundwater level since 2005.

2. Other factors, such as rainfall and evapotranspiration (related to temperature), have a much larger and measurable impact on surface water depletions than depletions from groundwater extractions.

3. Steelhead productivity in the mainstem of Soquel Creek does not show a strong relationship to summer flow and is affected by many factors. While fish populations are declining, shallow groundwater elevations have actually been increasing.

As described earlier, most measured groundwater level data for the Basin is around the Main Street municipal well. This is because the water agencies pumping groundwater in this area recognized their potential impact on surface water and proactively set up a monitoring and adaptive management program to quantify and manage their impacts. We do recommend expanding monitoring to improve the geographic range of data collected, this is discussed above in the Monitoring section.

Main Street pumping in combination with other municipal production wells caused groundwater level declines of around 30 feet in the deeper Purisima A and AA-unit aquifers by 2004/2005 (Figure 16). Groundwater levels in the Purisima A and AA-unit aquifers have since recovered those 30 feet due to increase water conservation efforts and pumping redistribution. Shallow groundwater elevations appear to have also increased by between 2 to 3 feet (Figure 20) over the period of the increasing groundwater elevations in the deeper Purisima aquifers. Although there is no immediate measurable depletion in surface water when the Main Street and nearby municipal wells are pumping, shallow groundwater does appear to respond to changes in groundwater levels in the deeper aquifers. Because of the direct connection of shallow groundwater with surface water, it is assumed that increased groundwater levels in the shallow aquifer will reduce or even reverse the very small surface water depletions where shallow groundwater levels are below creek level (losing reach). In areas where shallow groundwater levels are above the creek level (gaining reach), increased shallow groundwater levels will result in the creek gaining additional flow from groundwater.

Other than the Main Street well area down to the coast, there are no additional municipal pumping centers near creeks in other parts of the Basin where groundwater is connected to surface water. Groundwater extraction in the rest of the Basin is primarily from private domestic wells which pump small amounts of groundwater (up to around 0.5 acre-feet per year each) compared to municipal wells which pump several hundred acre-feet per year each. However, apart from the SC-10 monitoring well cluster, which is in a predominantly private pumping area but is still influenced by municipal pumping to the south, there are no existing monitoring wells near creeks with at least monthly groundwater level data from which to measure depletions in surface water from private well pumping. This is a recognized data gap that will be addressed during GSP implementation. Additional shallow monitoring wells and stream gauges will be needed to fill this data gap.

Based on our assessment that significant and unreasonable conditions have not occurred since 2001, we propose to establish minimum thresholds for shallow groundwater elevations in the vicinity of the stream that are based on the highest seasonal-low elevation during below-average rainfall years, over the period from the start of monitoring through 2015. The years after 2015 are not included because 2016 was an average rainfall year and 2017 was extremely wet, which increased overall Basin shallow groundwater elevations above all previous levels.

To improve our confidence in these groundwater elevation minimum thresholds going forward, implementation of the GSP will include establishing new monitoring wells in locations described in Section 2. As our understanding of surface water-groundwater interactions improves based on additional monitoring and improved modeling, minimum threshold will be re-evaluated.

Draft minimum thresholds compared to historical shallow groundwater elevations are provided on  through Figure 34 below.

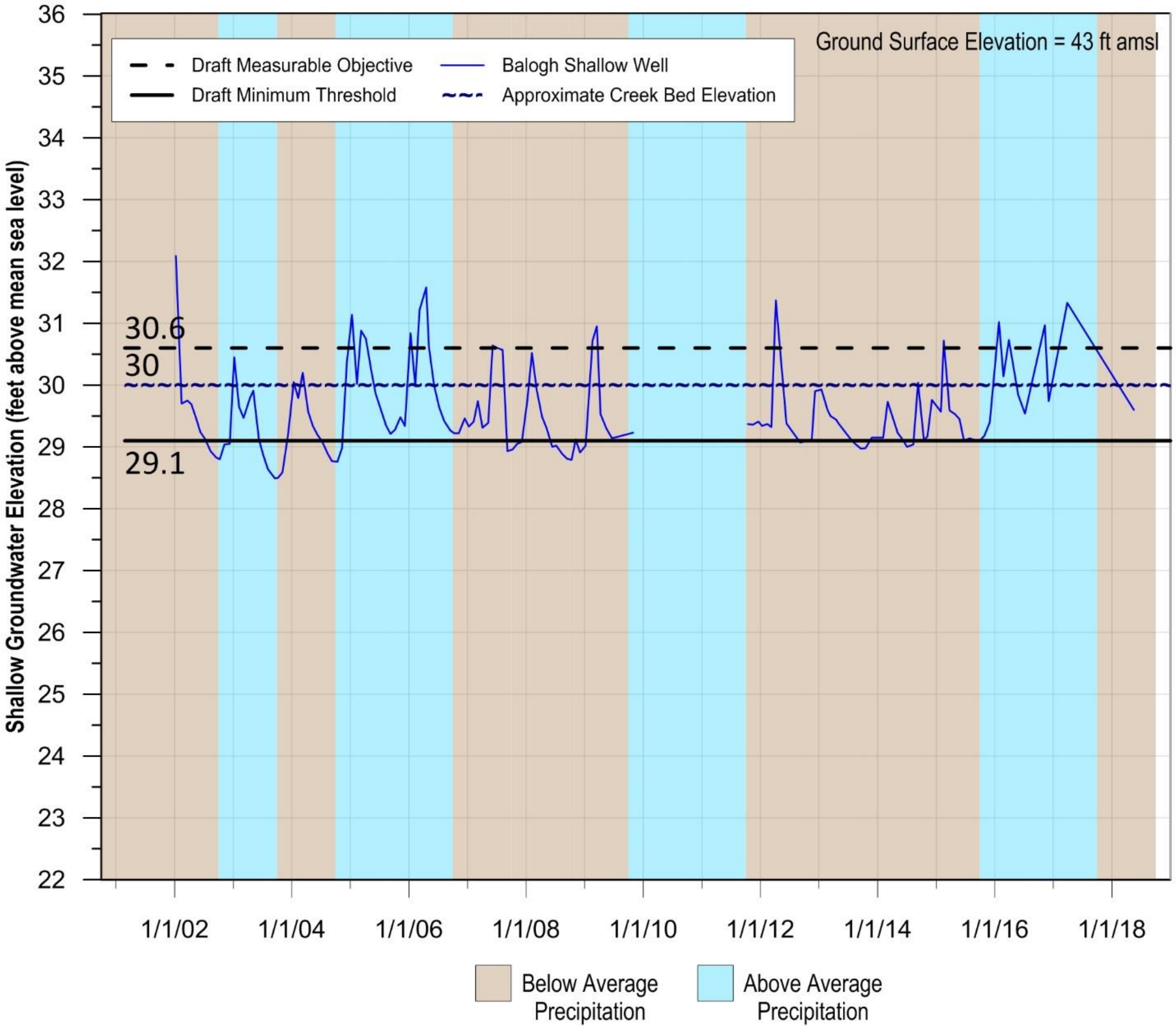



*Figure 31. Balogh Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective*

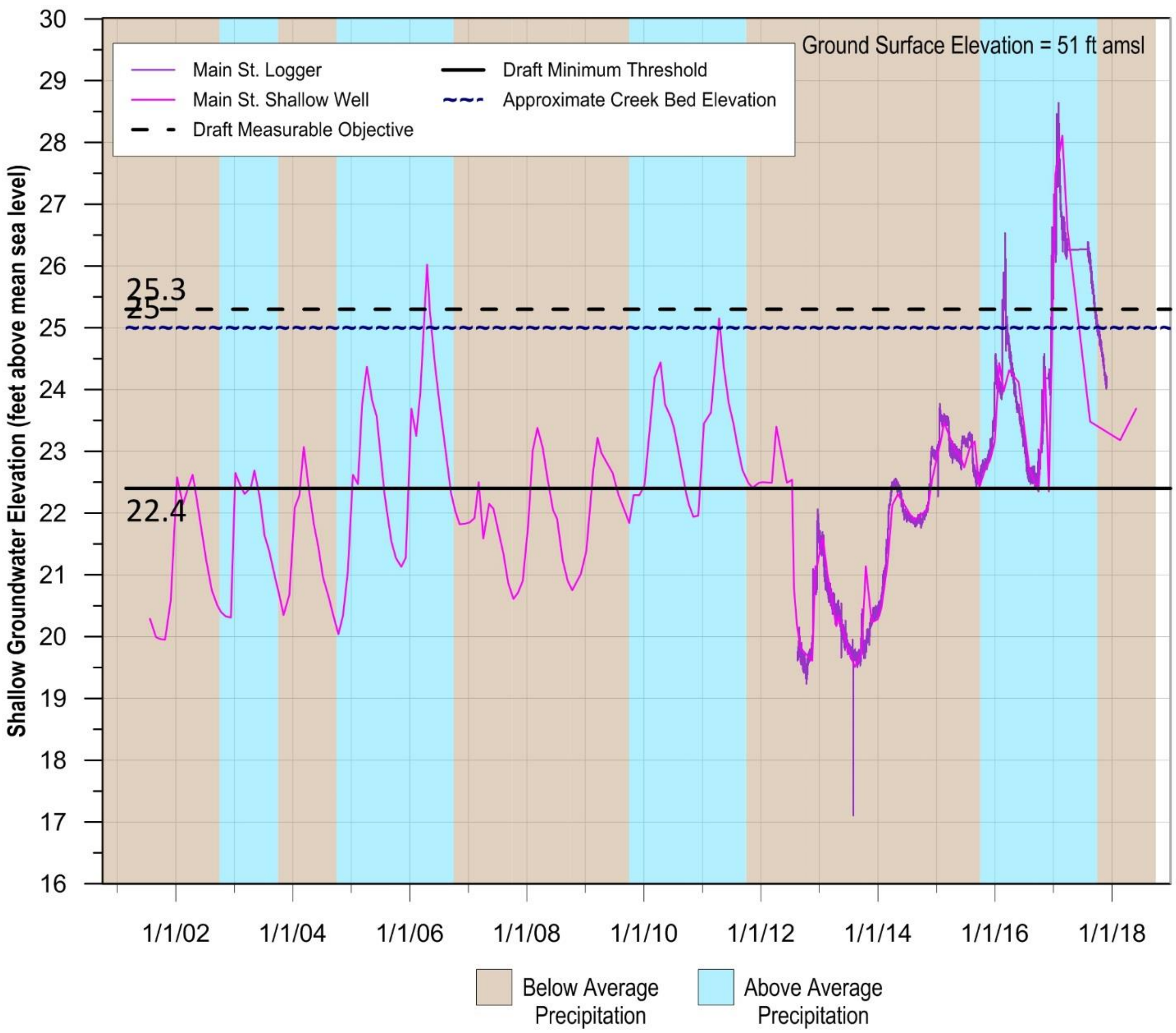



*Figure 32. Main Street Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective*

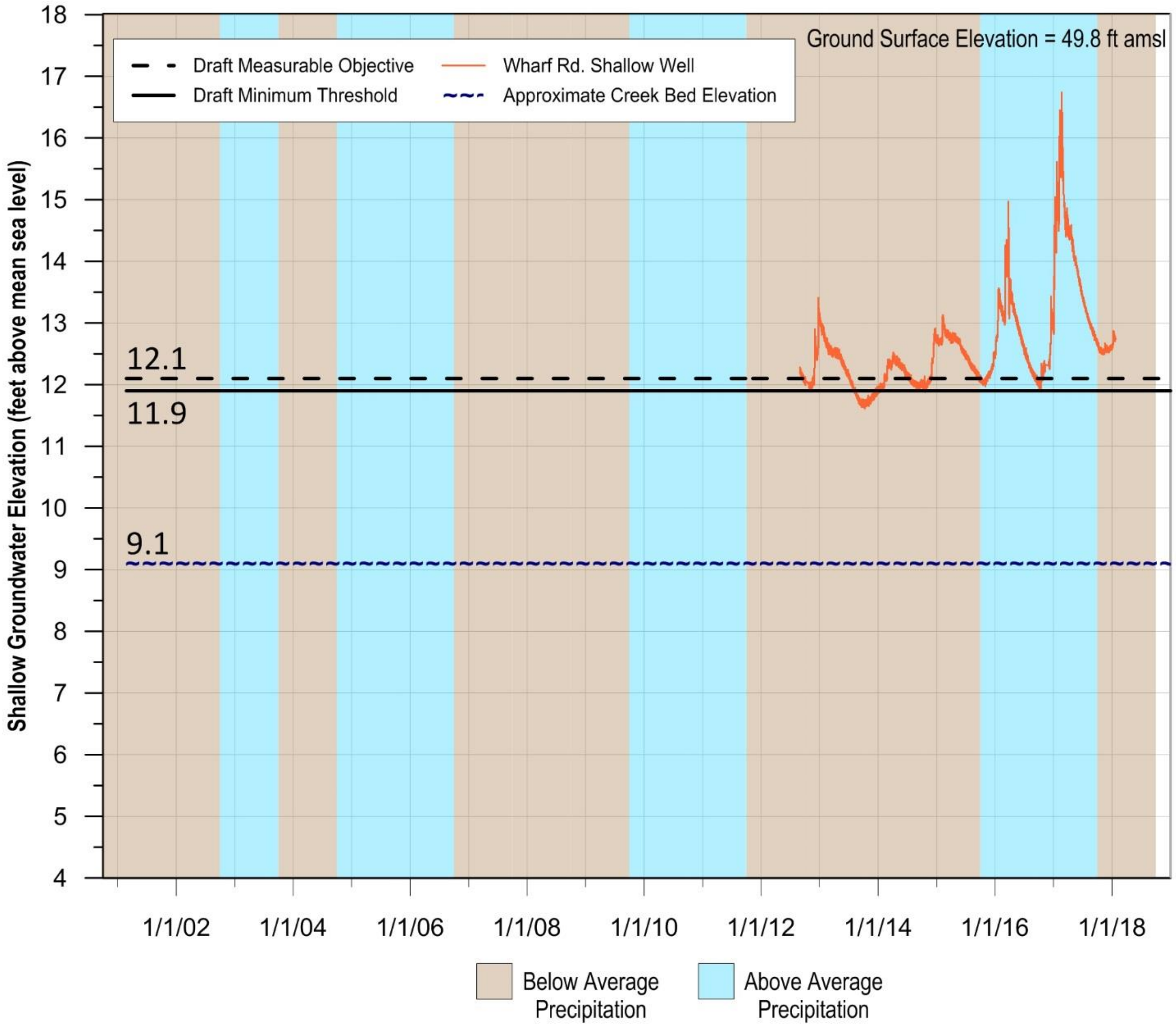



*Figure 33. Wharf Road Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective*

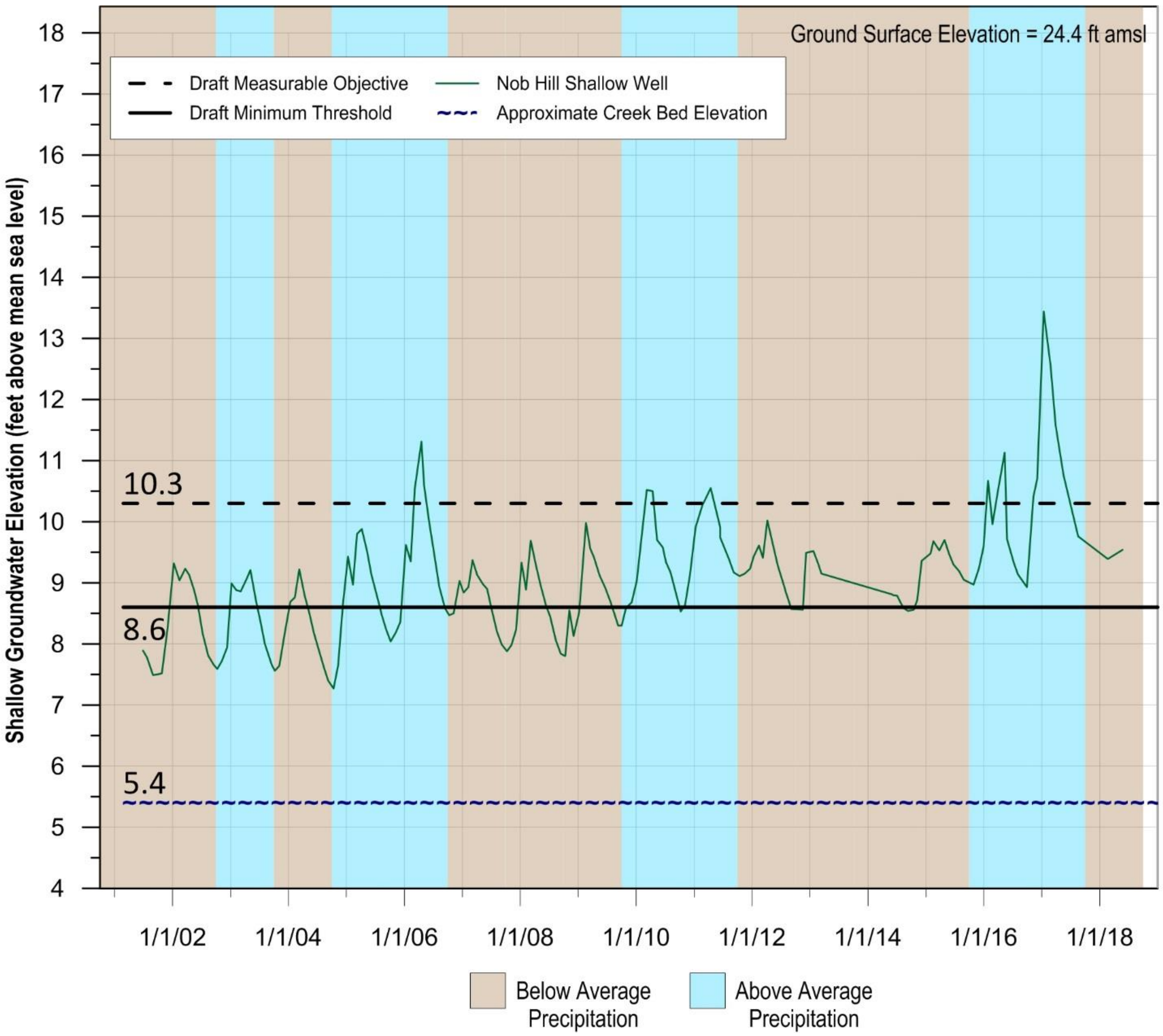



*Figure 34. Nob Hill Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective*

## RELATIONSHIP BETWEEN STREAMFLOW DEPLETION AND MINIMUM THRESHOLD GROUNDWATER LEVEL PROXIES

In order to use groundwater level proxies for minimum thresholds as proposed, a relationship between groundwater level proxies and streamflow depletion from pumping need to be demonstrated. The groundwater model is used to estimate streamflow depletion from pumping during the 2001-2015 period. This is the period where shallow groundwater level data are available and from which minimum thresholds are derived.

The streamflow depletion estimate is accomplished by testing the sensitivity of simulated groundwater contribution of streamflow to all pumping within the Basin (MGB on Figure 35 with modeled well locations shown on Figure 36). This sensitivity test is outside the bounds of conditions under which the model is calibrated and adds to uncertainty of the modeled results.

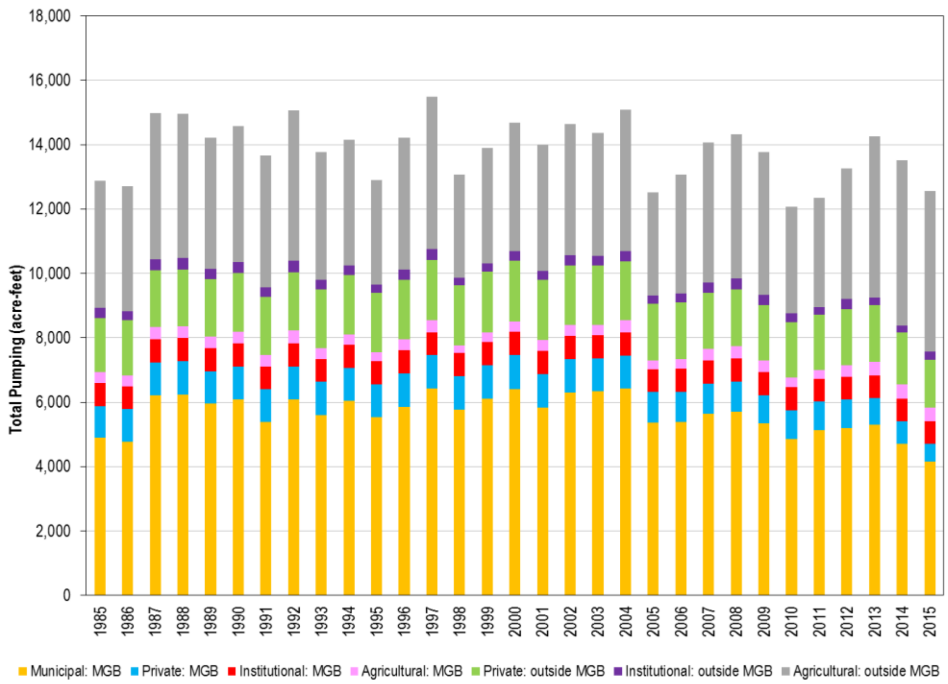



*Figure 35. Modeled Pumping within and outside of Santa Cruz Mid-County Basin (MGB) 1985-2015*

Figure 37 shows the sensitivity of additional groundwater contribution to streamflow for the Soquel Creek watershed during minimum flow months to Basin pumping. Removing Basin pumping in the model results in an increased groundwater contribution to Soquel Creek of up to 1.2 cfs for the 2001-2015 modeled period. This means that if there is more than approximately 1.2 cfs of surface water depletion is caused by groundwater extractions during low flow periods undesirable results will occur. The estimate of 1.2 cfs simulated over 2001-2015 is the minimum threshold for streamflow depletion. To reiterate, the uncertainty of this estimate and difficulty measuring streamflow depletion from pumping affirm the appropriateness of using a groundwater level proxy to prevent the undesirable result of increases in streamflow depletion above what occurred from 2001-2015.

