FINAL

CITY OF SANTA CRUZ INTERTIE BLENDING ANALYSIS

Water Quality Impacts Assessment

Technical Memorandum

B&V PROJECT NO. 190158

PREPARED FOR

Soquel Creek Water District

14 JUNE 2016

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Executive Summary

The Soquel Creek Water District (District) is entering into an agreement with the City of Santa Cruz (City) to purchase excess winter water supply from the City's surface water treatment plant. The main entry point of treated surface water purchased from the City will be at the intertie located at the District's recently completed O'Neill Ranch Water Treatment Plant (WTP). City water is expected to be served to the District during winter months when the City has excess supply, approximately between November and March of each year. The purpose of this project was to assess the compatibility of the two source water qualities and develop a monitoring plan to proactively anticipate and detect any potential concerns in the distribution system from a public health, aesthetic or regulatory standpoint.

The District has historically served 100 percent groundwater to its customers through fifteen operating wells located in four service areas (SA): SA1, SA2, SA3, and SA4. Some of the wells have treatment systems in place for iron and manganese, and a new treatment system designed to remove hexavalent chromium is expected to come online in 2017. The District's distribution system is predominantly composed of asbestos cement and PVC pipe, with no known unlined iron pipe in its system. There are also no known lead service lines in the system.

The new water which the District will receive from the City is treated with conventional processes at the Graham Hill Water Treatment Plant (GHWTP). The GHWTP receives source water supplies from three North Coast sources, the San Lorenzo River, and Newell Creek Reservoir. The City additionally feeds sodium phosphate for corrosion control.

Disinfection byproducts and Lead and Copper in both systems are well below the regulatory limits. Neither the District nor the City had a regulatory violation pertaining to the distribution system during the period that data was reviewed (past 3 years).

While both systems utilize free chlorine for disinfectant residual, the City's water is higher in organic carbon, which can react with the free chlorine to cause a loss of disinfectant residual and the formation of regulated disinfection byproducts. While the residual decay and disinfection byproduct formation in the City's system is low to moderate, the additional water age in the District's system will tend to increase these reactions. Bench scale disinfection byproduct formation testing showed that City water reached the regulatory limit for Total Trihalomethanes (TTHMs) after 28 days. The District should work to minimize water age in the system and monitor for water quality parameters as described in the monitoring plan in this document.

The District's water is higher in alkalinity and dissolved minerals compared to the City's surface water. This creates a condition in the District's distribution system where calcium carbonate would tend to precipitate out of the water solution and coat the pipe walls, which is considered beneficial from a water quality standpoint. The City, in contrast, has a lower potential for calcium carbonate precipitation and relies instead on the addition of orthophosphate (commonly referred to as a corrosion inhibitor) to create conditions whereby phosphate-based complexes will precipitate out and form a coating on the pipe walls.

While both of these mechanisms are considered beneficial by themselves, with use of the intertie the District will see variable conditions with phosphate present for just the portion of the year that the intertie is active. This creates the potential for subsequent release of phosphate based complexes when the intertie is inactive, though there are few full scale precedents for seasonal or intermittent usage of phosphate. It is additionally possible that the phosphate will precipitate out on the District's pipes which have not been historically exposed to phosphate addition, causing areas to receive City water without the presence of phosphate inhibitor. This would expose piping to a more aggressive water chemistry. Therefore a monitoring program has been established to better understand the impacts on distribution system water quality.

The monitoring program is designed to monitor for any changes in distribution system water quality as a result of introducing City water into the District's distribution system. Various sampling locations throughout the distribution system were selected to monitor those parameters which would be indicative of the specific water quality changes which may occur based on the review of the two sources' water chemistries. The results of the monitoring program should be regularly reviewed and can be used as an early detection should any adverse impacts arise from the blending of the two source waters.

Abbreviations and Acronyms

A list of abbreviations and acronyms used in this Technical Memorandum (TM) are summarized in the following list:

AOC	Assimilable Organic Carbon
City	City of Santa Cruz
CCPP	Calcium Carbonate Precipitation Potential
CCR	Consumer Confidence Report
CSMR	Mass Ratio of Chloride To Sulfate
DBP	Disinfection Byproducts
DDW	Monterey District Division Of Drinking Water At The State Water Resources Control Board
DIC	Dissolved Inorganic Carbon
District	Soquel Creek Water District
DOC	Dissolved organic carbon
EPA	US Environmental Protection Agency
GHWTP	Graham Hill Water Treatment Plant
gpm	Gallons Per Minute
HAA	Haloacetic acids
LCR	Lead And Cooper Rule
MCL	Maximum Contaminant Levels
mgd	Million Gallons Per Day
mg/L	Milligrams Per Liter
NO-DES	Neutral Output Discharge Elimination System
NTU	Nephelometric Turbidity Unit
ORP	Oxidation Reduction Potential
SA	Service Areas
SS	Sample Station
TCR	Total Coliform Rule
TM	Technical Memorandum
TOC	Total organic carbon
TTHMs	Total Trihalomethanes
WTP	Water Treatment Plant
ug/L	One Microgram Per Liter

Introduction

The Soquel Creek Water District (District) serves approximately 14,000 customers located in Santa Cruz County. The District is entering into an agreement with the City of Santa Cruz (City) to purchase excess winter water supply from the City's surface water treatment plant (the Purchase Agreement is included as Appendix A). The main entry point of treated surface water purchased from the City will be at the intertie located at the District's recently completed O'Neill Ranch Water Treatment Plant (WTP). Two other potential alternative interties include one on Baine St. and another on Jade St. The District is currently served solely by local groundwater supplies and is concerned with potential water quality events associated with introducing a new, treated surface water supply into the District's distribution system.

The purpose of this Technical Memorandum (TM) is to assess the compatibility of the two source water qualities and develop a monitoring plan to proactively anticipate and detect any potential concerns from a public health, aesthetic or regulatory standpoint. Hydraulic modeling to determine blending percentages, expected water age, and other hydraulic considerations was conducted concurrently (by others), and the water quality implications of those results are discussed herein.

Regulatory Requirements

In anticipation of receiving the necessary permit amendment for receiving water from the City, preliminary conversations were held with Monterey District Division of Drinking Water at the State Water Resources Control Board (DDW). The DDW indicated that the primary concerns of receiving water from the City are increased formation of DBPs and bacteriological presence (such as coliforms) as covered by the US Environmental Protection Agency's (EPA) Groundwater and Disinfection Byproduct rules. The specific regulatory requirements (i.e. monitoring requirements) will be addressed within the permit amendment. The DDW has indicated this is a very specific case with non-constant usage of an intertie, so a custom set of requirements may be developed later by DDW as part of the permit amendment.

Additionally, the water quality from the intertie will need to be reported in the Consumer Confidence Report (CCR), so a separate table for the water quality from the City will need to be reported in the Consumer Confidence Report for the District.

The DDW has indicated a preliminary list of documentation that will be required as part of the permit application for the addition of the new water source from the City of Santa Cruz. The documentation is intended to allow for the DDW to evaluate this permit request. The following documents will be prepared and submitted to DDW prior to issuance of a permit amendment:

- Signed permit application.
- A copy of the agreement between the City and the District, which describes all details including the amount of water contractually agreed upon to be transferred.
- Information on the interconnection(s) including length, material, and diameter of each interconnection.
- An estimation of the capacity of the intertie(s) in both gallons per minute and gallons per day.
- An operations plan for the use, maintenance, and inspection of the interties.
  - The operations plan shall also include the District's approach to ensuring a detectable chlorine residual throughout the distribution system when using the City's surface water.
  - The operations plan should also include any additional monitoring the District plans to collect from the interconnection.
  - The operations plan should include a plan for discontinuing use of the intertie in the event of any bacteriological or other immediate water quality issues.
- Any completed water quality studies, especially any studies that estimate the concentration of TTHMs and HAA5s received from the City.
- Updated bacteriological sample siting plan. The District shall choose at least one routine sample site in the area served by the interconnection (preferably at the connection itself). The plan must also include updated Groundwater Rule language (procedure for contacting the City after a coliform detection.)
- Updated Disinfection By Product Monitoring Plan, including the following information to determine the required number of samples/frequency:
  - Number of interconnections between the City and the District.
  - Frequency of use (# of months/year).

Water Sources and Water Quality

WATER SOURCES AND SYSTEM DESCRIPTION

Soquel Creek Water District

The District supplies groundwater from 15 operating wells separated into 4 service areas (SA), designated SA1, SA2, SA3, and SA4. The wells tap water from two distinct geological formations: 1) Purisima Formation to the West, and 2) Aromas Red Sands to the East. The relative extraction of water from each of the service areas is summarized in the following table.

Table 1 District Extraction Percentages Based on Service Area (2000-2005)

AREA	SOURCE (AQUIFER)	PRODUCTION TOTAL (%)
Service Area I	Deeper Purisima Formation aquifer A and AA	44%
Service Area II	Purisima Formation aquifers A, BC, DEF	18%
Service Area III & IV	Purisima F and Aromas Red Sands aquifer	38%
Source: Soquel Creek Water District & Central Water District Groundwater Management Plan-2007		

Naturally occurring drinking water contaminants in some of the production wells include iron, manganese, arsenic, and chromium 6. Nine treatment plants have been installed for iron and manganese removal. Although there is no existing regulatory requirement to do so since raw arsenic concentration is below the maximum contaminant levels (MCL), three of the wells are treated to remove arsenic using ferric chloride as a coagulant combined with anthracite filtration at treatment facilities located at T-Hopkins and Aptos Jr. High well sites. In order to meet the new California MCL of 10 ug/L for chromium 6, the District is installing strong base ion exchange treatment at a common facility which will treat water from three of the production wells in service area 3. It is expected to be online in 2017. It should be noted that in 2014, a temporary strong base ion exchange treatment system began operation which treats two wells for chromium 6.

The vast majority of the District's distribution system is composed of asbestos cement (57 percent) and PVC (37 percent) mains. The remainder is mostly cement mortar lined cast iron pipe. There are no known unlined iron pipes in the District system. Lead service lines or pipes have not been found to be used in construction in the District. Potential sources of lead in the District's system are primarily limited to lead containing solders and fixtures. The District has some homes which were constructed using copper pipes with lead solder prior to the 1986 federal ban on lead solder. Those homes make up the set of samples used for Lead and Copper rule compliance sampling.

Intertie Locations and Usage

The District anticipates purchasing water from the City for augmented supply between the approximate dates of November 1 and March 31 each year. While the intertie is bi-directional in its functionality, only the anticipated water quality impacts to the District's system from serving water from the City to the District are reviewed in this memorandum. Anticipated impacts to the City's system from serving water from the District to the City should be reviewed separately.

The proposed principal intertie location is at the O'Neill Ranch Well water treatment plant located near the west entrance to service area 1. The connection has the following characteristics:

- Total length is 127 feet, with 14 feet of 8" ductile iron aboveground, and PVC below ground.
- Connects to 18" District piping.
- Capacity of 1,000 gallons per minute (gpm); 1.44 million gallons per day (mgd).

A photo of the interconnection is shown in Figure 1 below. Additional details of the connection are provided in Appendix B.

Two alternative intertie locations have been proposed. One is a 2-inch line on Baine St. and a second is a 4-inch line on Jade St. These interties do not have as much capacity as the principal 8-inch intertie line, and therefore are not anticipated for predominant usage. A map of the District is provided in Figure 2 on the following page.

Figure 1 Interconnection Piping Between the City and the District

A sample tap will be installed on the intertie piping.

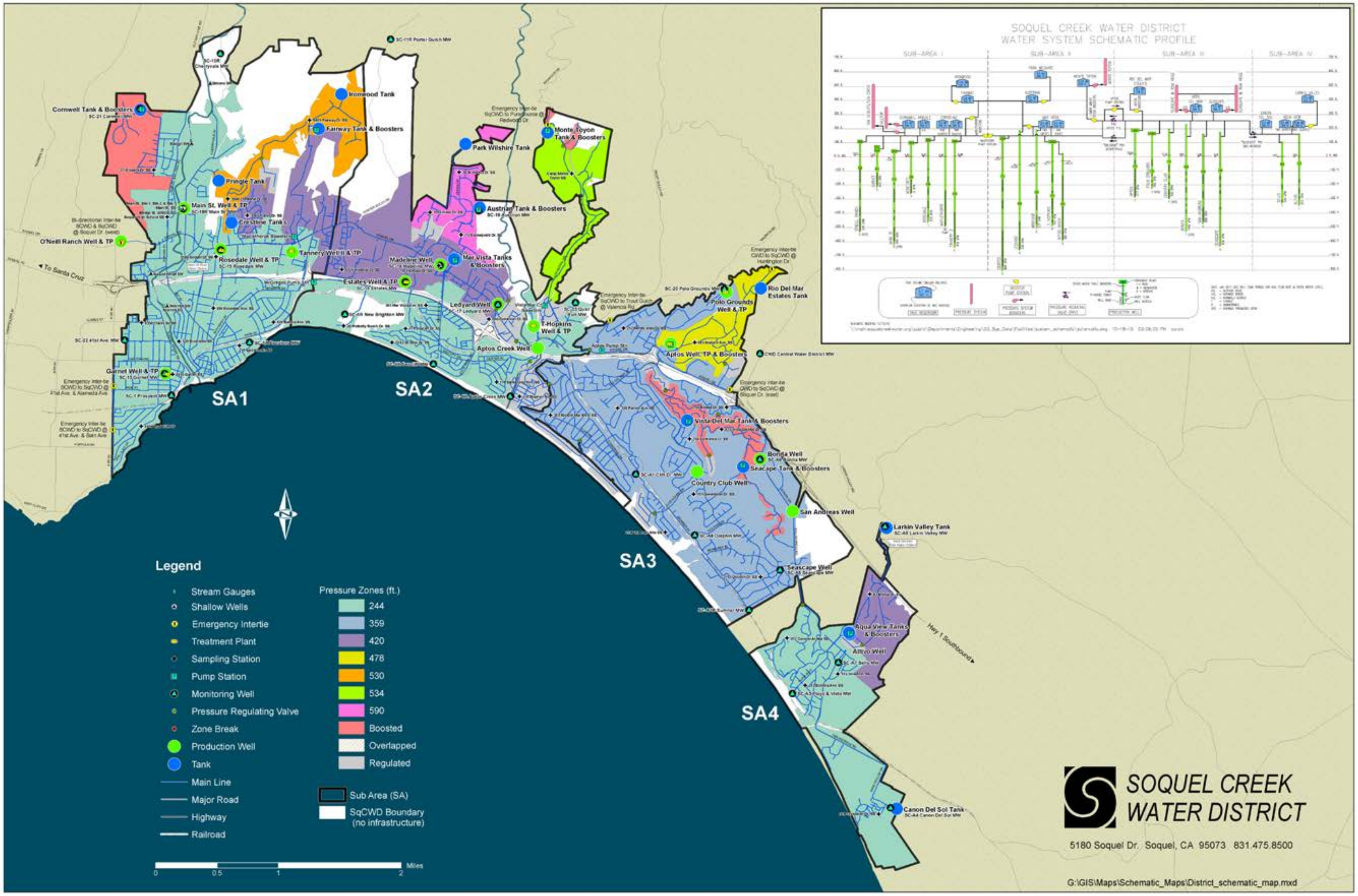

Figure 2 **District Map**

City of Santa Cruz

The City supplies surface water treated at the 24-mgd capacity Graham Hill Water Treatment Plant (GHWTP). The GHWTP receives source water supplies from multiple sources; three North Coast sources (Laguna Diversion, Liddell Springs, and Majors Diversion), the San Lorenzo River (Tait St Diversion, Tait Wells, and Felton Diversion), and Newell Creek Reservoir (Loch Lomond Reservoir). The raw source water entering the GHWTP for treatment is often a blend of these different sources.

The conventional treatment process of the GHWTP consists of taste and odor control, pre-chlorination, coagulation, flocculation, sedimentation, dual granular media filtration, corrosion control, and post chlorination. Filter backwash water and sedimentation basin sludge is recycled through a plate settler clarification system and the supernatant returned to the beginning of the conventional treatment process.

