Agenda

Santa Cruz Mid-County Groundwater Sustainability Plan

Advisory Committee Meeting #16

Wednesday, February 27, 2019, 5:00 – 8:30 p.m.
Simpkins Family Swim Center
Room B - 979 17th Avenue Santa Cruz CA 95062

Meeting Objectives

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

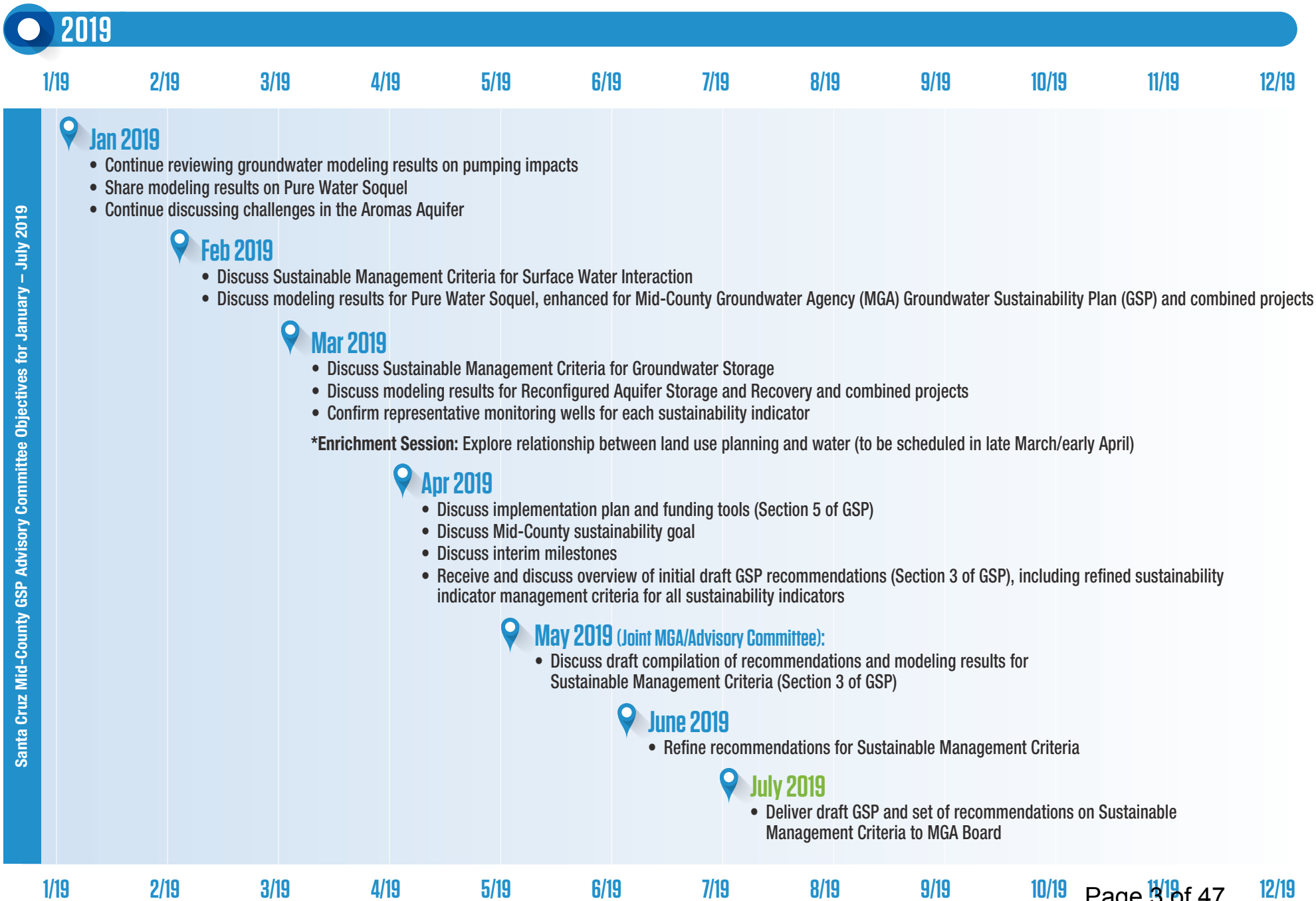
Agenda

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 • Review updated project timeline	• John Ricker, County of Santa Cruz • Eric Poncelet, Facilitator *Materials:* *1.1 Agenda* *1.2 Santa Cruz Mid-County Groundwater Sustainability Plan Advisory Committee Objectives for January – July 2019* *Refer to PowerPoint Presentation*
2.	5:10 p.m.	Oral Communications • *Members of the public to comment on non-agenda items*	• Public
3.	5:20 p.m.	Project updates • Groundwater modeling enrichment session (February 11, 2019) • Santa Margarita Basin informational meetings • DWR update	• Darcy Pruitt, Regional Water Management Foundation (RWMF) • Sierra Ryan, County of Santa Cruz

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

Item No.	Time[1]	Topic	Presenter & Materials
4.	5:25 p.m.	Review and discuss groundwater modeling results for sustainability strategies • Pure Water Soquel project, enhanced for MGA GSP • Combined projects	• Cameron Tana, Montgomery & Associates • Advisory Committee *Materials:* *4.1 Santa Cruz Mid-County Basin Climate Change Scenario Selection for Groundwater Sustainability Plan* *Refer to PowerPoint Presentation*
5.	6:45 p.m.	Public Comment	• Public
6.	*6:55 p.m.*	*Break*	
7.	7:10 p.m.	Discuss Proposed Draft Sustainable Management Criteria for "Surface Water Interaction" Sustainability Indicator • Report on outcomes from January 30 Working Group meeting • Provide initial input on proposed minimum thresholds and measurable objectives	• John Ricker, County of Santa Cruz • Georgina King, Montgomery & Associates • Advisory Committee *Materials:* *7.1 Technical Staff Proposal: Depletion of Interconnected Surface Water Sustainable Management Criteria* *Refer PowerPoint Presentation*
8.	8:10 p.m.	Public Comment	• Public
9.	8:20 p.m.	Confirm: • January 23, 2018 GSP Advisory Committee Meeting Summary	• Advisory Committee • Eric Poncelet, Facilitator *Materials:* *9.1 Draft Meeting Summary Groundwater Sustainability Plan Advisory Committee Meeting #15, January 23, 2019*
10.	8:25 p.m.	Recap and Next Steps	• Eric Poncelet, Facilitator
	8:30 p.m.	*Adjourn*	

Santa Cruz Mid-County GSP Advisory Committee Objectives for January – July 2019



Revised 02/14/2019

Santa Cruz Mid-County Basin
Climate Change Scenario Selection for Groundwater Sustainability Plan

This document summarizes the selection of the climate change scenario planned for modeling of future conditions in the Santa Cruz Mid-County Groundwater Sustainability Plan (GSP). The GSP regulations require utilization of climate change information in developing projected groundwater budgets in Section 2 of the GSP (Plan Area and Basin Setting) and evaluating whether projects and management actions meet sustainability goals in Section 4 of the GSP.

CATALOG CLIMATE SCENARIO PLANNED FOR USE IN GSP

The planned climate change scenario is called the Catalog Climate scenario. The premise of this approach is to use actual historical climate data representing the warmest years on record as opposed to modeled climate data from a global circulation model (GCM). This approach retains integrity of the climate data, as using historical data ensures that the combination of daily temperature data and daily precipitation data used for model input is realistic. Model Technical Advisory Committee (TAC) member Professor Andrew Fisher originally suggested this approach. After developing the scenario, Montgomery & Associates presented the Catalog Climate scenario to the TAC and provided comparisons to approaches based on GCMs. Two of the five TAC members, Professor Fisher and Soquel Creek Water District Board Vice President Dr. Bruce Daniels, expressed a preference on which climate change scenario should be used for the GSP, and they recommended using the Catalog Climate scenario. Their main concern with using GCMs is that the coarse spatial resolution of regionally downscaled GCMs cannot realistically represent weather patterns that have been observed at the climate stations used in the groundwater flow (GSFLOW) model of the Basin.

The development of the Catalog Climate scenario is described in the following document: www.midcountygroundwater.org/sites/default/files/uploads/TechMemo_Aug2017_Climate.pdf

CITY OF SANTA CRUZ WSAC CLIMATE CHANGE SCENARIO

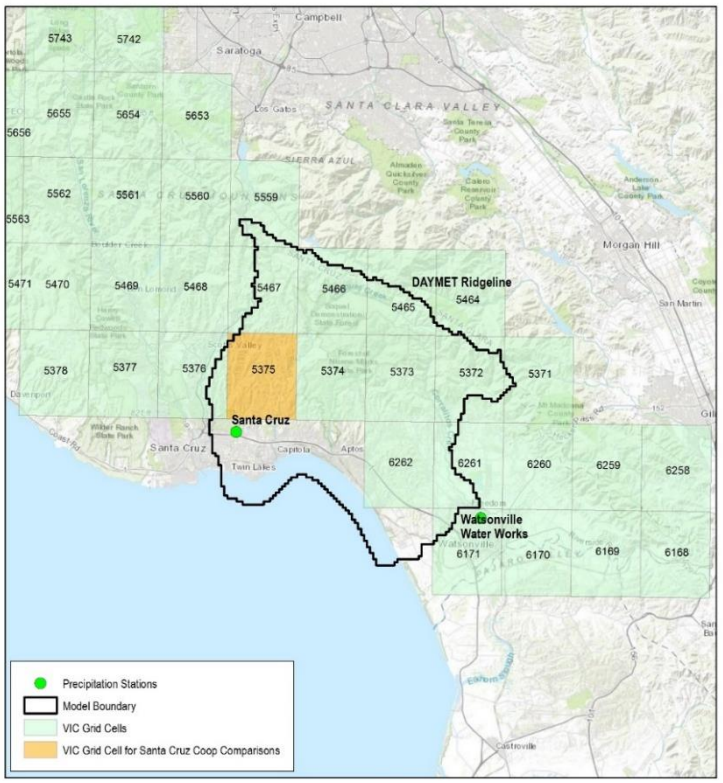
The City of Santa Cruz (City) Water Supply Advisory Committee (WSAC) evaluated drought supply alternatives based on NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) 2.1-A2 GCM, part of the CMIP3 (Coupled Model Intercomparison Project Phase 3) ensemble of GCMs. On behalf of the City, Montgomery & Associates has simulated Aquifer Storage and Recovery (ASR) preliminary alternatives based on this future climate

projection. In order to provide preliminary information to the GSP Advisory Committee about City ASR alternatives, results of model simulations based on the GFDL2.1-A2 GCM will be presented to the GSP Advisory Committee at the February 27, 2019 meeting. All projects and management actions included in the GSP will need to be evaluated using a consistent future climate scenario, so it is planned for City ASR alternatives to also be simulated using the Catalog Climate scenario.

DWR CLIMATE CHANGE DATASETS

California Department of Water Resources (DWR) has issued *Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development* (July 2018) that provides datasets for climate change scenarios. The guidance states that Groundwater Sustainability Agency (GSA) use of these datasets is optional: "GSAs are not required to use DWR-provided climate change data or methods, but they will need to adhere to the requirements in the GSP Regulations. Local considerations and decisions may lead GSAs to use different approaches and methods than the ones provided by DWR for evaluating climate change." One of the local considerations for the decision to use the Catalog Climate scenario in the GSP was based on a comparison of the Catalog Climate scenario to DWR climate change datasets.

The DWR climate change datasets provide climate change factors based on a CMIP5 (Coupled Model Intercomparison Project Phase 5) GCM for drier and warmer conditions in 2070. The climate change factors for 2070 provided nearest the Santa Cruz Co-op station (orange area in adjacent figure) used for climate input to the GSFLOW model of the Basin show an increase of 8% in evapotranspiration and an increase of 3% in precipitation from historical conditions. The Catalog Climate has an approximate increase of 6% in average evapotranspiration but a decrease of 10% in average precipitation from historical conditions. Although the Catalog Climate does not include hotter temperatures projected by GCMs for the future, it does represent drier conditions than DWR's datasets, and these drier conditions may be more appropriate for sustainability planning.



DWR Climate Change Dataset Grid Cells and Climate Stations Used in Santa Cruz Mid-County Basin GSFLOW Model

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 are most vulnerable to depletion of surface water interconnected with groundwater.
    - What we currently know about surface water and groundwater interconnection from the results of analysis of rainfall runoff relationships and initial model analysis.

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 sub-committee 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 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
- Resources Conservation District of Santa Cruz County
- The Nature Conservancy

- US Fish and Wildlife Service

The Working Group has met three times thus far, and plans to meet again one more time.

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 habitat and streamflow are influenced by many factors, including surface diversions, geology, soils, morphology and precipitation, among others, not just groundwater. Additionally, there may be a number of locations in the basin where groundwater is not historically connected to streamflow due to geologic conditions in those areas.

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 stream flow 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. Groundwater levels were seen by the Working Group as an appropriate proxy for measuring effect on interconnected surface water.

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 actions that affect stream flow including surface water diversions, evapotranspiration, and rainfall, that are beyond the

scope of the Groundwater Sustainability Plan (GSP). These actions must still be accounted for in the analysis.

- Steelhead and coho salmon are priority species for focusing on the effects of groundwater management. By managing for their specific habitat requirements in basin streams, the needs of other aquatic species will be met. 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.
- 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.
- More information is required on the following species and habitat types regarding either occurrence within the basin and/or whether groundwater management would benefit them: Santa Cruz Long-Toed Salamander, California Red-Legged Frog, Lamprey, California Brackishwater Snail, Tidewater Goby, Western Pond Turtle, Wet Meadows (see Table 1 for occurrences of non-salmonid aquatic species found through the County's monitoring program). For example, the Santa Cruz Long-Toed salamander requires breeding ponds, but these appear to all be in locations that are not interconnected with groundwater.
- Species and habitat types that are found in the basin but would not benefit 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.

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 both 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.