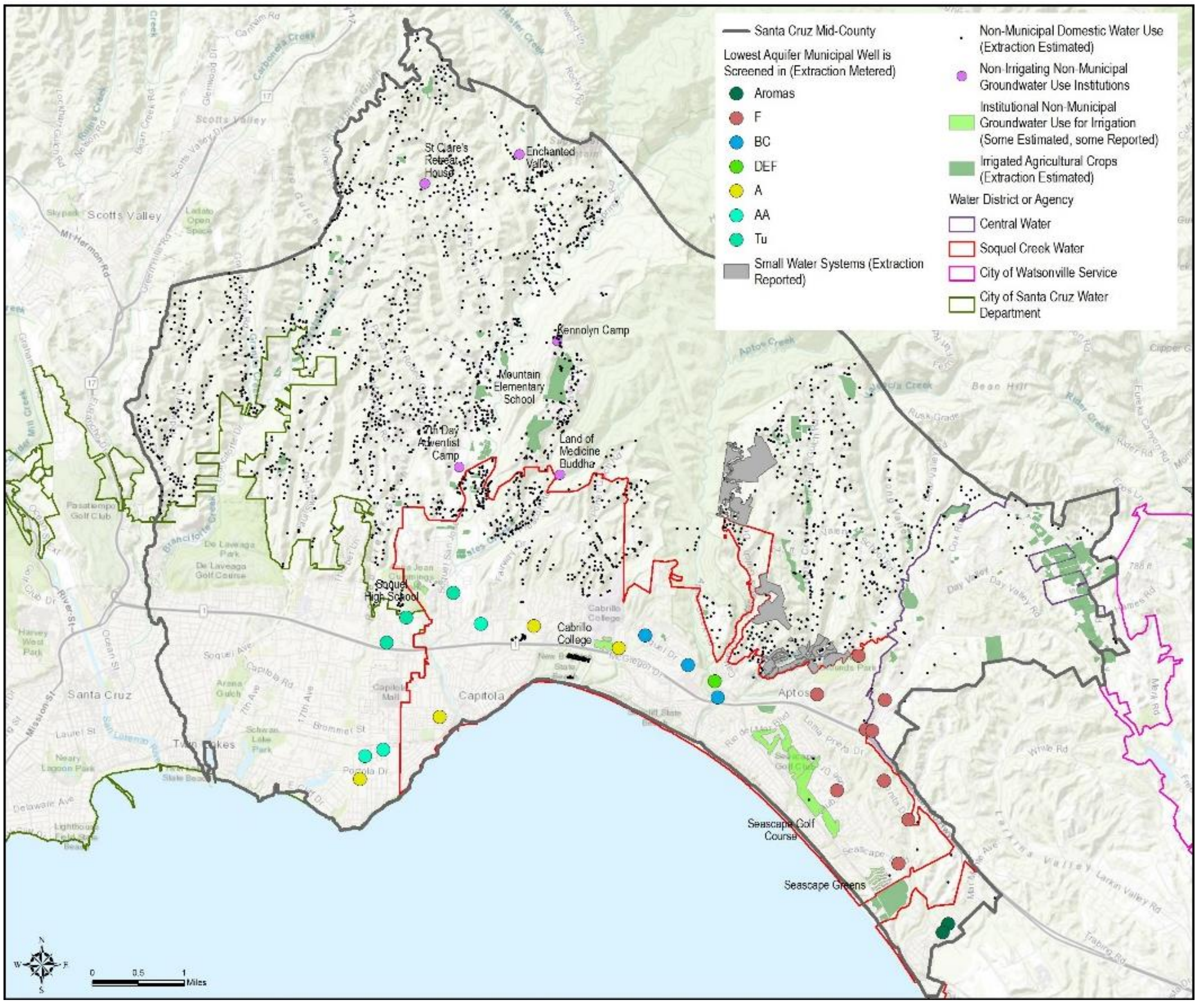



*Figure 36. Modeled Pumping Locations within Santa Cruz Mid-County Basin (MGB)*

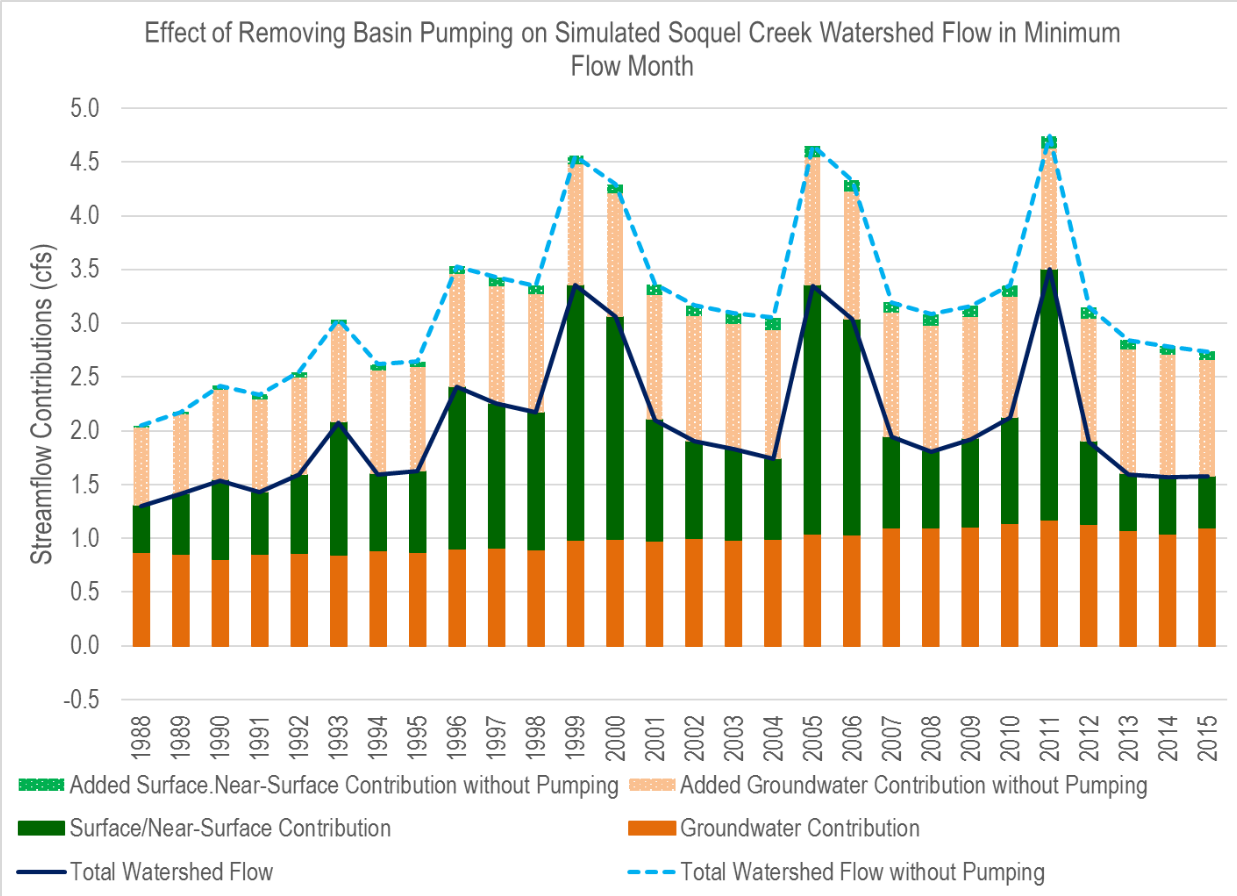



*Figure 37. Simulated Contributions to Streamflow for Soquel Creek Watershed with and without Historical Pumping*

## DRAFT MEASURABLE OBJECTIVES

Where groundwater and surface water are interconnected, measurable objectives at representative monitoring points are proposed to be groundwater elevations are greater than the minimum thresholds by the range in seasonal-low shallow elevations over the period of record through 2015. In all cases this results in groundwater elevations that are higher than the creek bed elevation at each representative monitoring point. The increased hydraulic gradient would increase groundwater contributions to streamflow.

The range in seasonal-low elevations represents known change in seasonal-low elevations that can occur and includes the years when groundwater elevations in the Basin as a whole have been increasing. The range effectively provides the operational flexibility that measureable objectives are intended to provide.

## RELATIONSHIP OF STREAMFLOW DEPLETION TO MEASURABLE OBJECTIVE GROUNDWATER LEVEL PROXIES

The measurable objective groundwater level proxies are meant to achieve a decrease in streamflow depletion from pumping that occurred from 2001-2015 that is the basis for the minimum threshold and defining undesirable results. Groundwater modeling will be used to estimate how much of a decrease in streamflow depletion will result from increasing shallow groundwater levels from the minimum threshold to the measurable objective. This relationship between increases in shallow groundwater levels and increases in streamflow will be estimated based on simulations of planned projects and management actions compared to baseline conditions.

Simulation of projects and management actions to address seawater intrusion are predicted to increase groundwater elevations in most of the area of municipal production, including fairly far inland of the area of municipal production in the Purisima A Unit underlying Soquel Creek (Figure 38) and the alluvium underlying Soquel Creek (Figure 39). Hydrographs for shallow wells along Soquel Creek show the increase resulting from projects and management actions at these specific locations (Figure 40). These simulations also show an increase in groundwater contribution to streamflow from implementation of projects and management actions in the Soquel Creek watershed and specific segments near shallow monitoring wells during seasonal low groundwater level and flow months (Figure 41 and Figure 42).

We will use these results to establish a relationship between increasing shallow groundwater levels and increase in groundwater contribution to flow to estimate the reduction in streamflow depletion from pumping represented by increasing shallow groundwater levels to measurable objectives. Figure 43 and Figure 44 show examples of this relatively linear relationship at the Balogh and Main Street wells. Relationships at representative monitoring points will provide estimates of streamflow depletion reduction for the measurable objective, but achieving the groundwater level proxy for the measurable objective is the best way to meet goals of raising shallow groundwater levels above the creek bed and achieving operational flexibility.

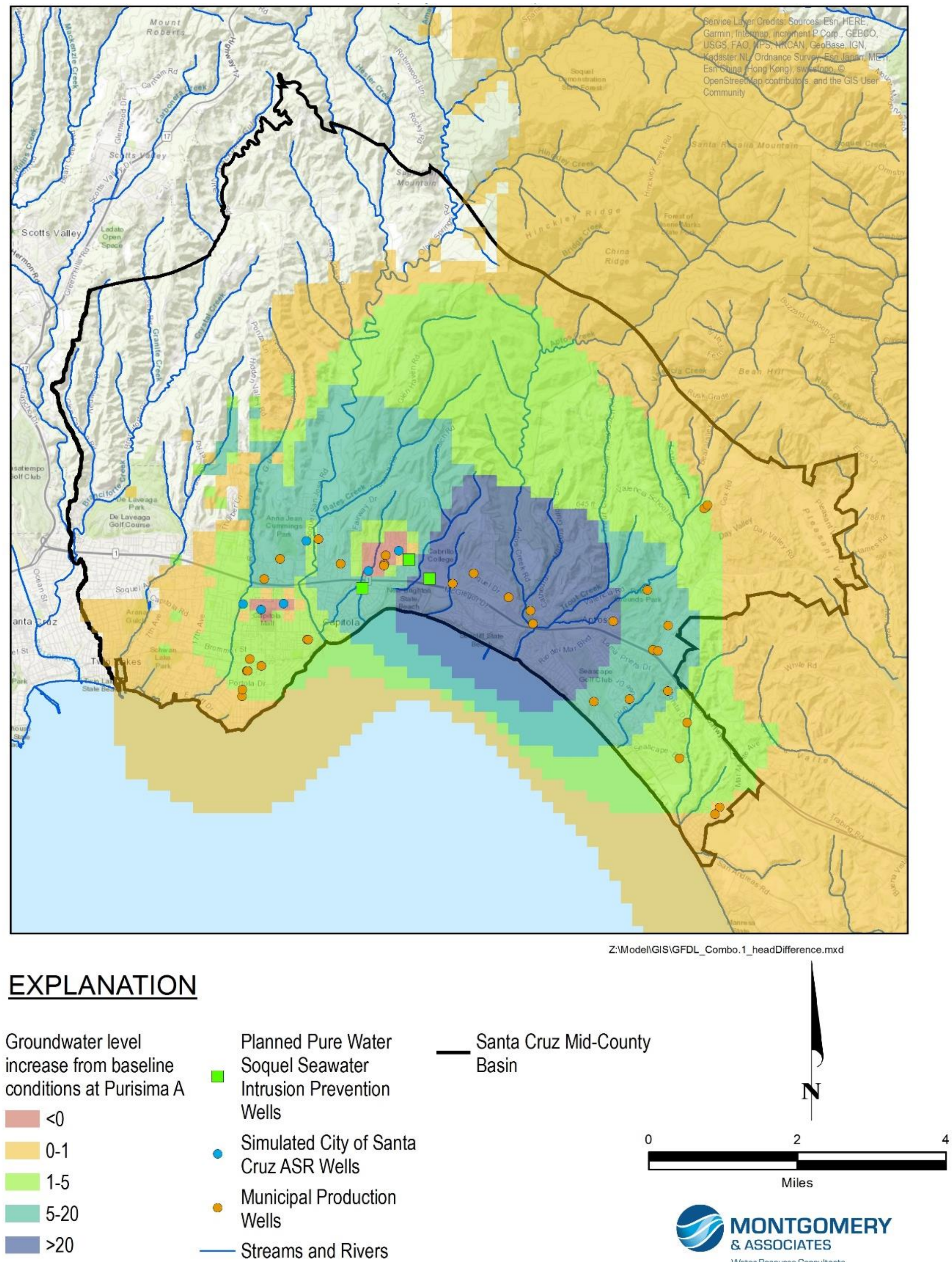



*Figure 38. Groundwater Level Increases in Purisima A Unit Underlying Soquel Creek Resulting from Combination of Pure Water Soquel and Preliminary Iteration of City of Santa Cruz ASR after Two Dry Years*

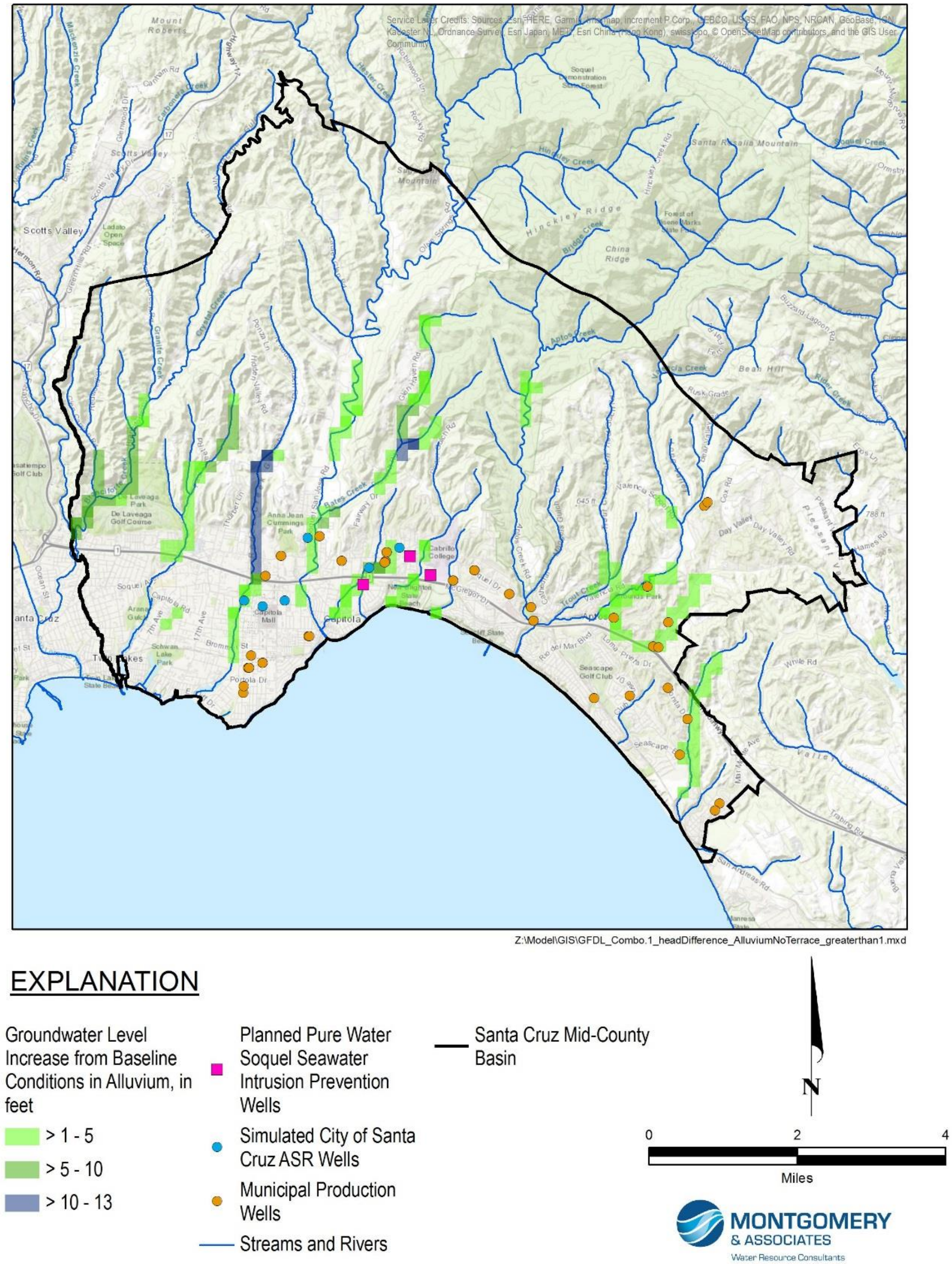



*Figure 39. Groundwater Level Increases in Alluvium Underlying Soquel Creek Resulting from Combination of Pure Water Soquel and Preliminary Iteration of City of Santa Cruz ASR after Two Dry Years*

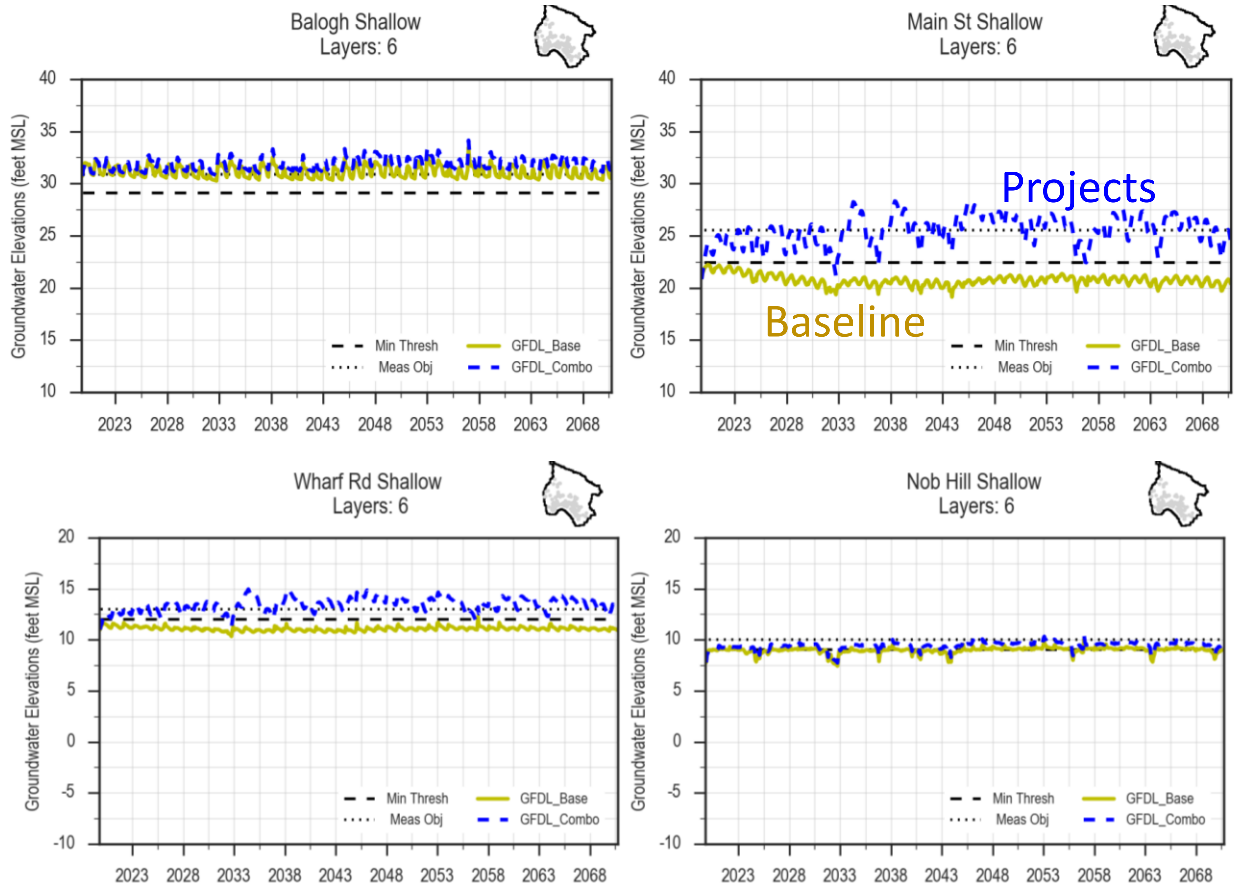



*Figure 40. Groundwater Levels at Shallow Wells for Combination of Pure Water Soquel and Preliminary Iteration of City of Santa Cruz ASR versus Baseline*