Treatment chemicals are used at the plant as follows: The water is treated ahead of the conventional treatment processes using free chlorine and potassium permanganate for disinfection CT credits and pre-oxidation; and PAC for taste and odor control. Aluminum sulfate coagulant and a cationic polymer are added at rapid mix. Disinfection is then further achieved by free chlorine. A sodium phosphate compound is added as post-treatment for corrosion control.

Additional description of the GHWTP is provided in Appendix C.

Treated surface water from the City will be primarily delivered to the District through the Intertie at the O'Neill treatment plant. At the time this memorandum was prepared a decision had not been made by the City as to which pressure zone within the City's system would supply the water. It should be noted that the City owns and operates wells near the intertie referred to as the Beltz Well System. These wells draw from the same aquifer as District's SA1 wells, do not receive phosphate treatment and are blended in to the Santa Cruz system during times of use, typically in the summer months. It is anticipated that the wells will not be in operation during times that the intertie is active.

Of the water quality data made available by the City, Sample Station (SS) 105 and SS 134 are the DBP locations nearest the intertie. SS 119 is the City's mid-point Disinfection Byproducts (DBP) station between the GHWTP and the intertie location, and represents City's average water age with DBP data in the gravity zone. The City has suggested the average of the SS 119 and SS 105 DBP data may be most representative of potential DBP's formed at the intertie location due to increased winter demand through the transfer of water supplied to the District (i.e. less water age, faster turnover in the intertie area).

HYDRAULIC MODELING RESULTS

Hydraulic modeling was conducted by Akel Engineering Group, Inc. and the results presented in the reports "WATER QUALITY AND TRACE ANALYSIS Final May 2016" and "WATER QUALITY ANALYSIS ADJUSTED TANK OPERATIONS Final May 2016." The full reports are included as Appendix D, and the key results are summarized in this section.

Hydraulic modeling was conducted for three main scenarios:

- Scenario 1: With the intertie inactive (i.e. current District conditions)

- Scenario 2: With the intertie active (i.e. with the water transfer)
- Scenario 3: With the intertie active and the Aptos pump station active.

The difference in results can then be used to understand the anticipated changes in source water composition and water age expected when the new intertie is brought online. The assumptions used in the hydraulic modeling are as follows:

Modeling Assumptions

- Minimum Month Demands, 2.153 MGD. (Observed December 2015)
- Shoretrails PRV to be turned off for intertie scenarios
- Wells to be turned OFF in the following priority:
  1. Ledyard and Madeline
  2. Estates
  3. Tannery
  4. Aptos Creek and T-Hopkins
  5. Country Club
  6. Rosedale
- Seascape, Altivo, and Sells wells are assumed out of service due to no CR6 Treatment
- Water Age scenarios to be ran for 120 days (To match planned intertie operation)
- City of Santa Cruz: Beltz Wells Turned OFF
- Aptos pump station (500 - 600 gpm) to be inactive in Scenarios 1 and 2 and active in Scenario 3
- Aptos Village pipeline improvements in place
- Vista Mar Pump Station operating under Time of Use Controls

Water Age

Water age was modeled to determine any expected changes to water age as a result of bringing online the intertie. A summary table of maximum tank water age modeling results is provided in Table 2. With the intertie off (i.e. current conditions, Scenario 1), the District's water age varies between one week in the lower portion of the system and three months in the upper zones. The longest tank water age is 90 days observed in Monte Toyon tank in Sub Area 2. This is a longer than desired age from a water quality standpoint due to potential degradation of water quality as discussed throughout this report. Seven of the District's 15 storage tanks are expected to have water age greater than 30 days under current operating conditions.

Water age modeling results with the intertie active and Aptos Pump Station inactive (Scenario 2) indicate an overall reduction in water age in Sub Areas 1 and 2 relative to current conditions. The maximum tank water age at Monte Toyon is reduced from 90 days without the use of the intertie to 65 days with the use of the intertie. Water age in SA3 and SA4 are not impacted as they do not receive intertie water when Aptos Pump Station is inactive. Six of the District's 15 storage tanks are expected to have water age greater than 30 days with the intertie active.

Usage of the Aptos Pump Station (Scenario 3) increases water age slightly in SA3 with a negligible impact elsewhere. The maximum tank water age in the system remains at 65 days.

Another way to view the age results is to plot the District's service area broken down into nodes, where the water age at each node can be calculated. An example for Scenario 2 is shown in Figure 3 on the following page.

Table 2 Modeling Results for Maximum Water Age

TANK	SCENARIO 1 (DAYS)	SCENARIO 2 (DAYS)	SCENARIO 3 (DAYS)
Sub Area 1			
Ironwood	42	40	39
Pringle	49	16	16
Crestline 1&2	7	6	6
Fairway	35	33	32
Cornwell	14	10	10
Austrian Way	16	16	15
Sub Area 2			
Monte Toyon	90	65	65
Mar Vista 1&2	13	8	5
Park Wilshire	48	41	40
Sub Area 3			
Rio del Mara Estates	12	12	15
Seascape	35	35	39
Vista del Mar	11	11	13
Sub Area 4			
Aqua View 1&2	9	9	9
Canon del Sol	18	18	18
Larkin Valley	36	36	36
Figure from Akel Engineering; See appendix D for full report.			

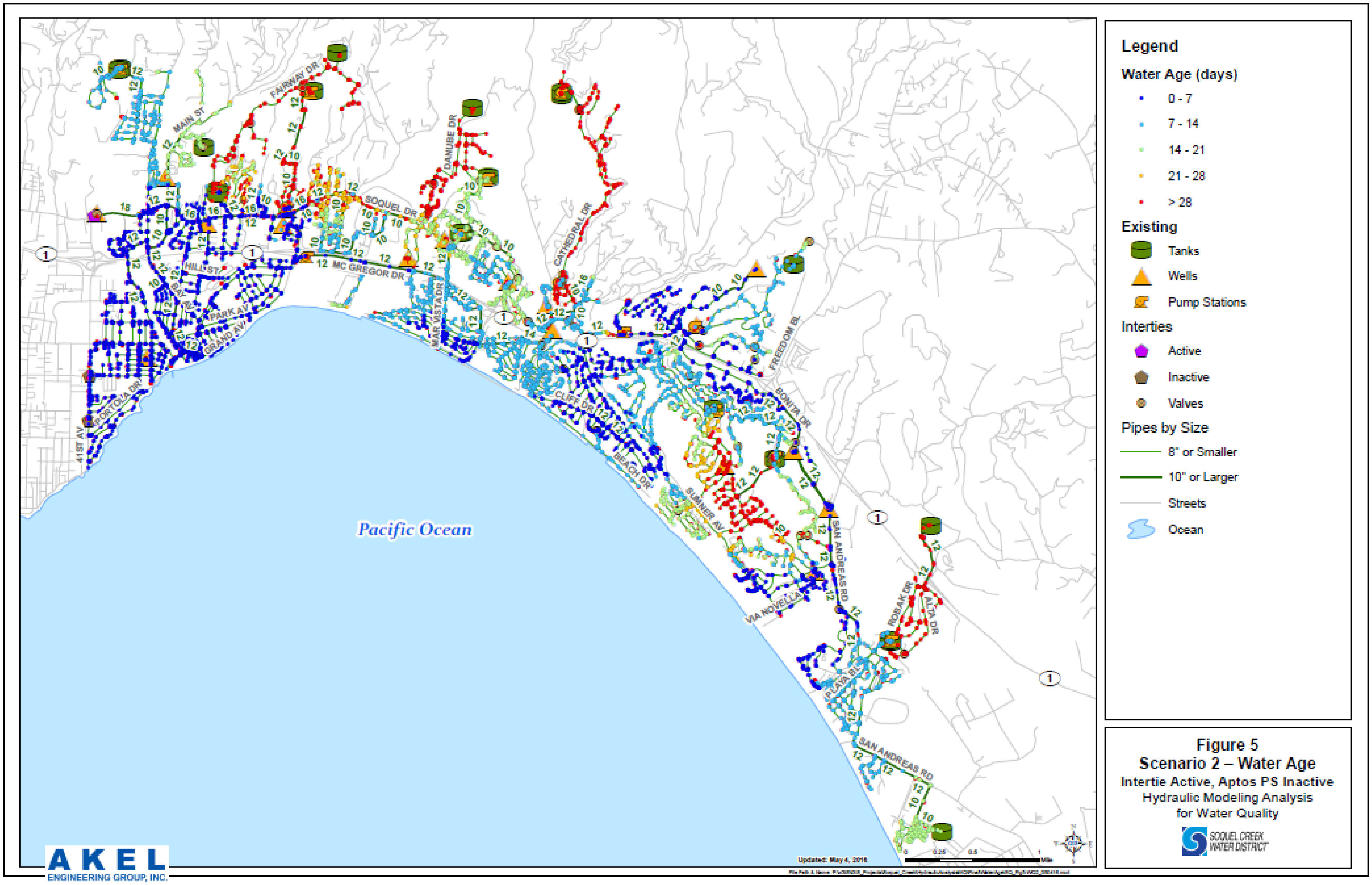

Figure 3 Water Age with the Intertie Active and Aptos Pump Station Inactive (Scenario 2)

Figure from Akel Engineering; See appendix D for full report.

Impact of Operational Practices on Water Age

The District conducted an additional modeling exercise to determine if water age could be reduced through reducing the minimum operating tank levels. The results for Scenario 1 (District water only, no intertie) with and without the modified tank setpoints are shown in Table 3 below. As shown, water age is between 25 percent and 75 percent lower at many tanks with the adjusted setpoints, including Monte Toyon which had the longest water age under current operating conditions. The number of tanks with water age at or greater than 28 days is reduced from seven to three tanks with the adjusted setpoints.

Table 3 Impact on Water Age from Reducing Operating Tank Levels

MAXIMUM WATER AGE				
Tank	**Scenario 1 Adjusted Minimum Levels (days)**	**Scenario 1A Adjusted Minimum Levels (days)**	**Percent Difference**	**Comments**
Sub Area 1				
Ironwood	42	30	-27%	
Pringle	49	-	-	
Crestline 2	7	4	-45%	
Fairway	35	22	-38%	
Cornwell	14	7	-54%	
Austrian Way	16	12	-26%	
Sub Area 2				
Monte Toyon	90	24	-73%	
Mar Vista 1	13	10	-20%	
Park Wilshire	48	35	-27%	
Sub Area 3				
Rio del Mar Estates	12	12	-1%	The water age remains constant due to higher water age at the suction side of the Aptos Pump Station. The age does not get higher due to increased cycling of the tank.
Seascape	35	11	-69%	
Vista del Mar	11	6	-45%	
Sub Area 4				
Aqua View 1&2	9	11	22%	The water age increase is due to the SA3 wells cycling less resulting with higher water age at the RRV to SA4.
Cannon del Sol	18	20	11%	
Larkin Valley	36	28	-22%	
Table from Akel Engineering.				

Source Trace

Modeling was conducted to predict the path the City water is expected to take (source trace) once introduced into the District's distribution system at the intertie. The source trace with the O'Neill Ranch intertie active and the Aptos Pump Station inactive (Scenario 2) is shown in Figure 4 below. Results indicate that SA1 and SA2 would be served almost entirely by 100% City of Santa Cruz water, as the water from the Intertie can mostly satisfy the demand in SA1 and SA2. In contrast, SA3 and SA4 are served entirely by District groundwater. This is due to the hydraulic isolation between SA2 and SA3 created when the Aptos Pump Station is inactive.

The source trace was additionally modeled with the O'Neill Ranch intertie active and the Aptos Pump Station also active (Scenario 3), and the results are shown in Figure 5 below. Turning on the Aptos Pump Station serves to remove the hydraulic isolation between SA2 and SA3, bringing intertie water further into the District's system, into SA3 in particular. Under this scenario, a larger "mixing zone" would be created near the area of the Aptos Pump Station where the City and District waters are blended, when the Aptos Pump Station is active.

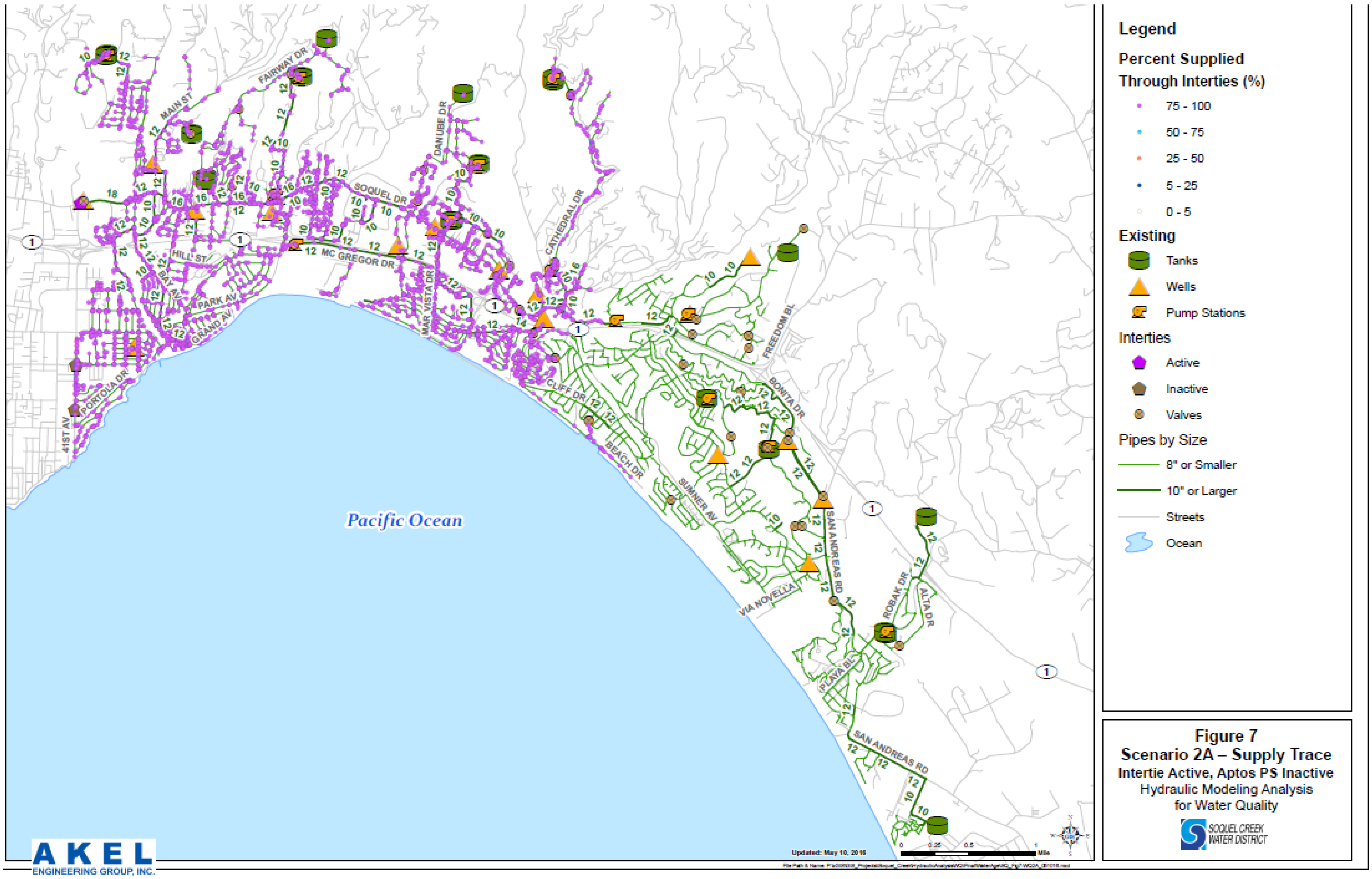

Figure 4 **Source Trace with Intertie Active and Aptos Pump Station Inactive (Scenario 2)**

Note that no intertie water reaches SA 3 or SA4 due to hydraulic barrier created when pump station is inactive. Figure from Akel Engineering; See appendix D for full report.