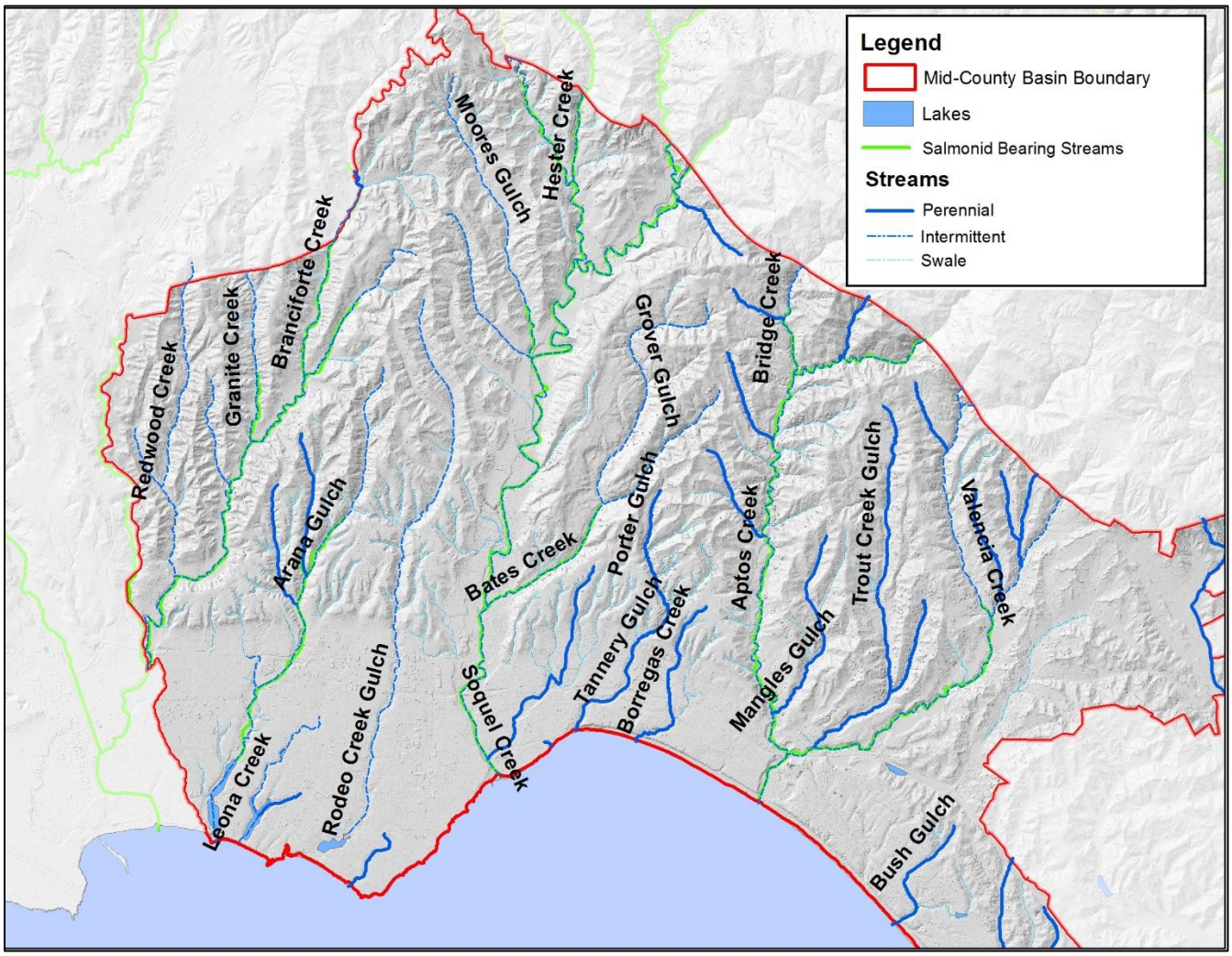


Figure 1: Stream Habitat in the Mid-County Basin

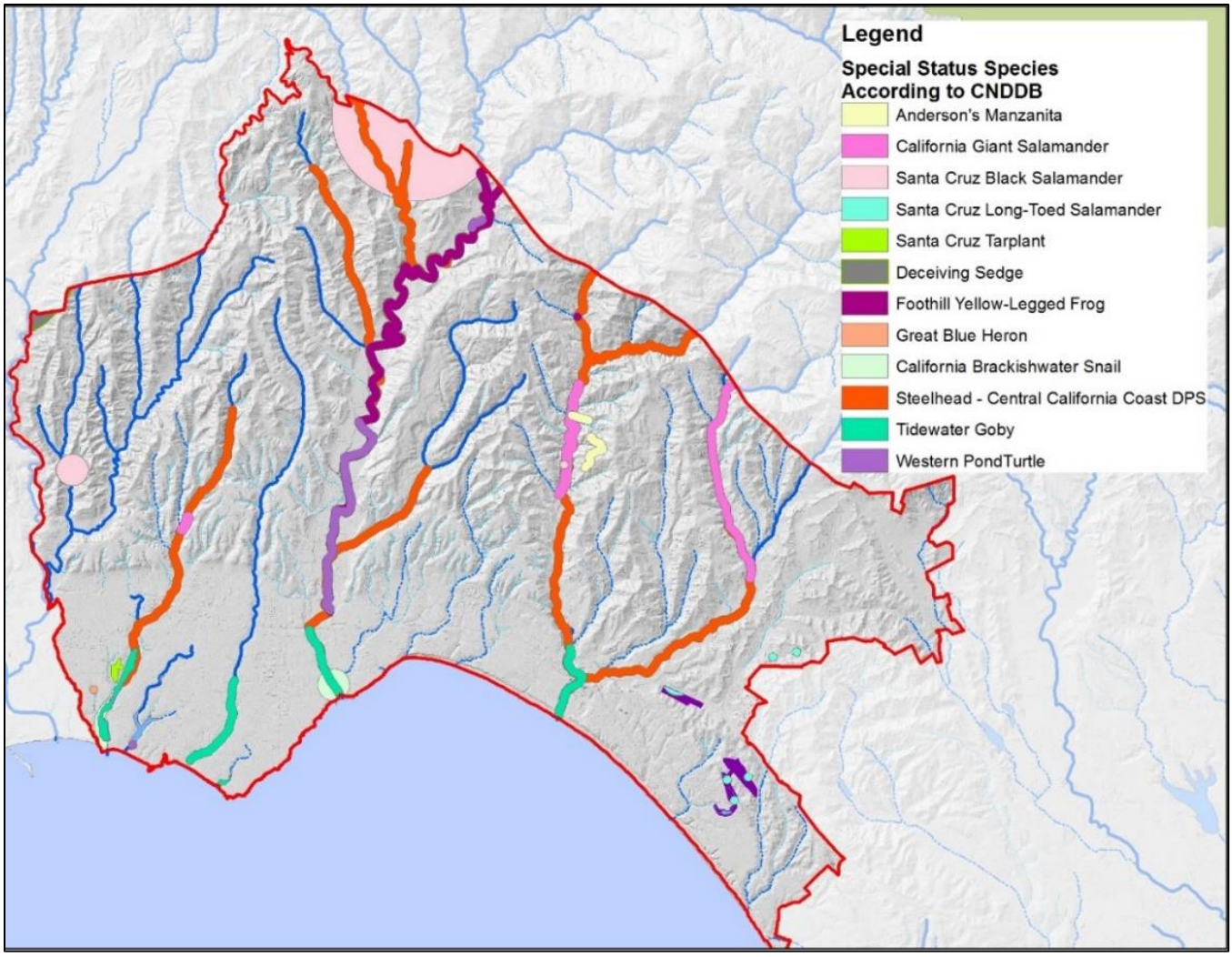


Figure 2: Distribution of Species throughout the Mid-County Basin according to the California Natural Diversity Database. Several streams support multiple species. Note that due to the layering of species on the map, some species that use the entire stream reach, steelhead for example, may appear only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

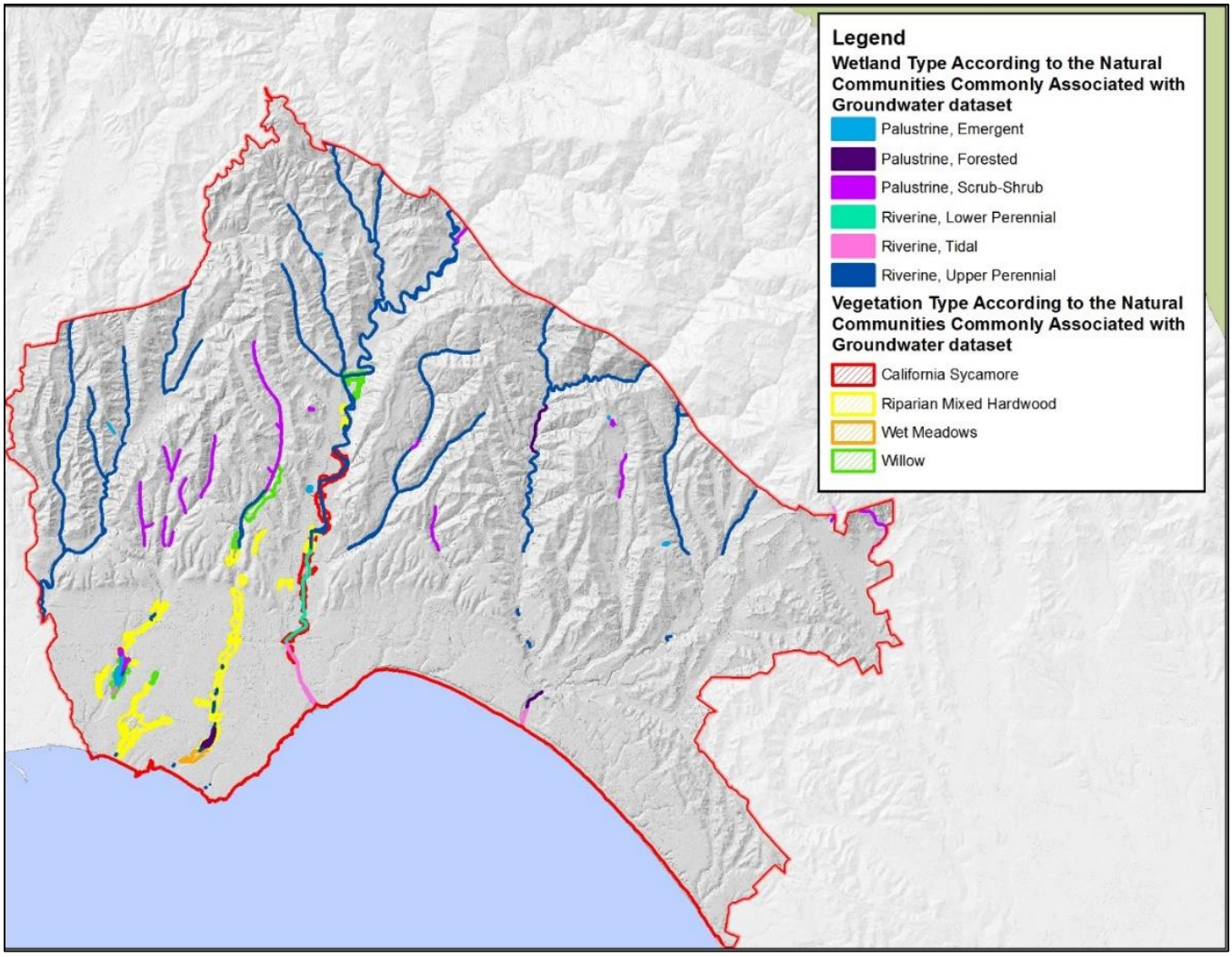


Figure 3: Wetland and Vegetation Types according to the Natural Communities Commonly Associated with Groundwater Dataset

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
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

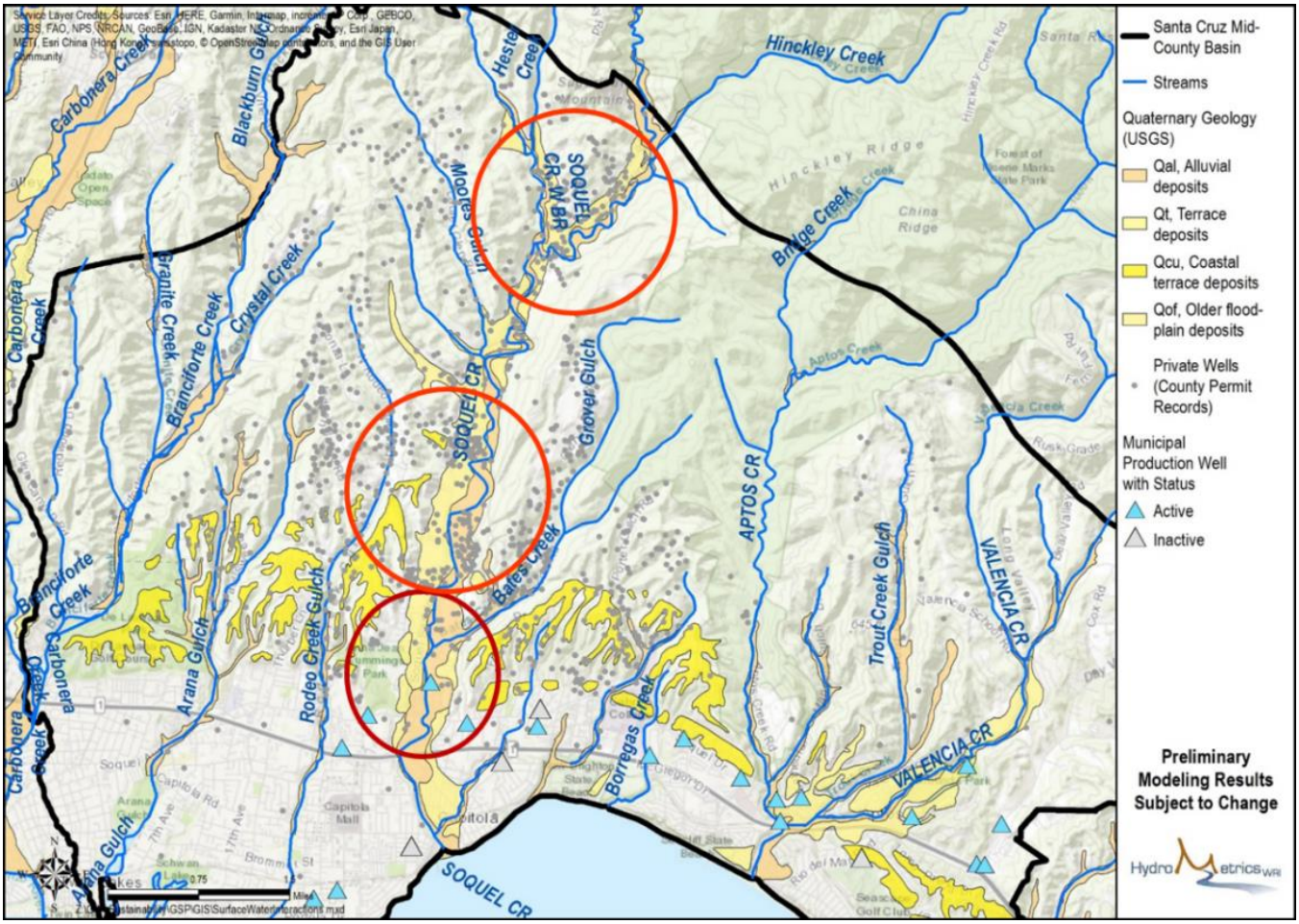


Figure 4: Areas of Concentrated Groundwater Pumping along Soquel Creek

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	Further input required
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	