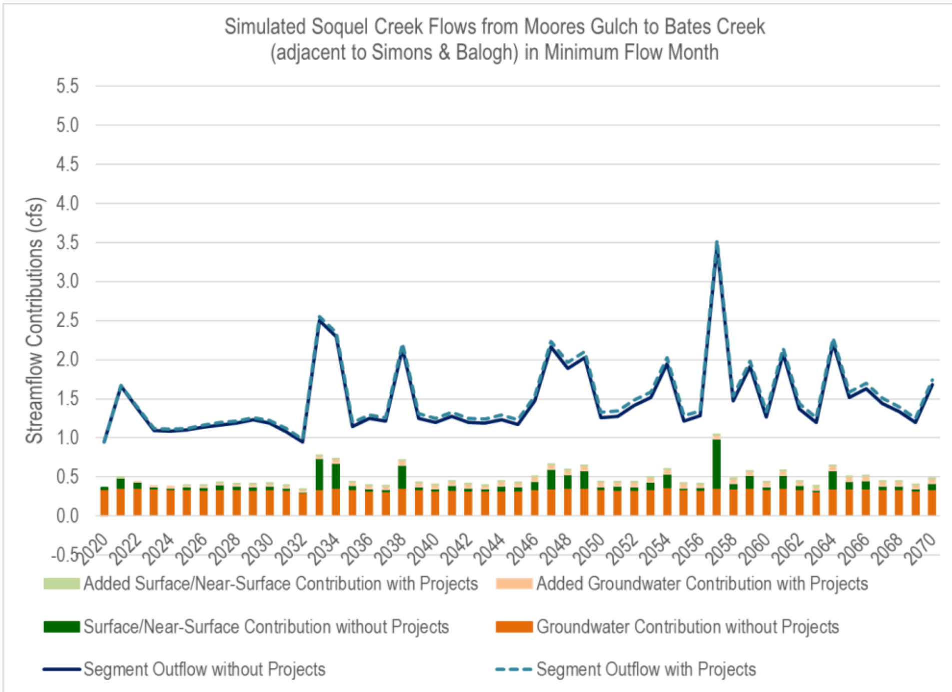



*Figure 41. Simulated Flow Contributions and Total Streamflow for Soquel Creek from Moores Gulch to Bates Creek in Minimum Flow Month with and without Projects*

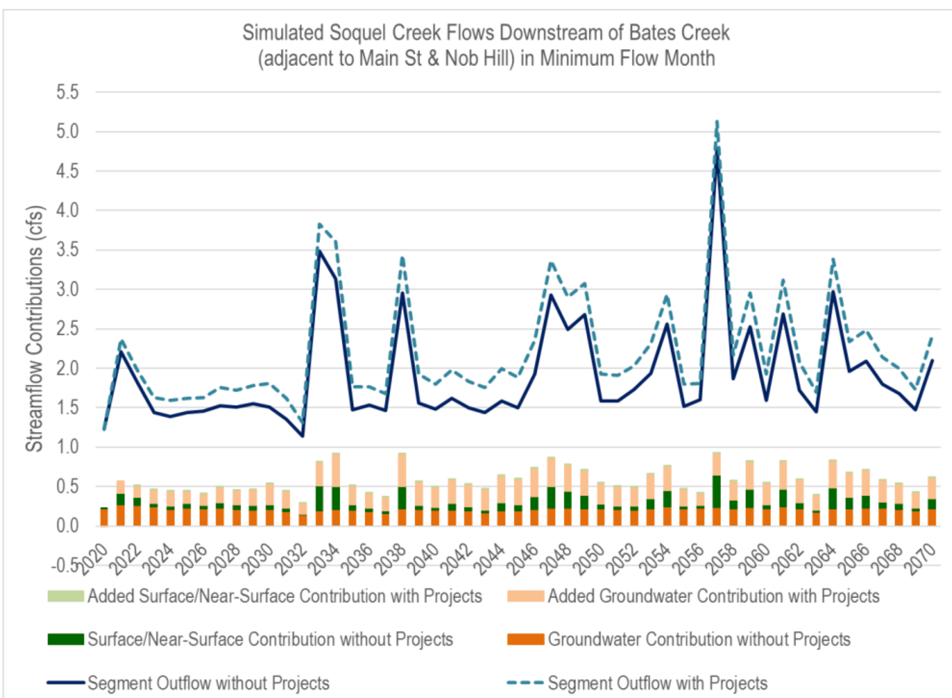



*Figure 42. Simulated Flow Contributions and Total Streamflow for Soquel Creek Downstream of Bates Creek in Minimum Flow Month with and without Projects*

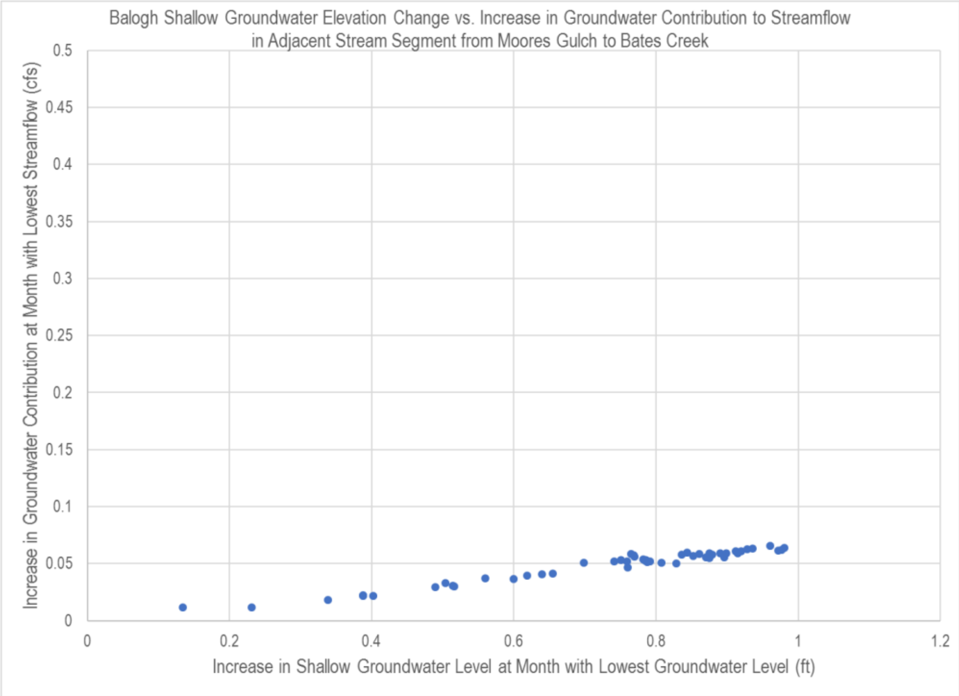



*Figure 43. Increase in Simulated Groundwater Contribution to Minimum Monthly Soquel Creek Flow vs. Increase in Minimum Monthly Groundwater Level at Balogh Shallow Well*

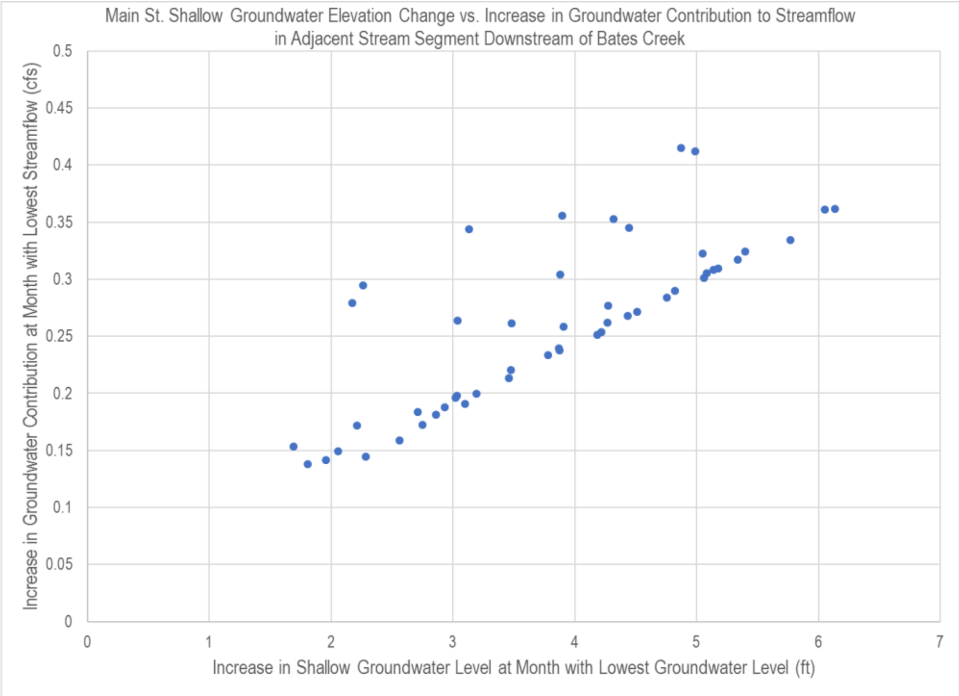



*Figure 44. Increase in Simulated Groundwater Contribution to Minimum Monthly Soquel Creek Flow vs. Increase in Minimum Monthly Groundwater Level at Main St. Shallow Well*

April 24, 2019

**MEMO TO GSP ADVISORY COMMITTEE**

Subject: Agenda Item 5.1

Title: Administrative Draft Groundwater Sustainability Plan (GSP) Sustainability Goal and Guidance

Attachment: Administrative Draft GSP Section 1.2 - Sustainability Goal

Attached for the GSP Advisory Committee's review and comment is an administrative draft of the sustainability goal developed for GSP (or Plan) section 1.2. The goal is based on the GSP Advisory Committee's vision for sustainability in the Santa Cruz Mid-County Groundwater Agency (MGA) basin, public comments received during the Committee's work, and Sustainable Groundwater Management Act (SGMA) requirements to achieve local and regional sustainability. Footnotes identify goal development information and note information needed prior to GSP submission.

**Background: DWR Guidance**

Department of Water Resources' (DWR) GSP Annotated Outline and GSP Emergency Regulations are included for this section. These guidance documents specify the components that must be included in the sustainability goal and information required to support the goal elsewhere in the Plan.

GSP Annotated Outline:
1.2 Sustainability Goal *[no description provided]*

GSP Regulations:
§ 354.24 Sustainability Goal

Each Agency shall establish in its Plan a sustainability goal for the basin that culminates in the absence of undesirable results within 20 years of the applicable statutory deadline. The Plan shall include a description of the sustainability goal, including information from the basin setting used to establish the sustainability goal, a discussion of the measures that will be implemented to ensure that the basin will be operated within its sustainable yield, and an explanation of how the sustainability goal is likely to be achieved within 20 years of Plan implementation and is likely to be maintained through the planning and implementation horizon.

Note: Authority cited: Section 10733.2, Water Code. Reference: Sections 10721, 10727, 10727.2, 10733.2, and 10733.8, Water Code.

MGA NOTE: MGA Planning Horizon January 2040, Implementation Horizon is January 2070.

Santa Cruz Mid-County Groundwater Agency (MGA)
Administrative Draft Sustainability Goal

## 1.2 Sustainability Goal

Regulations prepared by DWR to implement the SMGA require that each Plan develop a sustainability goal that "…culminates in the absence of undesirable results within 20 years.…" The Plan must include basin information used to establish the sustainability goal and a discussion of the measures that will be implemented to ensure that the basin will be operated to achieve sustainability within the 20 year planning timeframe.

As discussed in Section 2.1.5, the MGA selected a GSP Advisory Committee to obtain detailed public input from representatives of the MGA Basin's basin water uses and users. The GSP Advisory Committee recommended elements of the basin's sustainability goal for final MGA Board approval. Together with staff support, technical assistance, and community input, the GSP Advisory Committee developed their vision for MGA basin sustainability. This vision was reviewed, revised, and adopted by the MGA Board on _______.[1]

***The MGA Basin's sustainability goal is:***

> ***To provide a safe, reliable, and affordable water supply to meet current and expected regional demand without causing undesirable impacts. To achieve this goal will require groundwater management that:***
>
> - ***Ensures groundwater is available to a diverse population of users of all socioeconomic status,***
> - ***Resolves problems of groundwater overdraft within the MGA Basin,***
> - ***Maintains groundwater levels where groundwater dependent ecosystems exist,***
> - ***Maintains groundwater contributions to streamflow,***
> - ***Supports reliable groundwater supply and quality to promote public health and welfare,***
> - ***Protects groundwater supply against seawater intrusion,***[2]
> - ***Ensures operational flexibility within the MGA Basin by maintaining reserve water supply in drought, and***
> - ***Does no harm to neighboring groundwater basins in our efforts to achieve regional groundwater sustainability.***[3]

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[1] GSP Planning process statements are included to indicate that the MGA Board is the decision making body with advice from the public and GSP Advisory Committee.

[2] Sustainability goal statements 1-6 come from committee and public comments at GSP Advisory Committee meeting #3 summary on p.4.

[3] Goal statements seven and eight represent SGMA regional sustainability requirements.

Predictive modeling detailed in Section 4.0 of this Plan indicates that maintaining groundwater elevations needed to protect against seawater intrusion will largely prevent undesirable results occurring for all six sustainability indicators. Additional localized groundwater pumping management in the Purisima aquifers where those aquifers are connected to surface water may also be necessary to ensure significant and unreasonable depletion of surface water supporting groundwater dependent ecosystems does not occur from groundwater pumping.[4]

MGA Basin water budget detailed in Section 2.2.3 and water demand forecasts detailed in Section 2.1.3 of this Plan indicate that groundwater sustainability in the MGA Basin will require multiple groundwater management strategies. It is necessary to incorporate water conservation measures into our daily lives, to develop existing and new water supplies to reduce regional dependence on groundwater, and to replenish available groundwater storage for use during times of drought. Section 4.0 of this Plan discusses in detail the projects and management actions that are required and others that may be necessary to attain groundwater sustainability in the MGA Basin.[5]

[4] Review these statements in relationship to modeling data and recommendations on significant and unreasonable depletions of surface water from groundwater pumping.

[5] Discussion of measures needed to reach sustainability will require revisions as Section 4.0 & 5.0 analysis are further developed and evaluated using the MGA Groundwater Model.

# Santa Cruz Mid-County Basin
# Summary of All Sustainable Management Criteria

This summary document is a synthesis of all the sustainable management criteria (SMC) that have been developed with input from the Santa Cruz Mid-County Groundwater Sustainability Plan (GSP) Advisory Committee for the six required sustainability indicators to date. The rationales underlying the SMC are not provided in this summary but can be found in the various proposals that have been presented at previous GSP Advisory Committee meetings and are referenced at the beginning of each sustainability indicator section. Where very recent changes to the criteria have been made, they are indicated as red text for additions and strikeouts for deletions.

These SMC constitute a core component of the recommendations that the GSP Advisory Committee will submit to the Santa Cruz Mid-County Groundwater Agency (MGA) after the GSP Advisory Committee's June 19, 2019 meeting. They are intended for discussion and refinement, as needed, at the GSP Advisory Committee's April 24, 2019 meeting.

The order of each sustainability indicator in this summary follows the California Department of Water Resources (DWR) numbering for sustainability indicators.

# Sustainability Indicator #1
# Chronic Lowering of Groundwater Levels

Proposals for chronic lowering of groundwater levels SMC were discussed at the following GSP Advisory Committee meetings: May 2018, September 2018 and January 2019.

The chronic lowering of groundwater level sustainability indicator is different to other sustainability indicators that use groundwater elevations as measures of sustainability, i.e., seawater intrusion and depletion of interconnected surface water. For example, the seawater intrusion sustainability indicator focuses on groundwater elevations near the coast, while the chronic lowering of groundwater level sustainability indicator applies to groundwater elevations inland of the area of municipal groundwater pumping and are not set based on protective groundwater elevations.

## SIGNIFICANT AND UNREASONABLE CHRONIC LOWERING OF GROUNDWATER LEVELS

A significant number of private, agricultural, industrial, and municipal production wells can no longer provide enough groundwater to supply beneficial uses.

## MINIMUM THRESHOLDS - CHRONIC LOWERING OF GROUNDWATER LEVEL

Each representative monitoring well gets its own minimum threshold based on the groundwater elevation required to meet the typical overlying water demand in the shallowest well in the vicinity of the representative monitoring well. The minimum threshold is not allowed to be more than 30 feet below the historic low groundwater elevation. All representative monitoring wells must be equipped with data loggers.

Figures 1 through 17 include hydrographs showing historical groundwater elevations versus minimum thresholds and measurable objectives. **Figure** 18 shows the location of representative monitoring wells with chronic lowering of groundwater levels minimum thresholds.

## MEASURABLE OBJECTIVES - CHRONIC LOWERING OF GROUNDWATER LEVEL

Measurable objectives were initially proposed as the average groundwater elevations at each representative monitoring well over the past five years (2013-2017). As this was during the recent drought, these groundwater elevations are lower than what they have been historically. The current proposal for measurable objectives at each representative monitoring well is to use the 90th percentile of historical groundwater elevations for the period of record. The higher groundwater elevation more accurately reflects where the GSP Advisory Committee would like groundwater elevations to be in the future whilst acknowledging that setting measurable objectives at the maximum elevation is unrealistic as those elevations are generally associated with very wet years and would not be achievable most of the time.

Hydrographs in Figures 1 through 17 show measurable objectives for chronic lowering of groundwater levels compared to historical elevations and minimum thresholds.

**UNDESIRABLE RESULTS - CHRONIC LOWERING OF GROUNDWATER LEVEL**

The average monthly representative monitoring well groundwater elevation falls below the <Minimum Threshold>.

# Sustainability Indicator #2
# Reduction in Groundwater Storage

The proposal for reduction in groundwater storage SMC was discussed at the March 2019 GSP Advisory Committee meeting.

## SIGNIFICANT AND UNREASONABLE REDUCTION IN GROUNDWATER STORAGE

A significant and unreasonable reduction of groundwater in storage would be a net volume of groundwater extracted that will likely cause other sustainability indicators to have undesirable results.

## MINIMUM THRESHOLDS - REDUCTION IN GROUNDWATER STORAGE

Sustainable Yield representing the net annual volume of groundwater extracted (pumping minus annual volume of managed aquifer recharge) for any one of the groups of aquifers:

- Aromas aquifer and Purisima F aquifer (still to be estimated)
- Purisima DEF, BC, A, and AA aquifer (still to be estimated)
- Tu aquifer (still to be estimated)

## MEASURABLE OBJECTIVES - REDUCTION IN GROUNDWATER STORAGE

The maximum net annual groundwater to be extracted that ensures if there were four subsequent years of maximum projected net groundwater extraction, net annual groundwater extractions greater than the minimum threshold will not occur for any one of the following groups of aquifers:

- Aromas and Purisima F aquifers
- Purisima DEF, BC, A, and AA aquifers
- Tu aquifer

Annual net extractions for the different aquifer groups will be used to compare against measurable objectives, and not the five-year average of net extractions. This is because the Measurable Objective is the maximum that can be pumped if the next four years all had maximum projected pumping, and undesirable results are to be avoided.

**UNDESIRABLE RESULTS - REDUCTION IN GROUNDWATER STORAGE**

Five-year average net extraction exceeding the Sustainable Yield (minimum threshold) for the Aromas aquifer and Purisima F unit, five-year average net extraction exceeding the Sustainable Yield (minimum threshold) for the Purisima DEF, BC, A, and AA aquifers, or five-year average net extraction exceeding the Sustainable Yield (minimum threshold) for the Tu aquifer.

# Sustainability Indicator #3
# Seawater Intrusion

Proposals for seawater intrusion SMC were discussed at the following GSP Advisory Committee meetings: April 2018, September 2018 and March 2019.

## SIGNIFICANT AND UNREASONABLE SEAWATER INTRUSION CONDITIONS

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

## MINIMUM THRESHOLDS - SEAWATER INTRUSION

### Chloride Isocontours Minimum Threshold (Aromas and Purisima aquifers)

Separate 250 mg/L chloride isocontours for Aromas and Purisima aquifers ( Figure 19) based on current chloride concentrations in coastal monitoring wells.

### Groundwater Elevations as a Proxy Minimum Thresholds

Groundwater elevations are used as a proxy for seawater intrusion because it is more responsive to the threat of sweater intrusion to manage groundwater elevations and hydraulic gradients than the location of the chloride isocontour and chloride concentrations in monitoring wells that are not optimally located for purposes of tracking concentrations around an isocontour. Since 2009, seawater intrusion in the Basin has been managed using protective elevations established to prevent seawater intrusion at the coastline with great success. Protective elevations are established at specific elevations above sea level to keep the equilibrium position of the freshwater / seawater interface from impacting underlying aquifers from which production wells pump.

See Table 1 for listing of minimum thresholds and how they were established. Figure 20 shows the location of representative monitoring wells with their minimum thresholds.

## MEASURABLE OBJECTIVES - SEAWATER INTRUSION

### Isocontour Measurable Objective

Same locations as the minimum threshold isocontour shown on  Figure 19 but the concentration is reduced from 250 mg/L (minimum threshold) to 100 mg/L (Measurable Objective).

**Groundwater Elevations as a Proxy Measurable Objectives**

See Table 1 for listing of measurable objectives for representative monitoring wells and how they were established.

**UNDESIRABLE RESULTS - SEAWATER INTRUSION**

The undesirable results for seawater intrusion described below are related to the inland movement of chloride isocontours which would be considered significant and unreasonable. To be able to monitor the location of the isocontour, chloride concentrations in monitoring wells either side of the chloride isocontours are used in the definition of undesirable results.

1. **Undesirable Results for Intruded Coastal Monitoring Wells**
   Any coastal monitoring well with current seawater intrusion has a chloride concentration above its past five year maximum chloride concentration. This concentration must be exceeded in 2 or more of the last 4 consecutive quarterly samples.

2. **Undesirable Results for Unintruded Coastal Monitoring Wells, and Inland Monitoring and Production Wells**
   A. Any Unintruded Coastal Monitoring Well has a chloride concentration above 250 mg/L. This concentration must be exceeded in 2 or more of the last 4 consecutive quarterly samples.

   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.

3. **Undesirable Results for Protective Groundwater Elevations**
   Five -year average groundwater elevations below protective groundwater elevations for any Coastal representative monitoring well.