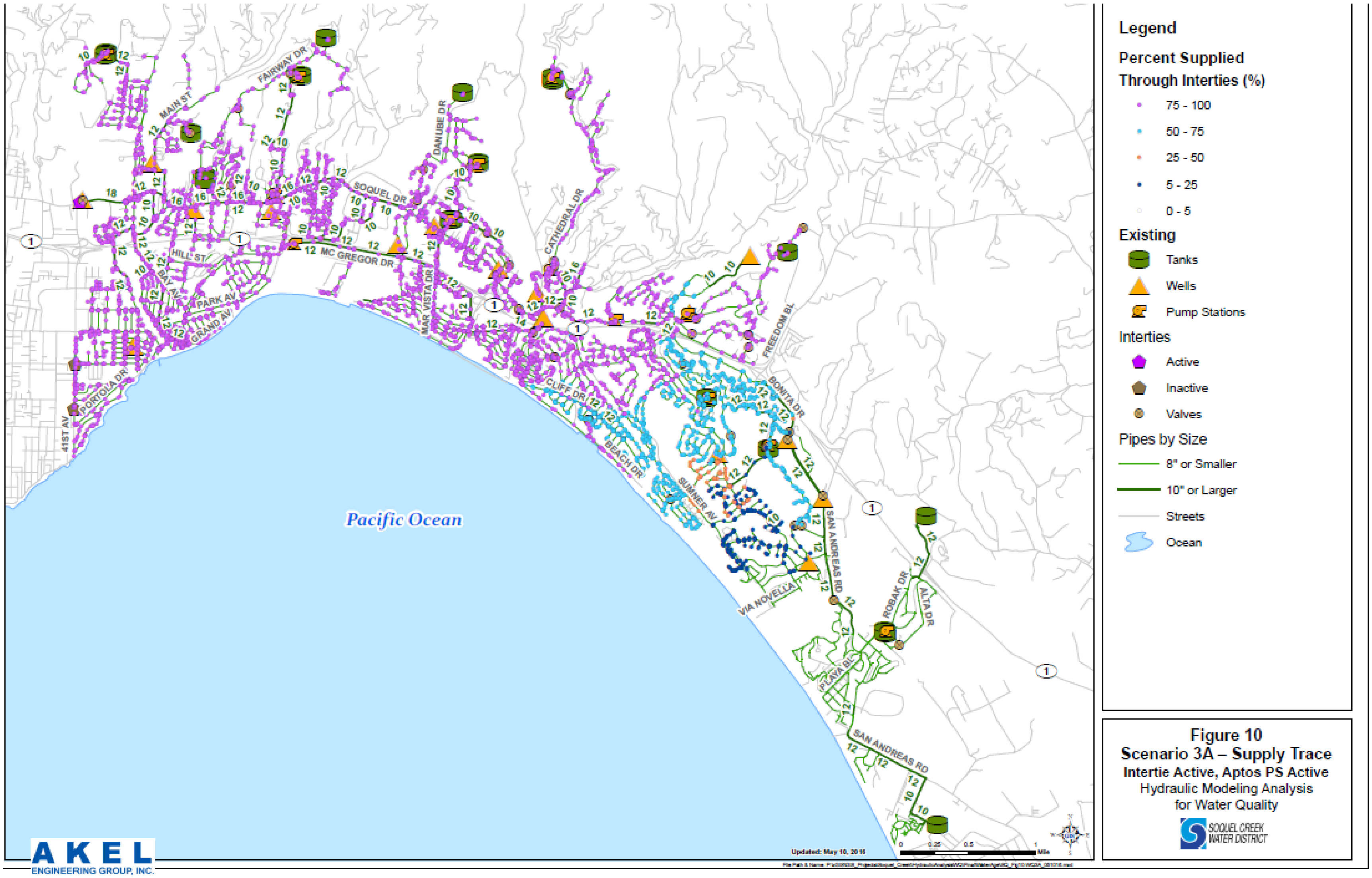

Figure 5 Source Trace with Intertie Active and Aptos Pump Station Active (Scenario 3)

Note that intertie water reaches SA 3 with the pump station active. Figure from Akel Engineering; See appendix D for full report.

Hydraulic Modeling Summary

The following observations summarize the hydraulic modeling results:

- The use of the intertie with Aptos Pump Station off will result in nearly 100 percent City water in most of SA1 and SA2 throughout the months the intertie is active.
- SA 3 and SA4 would continue to receive nearly 100 percent groundwater with the intertie active if the Aptos Pump Station is inactive, as there is a hydraulic grade barrier between zones SA2 and SA3.
- The use of the Aptos Pump Station will create a larger blending zone, and bring City water into SA3. Most/all of SA 4 would continue to be served by 100 percent groundwater as the intertie water does not reach that far into the District's system.
- The water age in the system is highest in the upper parts of the system. Six of the District's 15 storage tanks are expected to have water age greater than 30 days with the intertie active and under current operating conditions.
- Adjusting the tank level setpoints when served by 100 percent groundwater (without the intertie) showed very effective reductions in water age throughout the system, with water age between 25 percent and 75 percent lower in many tanks.

WATER QUALITY DATA ANALYSIS

Data from the District and the City service areas was analyzed over three winter periods covering approximately November through March each year (2012 – 2015). Data from the district's distribution system for SA1, SA2, and SA3 were used in the analysis as those are the zones expecting to receive water from the intertie based on the hydraulic modeling results.

Data for the City was analyzed for distribution system sample stations SS 105 and SS 119 as they are anticipated to be the most representative of the water reaching the intertie. GHWTP data was used in cases where distribution system data was unavailable.

Data were analyzed and reviewed from the following perspectives, as discussed further below:

- Regulatory compliance and customer aesthetics.
- Corrosion / chemical stability.
- Microbial regrowth.

Regulatory Compliance and Customer Complaint Data

Disinfection Byproduct Data

The District and City's disinfection byproduct data is summarized in the table on the following page. Additional compliance data is provided in Appendix E.

Table 4 DBP Data from the District and the City

LOCATION	TTHM LRAA (WINTER ONLY)	HAA LRAA (WINTER ONLY)	FREE CHLORINE LRAA (WINTER ONLY)	TEMPERATURE LRAA (WINTER ONLY)
District				
Fairway Dr. 4601 (SA1)	45 (43)	5.3 (4.6)	0.35 (0.42)	69 (62)
Vienna Dr. 3836 (SA2)	43 (36)	4.3 (3.8)	0.3 (0.3)	68 (60)
Robak Dr. 42 (SA4)	6 (7)	ND (ND)	0.61 (0.66)	66 (58)
Las Olas Dr. 749 (SA2)	39 (36)	4.5 (3.8)	0.45 (0.57)	70 (59)
City				
105 Gross and 41st Ave.	42 (48)	26 (36)	0.81 (0.87)	66 (61)
119 Corner of Marnell Ave.	41 (39)	24 (29)	1.0 (1.0)	62 (56)
Note: The District's source water is warmer than the City's source water in the winter time. However, due to the longer residence time in the District's system the water cools to approximately the same temperature as the City water at many locations.				

As indicated in the table, both the District's and City's DBP formation are well below the regulatory limits of 80 and 60 ug/L for TTHMs and Haloacetic acids (HAA), respectively. The City has slightly higher DBP formation in the winter compared to other months. It should be noted that the City has indicated that due to recent drought conditions, the past 3 years of wintertime DBP formation data may over-represent historical averages due to restrictions placed on the use of lower total organic carbon (TOC) source waters. This trend of higher wintertime DBP formation is not seen in the District's data, and in fact the District sees slightly lower DBP formation in the winter months.

With the addition of City water, the TOC and free chlorine in the District's distribution system are expected to increase. The winter time TOC in the District's water system has an average concentration of approximately 0.6 mg/L in all service areas, while the winter time TOC from the City is approximately 1.5 mg/L. The average winter time free chlorine concentration at the District's DBP sites is approximately 0.5 mg/L, while it is approximately 1.0 mg/L in the City's water. The two sources have similar winter water temperatures (approximately 60°F, see Note on Table 4 above).

Lead and Copper Rule Compliance Data

Lead and Cooper Rule (LCR) compliance data from the District and the City were reviewed.

The City is on reduced frequency monitoring due to an exemplary record of low lead and copper levels in the distribution system. The City is required to collect lead and copper samples once every three years, with the most recent data available collected in 2015. Both the 90th percentile and maximum lead concentration in the City's system were below the action level dating back to 2001 (all the years that data was reviewed. Copper has likewise been well below the regulatory action level of 1.3 mg/L, with a 90th percentile concentration of 0.40 mg/L in 2015.

The District has similarly low lead and copper levels and is also on reduced frequency monitoring with the most recent sample having been collected in 2013. The 90th percentile lead concentration was non-detect (at a 0.005 mg/L detection level) in seven of the 10 past monitoring events. The lead concentration ranged from 0.0050 to 0.0053 mg/L in the remaining three events. The historical average 90th percentile copper concentration is 0.46 mg/L. The next round of sampling will take place later in 2016.

Total Coliform Rule Compliance Data

Total coliform occurrence data was reviewed dating back to 2012. The District never had a coliform occurrence during this period. The City had only one coliform positive sample, which occurred in May of 2015. It should be noted that a repeat sample collected from the same location the following day was negative for coliform. The event therefore was likely attributable to a sampling error or contamination, as opposed to a compromise in distribution system integrity or sanitation.

Customer Complaint Records

Customer complaint records were reviewed from 2012 to 2015. Both the City and the District have historically received between 6 and 12 water quality related complaints per year, approximately evenly split between taste/odor type concerns (typically chlorinated taste/odor) and visual (cloudy, turbid) concerns.

Parameters that Describe Uniform Corrosion and Chemical Stability

Uniform corrosion and metal scale release (i.e. release of previously precipitated metals such as manganese) occurs through an electrochemical process where metal ions leave solid metal surfaces and form new compounds with other ions present in the water. It is the solubility of the new compounds that form that determine whether or not the metal will remain dissolved in the water, entrained in the water as solids, or fall out of the water onto the pipe wall as solids.

Certain anions such as chloride, sulfate, and phosphate; along with the water quality parameters that define dissolved inorganic carbon (DIC) in the water give us the best measure of whether corrosion or metals release is expected to occur within the distribution system.

A summary of parameters that influence corrosion and metals scale release are provided in the following table. It should be noted that the winter time water temperatures for both District and City are similar at approximately 60°F (see note from Table 4 above).

Table 5 Wintertime Water Quality from District and City

	DISTRICT						CITY	
	SERVICE AREA 1		SERVICE AREA 2		SERVICE AREA 3		CITY*	
PARAMETER	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE	AVERAGE	RANGE
Alkalinity	196	157-254	242	197-288	175	149-205	131	92-194
Calcium	72	34-110	38	21-59	29	14-36	50	48-51
Chloride	49	25-88	41	31-53	26	18-39	25	19-30
Magnesium	21	14-25	29	16 - 50	31	21-40	9	9 - 10
CCPP**	7		5		-1		-7	
Orthophosphate (as P)	.02	ND-.075	.04	ND-.09	0.2	0.15-0.34	0.2	0.1-0.3
pH	7.5	7.0–8.1	7.6	7.1-8.1	7.7	7.2-8.1	7.4	7.1-7.7
Sulfate	101	42-180	68	46-99	28	15-43	77	64-92
CSMR***	0.5		0.6		0.9		0.3	
Total dissolved solids	477	300-638	411	332-492	282	191-357	262	255-258

***Note: Data from SS 105,119, or GHWTP effluent as available**
**** CCPP results using Water!Pro modeling software. Results modeled for average conditions only**
***** Chloride to Sulfate Mass Ratio**

Precipitation and Dissolution Chemistry

Water quality was modeled for the data provided using the Water!Pro™ Corrosion Control & Treatment Process Modeling Program. This modeling software is useful in particular for the calculation of the calcium carbonate precipitation potential (CCPP), which describes the tendency for calcium carbonate to precipitate out based on the chemical interplay between various water quality parameters. It is generally desired to maintain a CCPP between +0 and +10 mg/L to minimize corrosion or excessive scaling. Note that when phosphate is added to the water, the CCPP calculation does not account for the phosphate chemistry and is not an accurate predictor of precipitation potential.

It was observed from the modeling results (presented in the table above) that the City's water has a similar calcium carbonate precipitation potential to that of District Service Area 3, but a lower CCPP than District Service Area 1 and 2, where it is expected to be present in the highest percentage of the total water supply. The City water has a CCPP of -7, whereas the CCPP of the District's water in Service Area 1 is +3. This by itself would tend to dissolve any calcium carbonate based scale present in the District's system. However, the City adds a phosphate-based corrosion inhibitor to its water, which indicates that the CCPP does not completely describe the tendency for precipitation.

Orthophosphate combines with various metals found in distribution systems and plumbing materials to form compounds that are insoluble and thereby precipitate and form a coating on the pipe wall surfaces. For this reason, the addition of orthophosphate minimizes the potential for corrosion and other metals release to occur and it is added to many systems to prevent lead release. It is also why in the presence of phosphates, the CCPP alone cannot be used to predict precipitation chemistry.

The blending of City water only during winter months will result in intermittent and variable concentrations of orthophosphate in the District's system throughout the year. This will tend to promote the precipitation of phosphate-based compounds during periods of blending, and create the potential for accumulated phosphate-based scale to re-release during periods when phosphate is not present. Additionally, more phosphate may precipitate out in the District's system relative to the City's system and not reach all extents; given that the pipes have not historically been exposed to the anticipated concentrations of phosphate present in the City's supply, more would tend to precipitate out in the District's system than in the City's system. This could expose some areas of the District's system to a more corrosive water (lower CCPP) without the necessary phosphate to promote precipitative reactions.

It should be noted that the District has higher naturally occurring concentration of orthophosphate in Service Area 3, with concentrations as high as 0.3 mg/L as P. This may currently be causing some phosphate variability in the system, without a noticeable adverse impact. Note that Service Area 3 is hydraulically isolated from Service Areas 1 and 2, which tend to have phosphate concentrations near non-detect. The average concentration found in the water served by the City is 0.2 mg/L as P.

It should be noted orthophosphate is typically added year-round, and that there are few precedents for seasonal or intermittent use of phosphate. The monitoring plan discussed below will be designed to monitor for the water quality impacts from this intermittent usage.

Oxidation Reduction Potential

Oxidation Reduction Potential (ORP) data was not available from either system. However, the ORP from the water served by the City is expected to be higher than that of the district, given the higher free chlorine concentrations (data presented in the regulatory compliance section above). This increase in ORP will occur at the locations nearest the intertie (SA1 and SA2) during the months that blending occurs, with a subsequent decrease in ORP to background levels after blending is stopped (similar to phosphate). Many metals, including lead and manganese, are less soluble under conditions of higher ORP, and under those conditions tend to precipitate out and incorporate into the pipe wall scale. However, frequent changes in ORP tend to weaken the pipe wall scale, making it easier for hydraulic disturbances to release chemical scale and metals to the water.

The monitoring plan described below is designed to collect the missing ORP data and monitor for the potential release of pipe wall scale due to fluctuations in ORP.

Metals

The District has treatment for manganese at wells with detectable concentrations. However, even small amounts of manganese present in the raw water can build up in the distribution system over time. In addition, the District did not historically treat for manganese, with some wells containing up to 400 ug/L manganese being served into the distribution system. It should therefore be assumed that there is manganese present on the pipe wall scale throughout the system, which if destabilized, could be released into the water. This could create a public health concern and risk of customer complaints should the concentration of Mn exceed the secondary action level of 0.05 mg/L.

The City's water has very low concentration of manganese, with the maximum detected concentration less than 5 ug/L, and is therefore not expected to be a significant source of manganese into the District's system.

In many systems trace metals are found in conjunction with manganese in the pipe wall scale. The District recently conducted a trial of NO-DES (Neutral Output Discharge Elimination System) flushing in SA1 and SA3. This method flushes, filters, and re-circulates the water within the water distribution system. Testing of the filters following flushing revealed the presence of antimony, arsenic, barium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, thallium, vanadium and zinc. It should be noted that while this does indicate the presence of these metals in the distribution system, it is very common that when utilities across the United States implement high velocity flushing that these same metals are found when testing the flushing water. It is currently considered a distribution system "best practice" to regularly flush out these solids. The District should consider implementing a program to intentionally remove distribution system solids through high-velocity flushing.

Chloride and Sulfate

Another electrochemical mechanism responsible largely for the release of lead in distribution systems has to do with the mass ratio of chloride to sulfate (CSMR) in the water, defined as:

$$\frac{\frac{mg}{L}Cl^{-}}{\frac{mg}{L}SO_4^{2-}} = CSMR$$

Research has demonstrated that 90th-percentile lead concentrations above the EPA action limit of 15 ppb are much more likely to occur in systems which have a CSMR greater than 1.0 (some research suggests a threshold value as low as 0.5). Systems are most at risk due to a rapid change in CSMR from treatment or change in source concentrations. Both the City's and the District's waters are below the 1.0 CSMR threshold. The introduction of City water is expected to lower the overall CSMR, and therefore the blending of the two sources is not expected to impact lead corrosion due to this mechanism.