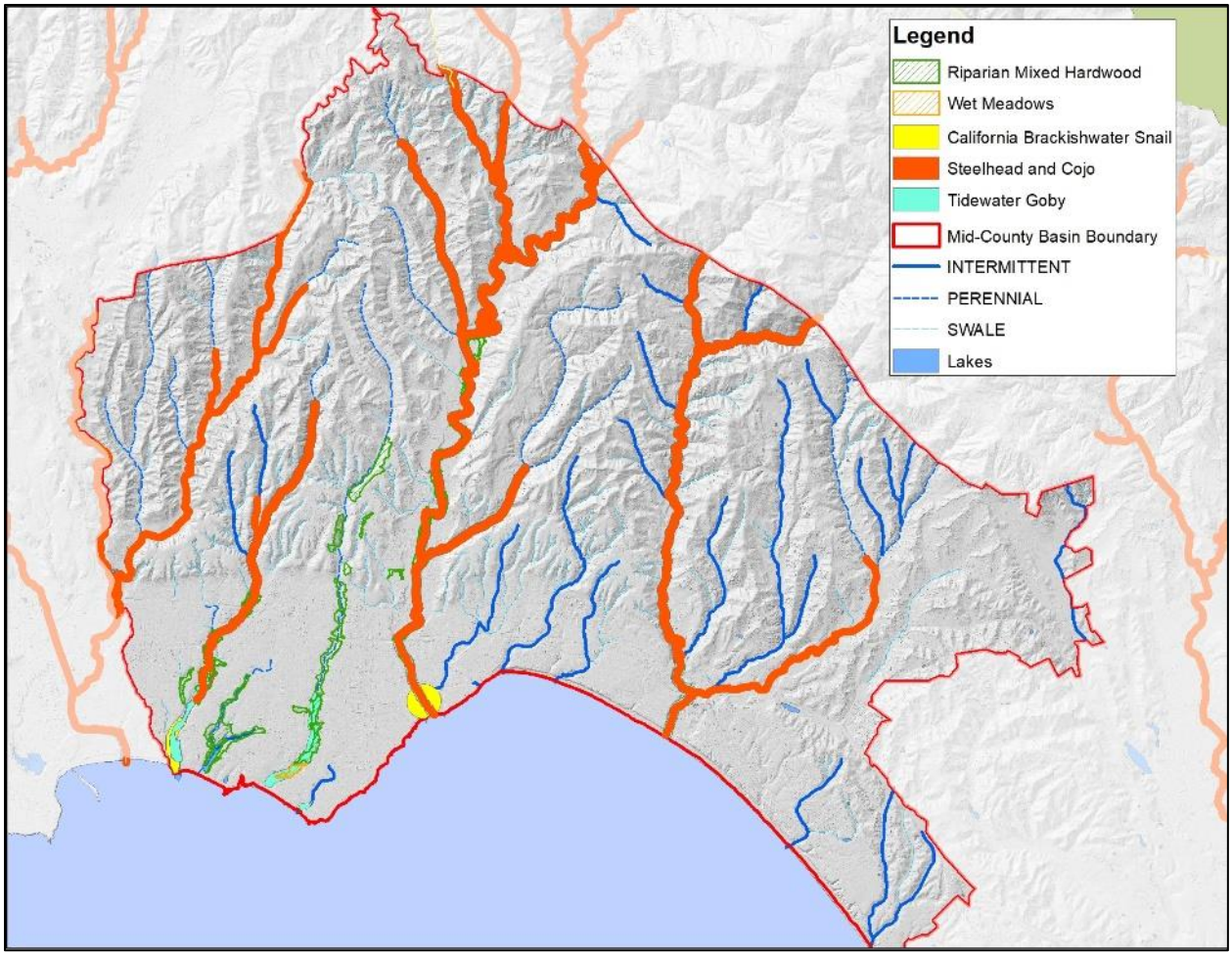


Figure 5. Final GDEs for Consideration

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.

Where streams are disconnected, groundwater levels are well below the bottom of the stream. 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 7, 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.

However, 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.

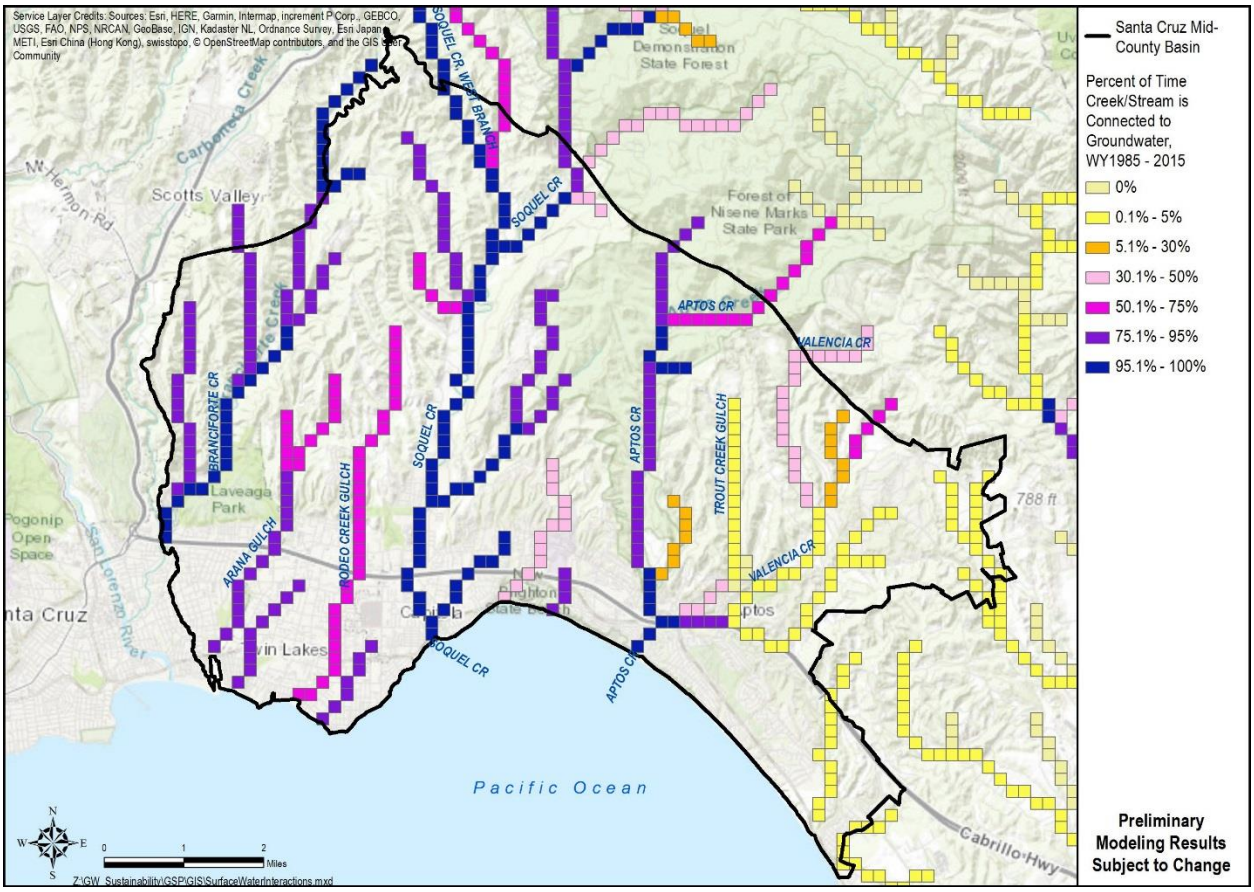


Figure 6: Percent of Time Streams are Connected to Groundwater (WY 1985 – 2015)

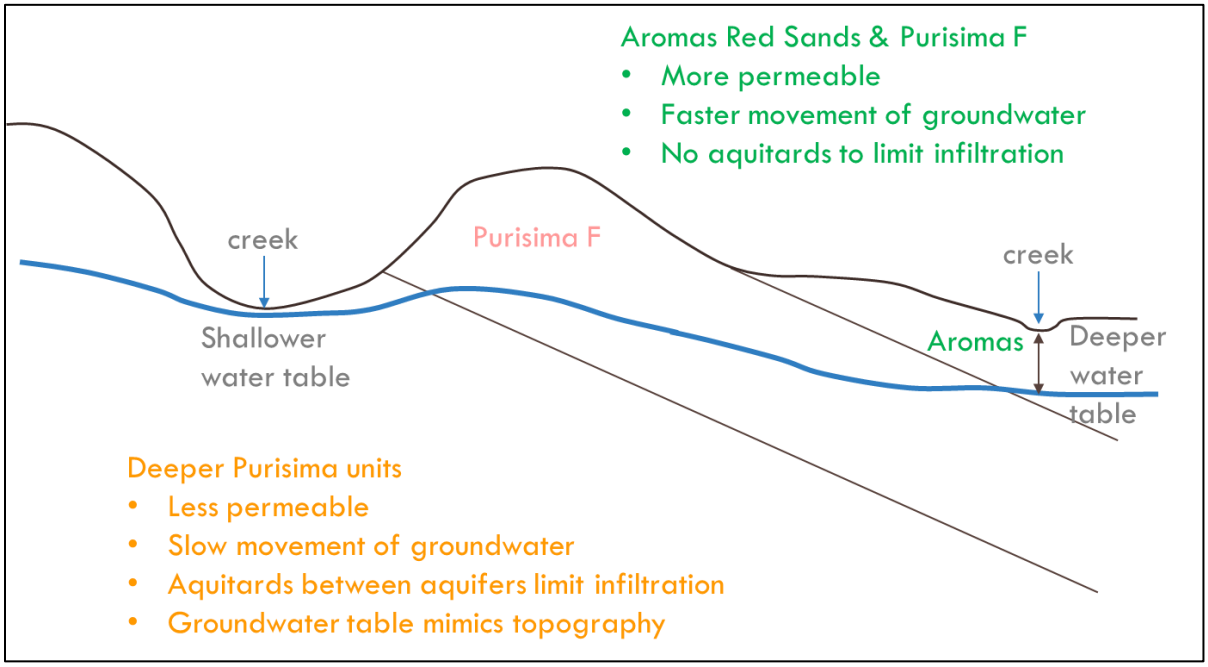


Figure 7. Schematic Illustrating the Difference between Purisima and Aromas Connection to Groundwater

Depletion of Interconnected Surface Water

HOW GROUNDWATER IS CONNECTED TO SURFACE WATER

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 8 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. Output from the calibrated groundwater model indicates that in the area where we have shallow groundwater data from which to calibrate (Main Street to Nob Hill), groundwater only contributes a small amount of summer flow (< 0.04 cfs) to Soquel Creek (Figure 9).

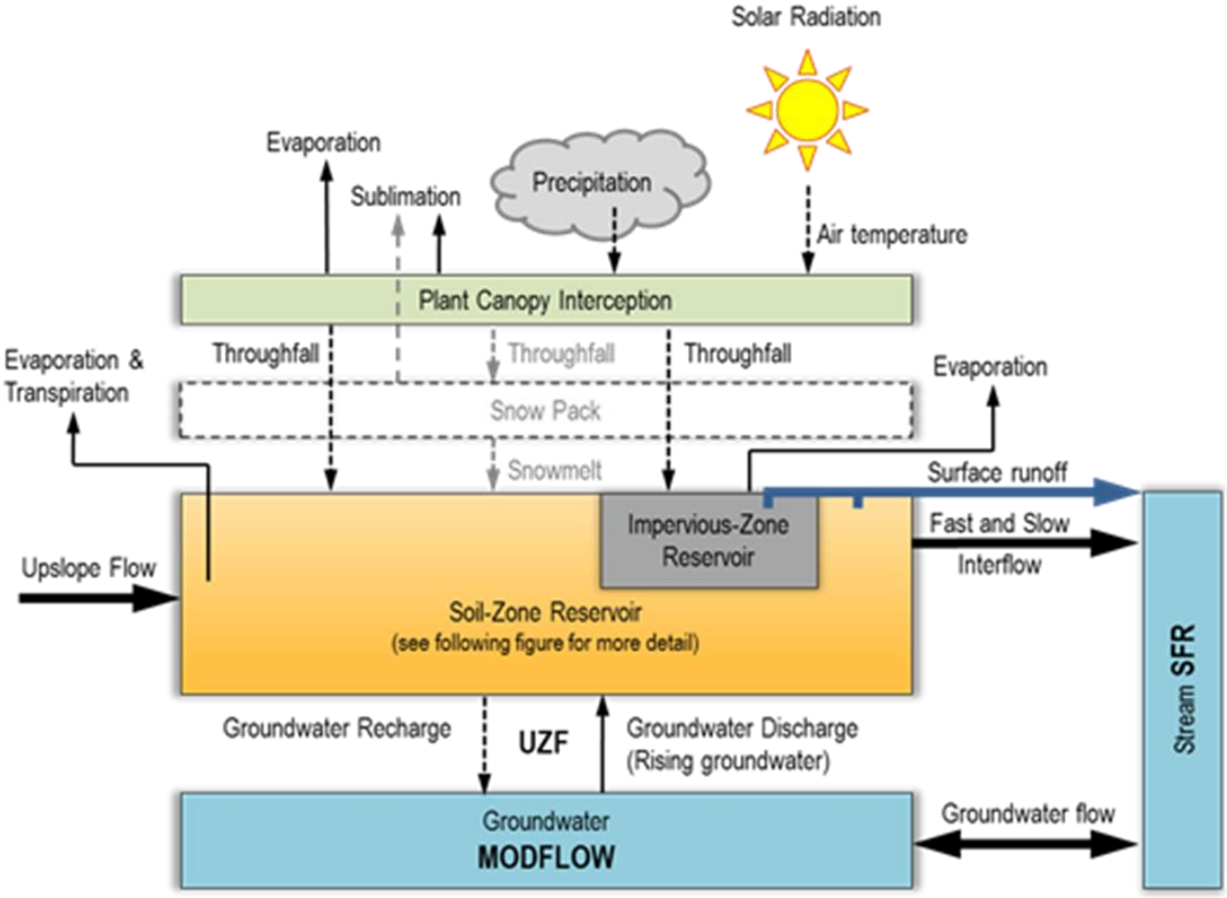


Figure 8. Hydrologic Process Simulated by the Precipitation-Runoff Modeling Systems

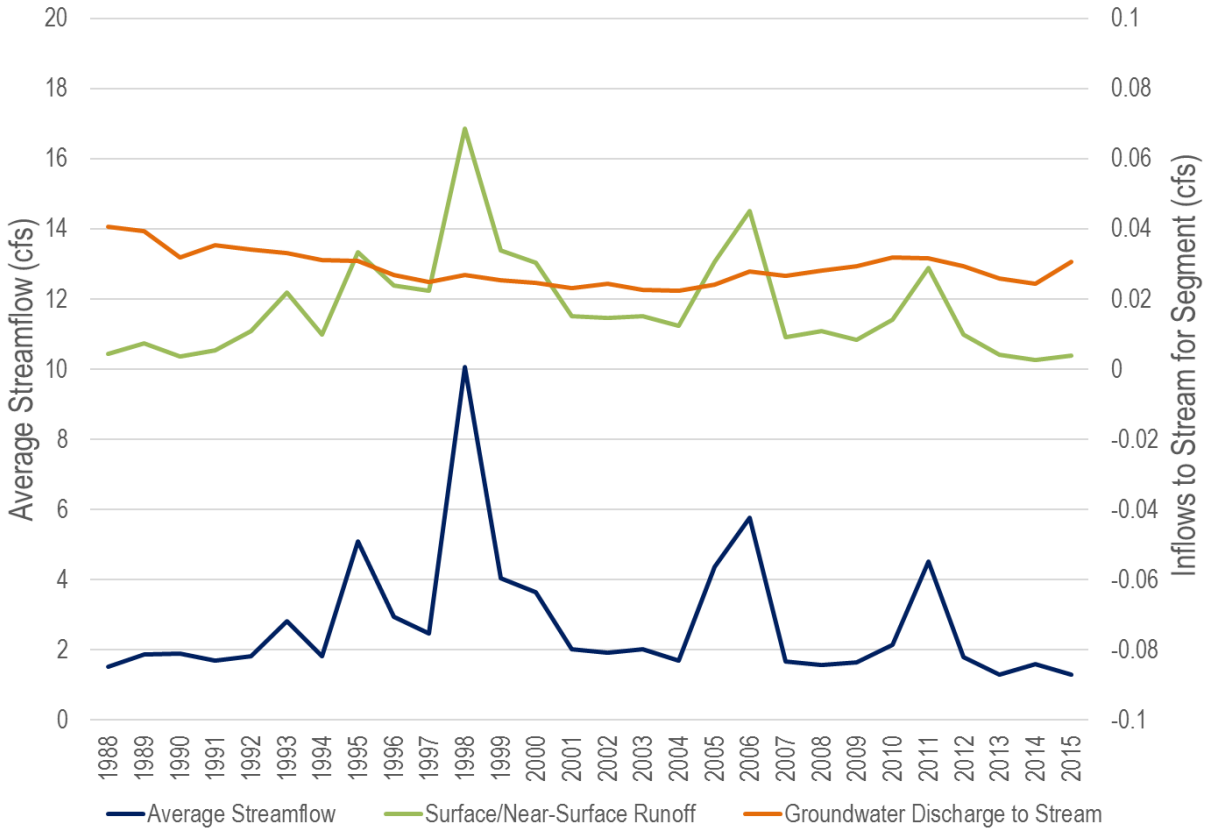


Figure 9. Average July through September Flows from Main Street to Nob Hill

CONCEPTUAL 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 10). The hydrographs on Figure 11 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 stream flow 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.