**Protective Elevation as a Proxy Minimum Thresholds for Seawater Intrusion**

**Table 1. Representative Monitoring Wells with Groundwater Elevations to be Used as Proxies for Minimum Thresholds and Measurable Objectives for Seawater Intrusion**

| Coastal Monitoring Well with Aquifer Unit in Parenthesis | Proxy Protective Elevation / Minimum Threshold (feet mean seal level) | Basis for Protective Elevation | Proxy Measurable Objective (feet mean seal level) | Basin for Measurable Objective |
|---|---|---|---|---|
| Moran Lake Medium (A) | 5 | GH BS | 6.8 | GH BU |
| Moran Lake Deep (AA) | 6.7 | GH BS | 16 | GH BU |
| Soquel Point Medium (A) | 6 | GH BS | 7.1 | GH BU |
| Soquel Point Deep (AA) | 7.5 | GH BS | 16 | GH BU |
| Soquel Point or alternate City location (Tu) | New monitoring well needed | - | 24 | GH BU |
| Pleasure Point Medium (A) | 6.1 | GH BS | 6.5 | GH BU |
| Pleasure Point Deep (AA) | 7.7 | GH BS | 16 | GH BU |
| SC-1A (A) | 4 | XS 70th | 6 | XS >99th |
| SC-13A (Tu) | 17.2 | GH BS | 19 | GH BU |
| SC-3A (A) | 10 | XS 70th | 12 | XS >99th |
| SC-3 (AA) | New monitoring well needed | - | 10.4 | GH BU |
| SC-5A (A) | 13 | XS 70th | 15 | XS >99th |
| SC-9C (BC) | 10 | XS 70th | 11 | XS >99th |
| SC-8B (BC) | 19 | XS 70th | 20 | SC-8D + GH |
| SC-8D (DEF) | 10 | XS 70th | 11 | XS >99th |

| Coastal Monitoring Well with Aquifer Unit in Parenthesis | Proxy Protective Elevation / Minimum Threshold (feet mean seal level) | Basis for Protective Elevation | Proxy Measurable Objective (feet mean seal level) | Basin for Measurable Objective |
|---|---|---|---|---|
| SC-A1B (F) | 3 | XS 70th | 5 | XS >99th |
| SC-A8A (F) | 6 | XS 70th | 3 | XS >99th |
| SC-A2A (F) | 3 | XS 70th | 4 | XS >99th |
| SC-A3A (Aromas) | 3 | XS 70th | 7 | XS >99th |

Notes:

GH BS = Ghyben-Herzberg bottom of screen

GH BU = Ghyben-Herzberg bottom of aquifer unit

XS 70th = Cross-sectional model with 70th percentile of runs being protective

XS >99th = Cross-sectional model with greater than 99th percentile of runs being protective

# Sustainability Indicator #4
# Degraded Groundwater Quality

Proposals for degraded groundwater quality SMC were discussed at the following GSP Advisory Committee meetings: June 2018, September 2018 and October 2018.

## SIGNIFICANT AND UNREASONABLE DEGRADED GROUNDWATER QUALITY

Significant and unreasonable degradation of groundwater would occur when groundwater quality, attributable to groundwater pumping or managed aquifer recharge, fails to meet state drinking water standards.

## MINIMUM THRESHOLDS - DEGRADED GROUNDWATER QUALITY

Minimum thresholds are state drinking water standards for each constituent of concern that is monitored in representative monitoring wells for degraded groundwater quality.

**Table 2. General Basin Constituents of Concern**

| Constituent of Concern | Reason for Concern | Minimum Threshold/ Drinking Water Standard |
|---|---|---|
| **Total dissolved solids** | basic health of basin | 1,000 mg/L |
| **Chloride** | basic health of basin | 250 mg/L |
| **Iron** | naturally elevated | 300 µg/L |
| **Manganese** | naturally elevated | 50 µg/L |
| **Arsenic** | naturally elevated | 10 µg/L |
| **Chromium (Total)** | naturally elevated | 50 µg/L |
| **Chromium VI** | naturally elevated | none set yet |
| **Nitrate as Nitrogen** | septic systems & agriculture | 10 mg/L |
| **Perchlorate** | agriculture related | 6 µg/L |
| **Organic compounds** | human introduced | various |

Each project or management action implemented as part of the GSP will have its own unique constituents of concern that will apply to the monitoring and production wells included in their use permits granted by the State Water Board Division of Drinking Water (DDW).

Pure Water Soquel is classified as a groundwater replenishment reuse project (GRRP). A compendium of groundwater replenishment reuse regulations (GRRR) (Title 22, Division 4, Chapter 3) were issued by the State Water Resources Control Board in 2014 (SWRCB, 2018). Article 5.2 applies to indirect potable reuse projects with subsurface application.

For projects injecting purified recycled water into the Basin, permits from State Water Board Division of Drinking Water (DDW) are required. Specific monitoring wells and a list of constituents to monitor are part of permit conditions. For Pure Water Soquel, the Title 22 engineering report that informs the DDW Title 22 permit has not yet been finalized but the permit will be approved before the project can be implemented. According to the GRRR Section 60320.200 (c), at least four quarters of background groundwater quality data are required to characterize the groundwater quality in each aquifer that will be receiving recycled water. Table 3 includes a summary of the constituents and constituent groups that will be included in background monitoring. Monitoring wells to be used for operational monitoring will be included as representative monitoring wells in the GSP and the constituents monitored will become constituents of concern at those particular representative monitoring wells.

**Table 3. Pure Water Soquel Summary of Constituents in Background Monitoring Program**

| Constituent or Constituent Group |
| --- |
| Total nitrogen (60320.210 and 60320.226) |
| Inorganic chemicals in Table 64431-A (60320.212) |
| Radionuclide chemicals in Table 64442 and 64443 (60320.212) |
| Organic chemicals in Table 64444-A (60320.212) |
| Disinfection byproducts in Table 64533-A (60320.212) |
| Lead and copper (60320.212) |
| Secondary maximum contaminant levels in Table 64449-A and B (60320.212) |
| Total organic carbon (60320.218) |
| Priority toxic pollutants in 40 CFR section 131.38 (60320.220) |
| Nitrate (60320.226) |
| Nitrite (60320.226) |
| Department and Regional Board specified chemicals per 60320.206.b and 60320.220.b |

The State Water Resources Control Board (SWRCB) has adopted general waste discharge requirements for Aquifer Storage & Recovery (ASR) projects that inject drinking water into groundwater (Order No. 2012-0010-DWQ or ASR General Order). The ASR General Order provides a consistent statewide regulatory framework for authorizing both pilot ASR testing and permanent ASR projects. Oversight of these regulations is through the Regional Water Quality Control Board (RWQCB) and obtaining coverage under the General ASR Order requires the preparation and submission of a Notice of Intent (NOI) application package. The NOI includes a technical report that, amongst other things, identifies and describes target aquifers, delineates the Areas of Hydrologic Influence, identifies all land uses within the delineated Areas of Hydrologic Influence, identifies known areas of contamination within the Areas of Hydrologic Influence, identifies project-specific Constituents of Concern (COCs), and groundwater degradation assessment.

For the City of Santa Cruz Aquifer Storage & Recovery (ASR) which will inject excess winter and spring flows from the San Lorenzo River that are treated to potable standards, the ASR General Order will require, at a minimum, the constituents listed in Table 4 to be tested. Any monitoring wells to be included in the ASR General Order will be added as representative monitoring wells in the GSP and the constituents monitored will become constituents of concern at those particular representative monitoring wells.

**Table 4. City of Santa Cruz ASR Summary of Background Monitoring Constituents**

| Constituent |
|---|
| Electrical conductivity |
| Total dissolved solids |
| pH |
| Arsenic |
| Iron |
| Manganese |
| Nitrate |



**MEASURABLE OBJECTIVES - DEGRADED GROUNDWATER QUALITY**

Measureable objectives for each representative monitoring well are equal to the 2013 – 2017 average concentrations for each constituent of concern. If a representative monitoring well does not have groundwater quality data during this period, the most recent concentrations will be used.

**UNDESIRABLE RESULTS - DEGRADED GROUNDWATER QUALITY**

Groundwater quality undesirable results in the basin occur when as a result of groundwater pumping or managed aquifer recharge, any representative monitoring wells exceeds any <minimum threshold> ~~annually~~.

# Sustainability Indicator #5
# Subsidence

Proposals for subsidence SMC were discussed at the following GSP Advisory Committee meetings: April 2018 and May 2018.

The sustainability indicator was found to not be applicable in the Santa Cruz Mid-County Basin as an indicator of groundwater sustainability and therefore no SMC were set. Even though the indicator is not applicable, a statement of significant and unreasonable subsidence caused by lowering of groundwater levels was discussed and is included below:

> Any land subsidence caused by lowering of groundwater levels occurring in the basin would be considered significant and unreasonable.

# Sustainability Indicator #6
# Depletion of Interconnected Surface Water

Proposals for depletion of interconnected surface water SMC were discussed at the following GSP Advisory Committee meetings: June 2018, February 2019 and April 2019. There have also been four Working Group meetings.

TO BE DISCUSSED IN SEPARATE AGENDA ITEM

# FIGURES

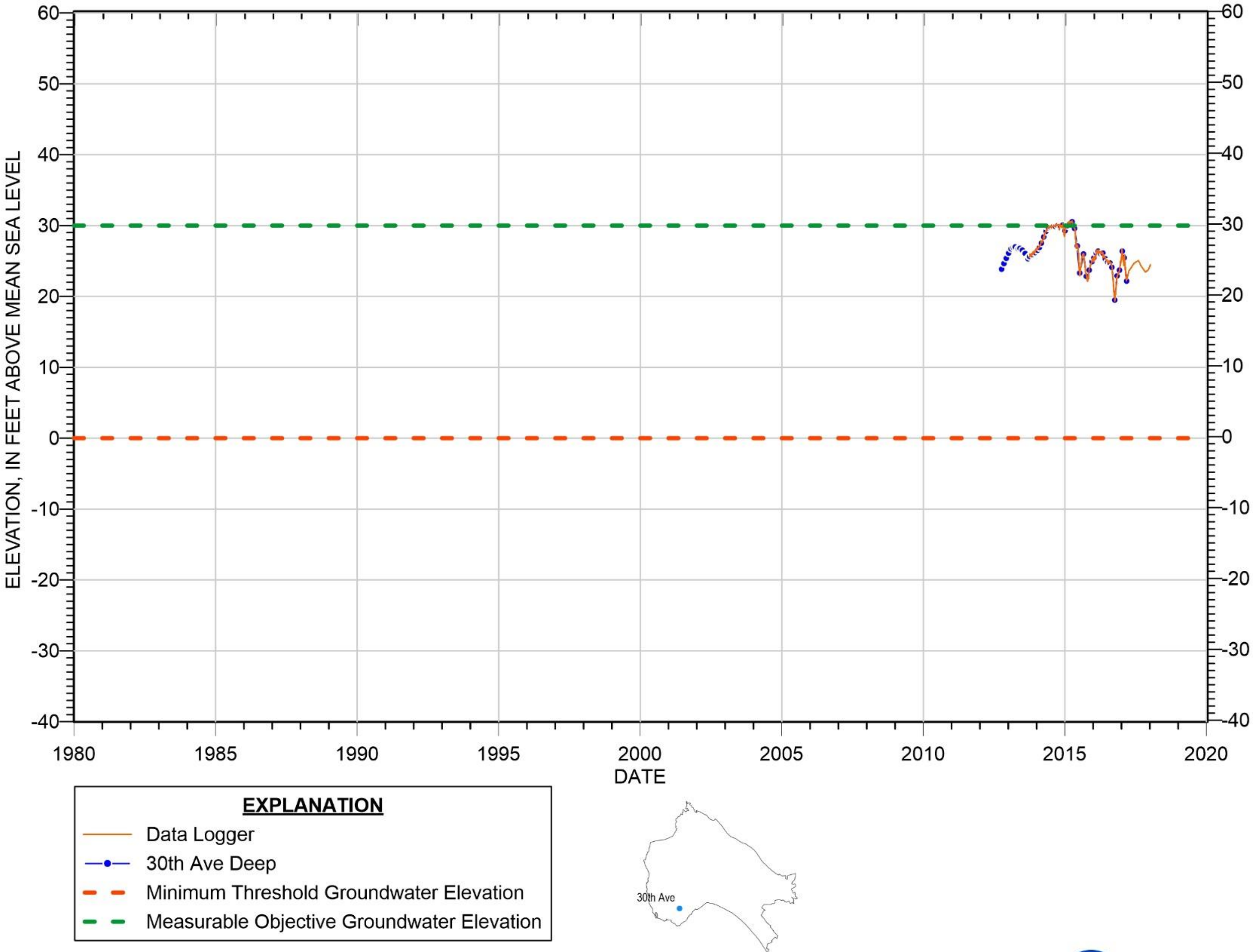


**FIGURE 1. 30th Ave Deep (Tu)**

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**Figure 1. 30th Ave Deep (Tu)**

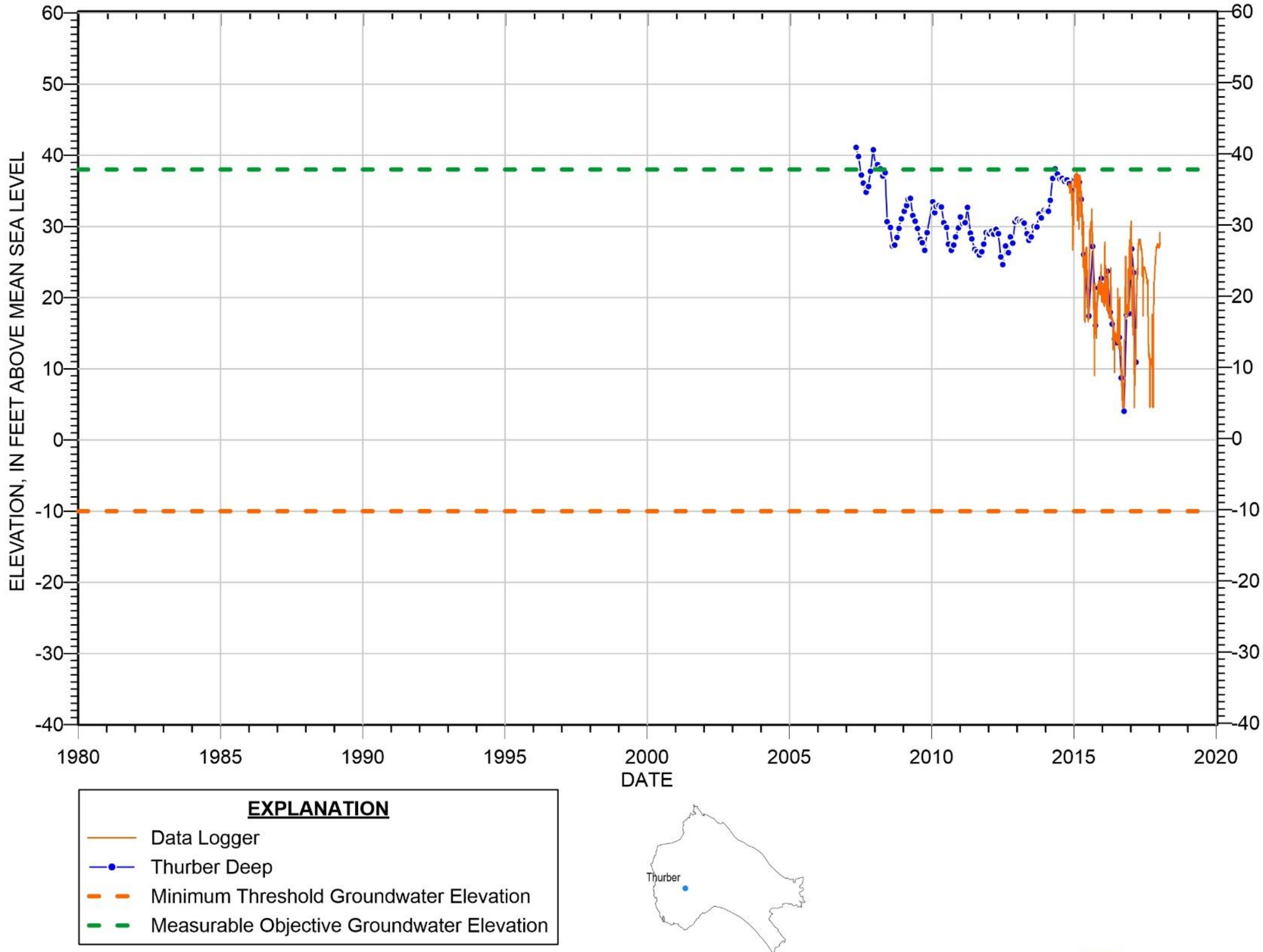


**FIGURE 2. Thurber Lane Deep (Pur AA/Tu)**

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Figure 2. Thurber Lane Deep (Pur AA/Tu)

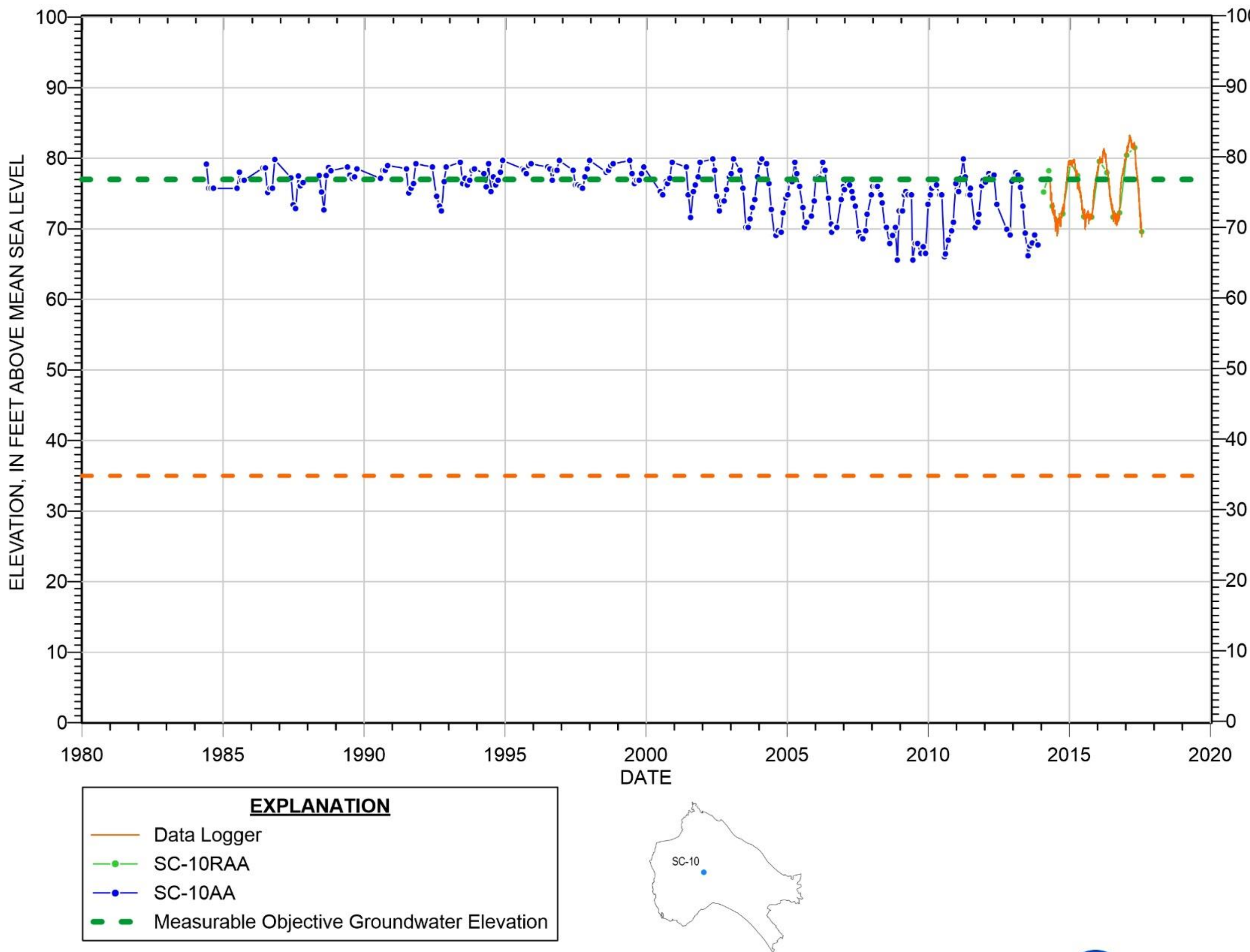


**FIGURE 3. SC-10RAA (Pur AA)**

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**Figure 3. SC-10RAA (Pur AA)**