Turbidity

Elevated turbidity in the distribution system can be indicative of poor water quality, precipitated metals, biological activity, and release of chemical and biological scale. Turbidity data was reviewed for the winter period from the last three years from both the District and the City's distribution systems. The District's average turbidity in all service areas is 0.2 NTU, with spikes observed up to 0.4 NTU. The City's turbidity as measured at the sample sites nearest the intertie averages 0.1 NTU, with spikes observed up to 0.4 NTU. It should be noted that the maximum turbidity leaving the GHWTP during the same time period was 0.05 NTU, indicating that the turbidity spikes observed likely represent changes to distribution system water quality as the water travels through the system.

Parameters that Describe Biological Stability

Biological stability in the distribution system is important to maintain to prevent excessive growth of microorganisms, which can cause taste/odor issues and lead to the proliferation of coliforms. Temperature, disinfectant residual, organic carbon, and phosphorus are the main parameters impacting biological stability in the distribution system. An increase in temperature, organic carbon, or phosphorus can promote biological activity, while an increase in disinfectant residual helps to control microbial activity. Temperature is similar between the two utilities (winter averages approximately 60 degrees F, see note on Table 4 above), and is not expected to be significantly impacted by the addition of City water.

Disinfectant Residual

Of those parameters, a utility typically has the most control over the disinfectant residual, and while guidance can vary, an industry standard is to maintain a disinfectant residual greater than 0.2 mg/L in all points in the distribution system. While in general the District maintains this condition, a few of the Total Coliform Rule (TCR) monitoring sites indicate potential problem sites for maintaining adequate disinfectant residual and have dropped below the recommended residual concentration on a number of occasions. Table 6 lists the TCR sites that have dropped below the recommended residual and have the lowest average disinfectant residuals in the system (below 0.3 mg/L).

Table 6 TCR Locations with Average Chlorine Residual Below 0.3 mg/L

	CHLORINE RESIDUAL	
Site Location	Average	Minimum
Crestline Way 3500	0.29	0.06
Haas Dr. 3355	0.25	0.08
Vienna Dr. 3836	0.27	0.04

The sample stations from the City's system near the intertie point are indicative of chlorine residuals between 0.8 and 1.0 mg/L. The higher free chlorine concentrations observed in City water will result in some areas of the District receiving water with a higher disinfectant.

Organic Carbon

While the most direct measure of carbon available to support biological activity is assimilable organic carbon (AOC), many utilities do not measure for this as the test is costly and not as straightforward as testing for TOC or Dissolved organic carbon (DOC). The City does not collect DOC measurements, but it does have data for TOC which can be used as an indirect measure of organic carbon in the distribution system available for microbial growth. The data provided by the District indicate that all TOC is dissolved, in the form of DOC. Thus, TOC data is provided in Table 7 as a measure of organic carbon in the distribution system. As shown in the table, the City's water is higher in organic carbon than the District's water.

Table 7 TOC Data

	DISTRICT		CITY	
Parameter	Average	Range	Average	Range
TOC	0.6	0.4-0.9	1.5	0.9-2.5

Phosphorus

Phosphorus is an essential nutrient for microbial growth, and higher phosphorus concentrations can support higher levels of microbial activity. As discussed in the previous section, the City adds a sodium phosphate compound to the water, which will increase the amount of phosphorus seen in the District's system after blending. This is expected to have the greatest impact in Service Areas 1 and 2, where the natural concentrations of phosphorus are lowest and the percentage of City water is expected to be the highest.

In summary, the higher organic carbon and phosphorus concentrations in the City's water would be expected to increase microbial activity; while the higher free chlorine concentration would be expected to mitigate this effect. The District should take care to minimize water age and residual degradation in the system, as that will create more potential for an increase in microbial activity. The monitoring plan described below is designed to monitor for any increase in microbial activity as a result of the new water quality.

BENCH SCALE CHLORINE DEMAND AND DBP FORMATION TESTING

Testing Outline

Bench scale testing was conducted in order to better understand the anticipated chlorine decay and DBP formation of City water at longer detention times anticipated to occur in the District's system. In particular, the hydraulic modeling results showed that SA1 and SA2 will receive approximately 100% City water during the transfer. The City's water is a surface water higher in organic carbon and is therefore expected to have a higher potential for DBP formation than the District's water. Simultaneously, the District conducted testing to better understand chlorine decay in its own system.

The City water sample was collected on April 4, 2016 from Sample Station #119, located on the corner of Morrissey Blvd. and Marnell Ave. Samples were collected in amber glass bottles to prevent UV degradation and were kept headspace free to simulate the distribution system conditions. This sample site was determined to be the most representative of the intertie water quality. In this way, the sample represents the water that will enter the District's system both with respect to chlorine residual and DBPs already formed from the City's system. This sample represents water quality at time = 0 in the District's system.

The District water sample was collected on April 4, 2016 from the effluent of the Tannery well water treatment plant. Samples were collected in amber glass bottles to prevent UV degradation and were kept headspace free to simulate the distribution system conditions. This sample represents fresh groundwater entering the system with the maximum expected chlorine residual and minimum residence time in the system. This sample represents the water quality at time = 0 in the District's system.

Chlorine Decay and DBP Formation Results

The results of the 28 day bench scale test are summarized in Table 8 below. The TTHM and HAAs (DBPs) from the City water at day zero represent the DBPs formed in the City's system before the water reaches the intertie. The DBPs from days 3, 7, 14, 21, and 28 represent the DBPs expected to form as the City water ages in the District's system. As seen in the table below, by 28 days the TTHM concentration had reached the regulatory MCL of 80 ug/L, while the HAAs remained below the MCL of 60 ug/L at a final concentration of 44 ug/L. It should be noted that the initial TOC of the City's sample of 1.4 mg/L on the day of testing was very similar to the historical average of 1.5 mg/L.

The chlorine decay testing results are shown in Figure 6 below and can be used to estimate the amount of chlorine decay expected in the distribution system based on water age. It should be noted that bench scale testing is conducted in clean amber glass jars and is expected to produce higher residuals than at full scale; chlorine decay in the actual distribution system is expected to be greater due to additional reactions with the material accumulated on the pipe walls and potential loss due to volatility. As shown in the table and figure below, the initial residual was higher in the City's sample but after about one week the residual decays were similar between the two water sources. By the end of 28 days, the City's sample had slightly less chlorine residual than the District's sample, indicating a slightly higher rate of chlorine decay.

Table 8 Chlorine Decay and DBP Formation Results for District and City Water

		DISTRICT (TANNERY WTP EFF)			CITY OF SANTA CRUZ (INTERTIE)				
Date	Day	pH (note 1)	Free CL2 mg/L	TOC mg/L	pH	Free Cl2 mg/L	TOC mg/L	HAA5 ug/L	TTHM ug/L
04/04/16	0	7.18	.99	.81 (note 2)	6.92	1.29	1.23	22	30
04/05/16	1	7.11	.87		6.88	1.09			
04/06/16	2	7.15	.81		6.82	1.01			
04/07/16	3	7.16	.76		6.84	.89		30	48
04/08/16	4	7.11	.68		6.76	.86			
04/11/16	7	7.14	.65		6.81	.70		33	60
04/12/16	8	7.13	.63		6.80	.66			
04/13/16	9	7.03	.61		6.60	.65			
04/14/16	10	7.00	.58		6.60	.62			
04/15/16	11	7.06	.58		6.62	.65			
04/18/16	14	7.24	.54	.71	6.87	.60	1.22	36	70
04/25/16	21	7.19	.47		6.81	.46		41	74
4/29/16	25	7.17	.44		6.79	.41			
05/02/16	28	7.16	.43		6.80	.39		44	81

Figures from testing conducted in April and May 2016.
Note 1. pH measured in field
Note 2. Average of 2 results

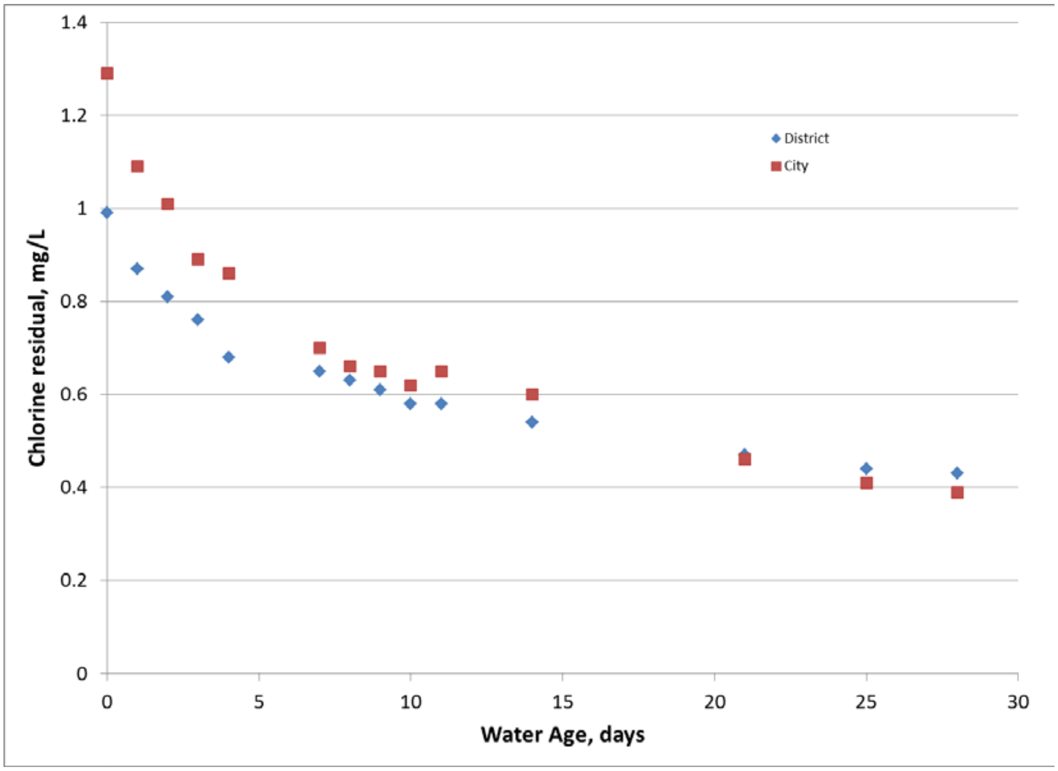

Figure 6 Chlorine Decay in the District and City Water Samples

Figure from bench scale conducted during April and May 2016.

WATER QUALITY SUMMARY

- Both the District and the City have excellent control of corrosion in their respective distribution systems, with lead and copper compliance results well below the action levels.
- The blending of the two sources during the winter months only will result in intermittent presence of phosphate in the District's system. During the months when phosphate is not in use it is possible that previously precipitated metals can re-release from the pipe walls and enter the water. It is additionally possible that the phosphate will precipitate out and not reach all areas of the District's system, resulting in exposure to a more aggressive water quality. While intermittent use of phosphate is not a generally recommendable situation, there is not a precedent to determine with any certainty the expected impact. Additional water quality monitoring should be conducted as prescribed in the following section to proactively detect any concerns.
- The City routinely blends groundwater without phosphate during the summer months with phosphate-treated surface water, and has not seen any adverse effects from this blending.
- The blending of the two waters may cause fluctuations in the ORP in some portions of the District's system due to the higher initial chlorine concentration in the City water. Fluctuations in ORP can lead to destabilization of accumulated scale and release of manganese and other trace metals to the water. If water age is not managed, additional loss of disinfectant residual could result in wider fluctuations to ORP. Additional monitoring should be conducted as described in the following section.

- Both the District and the City see low to moderate formation of DBPs throughout their systems. The fact that the City's DBP formation is higher in the winter suggests that longer detention times are influencing DBP formation in the City's water. The higher TOC and free chlorine concentration in the City's water could elevate the DBPs in those portions of the District's system receiving higher percentages of City water and having higher water age.
- The DBP formation on the City water from bench scale testing conducted in April and May of 2016 showed that TTHM formation reached the regulatory MCL of 80 ug/L after 28 days. The District should work to minimize detention times in its system, as hydraulic modeling results indicated water age greater than 28 days in portions of the system.
- The District currently has low chlorine residual and low odor, resulting in water without objectionable tastes and odors. With the increase in free chlorine concentration entering the system at the intertie, it is possible that some customers nearest the intertie will notice an increased chlorinated taste and odor to the water.
- The City's water is higher in organic carbon and phosphorus which can promote microbial growth. The District currently has three TCR sites which maintain average free chlorine residuals less than 0.3 mg/L, which would indicate areas most susceptible to microbial re-growth. These sites should be monitored to ensure further drops in residual do not occur. General microbial activity should be monitored as described in the following section.

Water Quality Monitoring Program

OVERVIEW

The intention of this water quality monitoring program is to proactively manage integration of the new water supply. A water quality sampling and monitoring plan will aid the District to track water quality before and after the switch from local groundwater to the City's surface water supply. The sampling and monitoring plan will help the District be proactive in managing the new water supply to avoid the presence of any unknown water quality issues that may arise in the distribution system.

In particular, based upon the water quality review, this sampling plan is designed to monitor the impacts of the variability in ORP, CCPP, and concentrations of phosphate, free chlorine, and organic carbon expected from the new source. The plan is intended to be for proactive monitoring only, and is not intended to represent or replace any additional monitoring requirements that may be imposed by the regulatory agency.

The recommendations contained in this TM are to establish a routine monitoring program that can be used to establish a baseline from which future changes in distribution system water quality can be assessed. To minimize the additional staff time required to implement the recommendations contained in this sampling plan, it is assumed that the existing total coliform sites can be used for additional monitoring. Under this scenario, District staff can collect the additional water quality parameters while collecting the required TCR compliance samples. An increase in sampling frequency at particular sites over what is required for regulatory sampling may be unavoidable, however.

The sampling recommendations contained in this plan should be implemented a minimum of one month prior to receiving water from the City, to establish a water quality baseline from which comparisons can be made and determination of the changes in water quality likely attributable to the new source. The sampling plan design is intended to capture the first year that the new water source is brought into the system. While monitoring should continue in subsequent years, it is likely that frequencies and monitoring of certain parameters could be reduced. The data collected from this monitoring program should be regularly reviewed to determine if changes are warranted based on actual observed water quality trends.

The District may also wish to design a sampling plan to "trace" the introduction of water from the City through the District's system in case of intertie usage. This is ideally done initially, when the intertie is first activated, and a parameter which is present in the water from the City but not from the District is "traced" as it travels through the system. Ideally this parameter is non-reactive so that its concentration is not changing as it travels through the District's system. However, given the similarities between the two water qualities and the inherent variability of water quality in the District's system, an ideal natural tracer may not exist. In that case, the District could consider temporary addition of fluoride as a tracer compound.

PARAMETERS, FREQUENCY, AND LOCATIONS FOR MONITORING

TCR monitoring should continue as currently being executed. TCR chlorine residual data should then be reviewed periodically to determine any system-wide changes in disinfectant residual on a locational basis. Additional data collected by the District, such as frequency of main breaks, should be reviewed for any trends after the new source is introduced into the system.

The following parameters are recommended to be analyzed at the listed TCR sites once per week. Sampling should start ideally at least one month prior to the introduction of City water and should continue at least three months following the withdrawal of City water. The District may wish to continue routine monitoring throughout the year.

It is recommended that sample sites be selected by the District based on the following criteria:

- The intertie point will be monitored and give the District information on the water quality entering its system from the intertie before any distribution system interactions occur.
- A site in SA1 will be monitored to determine the impacts of nearly 100 percent City water with a low water age on a portion of the system historically receiving District water.
- A site served by Ironwood, Monte Toyon, and/or Park Wilshire tanks will be monitored to determine the impacts of anticipated highest percentage of City water with the longest water age.
- A site in SA3 will be monitored to determine the impacts of City water in SA 3.
- A site in SA 4 will be monitored to confirm whether or not City water reaches that far into distribution system.