Depletion of Interconnected Surface Water

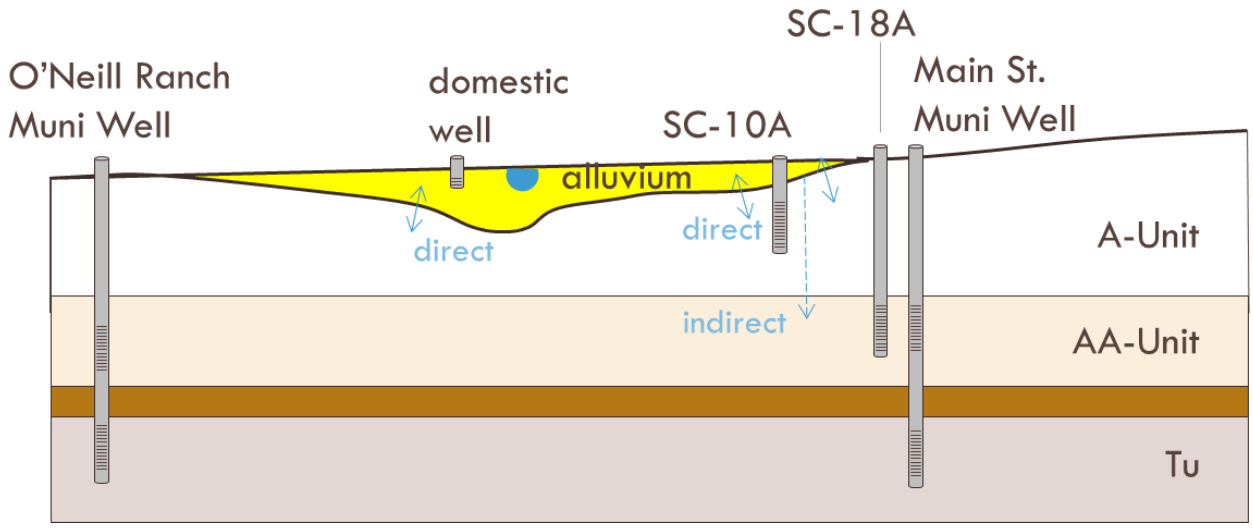


Figure 10. Conceptual Connections between Soquel Creek, Alluvium, and Underlying Aquifers

Evaluation of the relationships between measurements shown on Figure 11 indicate:

- Shallow groundwater levels fluctuate in response to both pumping and rainfall.
- Shallow groundwater levels recover 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.

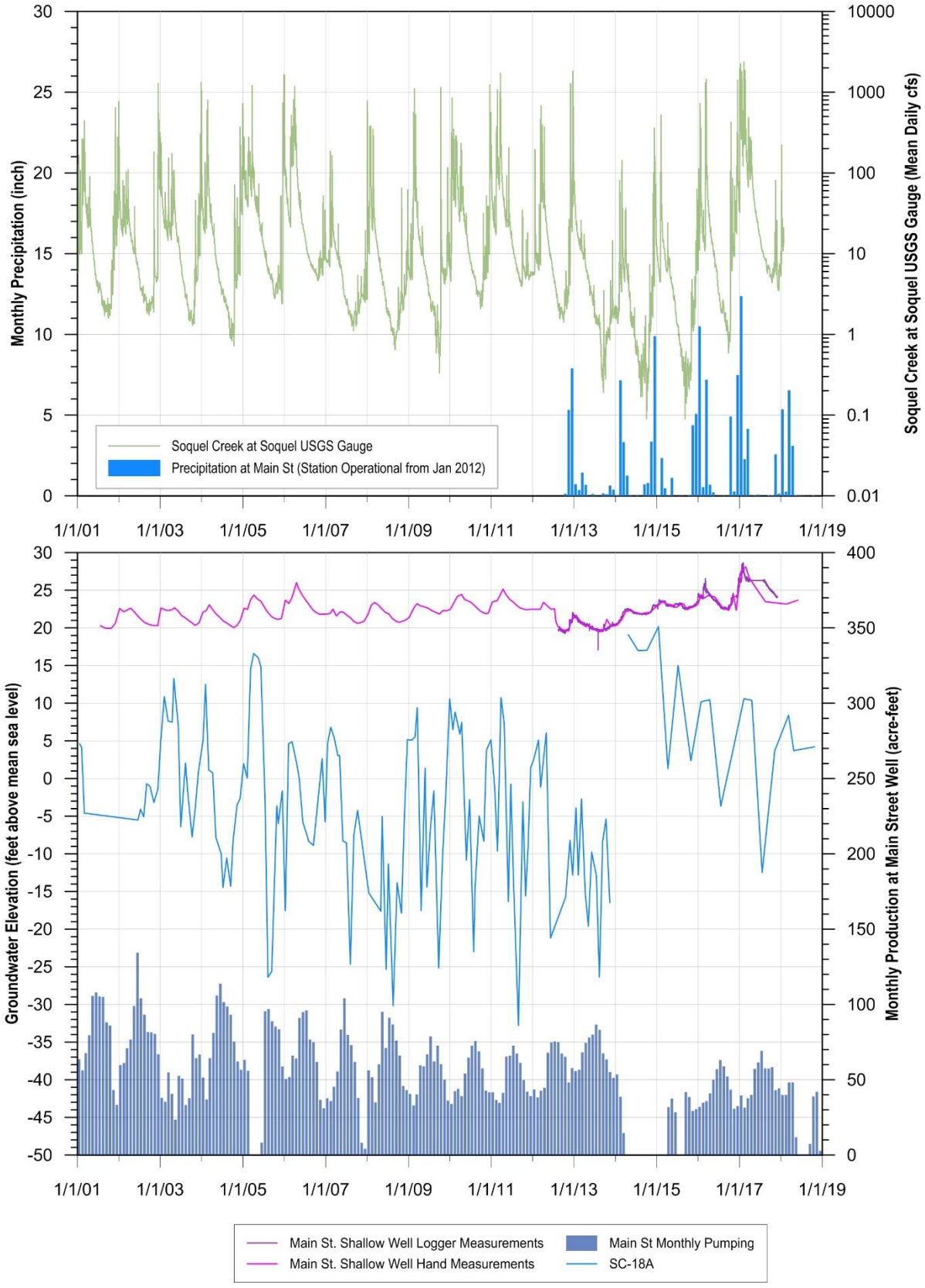


Figure 11. Hydrographs for Main Street Monitoring Wells Compared to Monthly Main Street Pumping, Creek Flow and Precipitation

Depletion of Interconnected Surface Water

HISTORICAL SOQUEL CREEK ZERO FLOW

There was zero flow in Soquel Creek in 1977, 1988, 1992, 1994, and 1995 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 years of below average rainfall, or after consecutive years of below average rainfall (Figure 12). In 2007 and 2008 there were also consecutive years of 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.

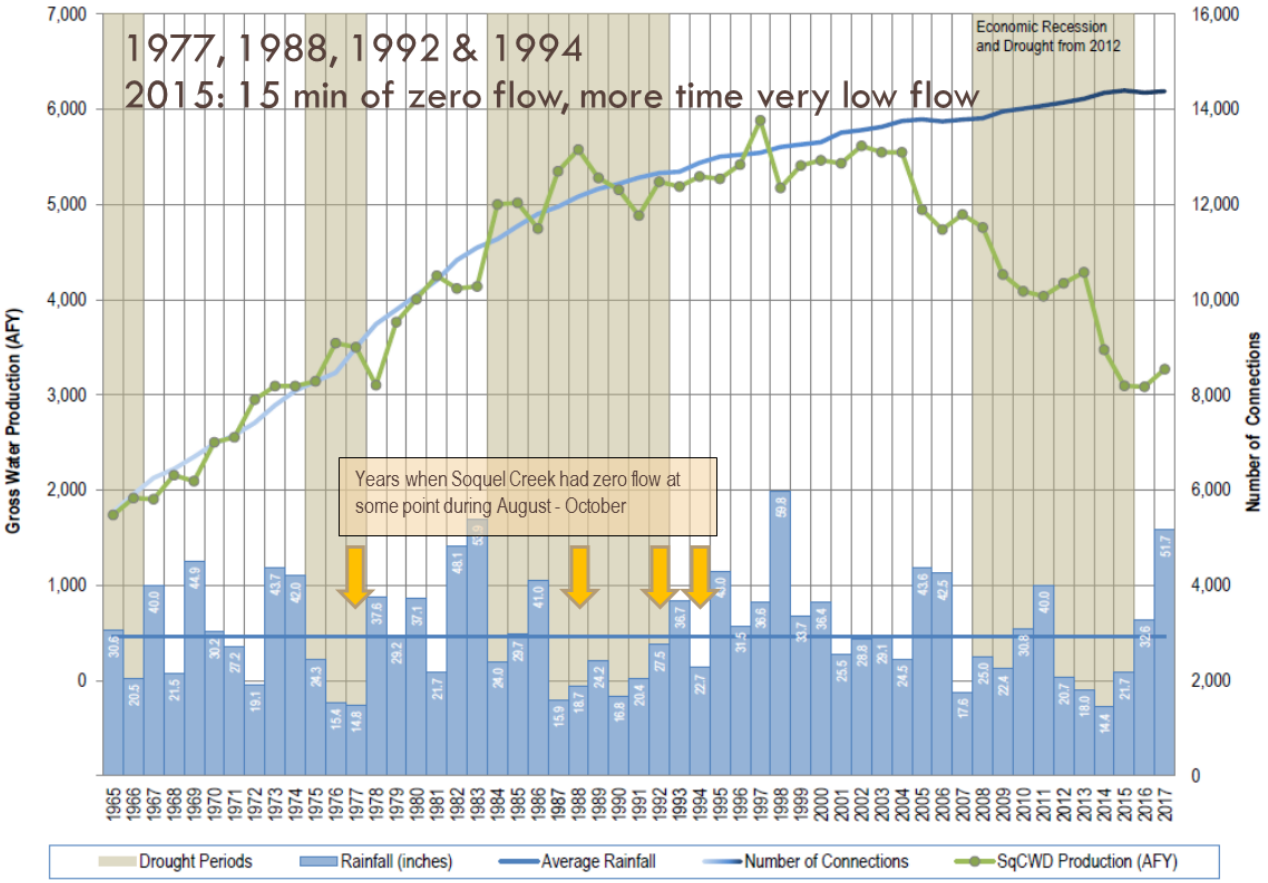


Figure 12. Annual Rainfall with Periods of Zero Flow at the USGS Soquel Creek gauge near Soquel

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 below the Purisima A-unit that directly underlies alluvium (Figure 10). 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 11 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 13 shows a hydrograph for the Main Street well, screened in the Purisima AA-unit underlying the Purisima A-unit, which is beneath alluvium (Figure 10). 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 observable 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 13). 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. The creek is in direct contact with the stream alluvium, and the production aquifers are at greater depths below the 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 stream flows.

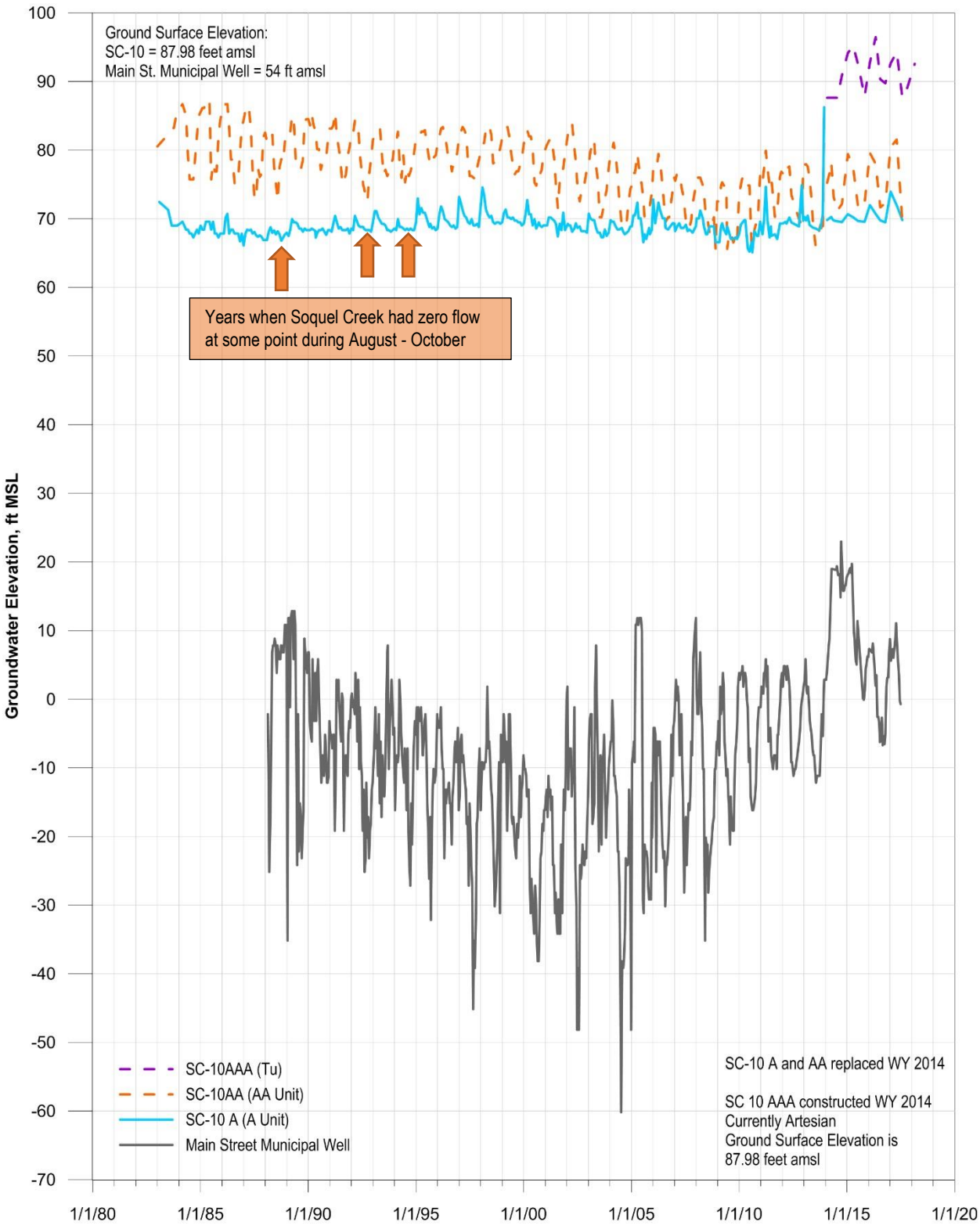


Figure 13. SC-10 Monitoring Wells and Main Street Municipal Well Hydrographs

Depletion of Interconnected Surface Water

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.