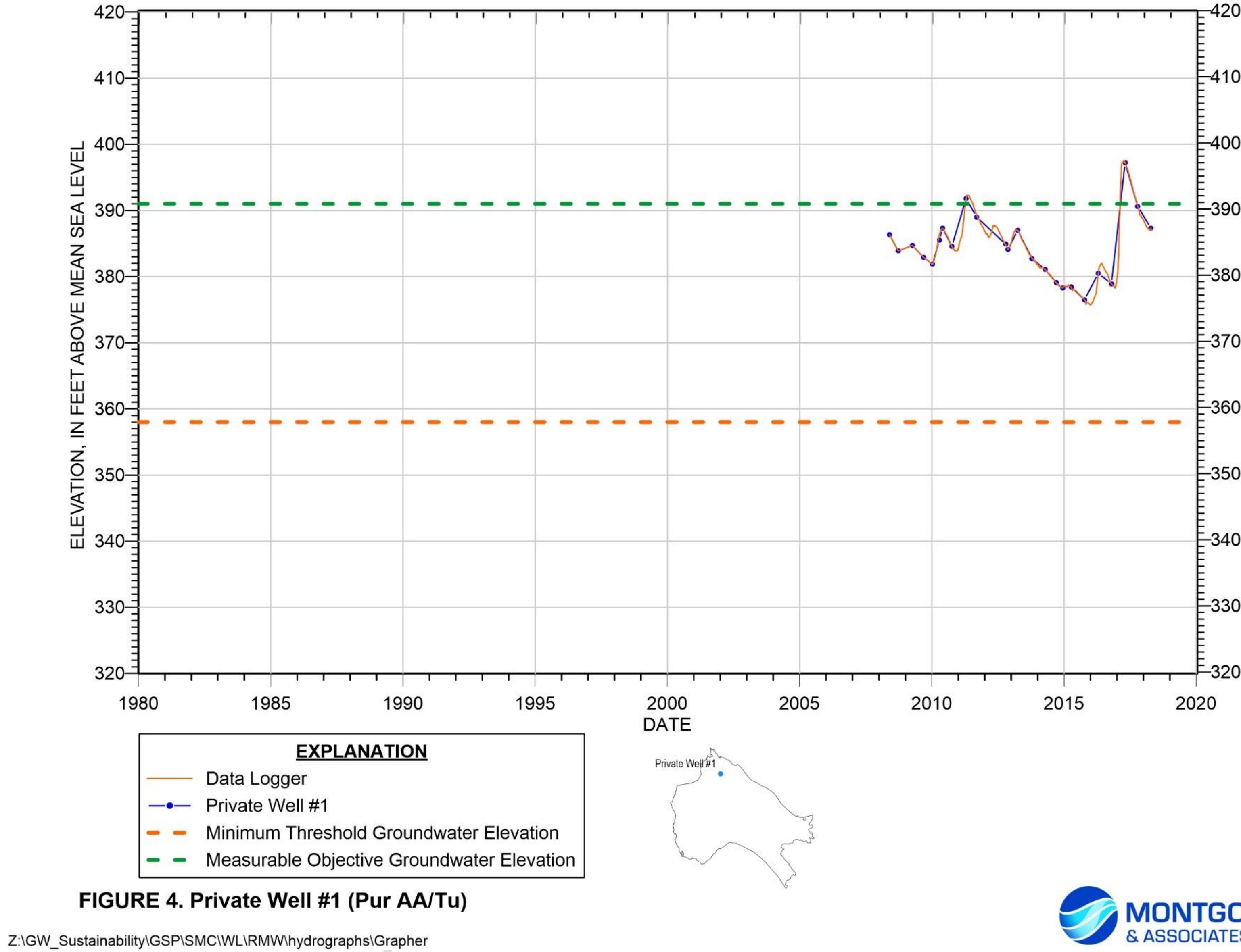


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**Figure 4. Private Well #1 (Pur AA/Tu)**

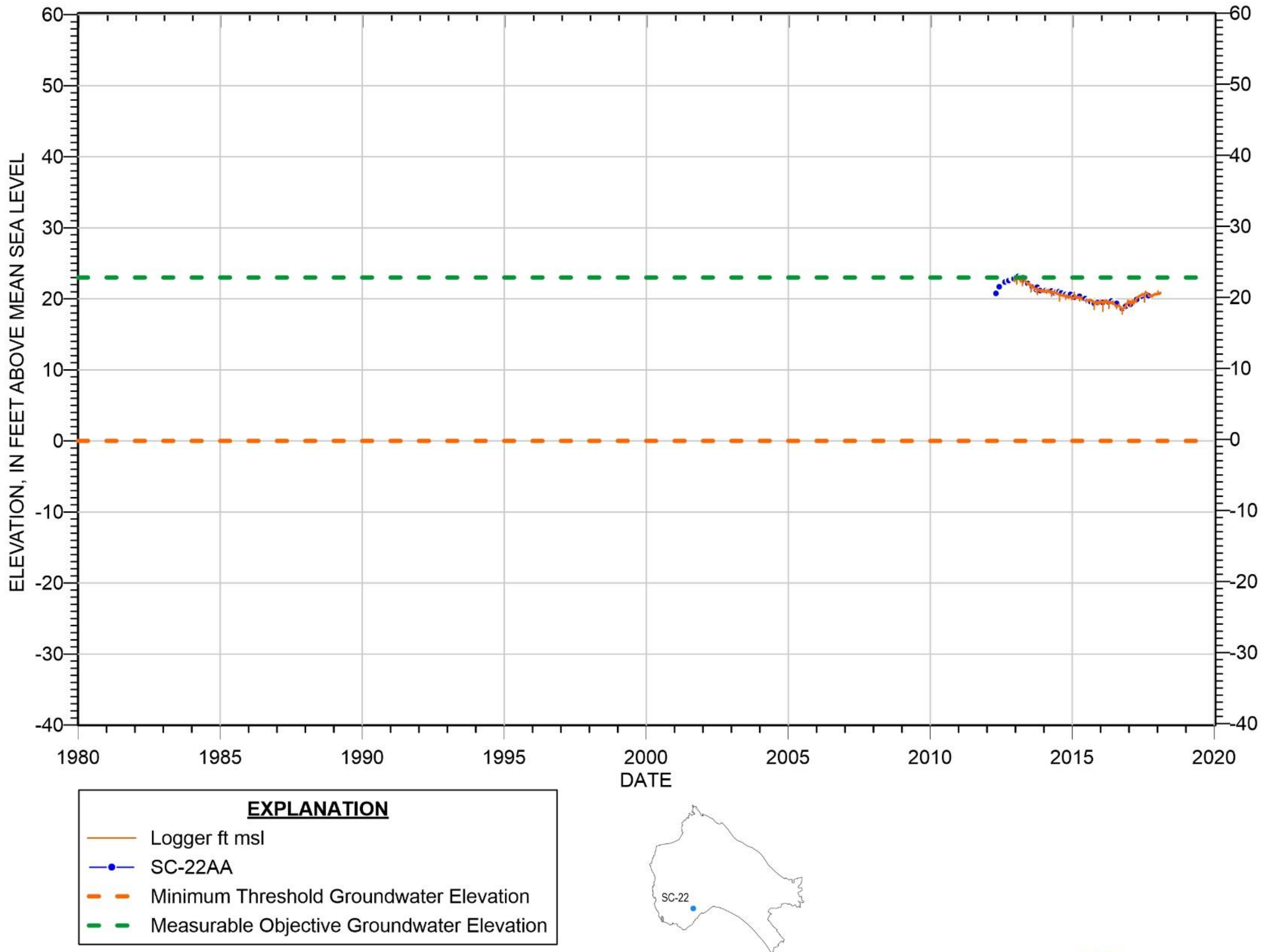


**FIGURE 5. SC-22AA (Pur A/AA)**

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**Figure 5. SC-22AA (Pur A/AA)**

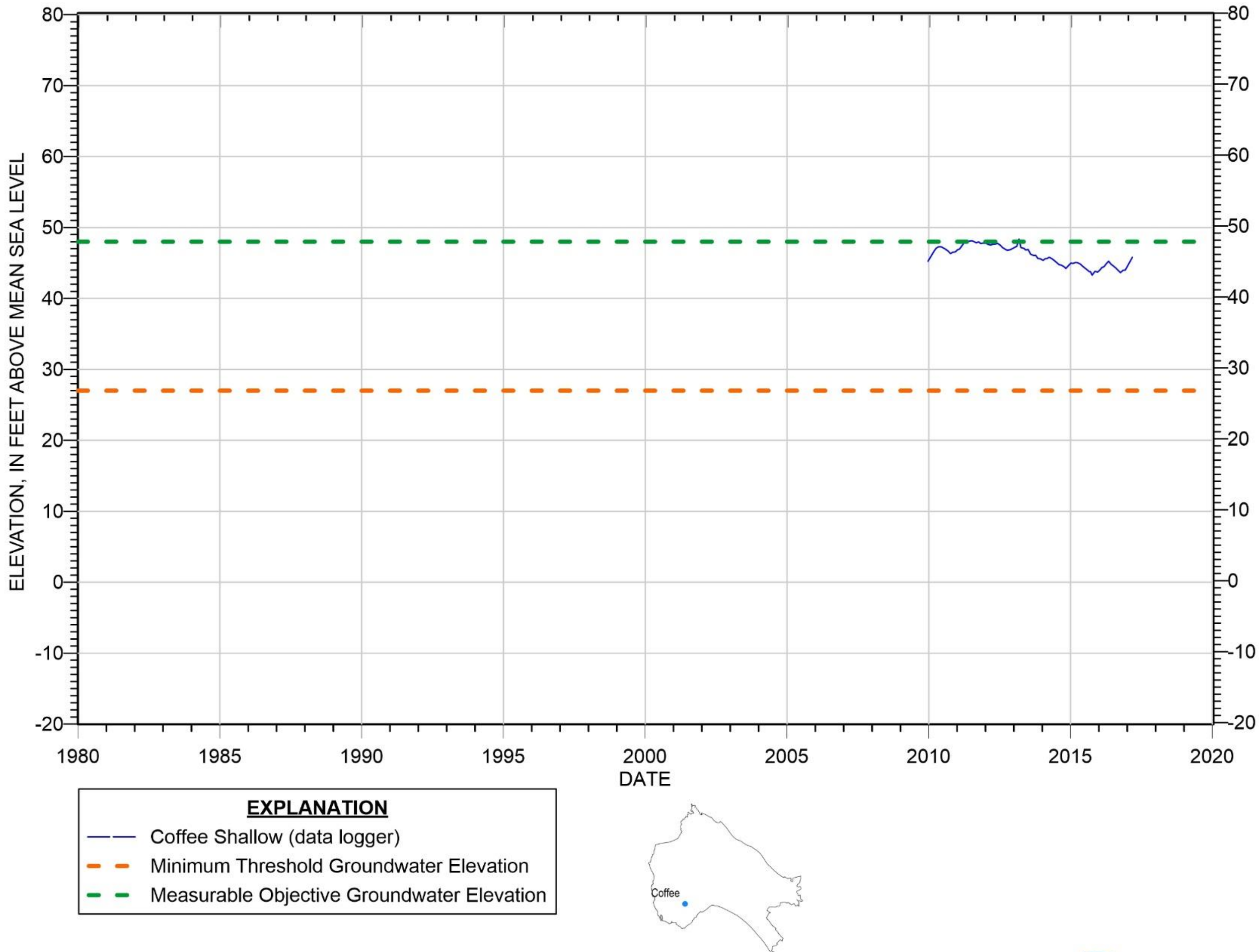


**FIGURE 6. Coffee Lane Shallow (Pur A/AA)**

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**Figure 6. Coffee Lane Shallow (Pur A/AA)**

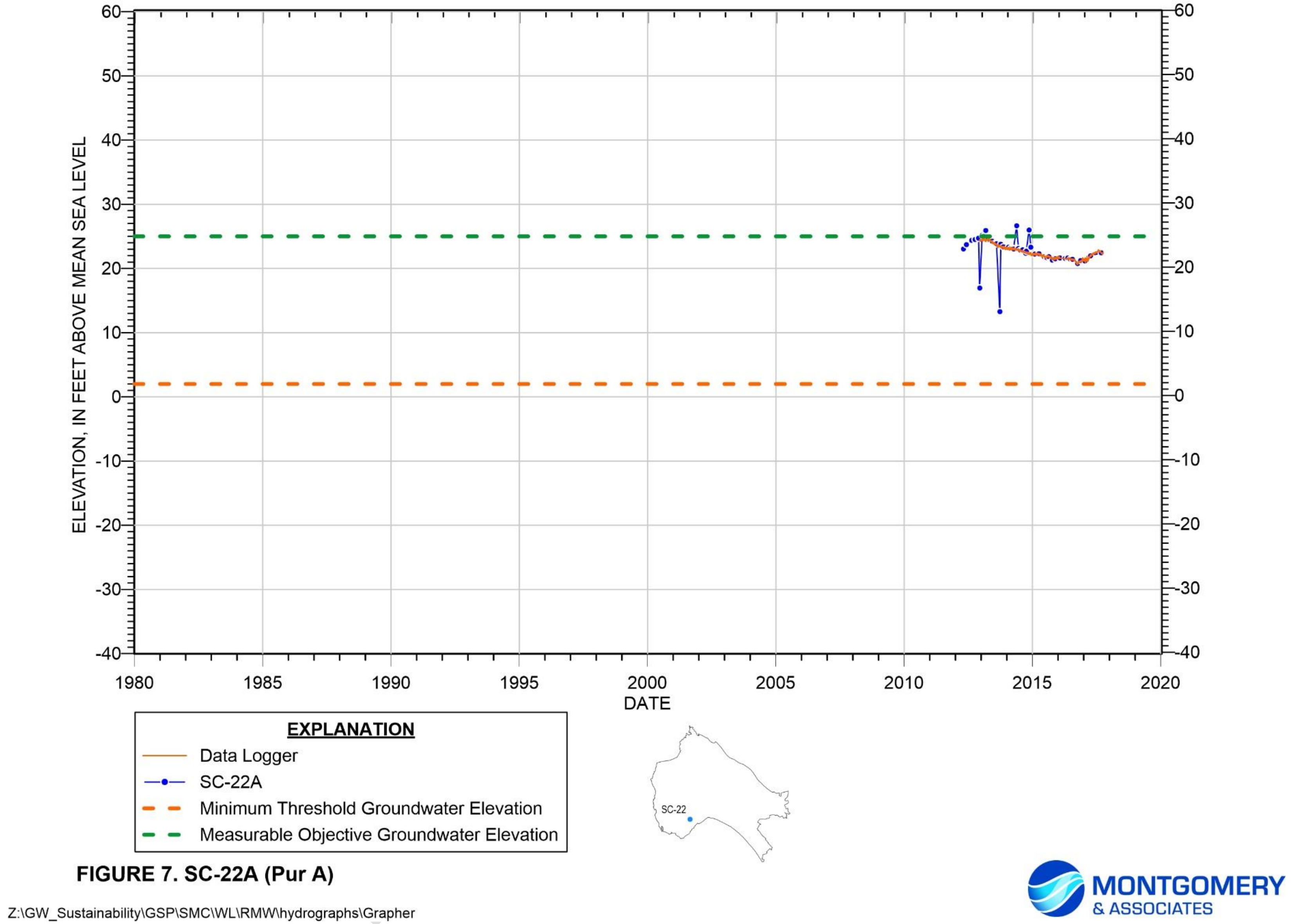


Figure 7. SC-22A (Pur A)

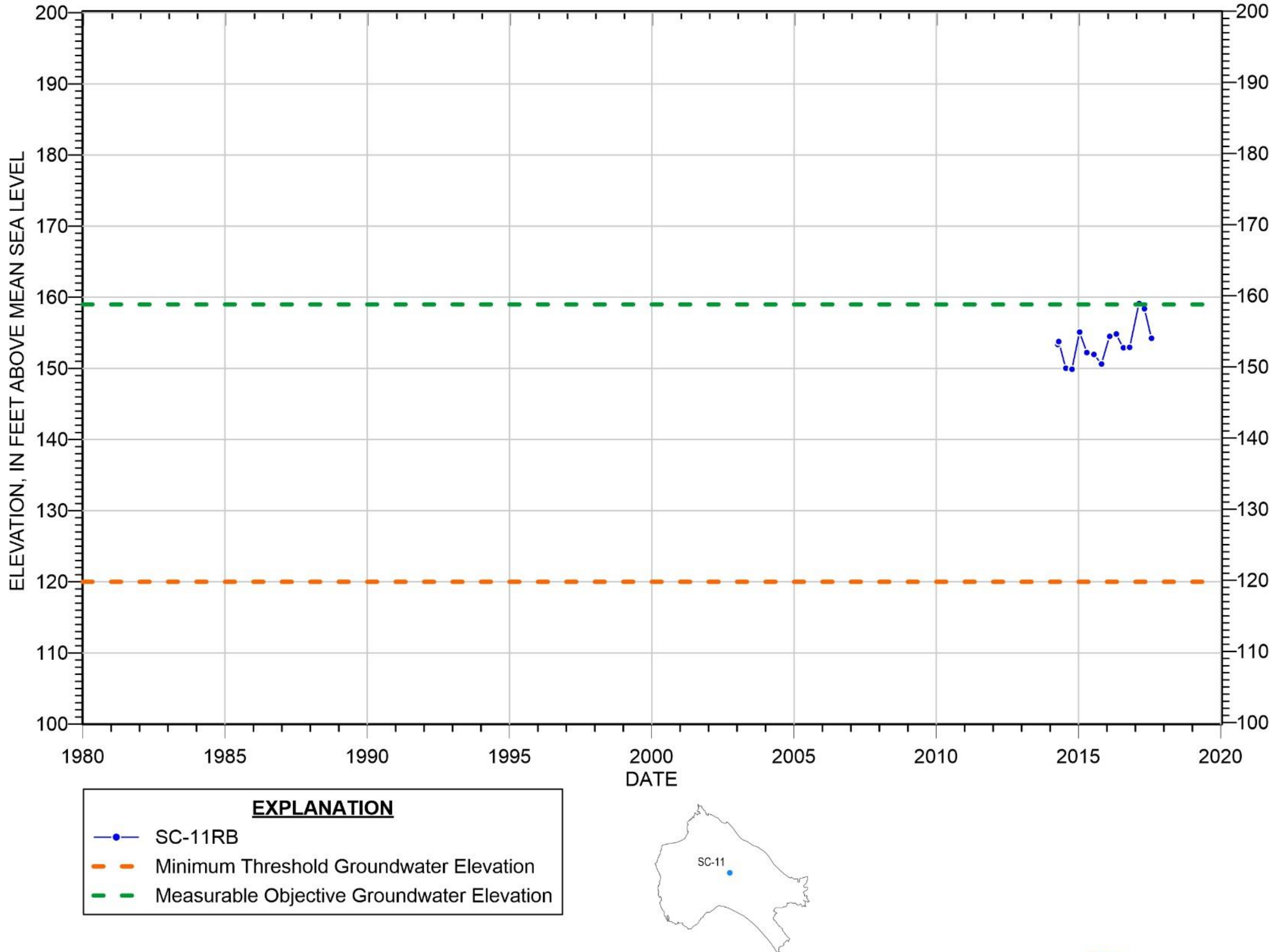


**FIGURE 8. SC-11RB (Pur BC)**

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**Figure 8. SC-11RB (Pur BC)**

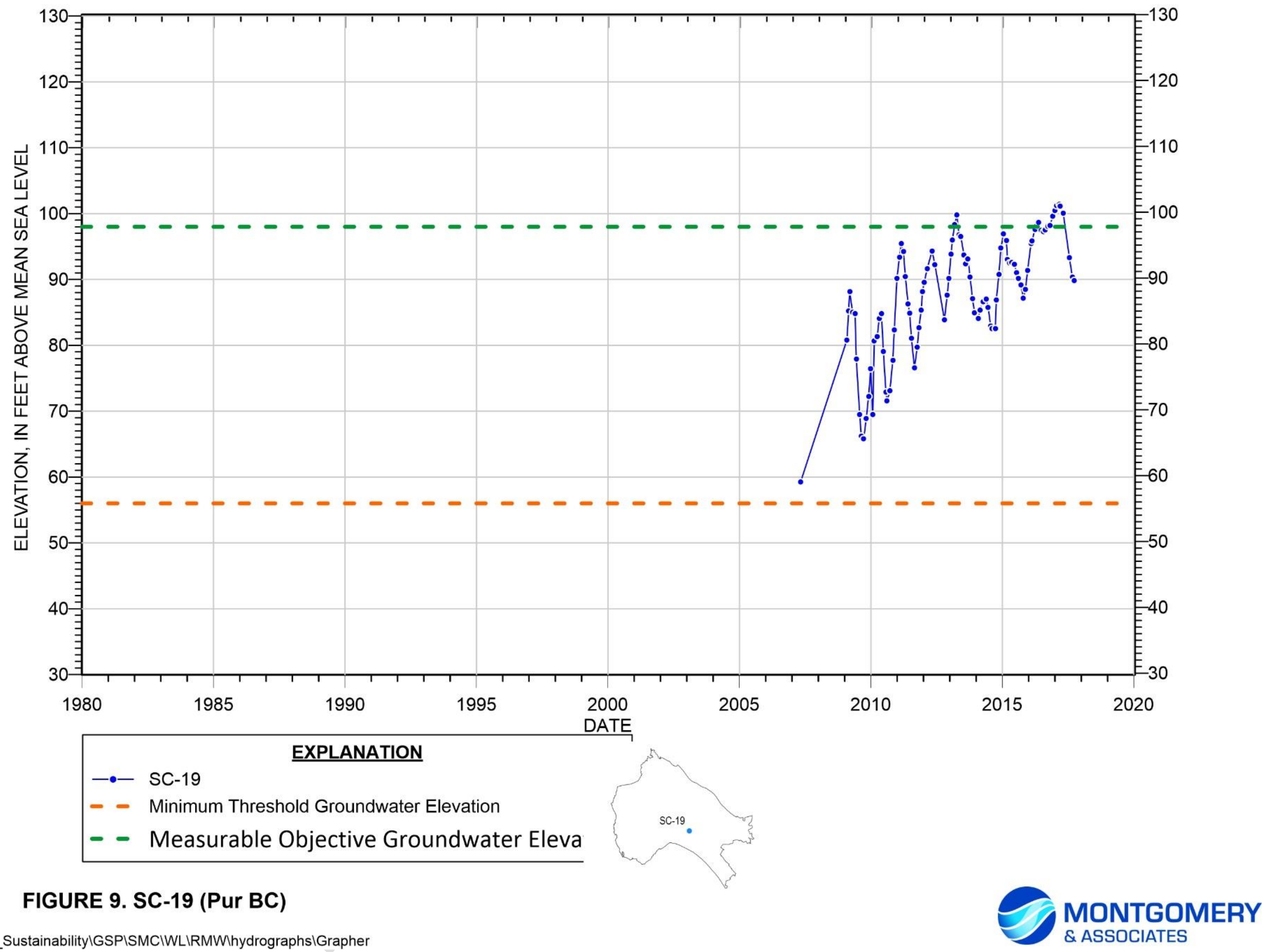


Figure 9. SC-19 (Pur BC)