Table 9 Additional Monitoring Parameters for All Sites

PARAMETER*
Total metals scan**
Total dissolved solids
Turbidity
Free chlorine
TOC
DOC
Orthophosphate
Temperature
pH
ORP
Alkalinity
ATP***
Asbestos****

Notes:
*** Turbidity, Cl2, temperature, pH, and ORP should be measured in the field. Remaining parameters should be measured in the lab as soon as practical from samples that have been kept on ice and preserved as required by the accredited laboratory methods.**
****Total and dissolved metals. Sample should be field filtered using a 0.45 nylon filter for dissolved metals analysis. At a minimum metals scan includes Fe, Mn, Al, As, Ca, Cd, Cr, Cu, Hg, Ni, Pb, Th, V and Zn. Alternatively and at District's option a CAM17 metals scan could be used which provides more information at a similar cost.**
*****Using LuminUltra QGA™ test kit. HPC is an acceptable alternative.**
******Asbestos sampling can be reduced at the District's discretion; it is recommended at a minimum one "before" and one "after" sample be collected at locations known to be served by AC pipe**

Overall Recommendations

Based upon a review of the information provided by the District, it is recommended to:

- Implement the additional water quality monitoring outlined in this report. Regularly review results from the monitoring program for early indications of water quality concerns.
- Prior to introducing the new supply, implement a unidirectional flushing program targeting the areas expected to receive the greatest percentage of intertie water. This can remove accumulated metals in the pipe wall scale, thereby minimizing the potential for release of metals and other solids due to changing water chemistry.
- Consider a gradual increase in percentage of intertie water into the system as the intertie is first used.
- Adjust operations as feasible to minimize water age throughout the District, in particular during times when City water is being transferred. Hydraulic modeling indicated between 25 percent and 75 percent reduction in water age when the tank level setpoints were lowered. These operational practices will need to be checked against system needs, such as minimum required fire flows.
- Establish a communications plan for the City to formally communicate to the District any changes to the City's treatment, source, or other changes that may impact water quality. Changes that should be communicated include a change in treatment chemicals or processes employed at the plant, change in source water, change in operational targets (i.e. change in disinfectant dose/residual target), etc.
- Even though the WWTP already receives water from the City of Santa Cruz system, the District should as a courtesy inform the WWTP regarding the expected increase in phosphate concentration during the months of blending, as this can impact some WWTP discharge permits.
- Communicate with District customers regarding the anticipated change in source, such as an FAQ page or other type of publication.
- Consider conducting additional research to further test the anticipated impacts to District's distribution system from City water. Tests might include further DBP testing of the City and District's water at longer water ages; or bench or pilot scale studies looking at the interaction of City water introduced into test coupons or sections of harvested District distribution system piping.

Appendix A: Water Purchase Agreement

CITY OF
SANTA CRUZ

WATER DEPARTMENT

February 24, 2016

Karen Reese, Executive Assistant/Board Clerk
Soquel Creek Water District
5180 Soquel Drive
Soquel, CA 95073

Re: Cooperative Water Transfer Groundwater Recharge and Resource Management Pilot Project between the City of Santa Cruz and Soquel Creek Water District

Dear Ms. Reese:

Enclosed are two Cooperative Water Transfer Groundwater Recharge and Resource Management Pilot Project between the City of Santa Cruz and Soquel Creek Water District. Please obtain the signatures from your District Counsel and the President of the Board of Directors and return both copies to me at 212 Locust Street, Suite A, Santa Cruz, CA 95060.

If you have any questions, please call me at (831) 420-5206.

Sincerely,

Amy Poncato

Amy Poncato
Administrative Assistant III

Enclosures: Two (2) Cooperative Water Transfer Groundwater Recharge and Resource Management Pilot Project Between City of Santa Cruz and Soquel Creek Water District

COOPERATIVE WATER TRANSFER GROUNDWATER RECHARGE

AND RESOURCE MANAGEMENT PILOT PROJECT

BETWEEN CITY OF SANTA CRUZ AND SOQUEL CREEK WATER DISTRICT

The parties to this Agreement are the CITY OF SANTA CRUZ, hereafter referred to as "CITY", and the SOQUEL CREEK WATER DISTRICT", hereafter referred to as "DISTRICT".

RECITALS

A. The CITY of Santa Cruz is charter city which owns and operates a municipal water system in the City of Santa Cruz and in portions of County of Santa Cruz adjoining the District water system.
B. The DISTRICT is a special district which operates a water system, adjacent to the eastern service boundary of the CITY, and provides water service to a significant portion of mid-Santa Cruz County.
C. A shared groundwater basin that the DISTRICT relies upon for a significant portion of its water supply, and from which the CITY obtains a small portion of its water supply, has been in a state of overdraft since the 1980s and is at risk of additional seawater intrusion.
D. The DISTRICT and the CITY cooperatively manage groundwater in the over-drafted basin and would benefit from this agreement.
E. The CITY and the DISTRICT have established three metered interties located at the DISTRICT's O'Neill Ranch well site, at Jade Street and at Bain Street.
F. During the winter and spring, the CITY may have available surface water from its pre-1914 North Coast water rights that could be treated and delivered to the DISTRICT for purchase.
G. Purchasing and using this treated surface water to meet some part of the DISTRICT's demand would enable the DISTRICT to reduce its groundwater pumping, reduce the potential for accelerating seawater intrusion, and contribute to the beginnings of a longer term process to ameliorate the overdraft condition of the groundwater basin that impacts both entities and other pumpers of groundwater from the Soquel-Aptos basin.
H. The period during which this agreement operates can be viewed as an opportunity to begin to assess the effects of reduced pumping of the basin by the DISTRICT on the shared groundwater basin. During this pilot project, the CITY and the DISTRICT intend to use this opportunity to collect information related to: 1) the physical operating system issues, 2) system water quality 3) response of groundwater levels from in-lieu recharge, and 4) the potential opportunity of developing a longer term agreement in which the groundwater basin would be used for a combined in lieu and aquifer storage and recovery program that would help resolve the basin overdraft that would protect CITY and DISTRICT wells from addition seawater intrusion and provide needed drought storage for the CITY.
I. The CITY and DISTRICT recognize that a fair and appropriate agreement can benefit both parties, the community, and provide better management of locally available water resources.

NOW, THEREFORE, IT IS HEREBY AGREED:

1. AGREEMENT TERM:

Except as provided in Paragraph 11 hereafter, the term of this Agreement shall be for the period commencing at the completion of the CEQA process or November 1, 2015, whichever date is later and ending approximately five years later on December 31, 2020. This Agreement shall not extend beyond said date unless the governing bodies of both the CITY and the DISTRICT so agree in writing.

2. TERMS AND CONDITIONS FOR PROVIDING WATER:

Contingent upon the CITY securing all necessary permits and completion of the environmental review process in accordance with Paragraphs 4 and 5 below, water supplied by the CITY will be made available to the DISTRICT for purchase within the scope of the CITY's valid pre-1914 appropriative water rights and changes thereto in compliance with the law. The quantity and availability of water supplied by the CITY under the terms of this agreement shall be based on the following conditions and at the sole discretion of the Director of the Water Department of the CITY. In determining whether supply can be provided, the CITY may take into account any or all of the following factors:

a. The CITY has not declared, and is not operating under, any mandatory water curtailment stage of its 2009 Water Shortage Contingency Plan, as it may be amended, updated, or replaced by the CITY from time to time.[1]

b. Loch Lomond Reservoir is full and is spilling, or if not spilling is projected to be full by April 1 of the water year during which water will be provided to the DISTRICT. The calculation of the potential for the Loch Lomond Reservoir to fill shall be based on the City's short term streamflow modeling tools used to conduct the City's annual water supply forecast, as those tools or other measures to forecast water supply may be amended, updated, or replaced from time to time by CITY.

c. The CITY is providing flow for aquatic resources that meet regulatory requirements, <u>or other requirements agreed to in writing with the fisheries agencies.</u>

d. On a monthly basis, the volume of water delivered to the DISTRICT shall be less than or equal to the amount diverted from the CITY's Liddell Springs and/or Majors Creek supplies as reported to the state of California.

e. The daily volume of water supplied shall not exceed the hydraulic capacity of the interties between the CITY's system and the DISTRICT's system located at the District's O'Neill Ranch well site and at Jade Street and Bain Street. The hydraulic capacity of these interties is estimated to be <u>1.5 million gallons per day (mgd) during normal operations and up to</u> 2 mgd <u>on an emergency basis,</u> and is a function of the pressure difference between the CITY and DISTRICT water systems at that point.

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[1] Mandatory curtailments begin with Stage 2 of the 2009 plan.

f. The CITY has not determined, in its discretion, that the supply of water to DISTRICT must be suspended or discontinued due to unusual or unanticipated circumstances, which suspension or discontinuation shall not be implemented without providing at least 3 days' advance written notice, except in the case of an emergency, in which event the City shall endeavor to provide DISTRICT notice as soon as reasonably possible after the emergency determination has been made.

3. PRICE

The CITY agrees to sell to the DISTRICT treated water delivered to the CITY-DISTRICT interties located on the DISTRICT's O'Neill Ranch well site and at Jade Street and Bain Street under the terms and conditions described hereof at a price that is equal to:

- the Santa Cruz Water Department's FY 2013 actual average annual cost of producing water plus
- the Soquel Creek Water District's FY 2013 actual average annual avoided cost of production for a total of (insert figure) per million gallons, or a pro rata amount thereof based on actual volume provided.

The CITY shall bill the DISTRICT on a monthly basis for water delivered to the DISTRICT based on the meter installed at the above specified intertie connections between the CITY and the DISTRICT.

4. REGULATORY COMPLIANCE – CEQA

The CITY shall be the designated lead agency for the purposes of California Environmental Quality Act (CEQA) compliance. Cost of CEQA compliance, including preparation of an initial study and any negative declaration, mitigated negative declaration or environmental impact report, and implementation of mitigation measures identified therein and agreed to by the CITY will be equally split between the parties, with the District's share shall be billed on a quarterly basis for the duration of this agreement.

CEQA compliance shall address the agreement herein to implement pilot testing of the transfer of water under certain conditions from the CITY to the DISTRICT commencing approximately November 1, 2015 and ending approximately five years later on December 31, 2020. Given that the agreement may potentially be extended beyond said date if both the CITY and the DISTRICT so agree in writing, CEQA shall also address the long-term transfer of water that may occur under such an extended agreement.

5. REGULATORY COMPLIANCE -- PERMITTING

The CITY shall be responsible for obtaining any other permits or approvals required to support providing water to the district under this agreement, and shall be responsible for compliance with all laws, as necessary to make water available for purchase or to transfer pursuant to this Agreement.

6. REGULATORY COMPLIANCE – TREATED WATER DELIVERIES

Delivered water shall be in compliance with all drinking water regulatory requirements at the intertie point of delivery. Once the water has been delivered the DISTRICT shall be responsible in all respects for that water, and its delivery and use, including without limitation compliance with any distribution system requirements, and any relevant water quality regulations.

7. OPERATIONS PLAN –

Prior to initiating the proposed water transfer, the CITY and the DISTRICT agree to jointly prepare and then implement an Operations Plan as the basis for joint operation. The CITY and the DISTRICT may amend the Operations Plan by written joint consent without needing to otherwise amend this agreement.

8. NOTICATION OF STARTING AND STOPPING WATER DELIVERIES

The water to be delivered hereunder shall be delivered to the DISTRICT on an interruptible basis, depending upon the availability of water and the terms and conditions described in paragraph 2 of this agreement. A determination that the delivery of water to the DISTRICT must be interrupted shall be at the sole discretion of the CITY Water Director, which determination shall be conclusive upon the DISTRICT. The CITY shall give the DISTRICT notice of interruption or cessation of the transfer of water in accordance with Paragraph 2(g), above.

9. DATA COLLECTION, MONITORING, AND ANALYSIS

The CITY and the DISTRICT shall jointly share the cost to develop, and implement, a data collection, monitoring, and analysis program to further characterize the benefits of the proposed water transfer and identify any potential issues. This program shall include, but not be limited to, monitoring and analyzing groundwater levels from existing wells in the vicinity of wells that the DISTRICT takes offline due to the available of water from an alternate water source, and distribution system water quality to assess any impacts from surface water being distributed through pipes that have only been used solely for groundwater distribution in the past. The plan shall be developed and implemented by the CITY and DISTRICT prior to commencing any sale of water.

10. NOTIFICATIONS AND RECORD KEEPING

For the purposes of this agreement, the parties shall abide by the record keeping and notification provisions in the Operations Plan included as Attachment B to this agreement

11. NATURE OF AGREEMENT

It is understood and acknowledged by the DISTRICT and the CITY that this Agreement is only for the term specified herein, that no obligations are imposed on the parties beyond the term hereof, that the water rights of the CITY are not impacted, and that the water during the term hereof is solely dependent on the availability of surplus water as stated in this agreement.

This agreement makes no assumption about the availability or quantity of water to be delivered back to the CITY for use as a drought supply.

12. EFFECTIVE DATE:

This Agreement shall become effective only upon its approval by the governing bodies of each party hereto.

13. TERMINATION ON THIRTY-DAY NOTICE

This Agreement may be terminated by either party hereto upon the furnishing to the other party by United States Mail, first class, a thirty (30) day notice of intent to terminate or with an email notification that is acknowledged by the receiving party provided, however that DISTRICT'S obligations to pay for water delivered and indemnify, defend and hold CITY harmless pursuant to paragraph 13, below, shall survive termination.

14. RELEASE AND INDEMNITY

DISTRICT agrees to indemnify, defend and hold harmless CITY, and any agency or instrumentality thereof, and its elected and appointed officials, officers, employees and agents from and against all liabilities, claims, actions, causes of action, proceedings, suits, damages, judgments, liens, levies, costs and expenses of whatever nature, including reasonable attorneys' fees and disbursements (collectively "Claims") arising out of any actions taken by the City in the implementation of this agreement, or any environmental review conducted under the California Environmental Quality Act (CEQA) in connection with this agreement.