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 14 and Figure 16. Further breaking the data up by quarter reveals further relationships. Figure 15 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 16 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 should have had zero flow but because of just over a combined 1 inch of rain in July and September, Soquel Creek had recordable flow.

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.

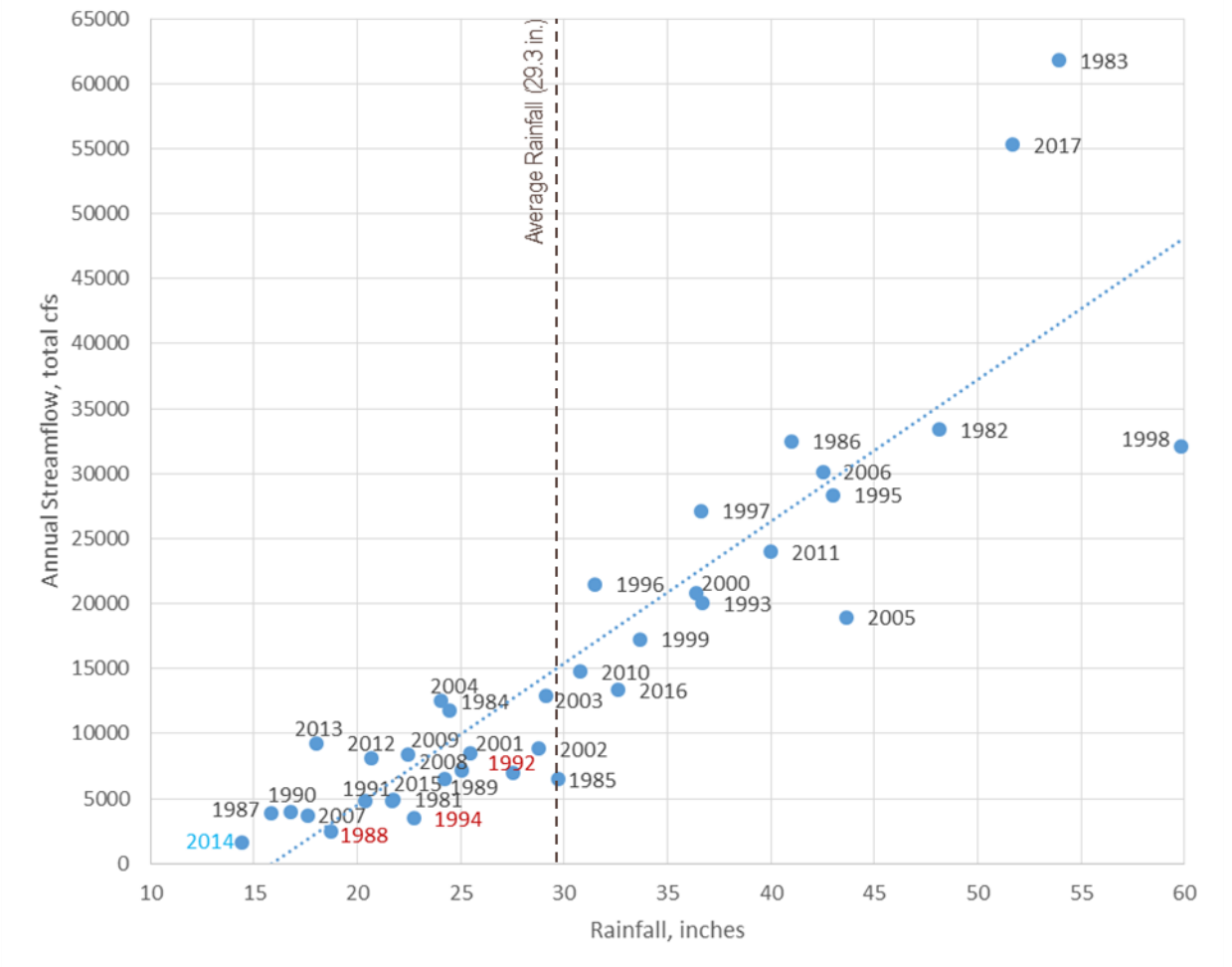


Figure 14. Annual Rainfall versus Flow at the Soquel Creek Gauge

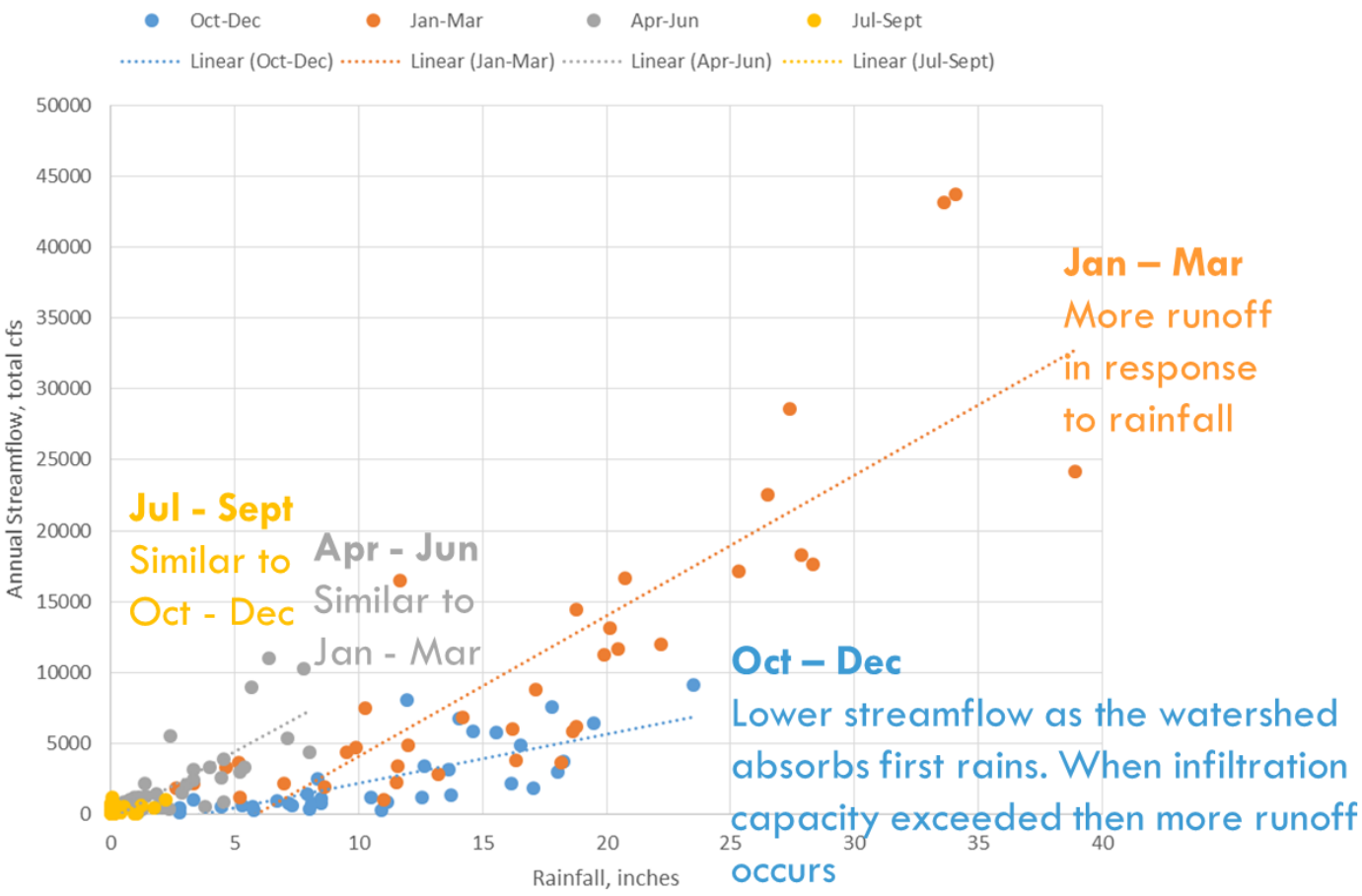


Figure 15. Seasonal Rainfall versus Stream Flow Relationships at the Soquel Creek Gauge

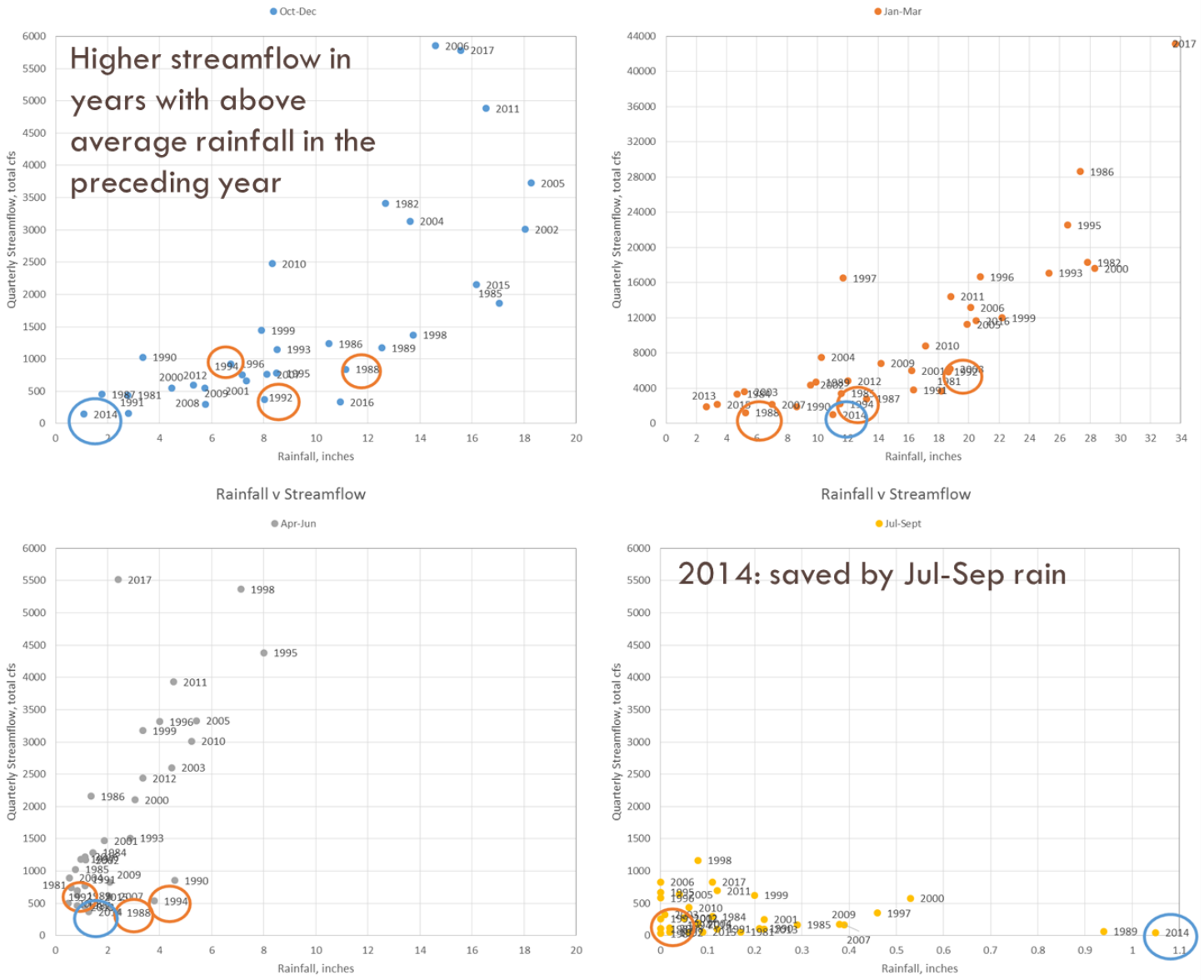


Figure 16. Seasonal Rainfall versus Stream Flow Relationships at the Soquel Creek Gauge by Season

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 17. 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.