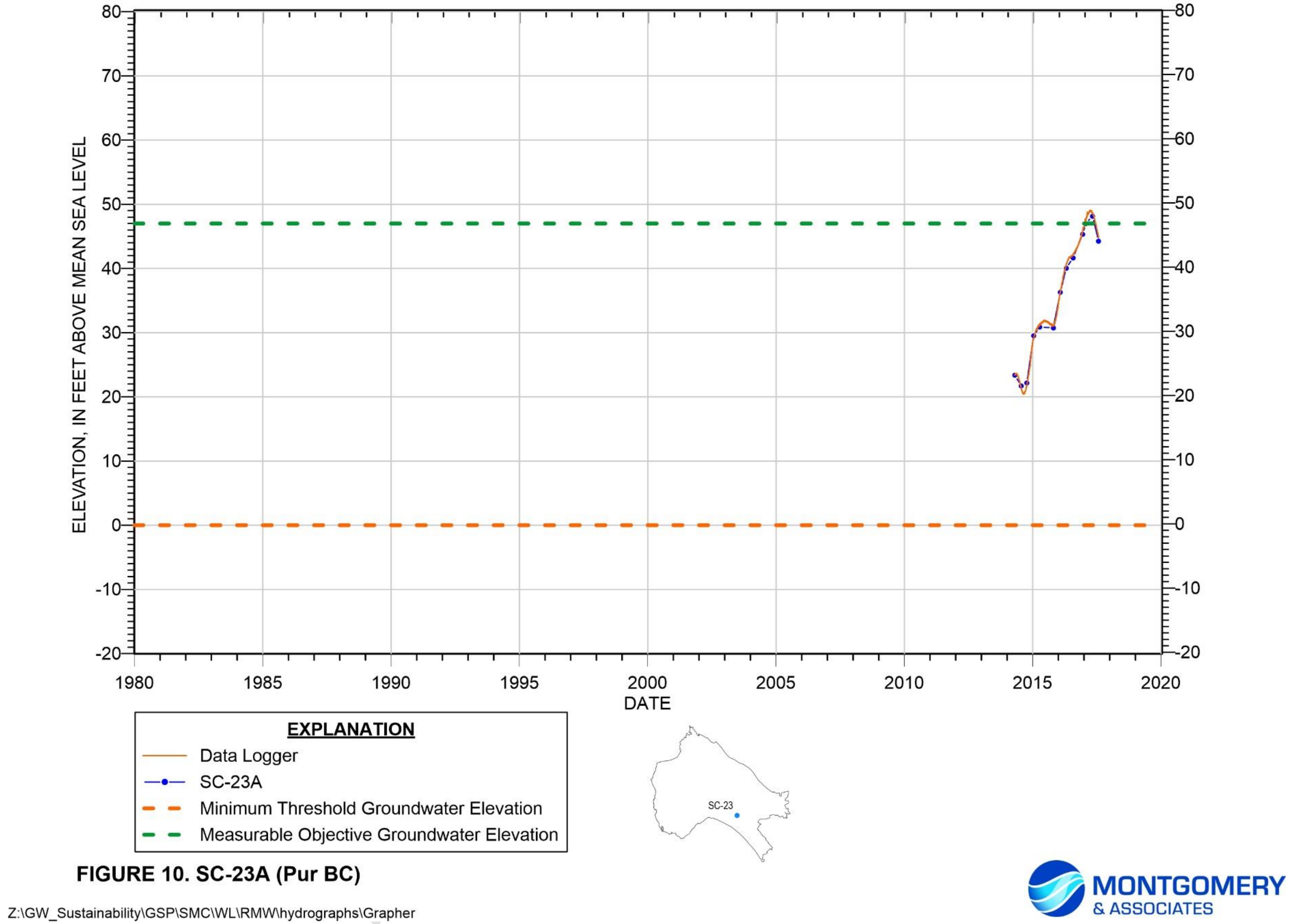


**Figure 10. SC-23A (Pur BC)**

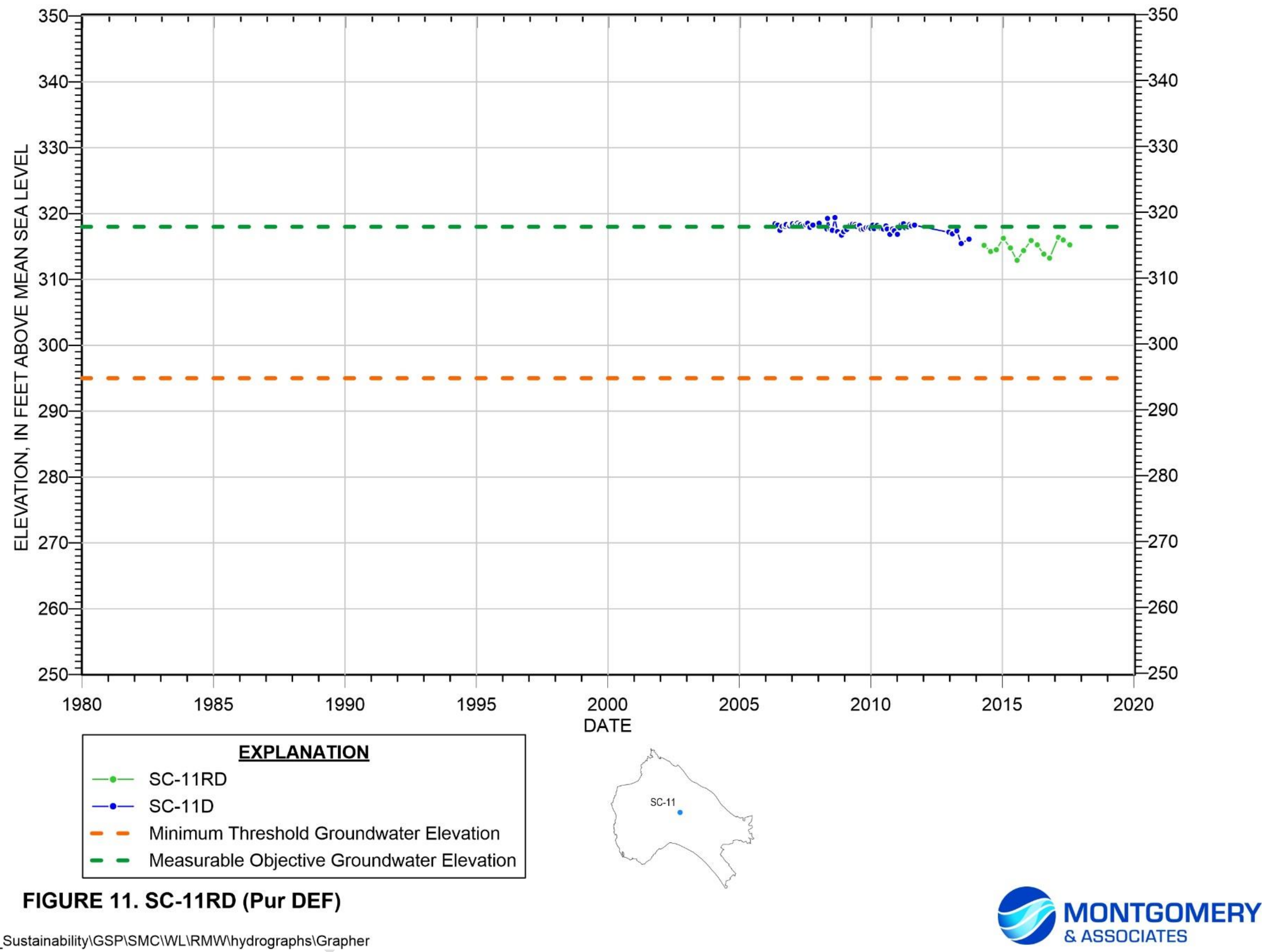


Figure 11. SC-11RD (Pur DEF)

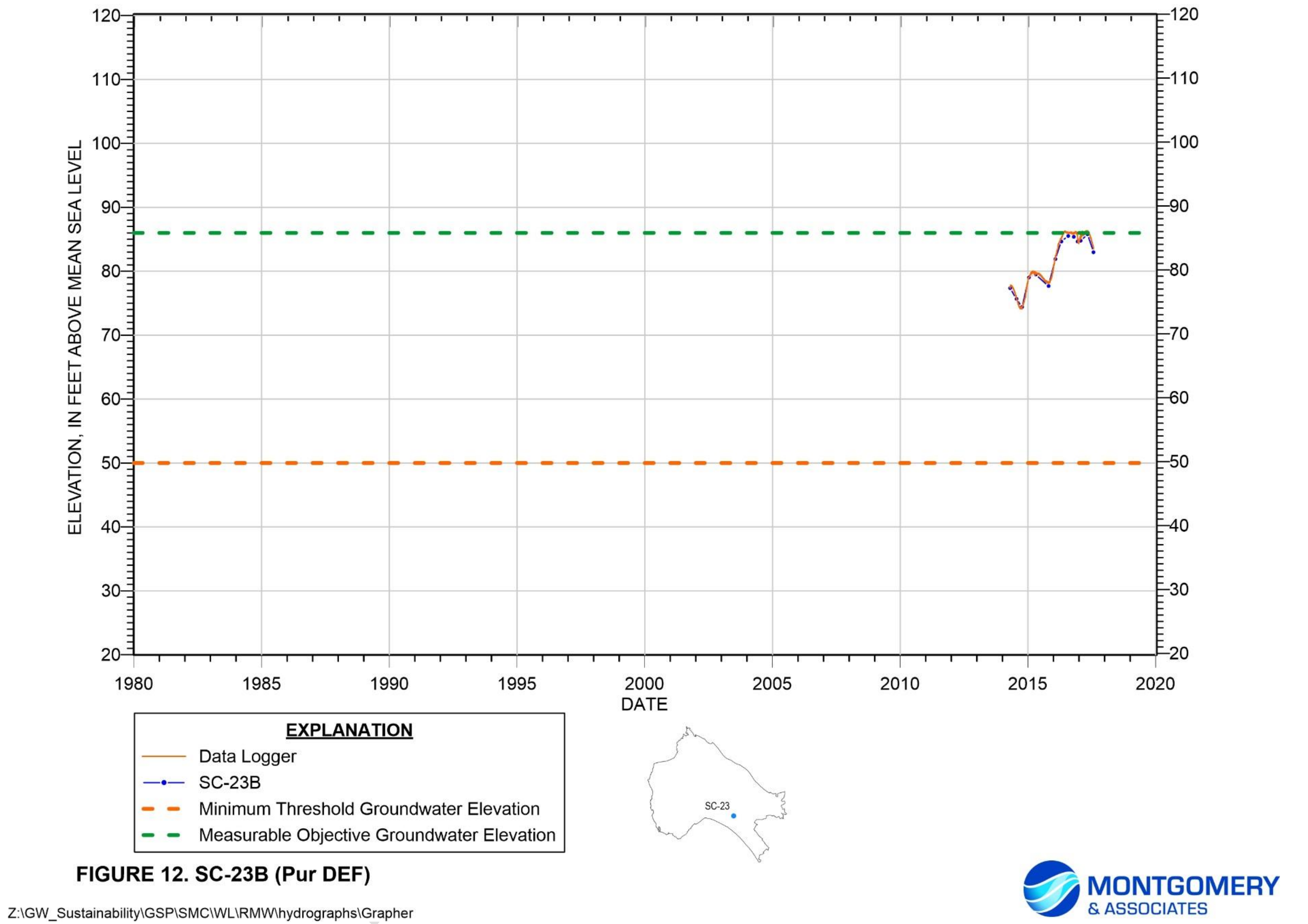


Figure 12. SC-23B (Pur DEF)

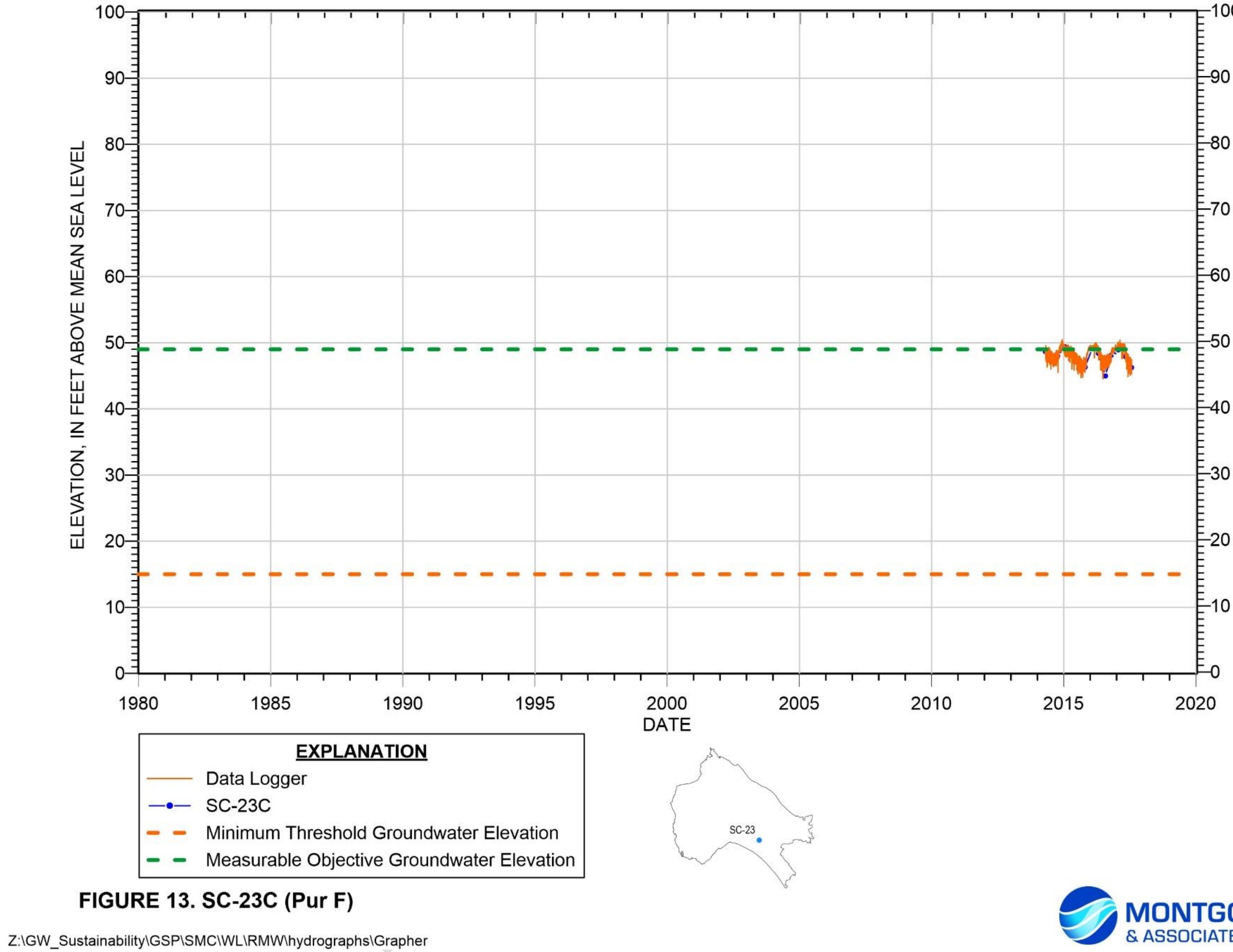


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Figure 13. SC-23C (Pur F)

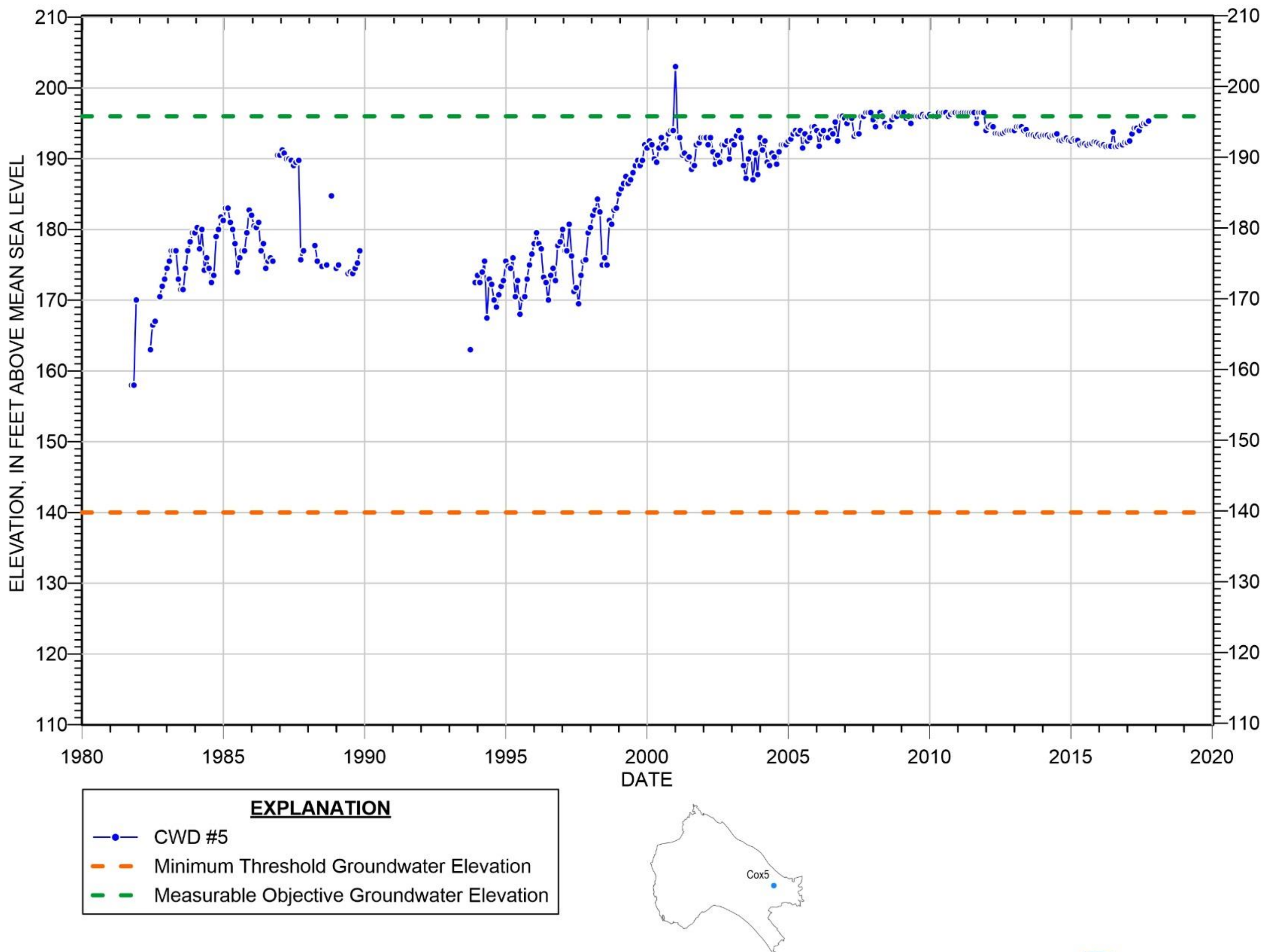


**FIGURE 14. Cox 5 (Pur F)**

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**Figure 14. Cox 5 (Pur F)**

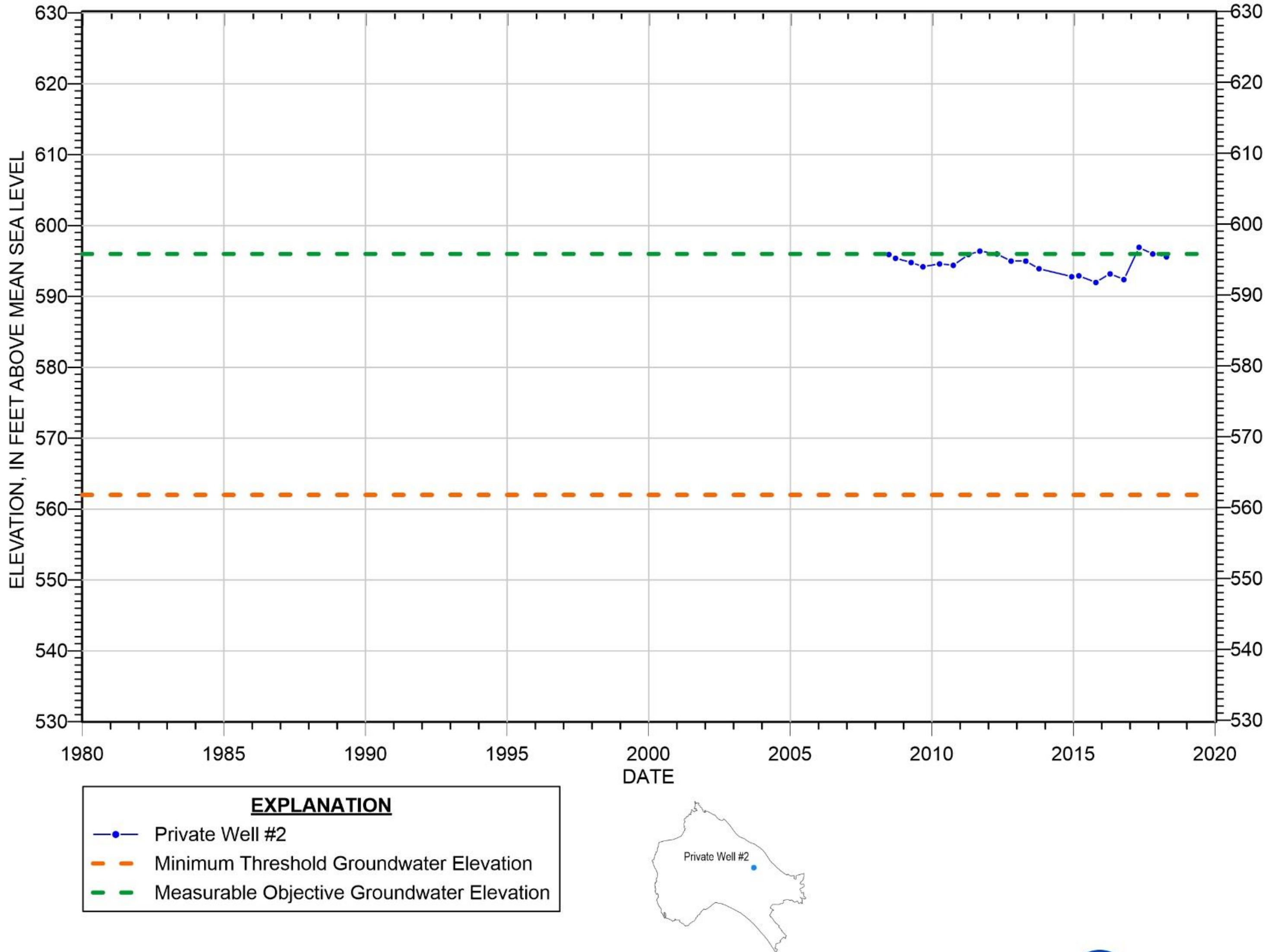


**FIGURE 15. Private Well #2 (Pur F)**

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**Figure 15. Private Well #2 (Pur F)**