CITY OF SANTA CRUZ

Dated:__________________ By: ___________________________________
City Manager of City of Santa Cruz

SOQUEL CREEK WATER DISTRICT

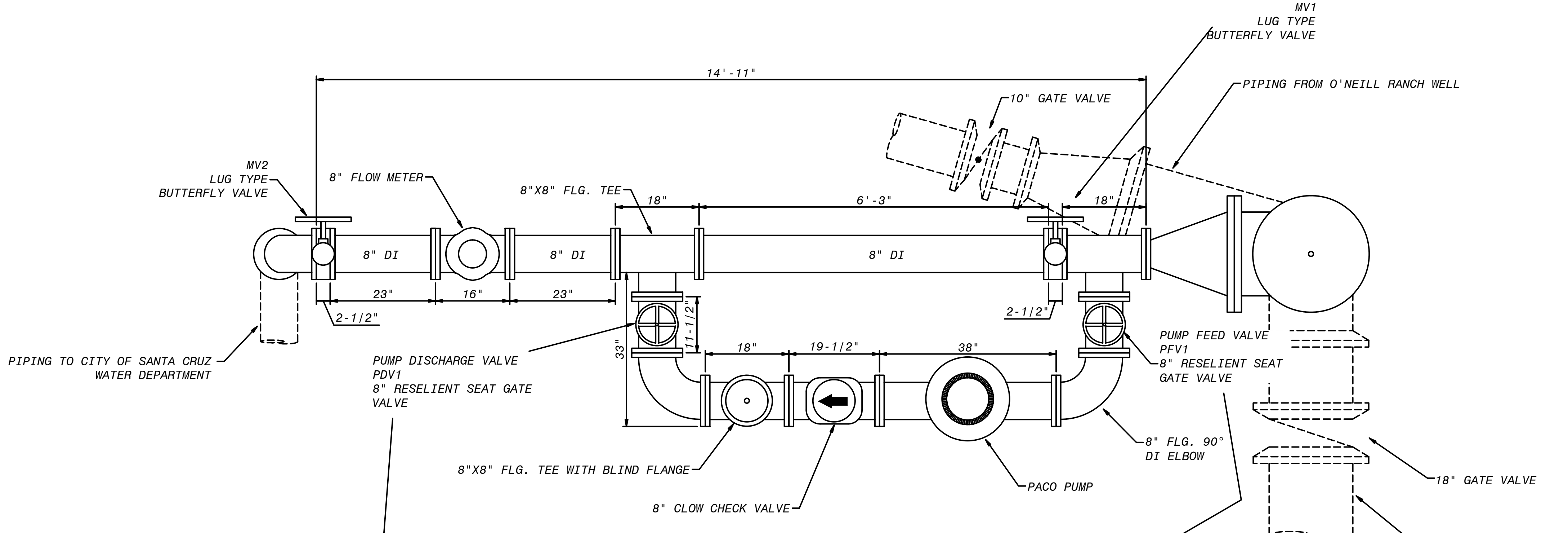
Dated:__________________ By: ___________________________________
President of the Board of Directors

APPROVED AS TO FORM:

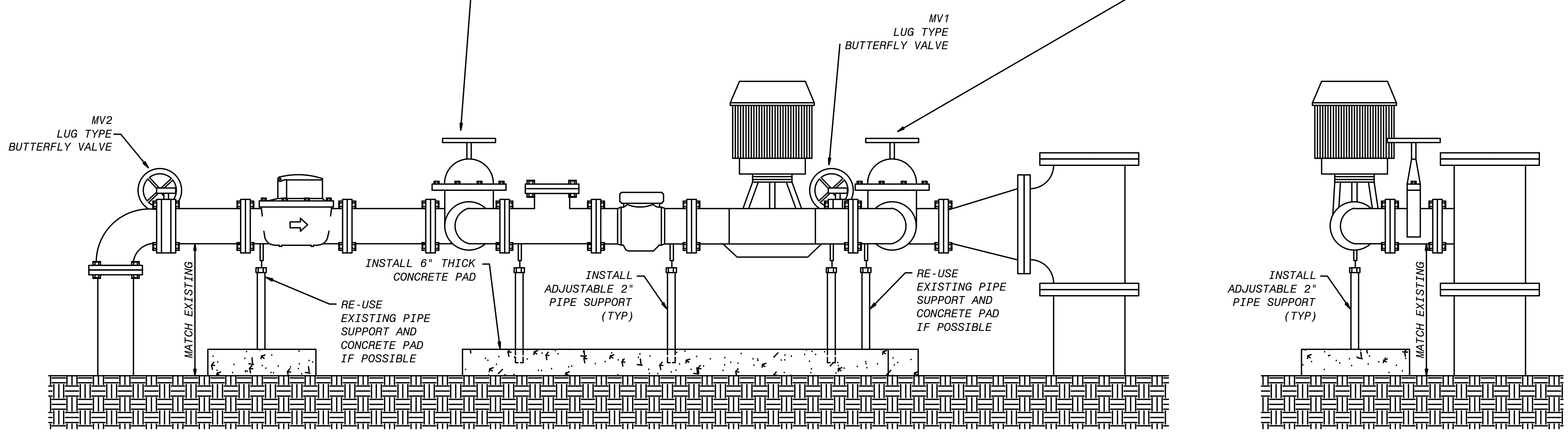
____
CITY Attorney

____
DISTRICT Counsel

Appendix B: Interconnection



PIPING PLAN



PIPE SUPPORT PLACEMENT

NO.	REVISION HISTORY	DATE	BY
A	REMOVED VFD CONTROL, UPDATED SIGNALS	10/27/15	GWR

PRIMEX
primexcontrols.com
22650 County Highway 6 - Detroit Lakes, MN 56501
888-342-5753

ADVANCED ELECTRIC
SYSTEM INTERTIE
QUOTE: 150929JAL1

DRAWN BY: G. RIEKE
DATE: 9/29/2015

PANEL REQUIREMENTS

SYM.	
VOLTAGE	120 VAC
PHASE	SINGLE PHASE
FREQUENCY	60 Hz
SCCR	5 kA RMS SYM
TOTAL FLA	15 FLA
TYPE	4

LARGEST MOTOR POWER REQUIREMENTS
HP
FLA

PROJECT NUMBER
PX1102553

Appendix C: Description of GHWTP

Kennedy/Jenks Consultants

6 June 2013

REGISTERED PROFESSIONAL ENGINEER
TODD K. REYNOLDS
No. C59630
Exp. 12/31/13
CIVIL
STATE OF CALIFORNIA
6/6/13

Technical Memorandum

To: Mr. Terry Tompkins, SCWD

From: Julia Sorensen Lund, PE
Todd Reynolds, PE
Craig Thompson, PE

Subject: Engineering Report to Demonstrate that the GHWTP Filters meet the Turbidity Performance Requirements for Increased *Giardia* Log Removal Credit
SCWD Graham Hill WTP Operations Permit Assistance
K/J 1268001*00

Introduction and Background

The Santa Cruz Water Department's (SCWD) Graham Hill Water Treatment Plant (GHWTP) is a conventional surface water treatment plant with pre-oxidation, taste and odor treatment with permanganate and powdered activated carbon, rapid mix (flash) coagulation, flocculation, sedimentation, granular media filtration, free chlorine disinfection, and corrosion control. The GHWTP receives source water supplies from three North Coast sources (Laguna Diversion, Liddell Springs, and Majors Diversion), the San Lorenzo River (Tait St Diversion, Tait Wells, and Felton Diversion via Newell Creek Reservoir), and Newell Creek Reservoir (Loch Lomond Reservoir). The raw source water entering the GHWTP for treatment often is a blend of the different sources.

Since 1998, the California Department of Public Health (CDPH) has required the GHWTP to achieve an increased level of pathogen removal and inactivation – a total of 4-log *Giardia* cyst and 5-log virus reduction – through filtration and disinfection to be in compliance with the California Surface Water Treatment Rule (SWTR). The basis for the increased removal-inactivation requirements is historically elevated levels of total coliform in the source water, primarily in the San Lorenzo River source water to the GHWTP.

The GHWTP has been able to meet the increased requirements by providing pathogen inactivation (1.5-log *Giardia* inactivation) through the addition of chlorine ahead of the settling basins to achieve the required disinfection CT (disinfectant concentration times contact time). However, the reaction of natural organic matter and the chlorine disinfectant in the settling basins creates disinfection byproducts (DBP) that are regulated by the Stage 2 Disinfectants and Disinfection Byproducts Rule (Stage 2 D/DBPR). As more water from Loch Lomond is treated at the GHWTP, the higher levels of organics in this water could lead to higher levels of DBPs.

The SCWD needs to meet SWTR requirements to control both acute microbial health risks from pathogens (*Giardia*, *Cryptosporidium*, and viruses) and chronic health risks from chlorinated DBPs. Complying with both the SWTR and the Stage 2 D/DBP Rules requires a balance

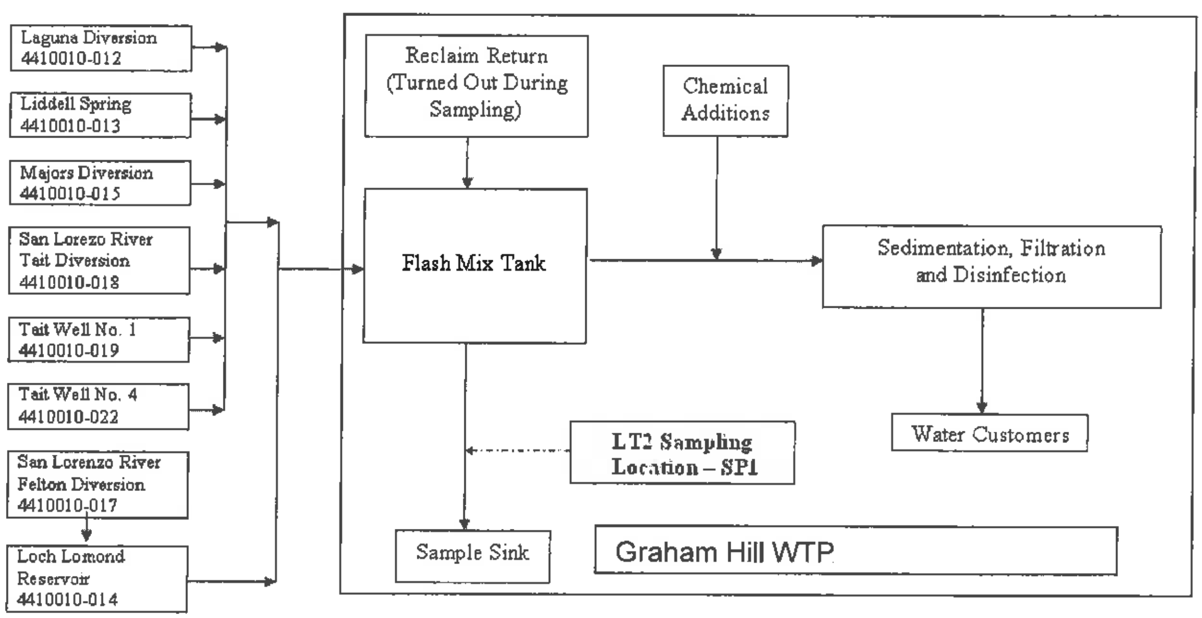
The TM describes the objectives and results of each evaluation in more detail in the sections below.

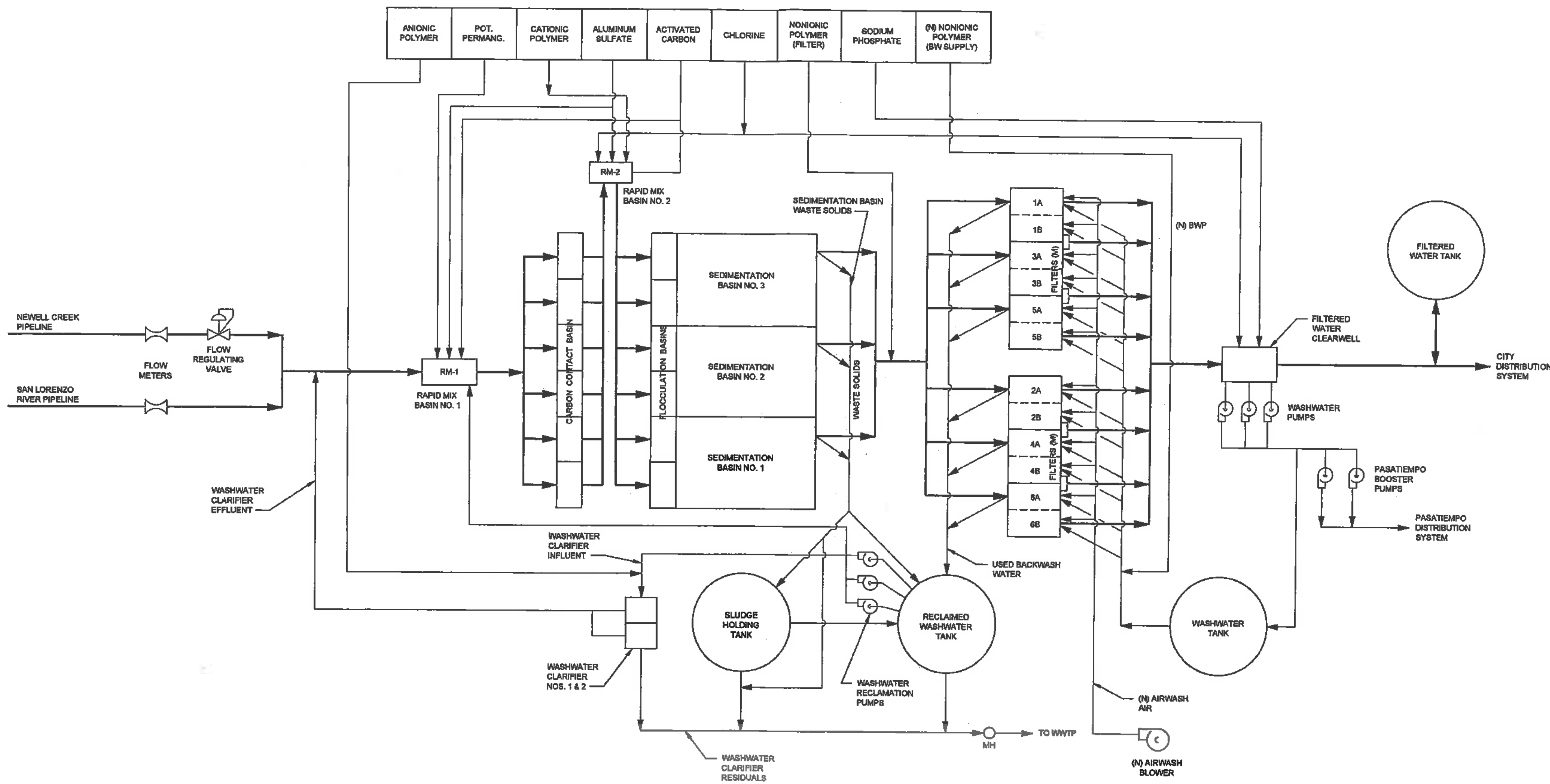
2 Background

2.1 Graham Hill WTP and Source Water Supplies

The GHWTP is a conventional surface water treatment plant with pre-oxidation, taste and odor treatment with permanganate and powdered activated carbon, rapid mix (flash) coagulation, flocculation, sedimentation, granular media filtration, free chlorine disinfection, and corrosion control. The GHWTP receives source water supplies from three North Coast sources (Laguna Diversion, Liddell Springs, and Majors Diversion), the San Lorenzo River (Tait St Diversion, Tait Wells, and Felton Diversion via Newell Creek Reservoir), and Newell Creek Reservoir (Loch Lomond Reservoir). The raw source water entering the GHWTP for treatment is often a blend of the different sources and is also sampled, in addition to the individual sources. Figure 1 shows a schematic of the source water supplies to the GHWTP.

Figure 1. Source Water Supplies to the GHWTP





NOTES:

1. UNLESS OTHERWISE NOTED AS NEW (N) OR MODIFIED (M) ALL FEATURES SHOWN ON THIS DRAWING ARE EXISTING.

ROYCE OKIMOTO 4/1/2014 10:53 AM

N:\2013\1368001.00 - SCWD GHWTP Filter Rehab\1368001-G3.dwg

USE OF DOCUMENTS

NO.	REVISION	DATE	BY

SCALES

0 — 1"

0 — 25mm

IF THIS BAR IS NOT DIMENSION SHOWN, ADJUST SCALES ACCORDINGLY

REGISTERED PROFESSIONAL ENGINEER — DEBORAH C. CORDOVA — NO. C49861 — Exp. 6/30/14 — CIVIL — STATE OF CALIFORNIA — 4-1-14

DESIGNED DCC

DRAWN ROO

CHECKED TKR

CITY OF SANTA CRUZ

GRAHAM HILL WATER TREATMENT PLANT

FILTER REHABILITATION AND UPGRADES PROJECT

Kennedy/Jenks Consultants

303 SECOND STREET, SUITE 300 SOUTH, SAN FRANCISCO, CA 94107

PROCESS FLOW SCHEMATIC

FILE NAME

JOB NO. 1368001.00

DATE MARCH 2014

SHEET G-3 OF

CITY OF SANTA CRUZ
WATER DEPARTMENT

SYSTEM NO. 4410010

GHWTP OPERATIONS PLAN

December 2014

APPENDICES

1. WATER QUALITY EMERGENCY NOTIFICATION PLAN
2. SOURCE WATER SPILL RESPONSE PROCEDURE
3. DIVISION OF SAFETY OF DAMS CONTACTS
4. GHWTP PROCESS DIAGRAM
5. WATER SYSTEM ELEVATION DIAGRAM
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7. WTP EVACUATION PLAN
8. SWTR MONITORING AND REPORTING REQUIREMENTS
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10. QUALITY CONTROL REPORT
11. DAILY PRODUCTION REPORT
12. CT WORKSHEET
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    - CHLORINE
    - CT MONITORING
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    - pH
    - TASTES and ODOR
    - KMnO4 DEMAND TEST
    - COAGULANT JAR TEST
    - FILTERABILITY
    - ALKALINITY
15. SAMPLING SOP DURING LAKE COPPERING
16. TURBIDITY ANALYZER CLEANING, CALIBRATION GUIDELINES
17. WASTE WATER DISCHARGE PERMIT
18. OPERATOR JOB DESCRIPTIONS
19. PLANT OPERATION SOP BINDER TABLE OF CONTENTS
20. SELF CONTAINED BREATHING APPARATUS INSTRUCTIONS
21. CORROSION CONTROL AND FEED SYSTEM
22. GHWTP PERMIT AMENDMENT LETTER, MARCH, 2014. INCREASED GIARDIA LOG REMOVAL CREDIT
23. WATER DEPARTMENT GENERAL EMERGENCY PLAN

CITY OF SANTA CRUZ

CITY OF SANTA CRUZ
GRAHAM HILL WATER TREATMENT PLANT
OPERATIONS PLAN

INTRODUCTION

The Graham Hill Water Treatment Plant (GHWTP) was built in 1961, expanded in 1968 and modernized in 1987. It is design with a nominal maximum capacity of 24 MGD. The GHWTP receives source water supplies from multiple sources; three North Coast sources (Laguna Diversion, Liddell Springs, and Majors Diversion), the San Lorenzo River (Tait St Diversion, Tait Wells, and Felton Diversion), and Newell Creek Reservoir (Loch Lomond Reservoir). The raw source water entering the GHWTP for treatment often is a blend of the different sources.
The conventional treatment process of the GHWTP consists of taste and odor control, pre-chlorination, coagulation, flocculation, sedimentation, dual granular media filtration, corrosion control and post chlorination. Filter backwash water and sedimentation basin sludge is recycled through a plate settler clarification system and returned to the beginning of the conventional treatment process. The GHWTP is in operation twenty-four hours a day, three hundred and sixty-five days a year and is staffed by a State certified Water Treatment Operators at all times. A central supervisory control and data acquisition system (SCADA) is used to monitor and control the treatment process and distribution system facilities.