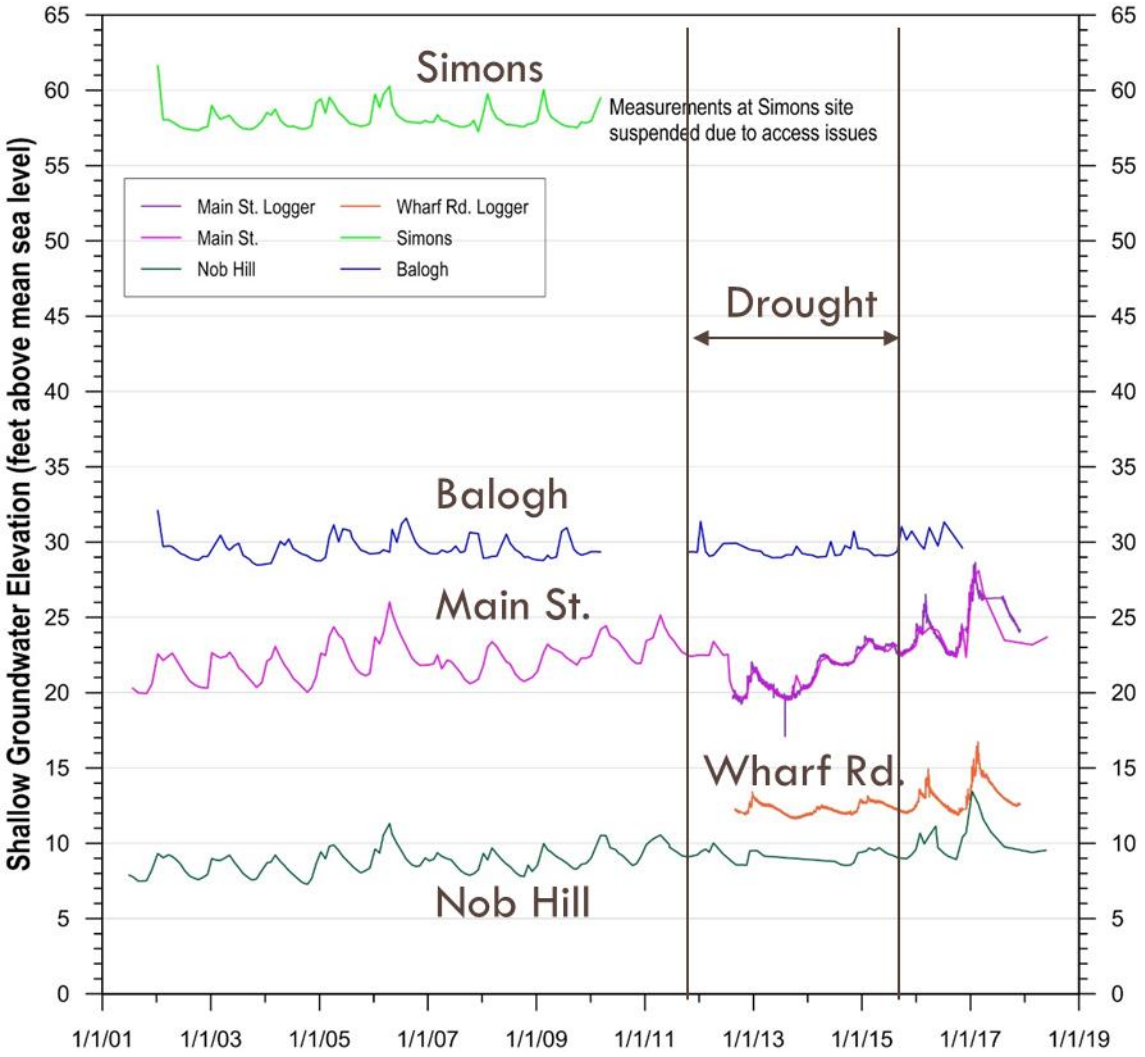


Figure 17. Shallow Groundwater Elevations along Soquel Creek

2. TECHNICAL STAFF PROPOSAL FOR REPRESENTATIVE MONITORING WELLS FROM WHICH TO MONITOR THE SUSTAINABILITY INDICATOR THROUGH USE OF GROUNDWATER LEVEL PROXIES

EXISTING MONITORING WELL LOCATIONS

There are several existing shallow monitoring wells adjacent to creeks in the Basin. Figure 18 shows five 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). Figure 19 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, shallow groundwater have increased and the stretch has been on occasion gaining.

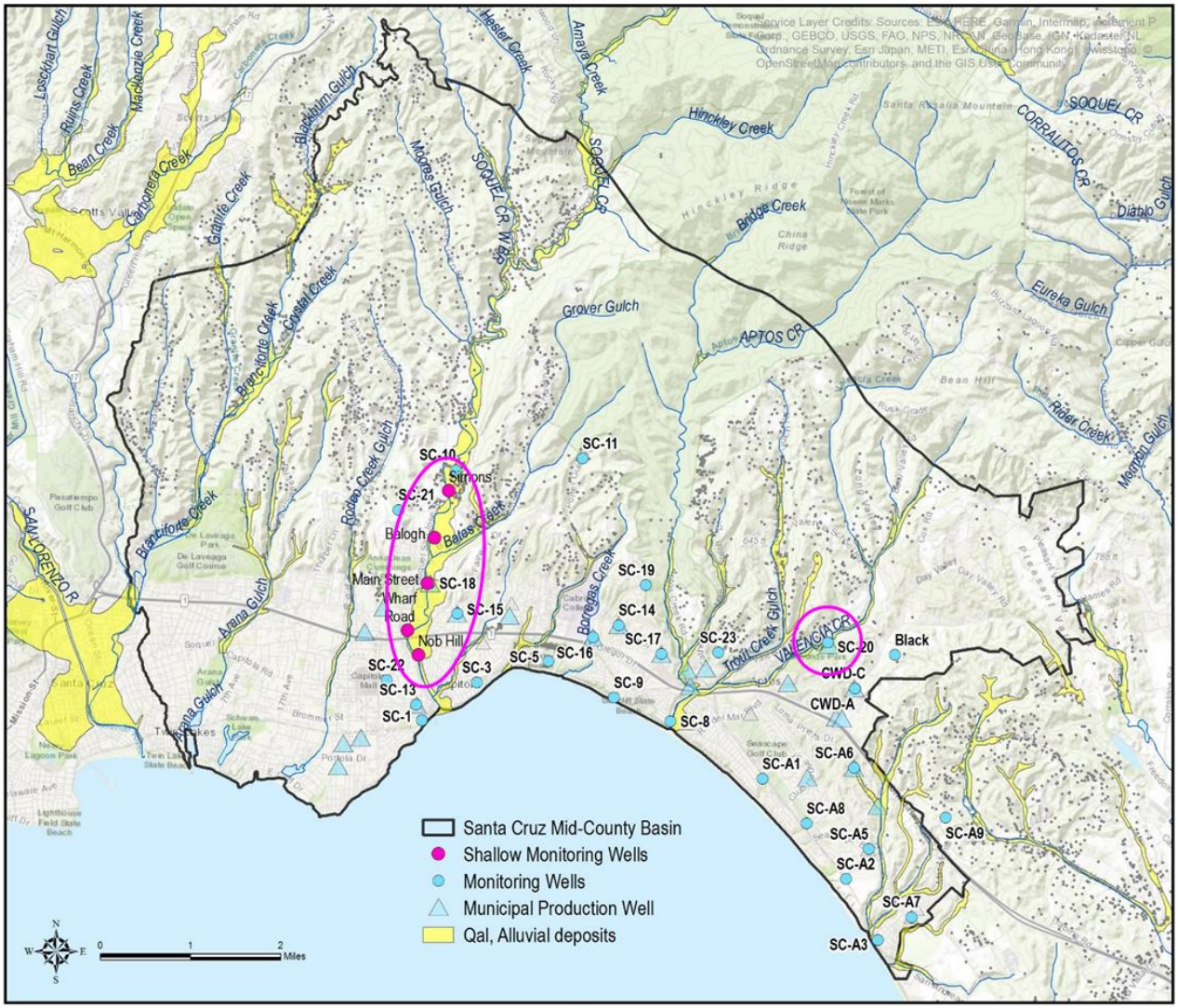


Figure 18. Monitoring Well Locations in the Santa Cruz Mid-County Basin (Pink circles represent monitoring wells near creeks)

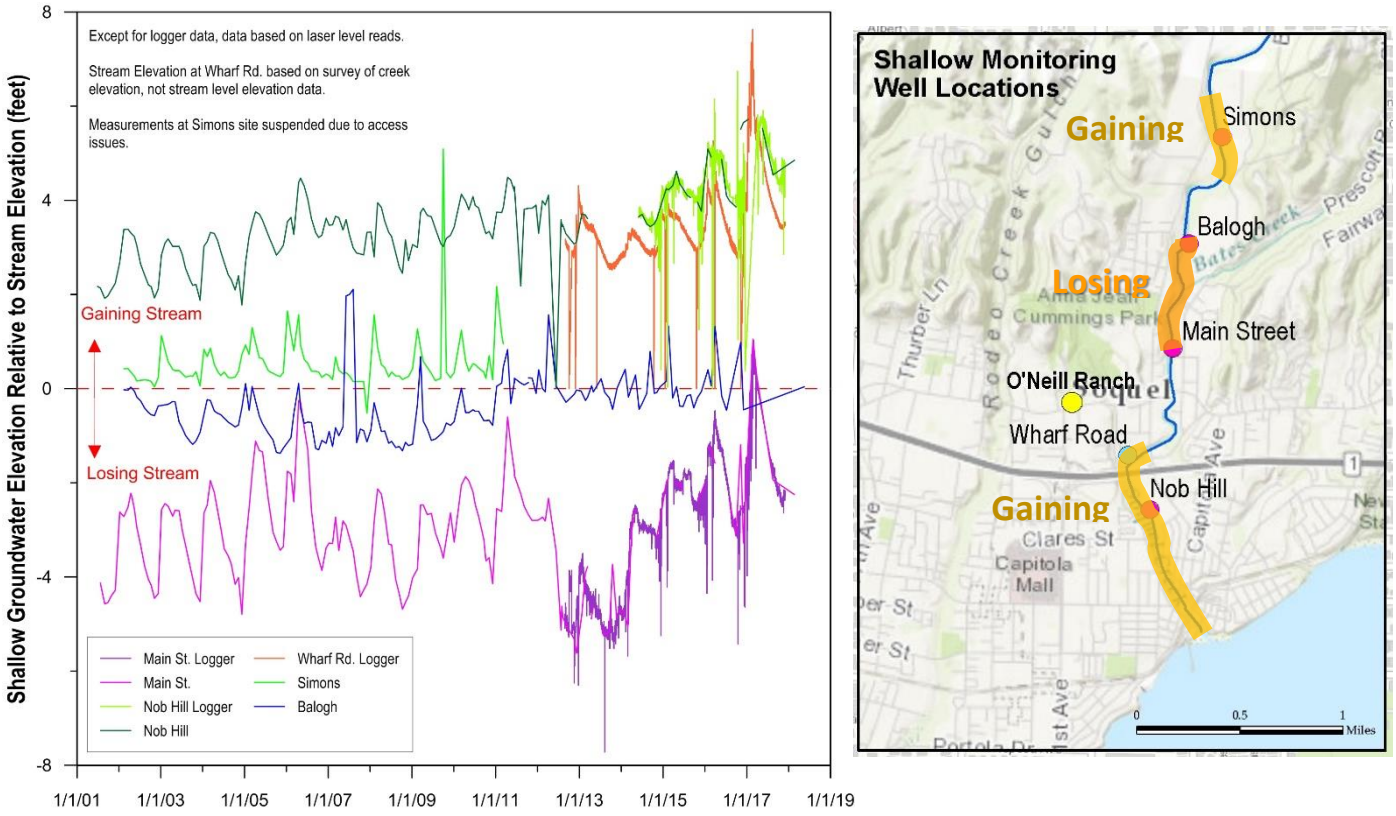


Figure 19. Shallow Groundwater Levels Relative to Adjacent Soquel Creek Levels

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

Dependent on land availability, the following sites are proposed for new monitoring wells to supplement the existing shallow well network (Figure 20):

- Next to Soquel Creek below Moore's Gulch
- Add a shallow alluvial well at SC-10
- 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 is not included as a proposed location at this time.

Depletion of Interconnected Surface Water

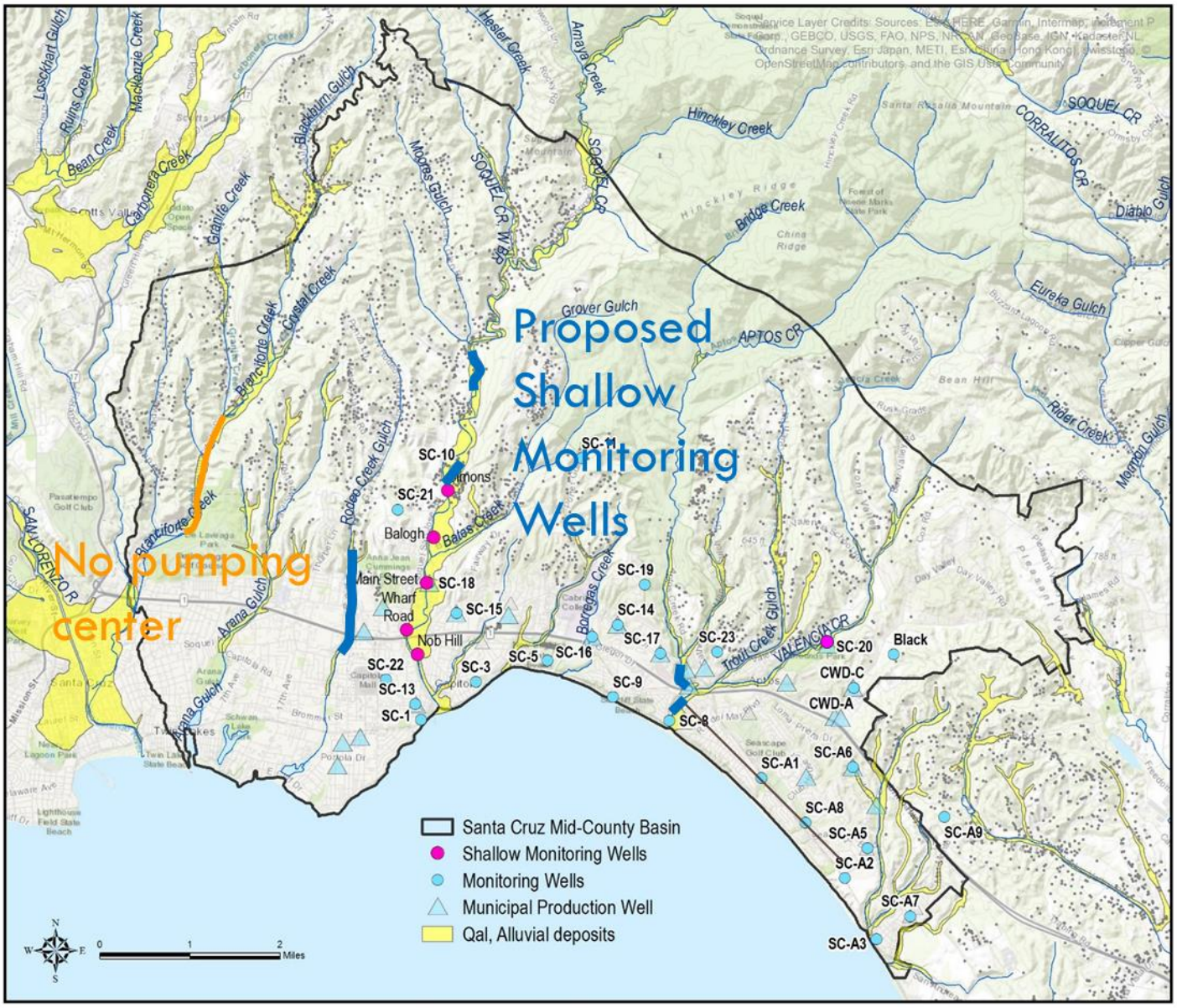


Figure 20. Proposed Surface Water/ Groundwater Proxy Representative Monitoring Wells

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 needed during GSP implementation to:
  - Understand link between alluvium and unit directly below alluvium
    - Need multi-depth monitoring wells in same location

        - Add shallow monitoring wells at SC-10
    - Understand where creeks are gaining and losing
        - Measure groundwater levels in private alluvial wells and compare against creek levels
        - More stream flow 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

Lowering of groundwater levels adjacent to interconnected streams supporting special status species, due to groundwater extraction, that results in a significant decrease in stream baseflow during the period from June - ~~October~~ November would be a significant and unreasonable condition.