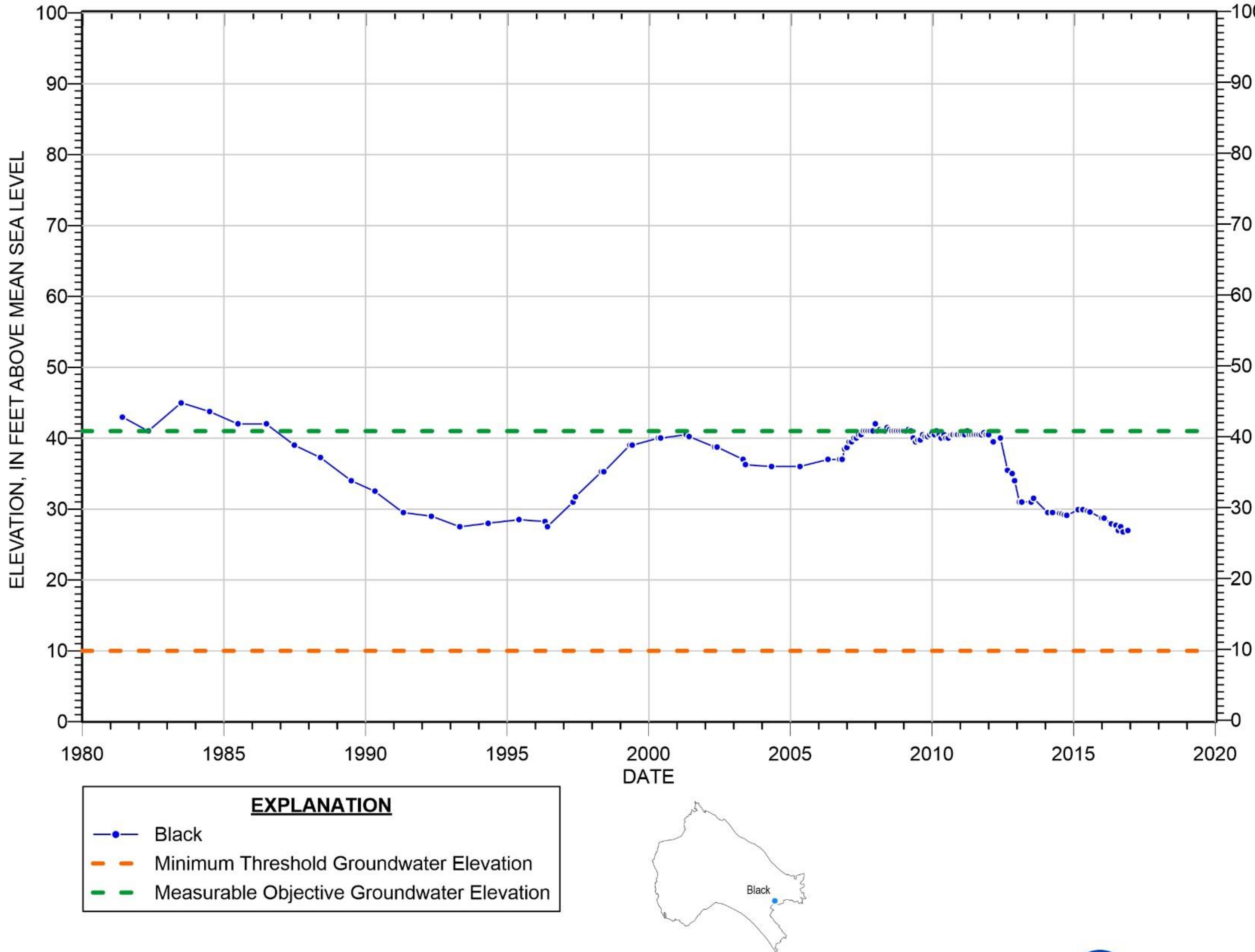


**FIGURE 16. Black (Pur F)**

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**Figure 16. Black (Pur F)**

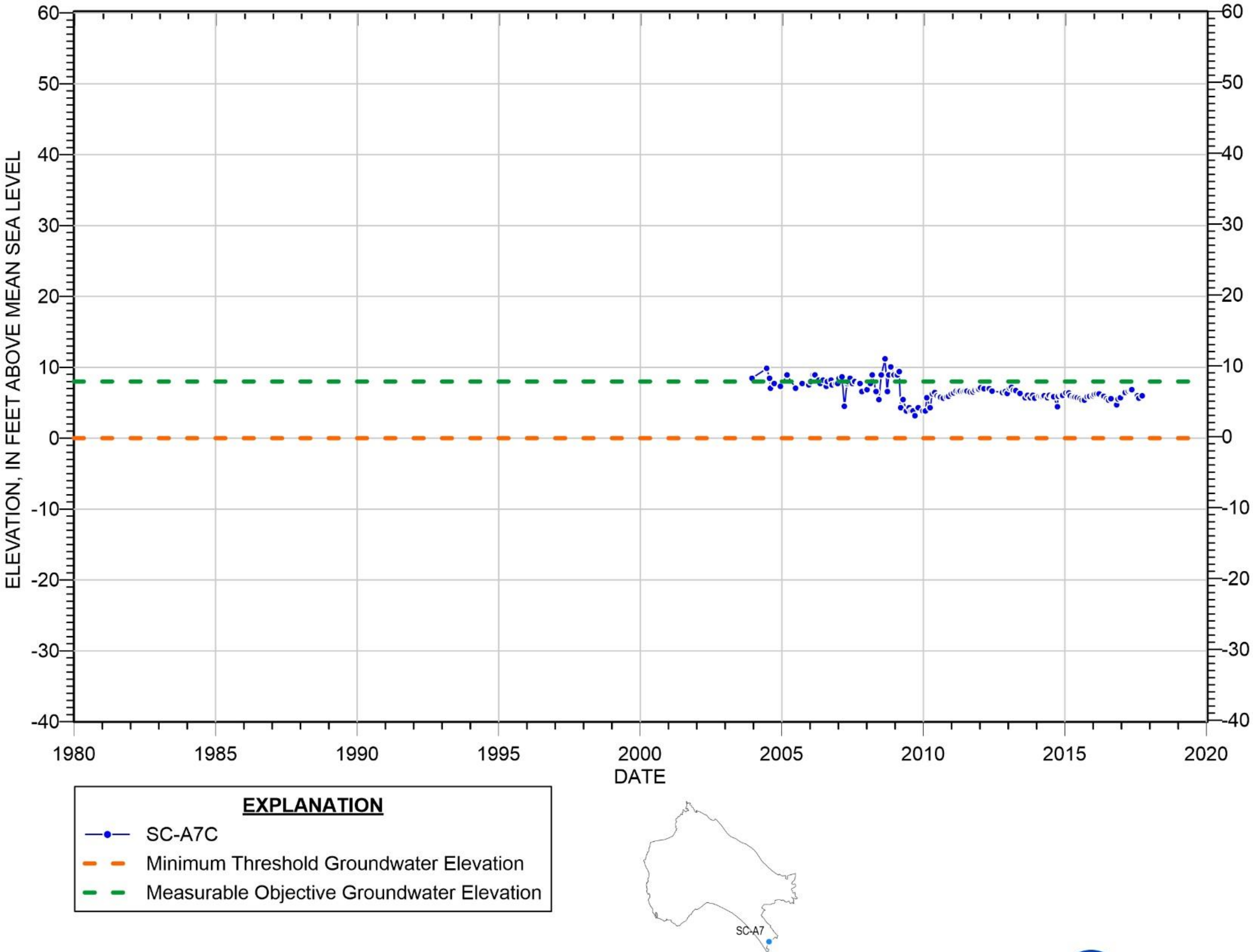


**FIGURE 17. SC-A7C (Aromas)**

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MONTGOMERY & ASSOCIATES

**Figure 17. SC-A7C (Aromas)**

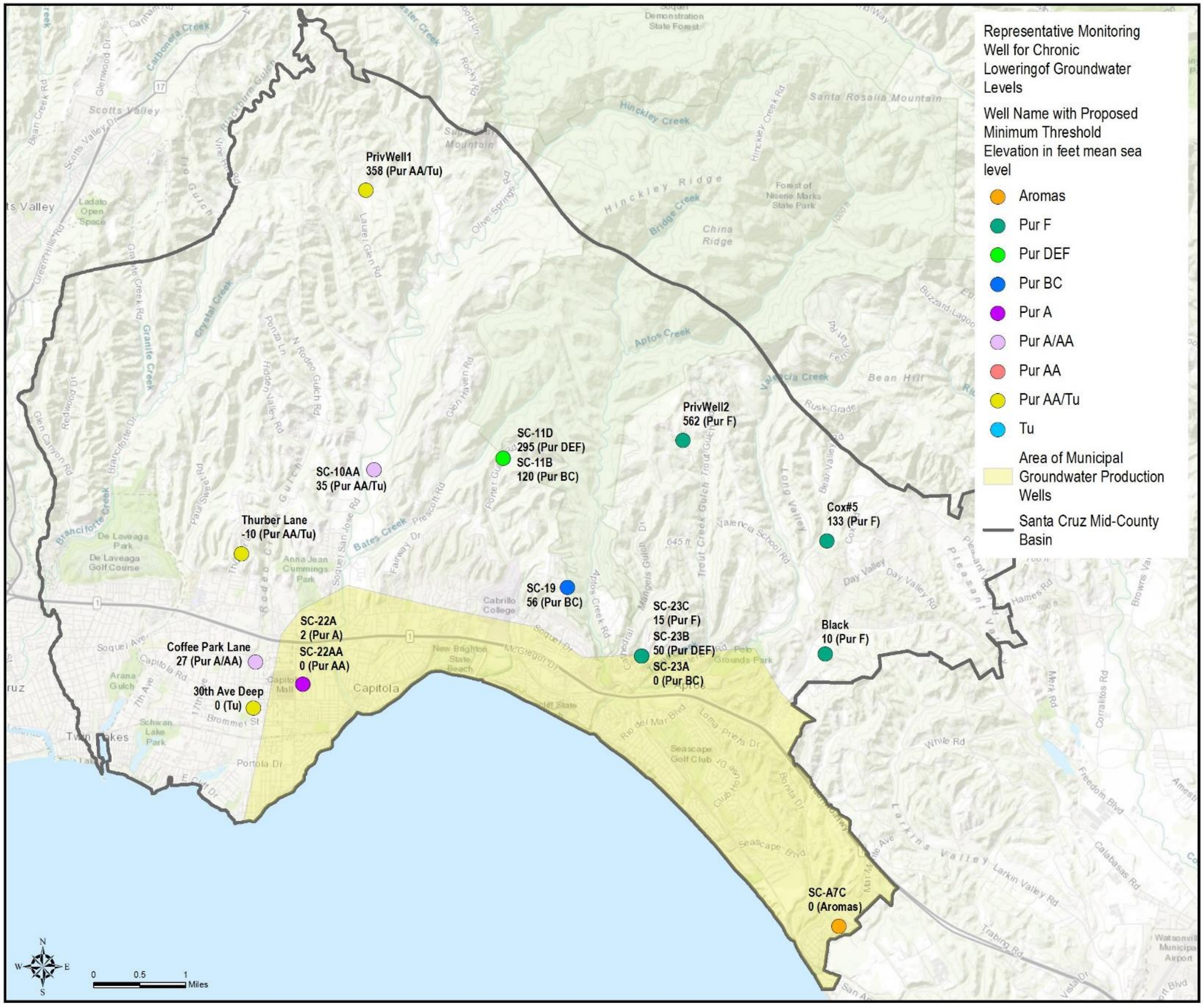


**Figure 18. Representative Monitoring Wells for Chronic Lowering of Groundwater Levels with Proposed Minimum Thresholds by Aquifer**

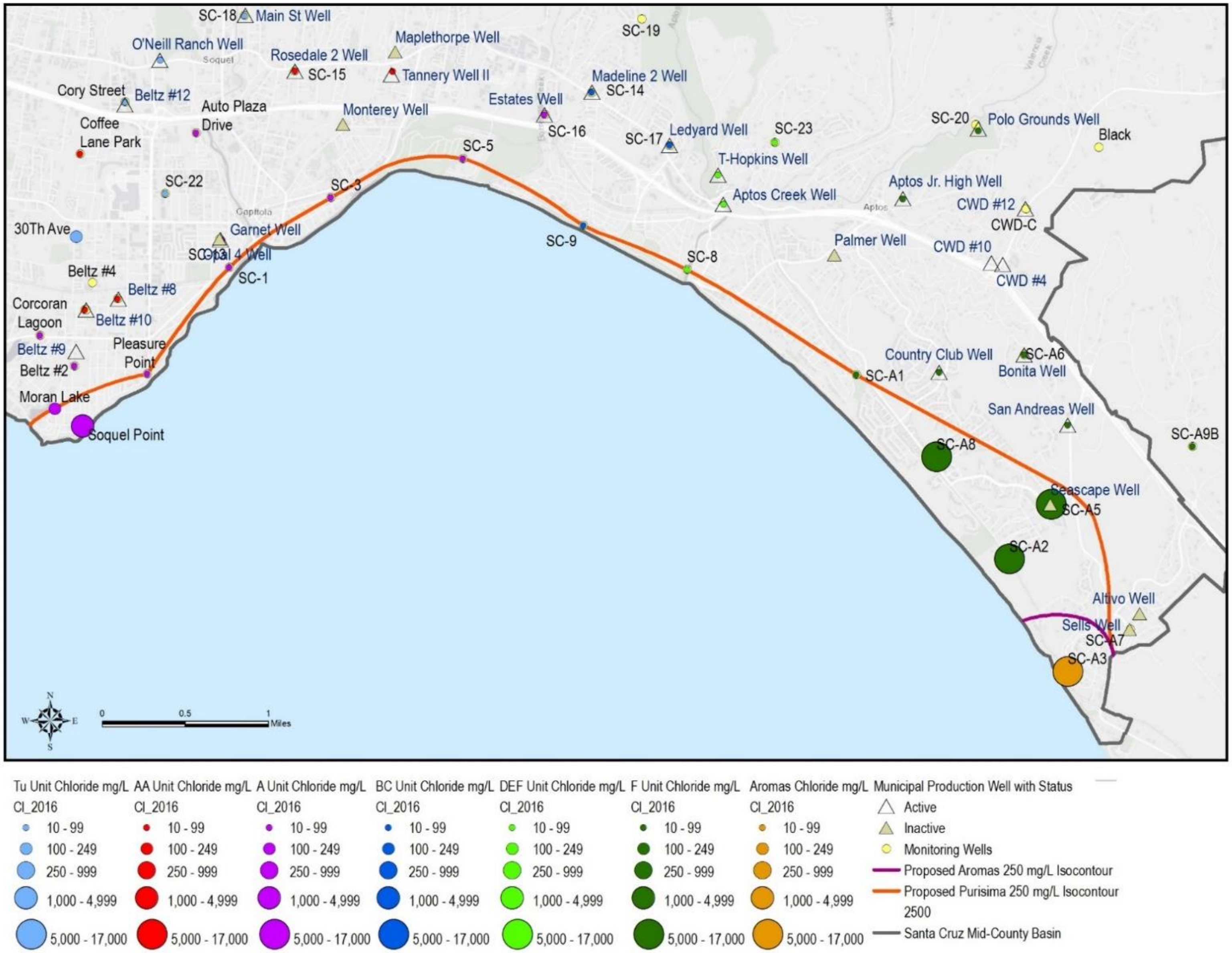


**Figure 19. 250 mg/L Chloride Isocontours for the Aromas and Purisima Aquifers**

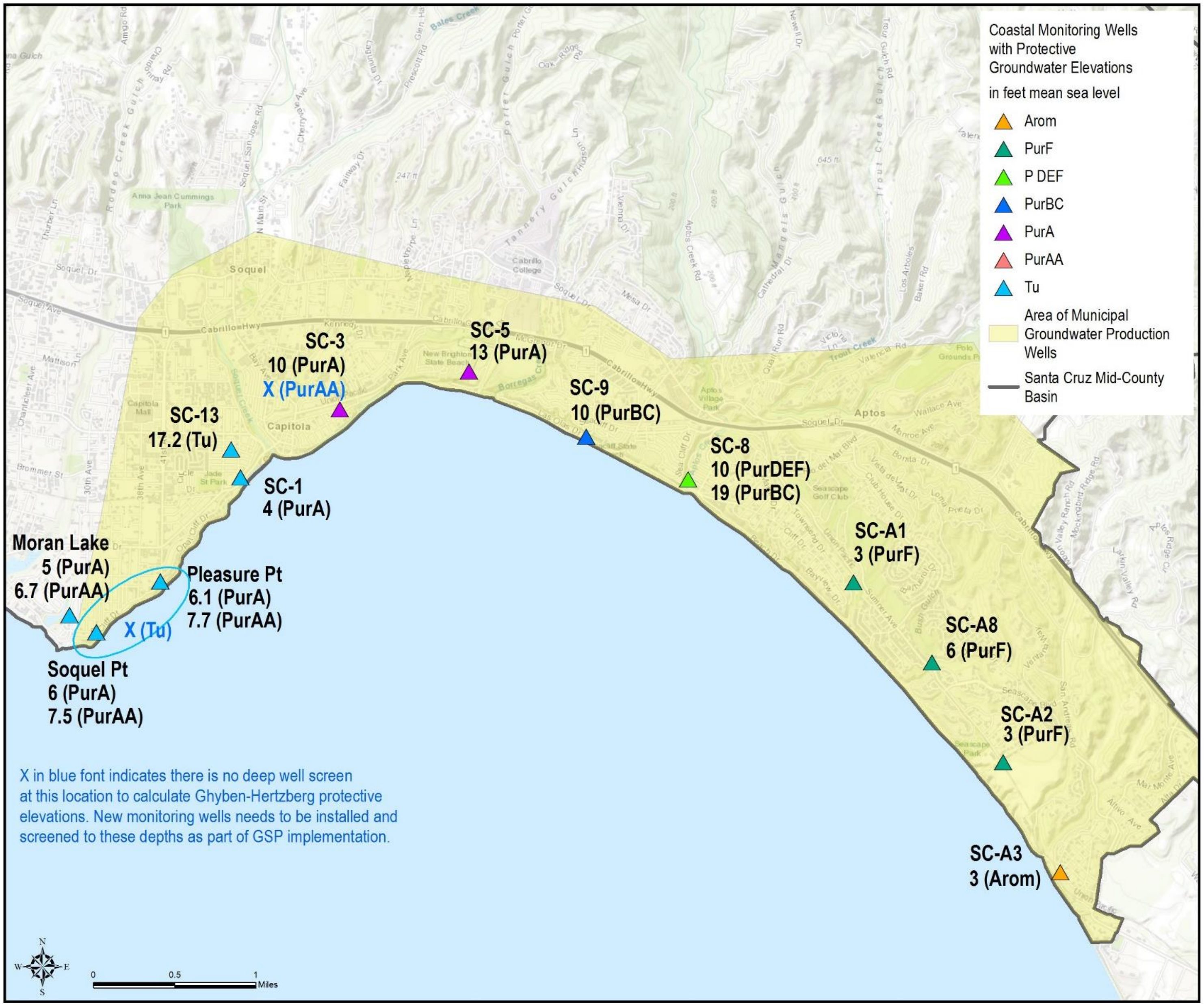


**Figure 20. Representative Monitoring Wells Used as Proxy Minimum Thresholds for Seawater Intrusion**

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# *Draft* Meeting Summary

## Santa Cruz Mid-County Groundwater Sustainability Plan
## Advisory Committee Meeting #16
**February 27, 2019, 5:00 – 8:30 pm**

This meeting was the sixteenth convening of the Santa Cruz Mid-County Groundwater Sustainability Planning (GSP) Advisory Committee. It took place on February 27, 2019 from 5:00 - 8:30 p.m. at the Simpkins Family Swim Center in Santa Cruz. This document summarizes key outcomes from Advisory Committee and staff discussions on the following topics: project updates; groundwater modeling results; and proposed draft sustainable management criteria for "surface water interaction." This document also provides an overview of public comment received. It is not intended to serve as a detailed transcript of the meeting.

**Meeting Objectives**

The primary objectives for the meeting were to:

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

**Action Items**

Key action items from the meeting include the following:

1. Staff to remind Advisory Committee of exact dates for upcoming and remaining Advisory Committee and joint MGA/Advisory Committee meetings.
2. Staff to consider options for convening a land use and water enrichment session and schedule it for some time in April.
3. In finalizing the definition of Significant & Unreasonable for the lowering of groundwater levels connected to surface water, staff to check with NOAA Fisheries regarding the necessity of the time period reference in the definition.
4. Surface Water Working Group to revisit analysis of temperature data relating to impacts on fish.

5. Kearns & West to revise and transmit the confirmed meeting summary for the January 23, 2019 Advisory Committee meeting for inclusion in the Mid-County Groundwater Agency's (MGA) Board meeting packet in March.