Information presented herein is limited to the specific operation of the GHWTP and is intended to meet the Operations Plan requirements of Title 22 California Code of Regulations, Section 64661.

A complete set of the plans and specifications for the treatment plant, as well as manufacture's plans, bulletins and instructions for each piece of plant equipment are on file at the plant.

Specific instructions regarding the duties of the GHWTP Operators are provided by the Standard Operating Procedures (SOP). Special instructions and other operating parameters are issued daily and are documented in the daily log book maintained by the Treatment Operators.

TREATMENT PLANT PERFORMANCE MONITORING PROGRAM

The Water Treatment Operator's main work station is centrally located within the GHWTP. Multiple SCADA system human/machine interfaces (HMI) are located at the main work station with additional interfaces in the Operator's process control lab, the chemical feed room, and the Chief Plant Operator's office. The Water Treatment Operators can monitor status of the following:

- Sources of Supply: valve status, flow, and water quality
- Treatment Plant Processes: flow, chemical feed rates, water quality
- Booster Pumping Stations: power status, disinfectant residual, flow, and pressure
- Storage Facilities: levels and rate of gain/loss, disinfectant residual

Monitoring Sources of Supply

Through the use of the SCADA system and in conjunction with remote transmitting units (RTU), as well as satellite communications systems, the operator can monitor numerous functions such as water quality, flow, and equipment status. Raw water sources can be turned in or out from the GHWTP through either the SCADA or satellite communications system. The Water Treatment Operator on duty is responsible for turning the sources in and out in accordance with the GHWTP SOPs and the directives of the CPO. In the event of an automated system failure the Water Treatment Operator is responsible for directing the on-call staff to address the issue.

GHWTP Sources of Supply:

- San Lorenzo River/Tait Wells 1 & 4
- Loch Lomond Reservoir (Newell Creek)
- Majors Creek
- Laguna Creek
- Liddell Spring
- Rigardio Creek

Monitoring Treatment Process

Via the SCADA system, the Water Treatment Operator monitors treatment process data such as flow, turbidity, disinfectant residuals, water temperature, pH, and chemical feed rates. Alarm set points are entered into the SCADA system to alert operators of various problems. Trending is used to examine the treatment process. SCADA information is verified by taking grab samples every two hours. These samples are tested for turbidity, chlorine residual, pH, alkalinity, temperature, odor, and color. In addition to the sampling, the disinfection CT ratio and chemical feed rates are calculated every two hours. Jar testing is done routinely to optimize the coagulation process after changes in source water quality. Plant tours for visual inspection of the treatment process are preformed routinely by the Water Treatment Operator on duty.

Monitoring Distribution Facilities

The GHWTP Treatment Plant Operators are responsible for monitoring potable water reservoir levels, pump stations, disinfectant residuals, and water pressures in the distribution system to ensure an adequate supply of water is available for use as well as an array of security cameras and remote station alarms. The GHWTP Treatment Operators also monitor an iron and manganese removal ground water treatment plant in Live Oak (see Beltz Water Treatment Plant Operations Plan). The Operators are responsible for directing Water Department and/or contracted security staff to respond to alarms, emergencies, and abnormalities; and to notify management when serious circumstances arise.

In addition, the City of Santa Cruz Water Department Water Quality section operates a State certified water quality laboratory with qualified staff. The Water Quality staff perform regulatory sampling at the GHWTP and in the Distribution System. Their procedures and sampling plans are separate from this GHWTP operations plan.

UNIT PROCESS EQUIPMENT MAINTENANCE PROGRAM

In addition to the Water Treatment Operators, the GHWTP employs a full maintenance staff including a Water Facilities Field Supervisor, two Plant Maintenance Mechanics, two Electrical/Instrumentation Technicians, and Service Maintenance Workers. The Plant Mechanics perform bi-weekly station checks of pump stations, intake structures, and reservoirs to confirm adequate operating condition of the equipment and to identify, report, and address maintenance needs.

Supervisors track equipment and maintenance with the Advanced Maintenance Management System (AMMS) software. The AMMS software is used to schedule preventative maintenance (PM), generate work orders, and track equipment maintenance history. Work orders are generated automatically based on PM schedules as well as manually when needed for corrective maintenance. Supervisory staff assign the work orders to the appropriate operations or maintenance staff for completion. When a work order is completed work order form is filled out and returned to the Supervisor who records the maintenance in the AMMS program.

Qualified staff rotate through an after-hours call duty assignment to provide the GHWTP with twenty-four hour maintenance support. The employee on call duty is required to stay within a thirty minute response time and to carry a pager or cell phone at all times.

Other routine maintenance such as grounds keeping, painting, and janitorial work is directed by the GHWTP supervisory staff on an as-needed basis.

The supervisory control and data acquisition (SCADA) hardware and software that the GHWTP depends on for its automation is maintained by a Water Treatment Plant Operator with the added title of SCADA System Coordinator. The SCADA System Coordinator works with the City of Santa Cruz Information Technology Department Staff as well as various software manufacturers and programmers to maintain and upgrade the automated and information recording capabilities of the GHWTP.

FILTER MEDIA INSPECTION PROGRAM

Reference: Intergrated Design of Water Treatment Facilities
Susuma Kawamura Pages 247-253

Plant Operators will inspect the filters for operation and maintenance on an ongoing basis. Inspections shall include observing the filter bed before, during and after a backwash, inspecting the surface wash system operation, and checking operation of related valves and electrical operation of the backwash sequence.

Before backwashing check the filter bed. Look for mudballs, cracks in the surface of the bed, lumps, mounding, concaved areas and obvious shifts in the media. When inspecting the bed during backwash watch for scouring action of influent, mal-distribution of backwash water, and boiling action in the filter bed. Turn the surface wash system off after two minutes of backwash. Note clarity of the water during entire backwash cycle. Note when and where the different parts of the filter clear up during backwash. Finally note appearance of filter at end of backwash. Report any unusual conditions to the Chief Plant Operator.

Surface Wash System

Annually the surface wash system will be inspected and evaluated.

> *Visually inspect the surface wash arms for possible blockage or damage.*
>
> *Drain the filter and observe surface wash system during operation. This will allow observation of the uniformity of the surface wash spray. At the same time observe the rotational speed of each surface wash arm for abnormalities.*

Filter Turbidity Profile

Once a year, the turbidity profile of the filters will be measured. Turbidity samples are taken of the backwash water at one minute intervals. After sampling is complete plot the curve. The desired curve profile is a high profile curve with a high peak curve. Refer to page 248 of Integrated Design of Water Treatment Facilities.

Filter Media Evaluation

An evaluation of the filter media in each of the six filters will occur every three years. If there is evidence of water quality deterioration, filters will be inspected as soon as possible.

Core Sampling:

Core samples will be taken from multiple locations in the filter bed in order to obtain a complete profile *of the filter condition. Use thin walled galvanized electrical conduit pipe, 5 ft long and 1.5 inches in diameter. The inner wall of the sample tube must have a certain amount of friction in order to retain the core samples; PVC piping is not suitable because the inner wall is too smooth. The filter cores will allow determination of the solids deposition pattern within the filter media. This will identify the efficiency of the backwash procedure for each filter, and determine if it varies between filters. The procedure will help identify possible filter underdrain problems. The core sampling process will include such information as coagulant, filter and doses, and run time on filter. During core sampling, record depth of anthracite, sand, and gravel layers. Prepare core samples to be sent to soil lab for analysis.*

Mudball Evaluation:

While taking filter media cores, a determination will be made of the quantity of mudballs within each filter. This is important in identifying possible deficiencies in backwashing and/or problems with filter underdrains.

Filter Gravel Investigations:

Determine the top elevation of the gravel in each of the six filters. This will be accomplished by using a small diameter metal rod; take depth measurements at frequent intervals within the filter. This will allow the development of filter gravel contours, which will show if there is any gravel mounding problems. Such gravel mounding problems are indicative of blocked underdrains.

Media Expansion Testing:

Media expansion will be measured for each filter during backwash. The actual expansion will be compared to expected expansion, which will aid in determining possible underdrain blockage.

Filter Underdrain Inspection:

Excavate the filter media and gravel, and expose the filter underdrain in one location in each filter. This will be accomplished by removing the media and gravel within a 4 ft x 4 ft x 4 ft wooden box. Once the top of the underdrains are exposed, it will be possible to see the extent of blockage, which will aid in identifying possible means of correcting the blockage.

OPERATING PERSONNEL

The Water Production Section of the Santa Cruz Water Department has ten State Certified Water Treatment Operators full time positions. Each is classified as a Water Treatment Operator OIT, II, III, IV, SUP IV, SUP V (the Chief Plant Operator), or Production Superintendent depending on the State operators certification that they hold in accordance with Title 22, Section 63765 and their promotional status. Employees classified as Water Treatment Operator OIT are required to have a Grade T1 certification and must obtain a Grade T2 certification within two years to keep their position. Until fully trained, employees classified Water Treatment Operator II will work under the direct supervision of either the Chief Plant Operator (CPO) or a qualified shift operator. Once adequately trained, the Water Treatment Operator II may work an assigned shift alone providing the CPO or a shift operator is available to be contacted within one hour, in accordance with Title 22, Section 64413.5 (d). Employees classified as Water Treatment Operator II are required to obtain a Grade T3 certification from the State within two years to retain their position. Job descriptions for Water Treatment Operators may be found online at http://www.cityofsantacruz.com/index.aspx?page=217#w.

The GHWTP is in continuous production mode with brief shutdowns scheduled only when necessary. The 24-hour workday is broken into three 10-hour shifts. Day shift extends from 5:00 to 15:00, and is staffed by at least one certified shift operator. Second shift is from 10:30 to 20:30, followed by third shift from 19:30 to 05:30. The same schedule is maintained on weekends. There is an additional shift from 07:00 to 17:30, Monday through Thursday, which is designed for our Water Treatment Operator III, SCADA system Coordinator.

GHWTP Operator responsibilities include, but are not limited to:

- Monitoring and controlling the GHWTP flow, chemical feed systems, filtration process, and equipment functions to ensure an adequate supply of safe and pleasant drinking water for the community.
- Monitoring and maintaining adequate disinfection residual throughout the treatment plant.
- Testing water samples throughout the treatment process to ensure optimum treatment and verifying SCADA system displays.
- Monitoring and controlling numerous remote facilities.
- Directing staff to respond to problems at the GHWTP or in the Distribution system.
- Maintaining Treatment Plant facilities and equipment
- Receiving, testing, stocking, and batching water treatment chemicals

GRAHAM HILL WATER TREATMENT PLANT
CERTIFIED WATER TREATMENT PLANT OPERATING PERSONNEL
October 2014

TERRENCE H. MCKINNEY
PRODUCTION SUPERINTENDENT
CERTIFICATE NO. 24031
CDPH GRADE T5

DUSTIN HOLTZCLAW
WATER TREATMENT SUPERVISOR IV
CERTIFICATE NO. 28375
CDPH GRADE T4

JEFFREY JONES
WATER TREATMENT OPERATOR IV
CERTIFICATE NO. 12625
CDPH GRADE T5

JAMES FARR
WATER TERATMENT OPERATOR IV
CERTIFICATE NO. 13301
CDPH GRADE T4

DOUG WOODALL
WATER TREATMENT OPERATOR III
CERTIFICATE NO. 14198
CDPH GRADE T3

DIMAS REYES
WATER TREATMENT OPERATOR IV
CERTIFICATE NO. 17490
CDPH GRADE T4

PHILLIP RODRIGUEZ
WATER TREATMENT OPERATOR IV
CERTIFICATE NO. 19110
CDPH GRADE T4

WAYNE HUNNEMAN
WATER TREATMENT OPERATOR III
CERTIFICATE NO. 21183
CDPH GRADE T3

KATHARINE MOORE
WATER TREATMENT OPERATOR IV
CERTIFICATE NO. 27601
CDPH GRADE T4

COLIN SMITH
WATER TREATMENT OPERATOR III
CERTIFICATION NO. 26619
CDPH GRADE T3

HOW AND WHEN EACH UNIT PROCESS IS OPERATED

Raw Water Supply

Raw water is delivered to the treatment plant through one 18-inch pipeline from Newell Creek Reservoir (Loch Lomond), and one 24-inch pipeline from the San Lorenzo River pumping station, which includes the San Lorenzo River, the coastal sources, and the Tait Street wells. These two raw water supply lines are monitored for turbidity, flow, and pressure; which are recorded and viewable via SCADA. Each of these lines is metered with a Fisher-Porter magnetic flow meter. The flow sensed in each of the flow meters is transmitted to the central control panel/ SCADA, by a 4-20 MA signal. In addition to the two raw water supply lines, recycled water from filter backwashes and the settled water basins sludge removal system is clarified through two lamella plate settlers and sent to the raw water head works. The recycled water is metered before entering the lamella plate settlers. The sum of the two raw water supply line meters and the recycled water meter is displayed, via the GHWTP SCADA interface, as the Total Raw influent flow to the plant. When in auto, the treatment chemical feed rates are flow-paced to the Total Raw flow, with the exception of the recycled water clarifier polymer that is based on flow through the lamella plate settlers.
Raw water source selection is determined by a number of factors; such as water quality, water rights, and availability. SOPs are maintained at the GHWTP for source-specific turn in/out procedures.

At the GHWTP, the Newell Creek pipeline flow is controlled by a Baily sleeve valve. The Baily valve is controlled by the Treatment Plant Operators in response to the elevation in the Newell Creek pipeline and flow through the Felton Booster Pump Station (FBPS). Throttling the flow of the Baily valve regulates pipeline water elevation between the treatment plant and the high point in the Newell Creek supply line, which is located in Henry Cowell Redwoods State Park. FBPS, located in Felton at 6000 East Zayante Road, is called to run by the GHWTP operator who selects the appropriate flow. Coordination of the FBPS flow and the throttling of the GHWTP Baily valve is needed to ensure the Newell Creek supply line is not over pressurized or drained. The FBPS is equipped with high and low pressure shut-off set points to protect the pumps.
A malfunction of the Newell Creek pipeline control valve (Baily valve) could create damaging pressure surges in the pipeline. To prevent this, a globe surge relief valve is installed on the raw water line immediately upstream of the Baily control valve. Whenever the pressure reaches 125 psi, the valve quickly opens, discharging water to the raw water header to relieve the pressure surge. As the pressure drops below 100 psi, the valve slowly closes.
A small amount of drainage from the valve vent is normal. A significant increase in flow from the vent indicates that the cup leathers in the cylinder are leaking and that the valve probably is inoperative.