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 and therefore the GSP guidelines allow for the use of groundwater levels as a proxy for volume or rate of surface water depletion. At the second meeting of the Surface Water Working Group, the group agreed that use of groundwater levels as a proxy was reasonable. Since that time, the Environmental Defense Fund (EDF) has 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 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 tend 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

PRELIMINARY MINIMUM THRESHOLDS

The proposed approach for developing minimum thresholds for this sustainability indicator is to select groundwater levels in shallow monitoring wells below which significant and unreasonable results occur. Our analysis thus far indicates that zero flow at the Soquel Creek at Soquel gauge is more influenced by the seasonal rainfall pattern than by shallow groundwater levels which remain fairly consistent. Our assumption is that if adverse effects did not occur during the period from 2001 – 2018, the minimum threshold is equal to the lowest annual minimum shallow groundwater level measured over the shallow groundwater well data period of record (2001 – 2018).

PRELIMINARY MEASURABLE OBJECTIVES

Initially an average of seasonal low groundwater levels between 2001 and 2018 was used to establish draft measurable objectives for each well. Based on comments received from the Working Group, this did not represent what we'd aspire conditions to be like

based on historical conditions and did not provide enough operational flexibility. We have revised that approach to rather use the maximum winter/spring groundwater levels in below average rainfall years. Note that by using the seasonal high instead of an average, most of the year, except in later winter/spring, groundwater levels will be below the measurable objective.

Preliminary minimum thresholds and measurable objectives are provided in Figures 21 – 24 below.

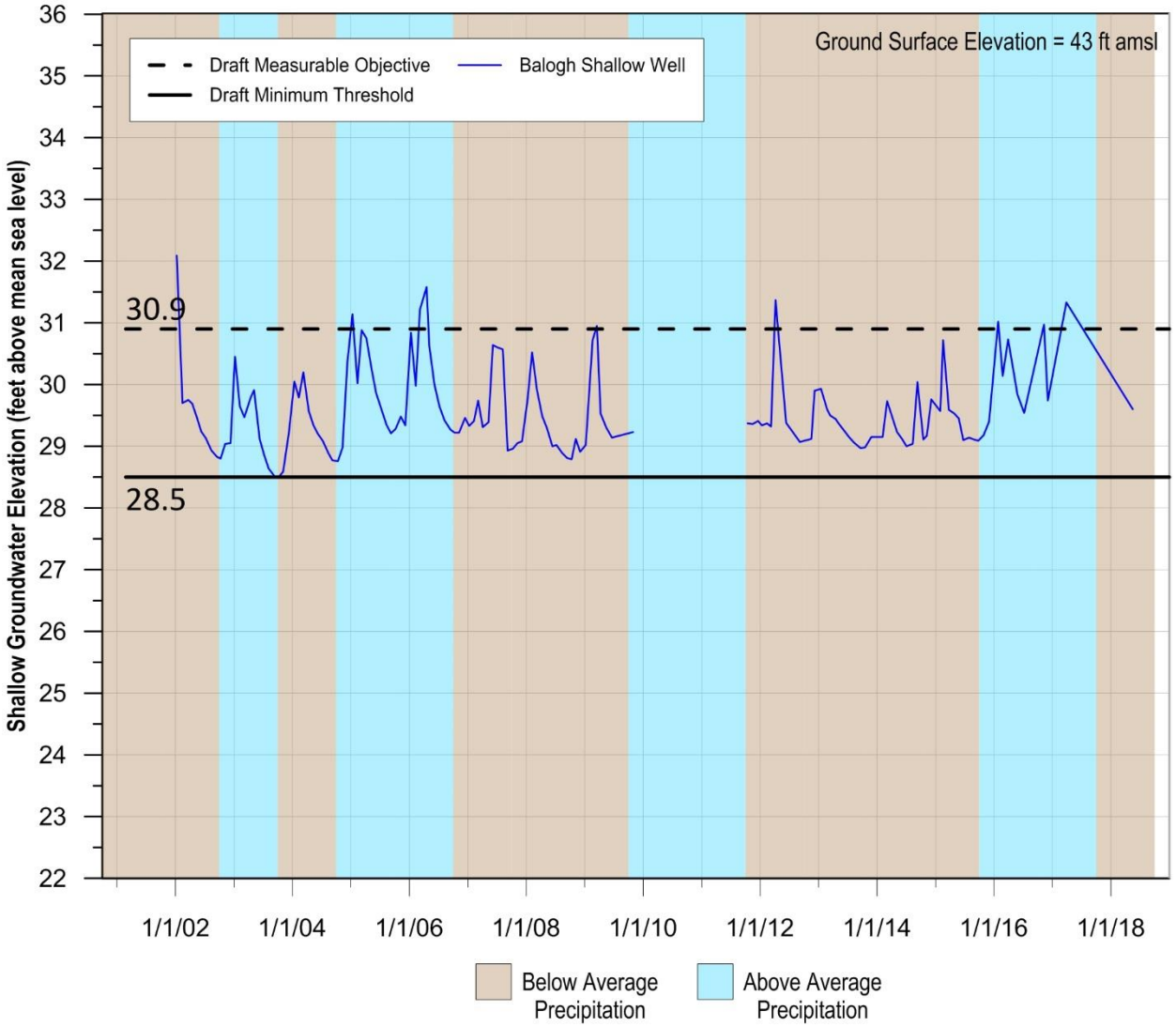


Figure 21. Balogh Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective

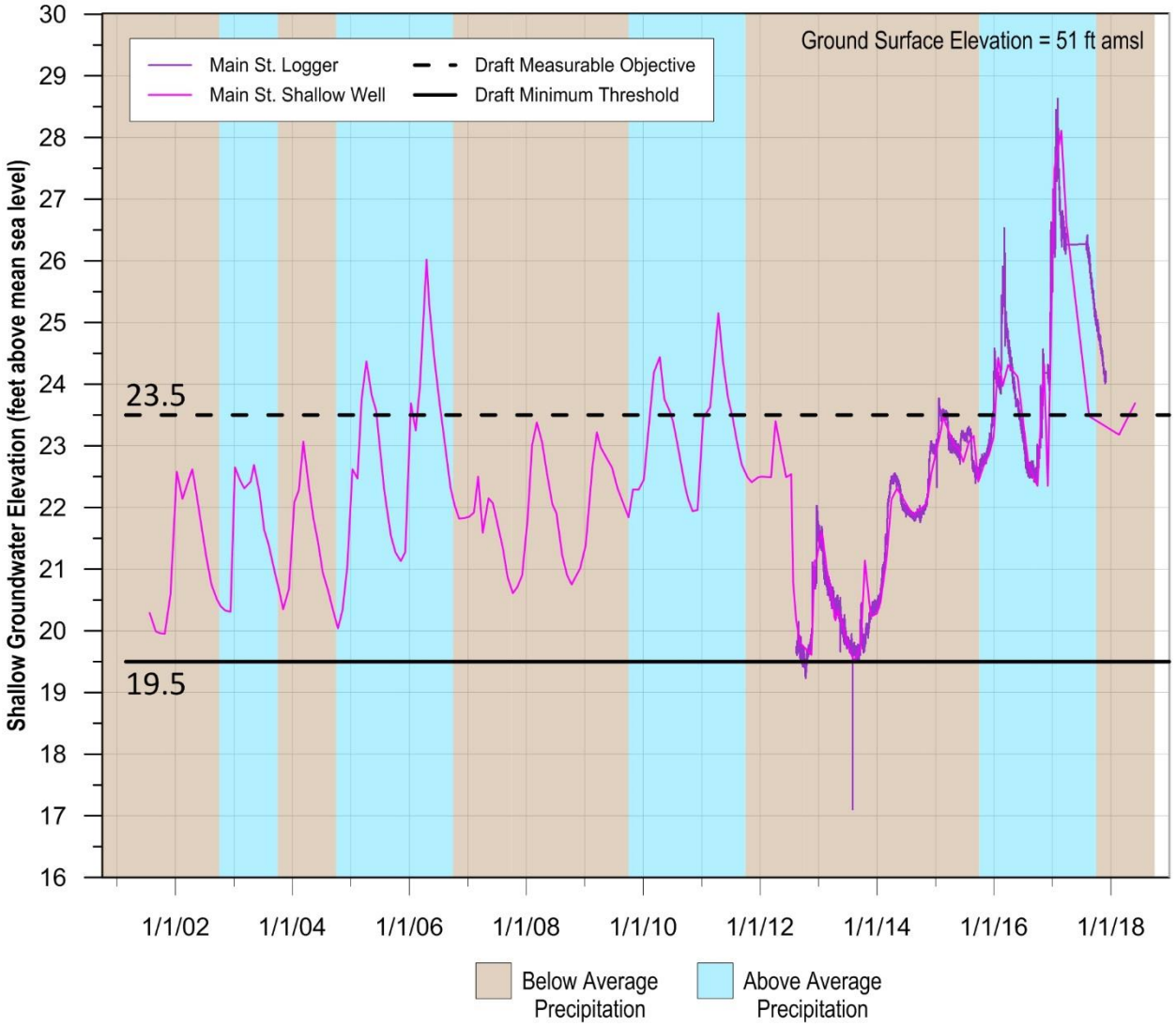


Figure 22. Main Street Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective

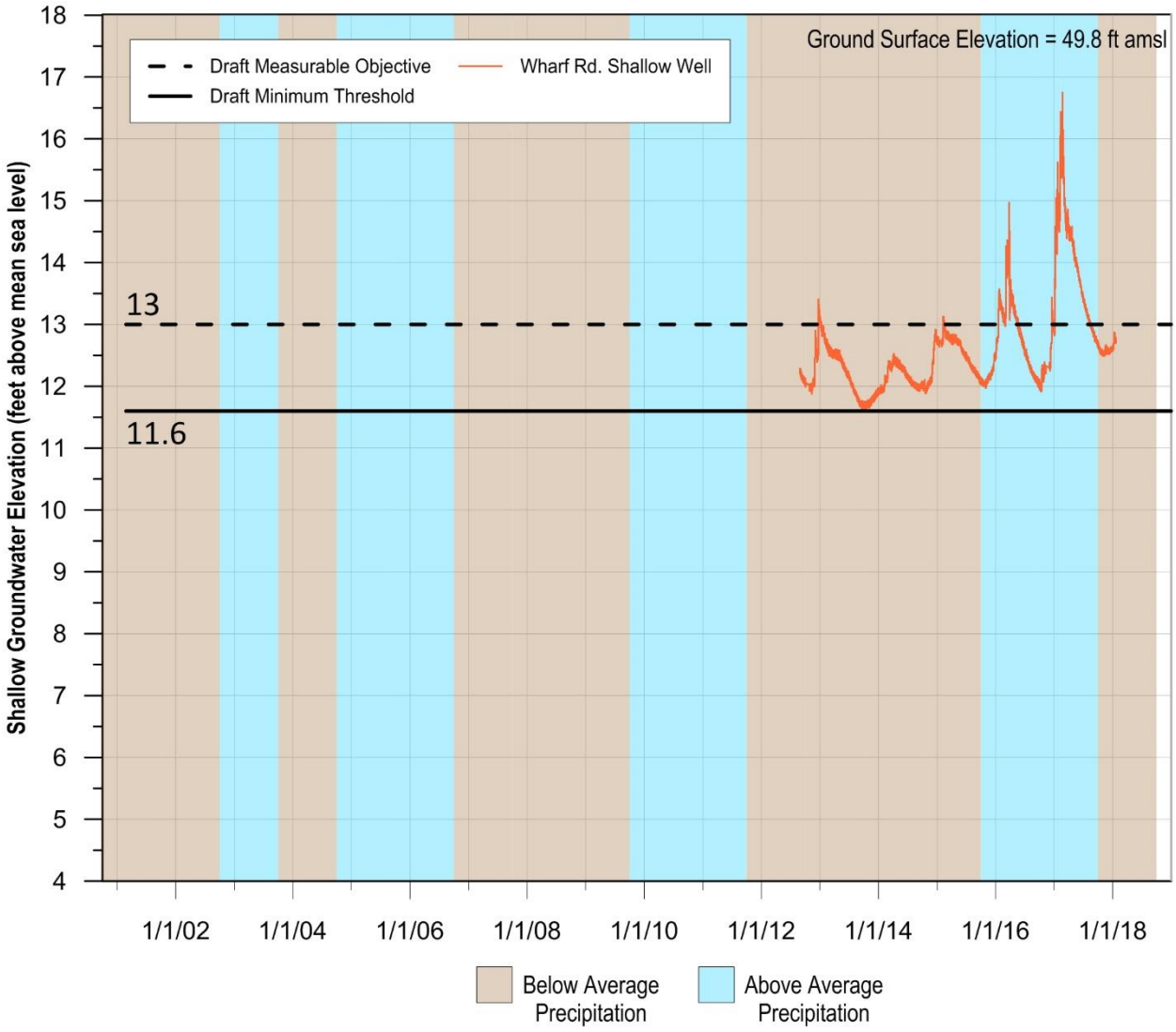


Figure 23. Wharf Road Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective

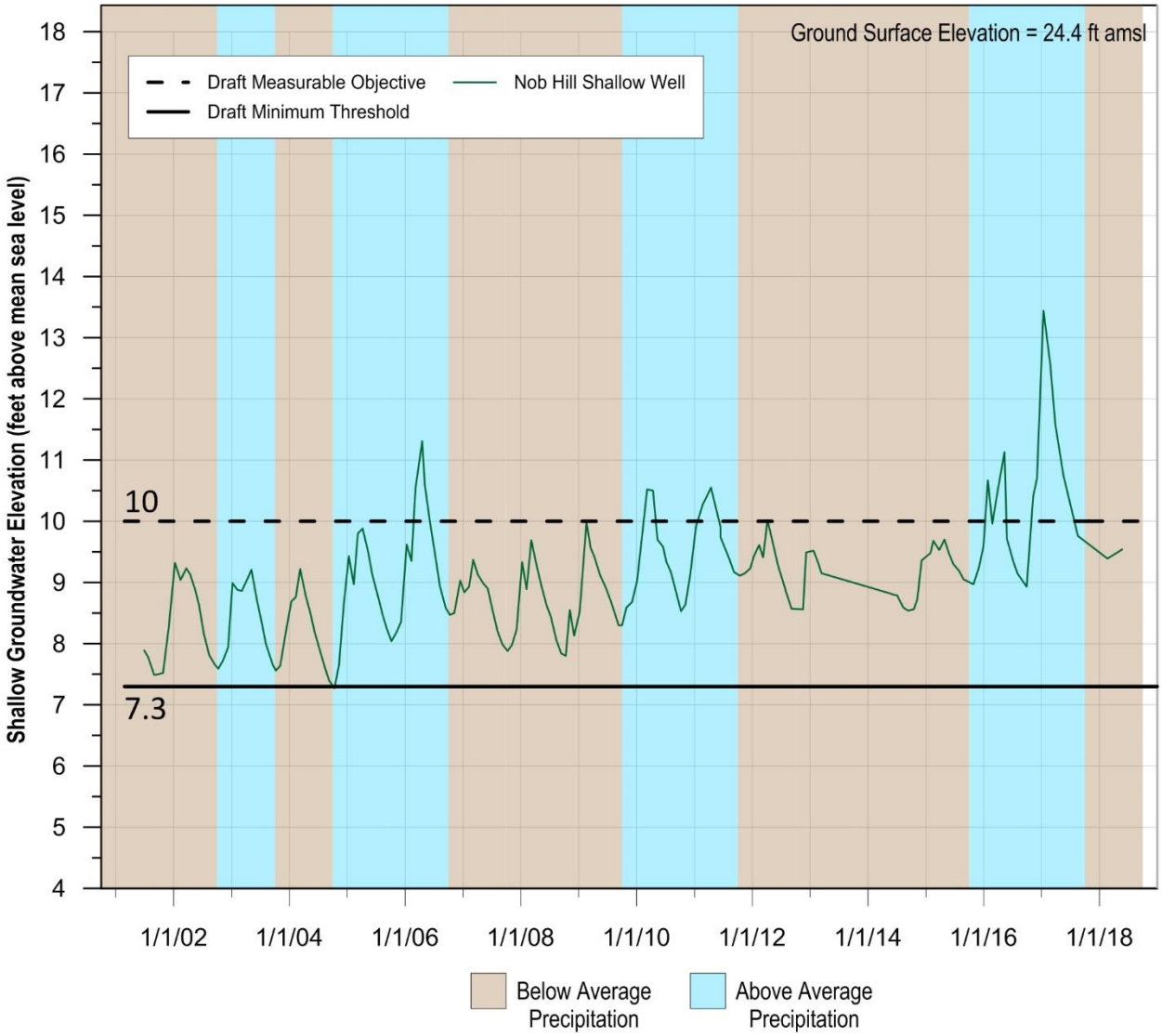


Figure 24. Nob Hill Shallow Monitoring Well Hydrograph and Draft Minimum Threshold and Measurable Objective