**Meeting attendance**

Committee members in attendance included:

1. John Bargetto, Agricultural Representative
2. David Baskin, City of Santa Cruz
3. Rich Casale, Small Water System Management
4. Keith Gudger, At-Large Representative
5. Bruce Jaffe, Soquel Creek Water District
6. Jon Kennedy, Private Well Representative
7. Jonathan Lear, At-Large Representative
8. Marco Romanini, Central Water District
9. Charlie Rous, At-Large Representative
10. Allyson Violante, County of Santa Cruz
11. Thomas Wyner for Cabrillo College, Institutional Representative

Committee members who were absent included:

1. Kate Anderton, Environmental Representative
2. Dana Katofsky McCarthy, Water Utility Rate Payer

**Meeting Key Outcomes (linked to agenda items)**

**1. Introduction and Discussion of GSP Process Timeline and Project Updates**

John Ricker, County of Santa Cruz, opened the meeting and welcomed participants. Mr. Ricker asked the GSP Advisory Committee members, MGA Executive Team, and the consultant support team around the room to introduce themselves. He also addressed members of the public in attendance and asked them for self-introductions.

Eric Poncelet, facilitator, reviewed the agenda and meeting objectives, and provided key updates to the project process for remaining five months of the GSP Advisory Committee process as reflected on the updated timeline. Additionally, Mr. Poncelet reported that staff will be planning an enrichment session on land use and water sometime in late March or early April.

Committee members made the following requests regarding the land use and water enrichment session:

- Invite a staff member from the County's planning department to present.

- Present on the relationship between water and permitting agencies and what happens if there's a conflict between the agencies. How does this tension get resolved and incorporated into GSP development?

With respect to the remaining GSP Advisory meetings, Committee members requested a reminder from staff on the exact dates for the upcoming Advisory meetings. Darcy Pruitt, Regional Water Management Foundation (RWMF), committed to sending out such a reminder.

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

Mr. Poncelet, facilitator, invited members of the public to make comments on any GSP-related issues not on the agenda.

One participant thanked staff for their recent efforts in the GSP-related work in the Mid-County and Santa Margarita Basins, which has resulted in a good level of coordination between agencies and jurisdictions. The participant also indicated that she had filed a CEQA petition in pro per legal action against the Pure Water Soquel (PWS) project asserting issues with the draft environmental impact report (EIR). The CEQA petition names the MGA as a real party of interest.

**3. Project Updates**

Mr. Poncelet invited the following project updates:

- **February 11 GSP Modeling Enrichment Session**
  Ms. Pruitt reported that there was good participation for the February 11, 2019 GSP modeling enrichment session. There was positive feedback that it helped participants have a better understanding of the groundwater model. Committee members agreed that details covered during the session were helpful in understanding model inputs and resulting outcomes. Staff reported that the session recording is posted on the MGA website for everyone's reference.

- **Santa Margarita Basin Educational Meeting Series**
  Sierra Ryan, County of Santa Cruz, provided an update on the February 9, 2019 Santa Margarita educational session covering water budgets and how groundwater dependent ecosystems (GDE) are incorporated as users of the system. Ms. Ryan announced that the final session of the educational series in March will cover climate change scenarios and types of management actions, and will include some fact-checking exercises.

- **DWR Update**
  Amanda Peisch-Derby, Department of Water Resources (DWR), shared that DWR will be hosting a Groundwater Sustainability Agency (GSA) forum on March 21, 2019 from 10 am – 3:00 pm, at the Civic Center Galleria in Sacramento. She indicated that the intended audience includes all

stakeholders and is focused on outreach. She added that Ms. Ryan will be serving as a forum panelist.

**4. Groundwater Modeling Results for Sustainability Strategies**

In this segment, Cameron Tana, Montgomery & Associates, described the Pure Water Soquel (PWS) project, including design components and modeling for environmental review, and provided an evaluation of the potential for benefits to the Mid-County Groundwater Basin from the project. In the second part of this segment, Mr. Tana gave a preview of modeling that Montgomery and Associates will be doing simulating a combination of PWS and the City of Santa Cruz Aquifer Storage and Recovery (ASR) project. In the final portion of this segment, Mr. Tana discussed climate change scenario selection for the GSP.

Following Mr. Tana's presentation, Committee members discussed following key points with respect to the groundwater modeling results for PWS:

- Modeling shows that recharge needs to continue in order for there to be benefits against seawater intrusion.
- The causal relationship between climate scenarios and groundwater levels is minor relative to the effects of projects and management actions
- The model shows increased groundwater levels from Pure Water Soquel in some areas when there is increased pumping. The effect of recharge at the seawater intrusion prevention wells outweighs the effect of increased pumping.
- The fact that the model design accounts for different pumping distribution scenarios and does not have political boundaries is a positive result for managing seawater intrusion in the Purisima.
- The model shows that recharge levels at 1,500 AFY is maintaining sustainability for the Basin. As such, the model could be used to evaluate more pumping redistribution.
- The timeframe to set up, assess and run different modeling scenarios is about one month.
- Mr. Tana responded to a question about why model simulation results showed a drop in groundwater levels around Water Year 2020. Mr. Tana incorrectly described the drop as resulting from a simulated increase in groundwater demand and pumping. Total municipal pumping is not simulated to increase in this year. Instead, the simulation implements a pumping redistribution beginning in this year – three years prior to commencement of Pure Water Soquel in the simulation. This helps display the effect of pumping redistribution without recharge from Pure Water Soquel seawater intrusion prevention wells.

The Committee exchanged the following ideas with respect to the ASR preview and climate scenario selection for the GSP:

- With respect to simulation of climate change, the worst case scenario (primarily from droughts) is not currently being modeled for the City's ASR or the GSP. Staff should consider it going forward.
- In the climate change scenario selection process, the catalog climate approach takes into account many dry years to model for longer drought periods.
- With the infrastructure in place for modeling different projects, it would be useful to build in sensitivity analysis to determine the best climate change modeling for the GSP.
- Climate change approaches either provide estimates of potential evapotranspiration or estimates of temperature for the model to calculate potential evapotranspiration. . The Santa Cruz Mid-County Basin model calculates potential evapotranspiration and then actual evapotranspiration based on rainfall and soil moisture.

**5. Public Comment**

Mr. Poncelet, facilitator, invited members of the public to comment on Mr. Tana's presentation on groundwater modeling results on sustainable strategies, the Advisory Committee's reflections on the presentation, and any other Advisory Committee work.

One participant asked for further explanation on why PWS is not considering in-lieu recharge, water demand offset policies and the scientific basis for the 1500 AFY recharge threshold for the Soquel Creek Water District.

Another participant asked whether the energy demand associated with redistributing pumping was factored into the PWS modeling.

**6. Proposed Draft Sustainable Management Criteria for "Surface Water Interaction" Sustainability Indicator**

In this segment, Ms. Ryan reported on the outcomes of the January 30, 2019 surface water interaction working group meeting. Her report was followed by Mr. Tana's presentation on surface water connection to groundwater in the Mid-County Basin and staff's request for the Committee to provide initial input on proposed minimum thresholds and measurable objectives.

Key discussion points on the topic of surface water interaction sustainable management criteria included:

- The surface water interaction analysis is variable for different areas and basins. Conclusions for the Mid-County Basin should not be extrapolated for other basins (e.g., Santa Margarita).
- It is necessary to conduct monitoring at different locations and at different groundwater levels as a way to adaptively manage for GDEs or other species. Further, DWR regulations require that GSAs incorporate varying levels of monitoring to demonstrate and justify the use of the groundwater level proxy for surface water and groundwater interactions.
- Some Committee members suggested the following revised language for Significant & Unreasonable conditions: "*Lowering of groundwater levels adjacent to interconnected streams due to groundwater extraction that results in a significant decrease in depletion of stream baseflow*." [Omits timeframe.]
- The definition of significant and unreasonable (e.g., what constitutes a "significant decrease") can be qualitative, but the minimum threshold and measurable objective criteria must be quantitative.
- Staff should further analyze temperature data relating to fish survival.

**7. Public Comment**

During this final public comment session, Mr. Poncelet invited members of the public to provide comments on the Committee's discussion of the working group's work on surface water connection to groundwater in the Mid-County Basin, the preliminary sustainable management criteria for surface water interconnections, and on any other Advisory Committee work.

One participant noted a few areas for further investigation with respect to surface water interconnections, including well data showing similar conditions, correlation of streamflow to groundwater levels under dry conditions, the effect of evapotranspiration, reconciliation of data gaps, and how to monitor around private wells.

**8. Confirm the January 23, 2019 2018 Advisory Committee Meeting Summary**

There were no comments on the January 23, 2019 Advisory Committee meeting summary, which was therefore considered confirmed for forwarding to the MGA Board.

**9. Next Steps**

In closing, Mr. Poncelet provided a recap of the GSP process timeline for March through July 2019, focusing on objectives for the March and April meetings, and discussed general next steps. He also confirmed that staff will be providing exact dates for all upcoming meetings, particularly the meetings dates that will be changed.

Committee members expressed concern that there may not be sufficient time to adequately address the topic of funding tools and the implementation plan in the remaining GSP Advisory Committee meetings.

Staff indicated that these topics will be introduced to frame the potential approaches but that the detailed evaluation of strategies is being deferred until there is more direction from the state related to fees that we anticipate is likely be coming over the next several years as a result of anticipated SGMA-related legal proceedings as SGMA is implemented across the state.

Executive Team members closed the meeting by thanking the attendees for their participation.

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# *Draft* Meeting Summary

## Santa Cruz Mid-County Groundwater Sustainability Plan Advisory Committee Meeting #17

**March 27, 2019, 5:00 – 8:30 pm**

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This meeting was the seventeenth convening of the Santa Cruz Mid-County Groundwater Sustainability Plan (GSP) Advisory Committee. It took place on March 27, 2019 from 5:00 - 8:30 p.m. at the Simpkins Family Swim Center in Santa Cruz. This document summarizes key outcomes from Advisory Committee and staff discussions on the following topics: project updates; groundwater modeling results for sustainable strategies; staff proposals on sustainable management criteria for Seawater Intrusion (updated) and Groundwater Storage; MGA Board funding approach; and representative monitoring wells for all Sustainability Indicators. This document also provides an overview of public comment received. It is not intended to serve as a detailed transcript of the meeting.

**Meeting Objectives**

The primary objectives for the meeting were to:

- Discuss groundwater modeling results for various sustainability strategies, including for combined projects
- Discuss draft proposed Sustainable Management Criteria for "Groundwater Storage" Sustainability Indicator and updated Sustainable Management Criteria for "Seawater Intrusion" Sustainability Indicator
- Receive primer and share initial reflections on the topic of "who pays for what?"
- Review and confirm representative monitoring wells for each sustainability indicator

**Action Items**

Key action items from the meeting include the following:

1. Staff to provide the Advisory Committee with more details on the input process for the pertinent GSP sections before the July Santa Cruz Mid-County Groundwater Agency (MGA) Board meeting.
2. Staff to ensure inclusion of an item on the July MGA Board meeting agenda for the Advisory Committee to discuss their recommendations and deliberations on the pertinent GSP sections to the MGA Board.

3. Sierra Ryan, County of Santa Cruz, to post details of the April 18 Water Use Forecasting enrichment session on the MGA website.
4. Technical staff to confirm the Santa Cruz Aquifer and Storage Recovery (ASR) project recharge average.

**Meeting attendance**

Committee members in attendance included:

1. Kate Anderton, Environmental Representative
2. John Bargetto, Agricultural Representative
3. David Baskin, City of Santa Cruz
4. Keith Gudger, At-Large Representative
5. Bruce Jaffe, Soquel Creek Water District
6. Dana Katofsky McCarthy, Water Utility Rate Payer
7. Jon Kennedy, Private Well Representative
8. Jonathan Lear, At-Large Representative
9. Allyson Violante, County of Santa Cruz
10. Thomas Wyner for Cabrillo College, Institutional Representative

Committee members who were absent included:

1. Rich Casale, Small Water System Management
2. Marco Romanini, Central Water District
3. Charlie Rous, At-Large Representative

**Meeting Key Outcomes (linked to agenda items)**

**1. Introduction and Discussion of GSP Process Timeline and Project Updates**

Ralph Bracamonte, Central Water District, opened the meeting and welcomed participants. Mr. Bracamonte asked the GSP Advisory Committee members, MGA Executive Team, and the consultant support team to introduce themselves. He also addressed members of the public in attendance and asked them for self-introductions.

Eric Poncelet, facilitator, reviewed the agenda and meeting objectives, and provided key updates to the project process for the remaining four months of the GSP Advisory Committee process as reflected on the updated timeline.

Committee members requested clarification on how staff plans for the Committee to provide input on the pertinent sections of the GSP to the Mid-County Groundwater Agency (MGA) Board members and the plan for staff to address Committee GSP-related questions after the June meeting. Committee members offered the following suggestions to staff:

- Develop a consolidated document containing the Committee's GSP-related input on the Sustainable Management Criteria for the Sustainability Indicators for the Committee's reference.
- Agendize discussion of Committee's recommendations/deliberations for the July MGA Board meeting.

Staff indicated that the opportunity for the Committee to provide additional input to the pertinent GSP sections would come at the July MGA Board meeting, but that the review of the full GSP was outside of its scope. Staff also indicated that it would provide the Advisory Committee with more details on the input process for the pertinent GSP sections before the July MGA Board meeting.

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

Mr. Poncelet, facilitator, invited members of the public to make comments on any GSP-related issues not on the agenda.

One participant announced that an upcoming meeting of the City of Santa Cruz Water Commission will review progress to date on the Water Supply Advisory Committee's (WSAC) recommendations will be held at the City of Santa Cruz, on April 1 at 7 pm. The participant also gave an update on the legal action against Soquel Creek Water District regarding issues related to approval of the Pure Water Soquel (PWS) project.

**3. Project Updates**

Mr. Poncelet invited the following project updates:

- **Upcoming GSP Advisory Committee meeting schedule**
  Darcy Pruitt, Regional Water Management Foundation (RWMF) provided updates to the upcoming Advisory Committee meeting schedule verbally and on a handout, emphasizing the following:

  - The May meeting will occur on May 16 as it is a joint meeting with the MGA Board.
  - The June meeting will occur earlier, on June 19 in order to accommodate Committee members who had conflicts with the regular 4th Wednesday schedule, since this is the last official Committee meeting.

- **March 21 2019 DWR GSA Forum**
  Ms. Ryan reported on the DWR-hosted GSA Forum at which she presented as a panelist on the topic of GSP-related stakeholder outreach and engagement. She indicated that the Forum was a

good opportunity for the GSAs in Basins to share information on their stakeholder engagement efforts.

- **Santa Margarita Groundwater Agency (SMGWA) Educational Series**
  Ms. Ryan also provided an update on the last of the Santa Margarita informational meetings, at which the deputy director from the State Water Resources Control Board presented the state perspective on issues related to GSPs (e.g., climate change scenarios, projects). Local representatives discussed climate change impacts and possible projects that could be implemented in the Santa Margarita Basin. She added that all of the meetings in the series were recorded and available for viewing on the SMGWA website.

- **April 8 2019 Surface Water Working Group Meeting and Updated Approach for Depletion of Interconnected Surface Water**
  Ms. Ryan explained that as surface water is a complex sustainability indicator, the working group is still working on finalizing the sustainable management criteria proposal and will be meeting again on April 8 to discuss it. Georgina King, Montgomery & Associates provided a brief update on the approach to linking groundwater elevation proxy with depletion of interconnected surface water.

- **April 18 2019 Enrichment Session: Forecasting Water Use from Land Use and Population**
  Ms. Ryan announced that the enrichment session on the topic of forecasting water use from land use and population will occur on April 18 and she will post details of the session on the MGA website shortly.

**4. Groundwater Modeling Results for Sustainability Strategies**

Cameron Tana, Montgomery & Associates, discussed modeling results for a combination of projects, including Pure Water Soquel (PWS) and City ASR. He also described possible future iterations of the model, which would include reconfigured ASR, in-lieu compatible with PWS, redistribution of PWS pumping, and evaluating City ASR and combined projects using the Catalog Climate approach.

Following Mr. Tana's presentation, Committee members discussed the following key points with respect to the combined project groundwater modeling results:

- The strategy behind the PWS project is to conduct recharge in specific locations to protect groundwater levels in those areas, and have the benefits ultimately distributed to a larger area.

- Currently, for City ASR pilot project, the only well used is the City Beltz 12 well. More reconfigured locations are being considered, including use of existing infrastructure, some of which will need rehabilitation before use.
- In structuring the process for the reconfigured City ASR that would meet the goal of addressing the City's water supply shortage, the technical team needs to determine factors such as the availability of water supply, capacity of wells, demand on particular wells, and other operational implications.
- Another key component of the projects is collaboration among all of the pumpers in the Basin, especially between the City and water districts to achieve sustainability.
- The technical team will confirm the City ASR average water injection amount, the current range of which is up to 1900 AFY.

**5. Public Comment**

Mr. Poncelet, facilitator, invited members of the public to comment on Mr. Tana's presentation on groundwater modeling results on sustainable strategies, the Advisory Committee's reflections on the presentation, and any other Advisory Committee work.

One participant asked staff to consider the effects of accumulation of salt from seawater inflows and outflows into the aquifers.

Another participant offered a number of comments on Mr. Tana's presentation and observed that recharge has primarily been used to increase surface streamflow, not to raise groundwater levels. The participant stated that this effect from the City ASR project reinforces that PWS is not needed.

A participant offered endorsement of the previous participant's comments and asked staff to consider incorporating the Lochquifer project.

**6. Proposed Draft Sustainable Management Criteria for "Seawater Intrusion" and "Groundwater Storage" Sustainability Indicators**

Georgina King, Montgomery & Associates, presented a staff proposal on updated Sustainability Management Criteria for the Seawater Intrusion Sustainability Indicator. This proposal contained updates to the proposal originally presented in May 2018 and included the addition of Representative Monitoring Wells for the Purisima AA/Tu units and their associated minimum thresholds, plus Measurable Objectives previously discussed in September 2018.

Ms. King asked the Committee for feedback on the staff recommendation to use five-year (versus 10-year previously proposed) average groundwater elevations relative to protective groundwater elevations in coastal monitoring wells for any coastal monitoring well by which undesirable results would be evaluated.

Key input from the Committee on the five-year average for groundwater elevations include:

- If any average is to be used in evaluating undesirable results for Seawater Intrusion, the following needs to be addressed:
  - The problem needs to be clearly stated.
  - Provide an estimate of how much Seawater Intrusion is being underestimated if it falls below the average and what the impact on sustainability will be.

Ms. King also requested Committee feedback on staff's proposal for the Measurable Objective isocontour to be the same as the Minimum Threshold isocontour, but reduced concentration from 250 mg/L (Minimum Threshold) to 100 mg/L (Measurable Objective).

Committee members provided feedback on this proposal as follows:

- The 250 mg/L chloride minimum threshold standard is too high; 150 mg/l would be a more reasonable level. This level needs to be monitored very closely.
- As there are areas (e.g., Moran Lake) that register higher chloride levels than 100 mg/L, it is necessary to explain these higher levels in the GSP.
- Include levels in the GSP that would ensure against undesirable results, requiring State intervention.

In the second part of this agenda item, Ms. King presented a proposal on Groundwater Storage and requested that the Committee provide feedback on proposed theoretical approach to Sustainability Management Criteria, and representative monitoring points used to measure the Minimum Threshold and Measurable Objective metrics.

Key discussion points on Ms. King's proposal on Groundwater Storage included:

- With respect to Significant and Unreasonable Conditions, Committee members suggested that staff should consider water budget figures and changing the language regarding the volume of water "escaped" or "extracted" rather than "pumped."
- Regarding the proposed Undesirable Results, Committee members requested that staff consider all variables to come up with the most efficient way to maximize sustainability and keep in mind other Undesirable Results the basin would want to avoid.
- On Minimum Threshold, the Committee generally supported using the sustainable yield, but also recommended dividing up the data by aquifer and doing more than the regulations require.
- With respect to the proposed Measurable Objective, the Committee discussed the following:
  - The maximum pumping number can be recalculated and varied every five years, if needed.

  - The Measurable Objective levels are not enforceable, whereas the Minimum Threshold levels are enforceable. Sustainability should still be evaluated based on the Measurable Objective, taking into account the previous five years.
- Regarding the Representative Monitoring Points, staff clarified that leakage is included in the Sustainable Yield figure.

**7. Santa Cruz MGA Ongoing Funding**

The MGA will require ongoing funding to implement its Groundwater Sustainability Plan once it has been accepted by the State. Ms. Ryan presented on considerations and approaches on the potential Santa Cruz MGA ongoing funding and next steps. She requested initial reflections from the Committee.

The Committee's discussion on the funding considerations focused on the following key points:

- There are pros and cons to metering and charging a fee to *de minimus* pumpers. The Board should continue to monitor and analyze evaluation methods.
- The MGA Board is exploring metering for large volume water users.
- The rate of development in rural parts of the basin very minimal currently. Therefore, trend data for well installations has not been assessed.

**8. Representative Monitoring Wells for Each Sustainability Indicator**

Ms. King presented on the representative monitoring wells proposed for each sustainability indicator, including a discussion of data gaps for each indicator. The Committee requested that staff share this information again once the analysis for the Sustainability Indicators are finalized. Ms. King indicated that information on representative monitoring wells will be included in the appropriate chapter of the GSP.

**9. Public Comment**

During this final public comment session, Mr. Poncelet invited members of the public to provide comments on the Committee's discussion of Seawater Intrusion and Groundwater Storage technical staff proposals, the proposed funding approach, representative monitoring wells, and any other aspect of Advisory Committee work.

One participant provided general comments on various sections of the presentation under agenda items 7 and 8 and encouraged the MGA staff to hold public meetings regarding its decision to assess fees under Proposition 26 and Proposition 218.

Another participant encourage staff to consider projects other than ASR and PWS for the Basin.

**10. Confirm the February 27, 2019 2018 Advisory Committee Meeting Summary**

This item was deferred to the next meeting on April 24, 2019.

**11. Next Steps**

In closing, Mr. Poncelet provided a recap of the GSP process timeline for April through July 2019, focusing on objectives for the April enrichment session, the April, May and June meetings.

Executive Team members closed the meeting by thanking the attendees for their participation.