SANTA CRUZ MID-COUNTY GROUNDWATER AGENCY

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

5180 Soquel Drive • Soquel, CA 95073 • (831) 454-3133 • midcountygroundwater.org

Draft Meeting Summary

Santa Cruz Mid-County Groundwater Sustainability Plan
Advisory Committee Meeting #15
January 23, 2019, 5:00 – 8:30 pm

This meeting was the fifteenth convening of the Santa Cruz Mid-County Groundwater Sustainability Planning (GSP) Advisory Committee. It took place on January 23, 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 sustainability strategies; groundwater modeling results for non-municipal pumping effects; and an update on minimum thresholds for chronic lowering of Groundwater Levels sustainability indicator. 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:

- Continue reviewing groundwater modeling results from pumping impact scenarios.
- Discuss challenges in the Aromas Aquifer and options for moving forward.
- Discuss proposed refinements to minimum thresholds for the Chronic Lowering of Groundwater Levels Sustainability Indicator.

Action Items

Key action items from the meeting include the following:

1. Staff to convene Groundwater Modeling Enrichment Session on February 11, 2019.
    a. Staff to post an announcement for the enrichment session on the MGA website by February 4, 2019, requesting RSVPs (attendance in person or by webinar).
        i. This will not be a formal Advisory Committee meeting.
        ii. The public is welcome to attend by webinar or in person at the Community Foundation.
2. Staff to invite Committee members to the January 30th surface water interaction working group meeting, making sure to include members who expressed direct interest in participating: Marco Romanini, Jon Kennedy, Kate Anderton, Keith Gudger, and Jonathan Lear.

3. Staff to provide more opportunities to discuss climate scenarios and policy decisions relevant to GSP planning.
4. Kearns & West to revise and send confirmed meeting summary for the December 12 Committee for inclusion in the Mid-County Groundwater Agency's (MGA) Board meeting packet in March.

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. Marco Romanini, Central Water District
8. Charlie Rous, At-Large Representative

Committee members who were absent included:

1. Rich Casale, Small Water System Management
2. Jon Kennedy, Private Well Representative
3. Jonathan Lear, At-Large Representative
4. Allyson Violante, County of Santa Cruz
5. Thomas Wyner for Cabrillo College, Institutional Representative

Meeting Key Outcomes (linked to agenda items)

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

Rosemary Menard, City of Santa Cruz, opened the meeting and welcomed participants. Ms. Menard asked the GSP Advisory Committee members, MGA Executive Team, and the consultant support team around the room to introduce themselves. She 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 February and March as reflected on the updated GSP process timeline. Ms. Menard added that Santa Margarita Groundwater Agency's (SMGA) January 12th Water Education Series, Workshop 1 on land use and water, is now posted on the SMGA's website[1] for everyone's reference.

[1] https://smgwa.org/meetings/understanding-our-water-educational-series/

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

No public comments were provided on non-agenda items during this session.

3. Project Updates

Mr. Poncelet invited the following project updates:

- **Surface Water Interaction Working Group**
  Sierra Ryan, County of Santa Cruz, reported that the surface water interaction working group will convene on Wednesday, January 30, 2019. Ms. Ryan indicated that while the wildlife agencies will not be in attendance due to the government shutdown, staff from the Environmental Defense Fund (EDF) will be presenting their guidance for meeting the Sustainable Groundwater Management Act (SGMA) requirements.

- **February 11 GSP Modeling Enrichment Session**
  Cameron Tana, Montgomery & Associates, announced that he will be conducting a webinar enrichment session on Mid-County Groundwater modeling in support of the GSP on Monday, February 11, 2019, from 5:00 to 7:00 p.m. Mr. Tana added that there is a conference room reserved at the Community Foundation in Aptos for participants to view the webinar together and offered to present in person if there was enough interest from the Committee members.

  Tim Carson, Regional Water Management Foundation (RWMF), indicated that he will post an announcement on the enrichment session in early February. John Ricker, County of Santa Cruz, recommended that the webinar be publicly noticed as an enrichment session and not as a formal Advisory Committee meeting.

- **Upcoming Santa Margarita Basin Meetings**
  Ms. Ryan, provided a brief update on topics to be covered in the upcoming Santa Margarita Basin educational series on water in February and March, 2019, including:
  - February: Basin hydrogeology and water budget; surface water interactions; groundwater dependent ecosystems; local efforts to improve stream flows and aquatic ecosystems; and users in the Basin.
  - March: projects and management of aquifers.

- **DWR Update**
  Ms. Menard provided the DWR update on behalf of Amanda Peisch-Derby, DWR, in her absence. The update addressed the Advisory Committee's inquiry at the December 12, 2018 meeting regarding DWR's approach for determining whether a basin's (e.g., Pajaro Valley) decision for an

alternative plan will adversely affect the ability of an adjacent basin (e.g., Mid-County) to implement its GSP or impede the achievement of its sustainability goal. Ms. Menard reported that DWR will consider and review alternative plans as they would GSPs, while strongly encouraging coordination among basin agencies on any adverse cross boundary effects resulting from either the alternative plan or GSP.

Given this response from DWR, John Ricker, County of Santa Cruz, informed the Committee that the Executive Team is beginning this coordination process and will be discussing Pajaro Valley's alternative plan with the Pajaro Valley Water Management Agency's (PVWMA) Board.

A Committee member asked how far south does the Pajaro Valley Basin extend and whether this area is within district boundaries. Mr. Ricker responded that the Pajaro Valley Basin extends to Elkhorn Slough, which is within the district boundaries. He added that the Basin is limited in its recycled water production, and the College Lake project is critical to augment the amount of water available for their pipeline.

- **Water Exchanges**

  Ms. Menard indicated that the City of Santa Cruz made water transfers to Soquel Creek on December 3, 2018. Since then, the water exchanges have been operating consistently, with only weekend shutdowns. She reported that the City's Aquifer Storage and Recovery (ASR) project is being piloted at Beltz 12 and is currently in round two of the seven-day injection process, which would go into a 30-day injection cycle thereafter. Ms. Menard added that the pilot is showing a good level of water availability as the inflows from the recent storms have been strong.

  A Committee member asked whether ASR operates seasonally. Ms. Menard responded that the pilot has only run for two months, and the City will continue with the 30-day injection cycle in order to determine water quality and measure and understand any water losses.

- **Pure Water Soquel**

  Ron Duncan, Soquel Creek Water District (SqCWD), reported that Pure Water Soquel's (PWS) Environmental Impact Report (EIR) has been certified, and the project was approved in December, 2018. Mr. Duncan added that a member of the public has recently filed a California Environmental Quality Act (CEQA) lawsuit against PWS. He indicated that SqCWD plans to defend the PWS EIR. Mr. Duncan added that SqCWD intends to apply for a second round of Proposition 1 funding.

Taj DuFour, Soquel Creek Water District shared that the recent comments about ammonia issues at the O'Neil well are incorrect and that the PWS wells have been run using an approach intended to, in good faith, coordinate with the City of Santa Cruz's schedule.

4. Groundwater Modeling Results for Sustainability Strategies

In this segment, Mr. Tana introduced the Committee members to additional evaluations of modeling results, presented the approach of using 10 year averages to evaluate groundwater level proxies for seawater intrusion sustainable management criteria, and discussed areas affected by a project or management action that reduces municipal pumping and a preliminary iteration of the City's Aquifer Storage and Recovery (ASR) project.[2] Mr. Tana explained that the projects and management actions discussed are primarily evaluated based on the seawater intrusion sustainability indicator. Further, he stated that because of the Basin's objective for long term prevention of seawater intrusion, groundwater level proxies for sustainability management criteria have been proposed to use a trailing 10-year average to ensure that groundwater levels are high enough to counteract seawater intrusion. Therefore trailing 10 year averages are calculated from model results for groundwater levels to compare to groundwater level proxies for minimum thresholds and measurable objectives.

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

- The increase in sea level rise from 1.5 feet (from fall 2018) to 2.3 feet in the most recent DWR update infers a possible upward trend in water levels. As it also relates to evaluating minimum threshold for the seawater intrusion sustainability indicator, it is worth closely monitoring.
- Proactive evaluation of a basin's sustainability based on the 10-year average approach should include analyses of data trends. If modeling can show that long term averages of groundwater levels and concentrations are achievable, there is a higher chance of preventing seawater intrusion.
- In contemplating the Technical Advisory Committee's (TAC) recommended climate catalog approach to modeling longer term severe climate change patterns, some Advisory Committee members expressed the desire to further discuss the policy implications of the modeling work on climate, unpack and analyze the scientific assumptions and the purpose, and discuss the intersection of these two issues (policy and science).

[2] Model results for these projects and management actions were previously covered at the October 2018 Advisory Committee meeting.

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 comments on the presentation, and any other Advisory Committee work.

One participant asked for further justification on the TAC's recommended climate catalog approach to modeling and emphasized that it is important to choose the best model at the beginning.

Another participant asked for confirmation of the outer limit of the time period associated with the 2.3 feet sea level rise. Mr. Tana responded that the outer limit of the time period is 2070.

6. Groundwater Modeling Results for Non-municipal Pumping Effects

In this discussion on groundwater modeling results for non-municipal pumping effects, Mr. Tana underscored that non-municipal pumping inland of the municipal pumping area has a greater effect at the coastal Purisima wells than non-municipal pumping in the municipal pumping area due to the extraction of larger volumes in that area. Mr. Tana illustrated this effect by showing sensitivity analyses of various categories and areas of pumping.

Key discussion points on the topic of groundwater modeling results for non-municipal pumping effects included:

- The Committee should contemplate how to model non-municipal pumping to determine management actions; and from a policy perspective, how to monitor the modeling results in order to come up with longer term solutions to collective problems.
- It would be useful for the Committee to better understand the following related to non-municipal pumping modeling:
    - The breakdown or categorization of pumpers, especially the *di minimis* pumpers (e.g., private, institutional, etc.).
    - The methodology behind the measurement and plotting of the change in groundwater levels.

7. Groundwater Modeling Results for Theoretical Managed Recharge in Coastal Aromas Area

Mr. Poncelet referred to ongoing coordination with Pajaro Valley Water Management Agency (PVWMA) and turned it over to Mr. Tana to present new groundwater modeling scenarios for theoretical managed recharge in the coastal Aromas Area. Ms. Georgina King pointed out that Montgomery & Associates had already presented on the differences between the Purisima and Aromas Aquifers in previous meetings.

Mr. Tana asked for the Committee's feedback on how groundwater levels and seawater intrusion in the theoretical areas should be addressed.

The Advisory Committee discussed the following ideas on how to address groundwater levels and seawater intrusion in the theoretical areas:

- Recharge would be most effective at site SC-A8 if it is the only scenario to address in the Aromas area. However, other in-lieu alternatives can boost groundwater levels in that area, possibly rendering managed recharge unnecessary.
- Recharge at 500 acre feet (160 M gallons) seasonally is a good approach.
- There are tradeoffs to keeping water levels high as Pajaro Valley would be able to benefit from the overflow. This could be managed and compensated for through inter-basin agreements.
- There may be a potential need to use recycled water or conduct additional recharge using water from Watsonville Slough.

8. Update on Minimum Thresholds for Chronic Lowering of Groundwater Levels Sustainability Indicator

Ms. King presented an updated version of the sustainable management criteria to be included in the GSP for chronic lowering of groundwater levels. She emphasized that in this version, the minimum threshold analysis selected nearby wells with similar screened elevations to the screened elevations of the representative monitoring wells to use to determine minimum well depths for the analysis of minimum thresholds. The previous draft used depths of the wells. The other sustainable management criteria, including significant and unreasonable conditions and undesirable results, have not changed.

In her updated proposal, Ms. King recommended using 30 feet below historic low groundwater levels as the maximum decline allowed before it is considered significant and unreasonable. She asked the Committee members to provide feedback on whether they agree with this maximum decline or if another decline depth should be used.

The Committee members indicated that they did not have enough information to make a determination on whether the 30 feet is the maximum decline should be used. One Committee member requested that the assumptions for the 30 feet recommendation be clearly incorporated into the GSP.

9. Public Comment

During this final public comment session, Mr. Poncelet invited members of the public to focus comments on the Committee's discussion of modeling results for non-municipal pumping, approaches to addressing challenges in the Aromas Aquifer, the updated minimum thresholds for chronic lowering of groundwater levels sustainability indicator, and on any other Advisory Committee work.

One participant suggested additional outreach to private well owners on pumping protocols. This participant also expressed that 500 acre feet of recharge is too much for the Aromas area and suggested combining recharge for two sites. Last, the same participant suggested modeling groundwater levels for seawater intrusion using average minimum rather than a 10-year average approach. Mr. Tana addressed the participant's last point, explaining that the minimum average approach uses one data point, which would not represent overall conditions over time and thus would not help in preventing long term seawater intrusion.

10. Confirm the October 23, 2018 GSP Advisory Committee Field Trip and the October 24, 2018 Advisory Committee Meeting Summaries

One Committee member identified a possible inaccuracy in the segment on the differences between the Aromas and Purisima. Mr. Poncelet indicated that staff will review this segment and make the necessary edits before forwarding it to the MGA Board.

11. Next Steps

In closing, Mr. Poncelet provided a recap of the GSP process timeline February and March 2019 and discussed general next steps.

Before the meeting adjourned, Mr. Carson reminded the Committee that the next MGA Board meeting is on March 21st at 7:00 p.m.

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