Both raw water pipelines combine in a raw water header before entering the first rapid mixer (FM1). Recycled backwash water is clarified before it joins the raw water blend at FM1. Each of the two raw water pipelines, the recycled water, and the combined raw water blend at the first rapid mixer are continuously monitored for turbidity through the SCADA interface. The sample lines also flow to the Operator's Lab where bench top testing is performed to confirm the on-line turbidimeter readings.

Disinfection

The GHWTP uses pre and post chlorination. The pre-chlorination dose is injected at Flash Mixer #2 (FM2), while the post chlorination dose is injected into the filtered water clear well. The chlorination system is discussed in detail later in the Chemical Feed Systems section and the Disinfection Monitoring (CT Values) section, the Procedures Used to Determine Chemical Dose Rates section, and the Emergency Plan for Disinfection Failure.

Flash Mixing Units

Two flash mixers provide rapid and complete dispersion of the chemicals added to the raw water. Pretreatment chemicals normally include potassium permanganate ($KMnO_4$) or powdered activated carbon (PAC) at Flash Mixer #1 (FM1). PAC, chlorine, alum or aluminum chlorohydrate (ACH), and cationic polymer are usually fed at flash mixer #2 (FM2). Chemicals are added to the flow as the raw water enters the flash-mixing flume. For better flocc production alum or ACH is sometimes fed at FM1.

Taste and Odor Control

Taste and odor have historically been a problem during the summer and early fall periods. KMnO4 and/or powdered activated carbon are used for taste and odor control. Six ninety-thousand gallon contact basins with vertical shaft mixers, driven by variable frequency drives (VFD), are located in between FM1 and FM2. These contact basins provide the contact time necessary for KMnO4 and PAC to affect tastes and odors in the raw water. KMnO4 is fed primarily into FM1. It is used as a pre-oxidant for taste and odor control with the added benefit of satisfying some of the oxidation demand before chlorination. When odor problems are not severe KMnO4 is added at a dosage slightly above dosage test requirements at FM1. Feeding 5 mg/L of PAC at FM#2 to remove any color caused by the excess KMnO4 feed is an option.
During times of heavier odor, KMnO4 is discontinued and PAC is fed at FM1 at a dose of 6 to 10 mg/L.

Direct Filtration

A significant amount of process flexibility and potential chemical cost savings can be provided when providing for direct filtration. Direct filtration may be practical during certain periods of the year as raw water conditions allow. In this mode the effluent from the existing contact mixer basins will flow to the east in the cross channel and discharge to the pipes running from the sedimentation basins to the filters. This was accomplished by constructing a concrete box around the 48-inch pipe running to the west filter bank. During low flow periods (winter) this line can be temporarily sealed at the existing upstream diversion box so that all flow is directed to the east filter bank. The pipe can then be cut out of the new box so that flow can be split between the east and west filter banks. **Prior approval by the California Department of Public Health is required before switching to direct filtration mode.**

Coagulation

Aluminum Sulfate (ALUM) is the primary coagulant used at the GHWTP and is stored in two 6,500 gallon tanks. Dosage is determined by jar test. Feed rate is flow proportional and is controlled by SCADA. Coagulation is enhanced by the addition of cationic polymer which is stored in a 2,250 gallon tank. Dosage is determined by jar testing. Feed rate is flow proportional and is controlled by SCADA. In addition to jar testing, a streaming current detector (SCD) is used to monitor ion charge in the water which has a direct relation to coagulant feed. A drop in the SCD set point alerts the operator to a coagulant feed failure or a change in raw water quality.

Aluminum Chlorohydrate (ACH) can be used as the primary coagulant, or in conjunction with alum, to achieve high quality settled water without dropping the pH of the finished water below the SCWD Corrosion Control Program permitted pH limit of 7.1.

Coagulants are applied at FM2. The upper portion of a transverse channel delivers water from the taste and odor control contact basins and directs it to FM2. The lower portion of this channel delivers water from FM2 to the three Primary Flocculation basins. This lower portion consists of pipe sections tapered from 54 to 36 inches in diameter to maintain velocities. There is an option of direct filtration by opening a bypass valve that leads to the settled water channel, thus omitting the flocculation and settling stages of the treatment process. **This valve is never to be opened without the prior approval of the California Department of Public Health.**

Flocculation

The advantages of multi-stage flocculation are well documented in the literature and have been demonstrated by jar testing and pilot plant testing at the GHWTP. The advantages are that a tapered energy input can be provided and short-circuiting reduced.

The outlet gate arrangement of the taste and odor contactors is structured to allow their use as the first stage of a multi-stage system. Their use for flocculation is desirable during the high turbidity periods, which generally does not coincide with the periods for taste and odor control. The openings into and out of the cross channels are sized to limit the velocity to l.5 fps at 24 mgd to reduce floc-shearing potential. The openings are equipped with sluice gates to allow de-watering of individual basins and to operate in the direct filtration mode. The channel size is also constrained by the minimum velocity necessary to maintain carbon in suspension. A minimum velocity of 0.5 fps at approximately 12 mgd (typical flow during late summer and early fall, when carbon is most likely to be used) is considered reasonable.

The two stage flocculation basins (stages 2 and 3 of the multi-stage system) provide 24 minutes detention at 24 mgd. Each is equipped with a dual set of horizontal paddle flocculators. The stages are separated by a solid baffle wall with a perforated baffle between the last stage and the sedimentation basin. The paddles are designed with a maximum top speed of approximately l.5 fps.

Chlorine residual is monitored at the first stage of flocculation to assist in determining demand and to serve as early detection of disinfection failure. Samples can be taken from either basin #1 or #2 to allow for a basin to be offline for maintenance.

A streaming current detector (SCD) is installed to monitor coagulation effectiveness. It is capable of grabbing samples from either basin #2 or #3 to allow for a basin to be offline for maintenance.

Both the chlorine residual analyzer and the SCD have local readouts and a 4-20 mA signal that allows for SCADA monitoring.

Sedimentation

The GHWTP has three sedimentation basins with a total surface area of 18,750 square feet and a volume of 885,600 gallons per basin. Inclined tube settlers are used to increase the allowable overflow rate. The tube settlers are designed for a flow rate of 2 gpm/sf.

Launders are a "V" notch system. This is considered necessary to provide better flow splitting between basins. It also helps to release entrained air. At a weir-loading rate of 8-10 gpm/ft, 7 transverse launders cross each of the 3 basins.

A chlorine residual analyzer is located half way through the sedimentation process to monitor residual loss through the process. Data can be viewed locally or at SCADA.

Settled water is monitored at the combined settled water effluent channel. On-line analyzers check for NTU and chlorine residual. A sample is also continuously delivered to the Operator's Lab sink for bench top testing. The combined settled water chlorine residual, pH, and temperature are used along with the settled water detention time to calculate the CT value of the disinfection process through the GHWTP.

Continuous sludge removal is provided to alleviate taste and odor problems, allow for regular sludge disposal to the City sewer system, and reduce potential short-circuiting caused when sludge builds up in the basins. Each basin has a sloping floor with two parallel "Meurer" sludge removal units (6 total). The units are cable driven along a track on the basin floor. Sludge is withdrawn by siphoning flow through a flexible hose attached to the removal unit and discharged to the plant's reclaim tank or the City's sewage collection system.

Basins are completely emptied at least twice a year for maintenance of all submerged equipment.

Filters

The GHWTP has 6 dual-media filters with a surface area of 715 sqft each. The beds are made up of a top layer of anthracite coal (18"), sand (9"), and graded pea gravel (12"), all of which sits on a Leopold tile structure.

Individual Filter operation

In accordance with the CDPH letter dated July 13, 1998, the GHWTP shall reliably achieve at least 4-log Giardia reduction, 5-log virus reduction, and 2-log Crypto reduction through filtration and disinfection.

However, beginning with the completion of the permit amendment applied for on June 20, 2013, the CDPH has agreed to the following amendment:

The GHWTP will receive an additional 0.5-log Giardia and Crypto removal credit during any month that the combined filter effluent (CFE) 95th percentile turbidity level is less than or equal to 0.15 NTU, based on measurements recorded at fifteen (15) minute intervals. In addition, the plant shall receive an additional 0.5-log Giardia and Crypto removal credit during any month that the individual filter effluent (IFE) 95th percentile turbidity level for each filter is less than or equal to 0.15 NTU, based on measurements recorded at fifteen (15) minute intervals, and no individual filter has a measured turbidity greater than 0.3 NTU in two consecutive measurements taken 15 minutes apart.

Plant operators have control of actual filter efficiency by adding or removing filters from the process and by increasing or decreasing the run of each filter. The operator will know, at any given time, how each filter is performing by observing the turbidity, head loss, run time, valve position and water level. Operators will periodically clean the filters by backwashing. The criteria for taking an individual filter offline and placing it into backwash are any of the following:

- Prior to effluent turbidity reaching .3 NTU after the first fifteen (15) minutes in operation
- If the filter effluent NTU reaches .1 NTU any time after four hours in operation
- Headloss reaching 46 inches.
- At 70 hours of filter run time
- Re-establishing equal run time hours between filters.
- Maintenance or filter evaluation

Operators will maintain a filter operation log where they will record filter head loss, NTU, run hours, wash water used and the duration between start-up and production of less than 0.1 NTU for each start/stop time and date.

Filter Rate Control

Flow to the filters is equally distributed by weir plates located at the influent to each filter. Electrically operated filter effluent valves on each filter are controlled by SCADA to maintain a constant level in the filter. If flows were to increase, a corresponding rise in the filter level would occur. SCADA would respond by sending a signal to the effluent valves to open thus returning the filter level to the predetermined set point. If flows were to decrease, a corresponding drop in filter level would occur. SCADA would respond by sending a signal to the effluent valves to close thus returning the filter level to the predetermined set point.

Differential head loss gauges are provided on each filter and are monitored through SCADA. Standard operating procedure calls for operating the filters at no more than 46 inches of head loss.

Filter flow rates

2 filters on line if plant flow is less than 5 MGD for an extended period of time (multiple days)
3 filters on line up to 9 MGD (up to 2.9 gpm/sqft)
4 filters on line up to 12 MGD (up to 2.9 gpm/sqft)
5 filters on line up to 15 MGD (up to 2.9 gpm/sqft)
6 filters on line at 15+ MGD (2.9gpm/sqft @ 18 MGD)

More filters will be put online if water quality makes it difficult to achieve seventy (70) hour filter runs.

Filter Aid

A nonionic polymer is added prior to filtration and is typically dosed at 0.06 to 0.15 mg/l depending on settled water conditions, filter break-in times, filter headloss, and filter effluent turbidity. Feed pumps deliver it to the settled water effluent channel where a jet mixer pump disperses it evenly in the channel. Control is either manual or automatic, flow proportional through SCADA.

Support, Gravel & Media

There are approximately 12 inches of graded gravel, 9 inches of sand and at least 20 inches of anthracite coal. The bed is of standard design with sand of approximately 0.45 mm effective size, and coal l.0 to l.l mm effective size.

Under drains

Under drains are Leopold tile.

Backwash Troughs

All troughs are fiberglass. They are braced above the media to allow up to 50% bed load expansion without the expanded beds reaching the troughs.

Backwash Flow Measurement & Control

The overall backwash flow rate is 25-35 gpm/sqft. Typical backwash time length is approximately 20 minutes. Backwash flow is metered after it leaves the Wash Water Tank. Both flow rate and duration are adjustable and may be optimized by the operator, but generally an automatic backwash sequence is initiated by the operator through SCADA. During the sequence the following will occur:

- Surface wash agitation without back flow for 1 minute.
- Low flow with agitation for 1 minute.
- High rate backwash with agitation 8 minutes.

- High rate backwash without agitation 1 minute.
- Low rate backwash without agitation for 2 minutes.

Filter Surface Wash

Each filter is equipped with four filter surface wash units. The units are hydraulic and have trailing edge agitator nozzles to agitate and clean media during backwash. A rotation indicator is provided on each agitator. The indicator is above the backwash troughs and is clearly visible during backwash.

Filter Level Protection

In the event of a high filter water level event, SCADA will provide a visual and audible alarm at all SCADA work stations. The set points are layered to give the operator a warning before a second alarm is given. The same system is in place for a low filter water level event.

Wash Water Clarification and Return to Headworks

In accordance with the Filter Backwash Recycling Rule, spent backwash water is sent to the reclaim tank with the sedimentation basin sludge. A jet mixing system keeps solids in the reclaim tank in suspension for uniform delivery to the recycled water clarifiers. The clarifiers receive a rate of 250 to 600 gpm from the reclaim pumps. Flow rate and raw turbidity of the reclaimed water is monitored by SCADA and a proper anionic polymer dose is determined and delivered to the recycled water flow upstream of the clarifiers. Flocculation then occurs at the clarifier followed by settling through the "Lamella Plate Settlers". Effluent decant is monitored for continuously for turbidity. An operational goal of 2 NTU or less with recycled water below ten (10) percent of total plant flow has been set for water recycled to the head works (Flash Mixer # 1). Settled solids from the process are wasted to the sanitary sewer. Our current permitted level of total suspended solids disposal is 2085 lbs/day.

Pasatiempo Booster Pump Station

The Pasatiempo Booster Pump Station is designed to deliver treated water from the wash water storage tank to the Kite Hill tanks.

Pumping equipment consists of two horizontal centrifugal aurora pumps each with a capacity 1450 gpm. Surge control for each pump is provided by a solenoid operated pump control valve (Baily P.C.V.). A mechanical interlock prevents both pumps from running at the same time.

Elevator

An elevator to the basement is provided and is operated by a hydraulic cylinder. The carrying capacity is 8000 pounds. The power equipment, consisting of a pump storage tank and controls, is housed in a cabinet adjacent to the elevator wall in the basement. The elevator is serviced by the City's elevator service contractor.

Air Compressors

Compressed air is supplied by two Ingersoll Rand screw drive A/C units. Compressors are set up in a lead/ lag arrangement with start and stops pressure settings of 80 and 90. In the event of a plant power failure, compressors will need to be started by pressing the reset button and then the start button.

SCADA System

SCADA consists of Software by Invensys called Wonderware. It allows for monitoring, control, redundancy and data archiving. HMI's (Human to Machine Interfaces) allow State Licensed Operators to manually control processes or allow auto control of various systems. Most control actions are performed automatically by RTUs (Remote Telemetry Units) or by PLCs (Programmable Logic Controller). Control functions allow overriding depending on Security level intervention. For example, a PLC may control the flow of water through the Water Treatment Plant, but the SCADA system may allow operators to change the set points for the flow, and enable alarm conditions, such as loss of flow and high NTU's, to be displayed and recorded. The feedback control loop passes through the RTU or PLC, while the SCADA system monitors the overall performance of the loop. Data Acquisition begins at the RTU or PLC level and includes meter readings and equipment status reports that are communicated to SCADA as required. Data is graphically formatted so that the operator, using the HMI can make supervisory decisions to adjust or override normal RTU or PLC controls. Data is also archived to a Historian to allow trending and other analytical auditing combined with Reports.

PLC System

SCADA interfaces with the Plant PLC's, which are Schneider Electric's Modicon TSX Quantums. The Plant PLC's (Programmable Logic Controller) are programmed and monitored using ProworxNT software. The PLC's have redundancy and allow field devices to transmit their data to and from the Plant via Radios using Modbus Serial protocol.

Electrical System

Electrical power for normal plant operation is furnished by Pacific Gas and Electric Company from a 21 K.V. distribution line. At the plant a transformer station reduces the voltage to 480 V. A lighting transformer in the basement further reduces the voltage to 208/120 for equipment not operated at 480 V.

In the event of power outage in the Pacific Gas & Electric system, the 1500 K.W. emergency diesel generator starts automatically and provides power for plant functions. In the event of a power outage an automatic switchover device engages the power from the emergency generator. When power is restored from Pacific Gas & Electric, the automatic switchover device engages the main lines to PG & E power.

The uninterruptible power supply system (UPS) is a solid-state power supply system. The UPS consists of a rectifier/charger, battery bank, inverter, synchronizing equipment, protective devices, static bypass, and accessories to provide regulated uninterruptible electrical power to the programmable logic controller (PLC) and other equipment.

Plant Drainage and Sewage System

Most surface water is carried from the plant site by a system of culverts, gutters and ditches. An underground pipe system is used to collect drainage from paved area adjacent to the operations building and to carry it to the San Lorenzo River. An air actuated knife gate valve has been installed on this storm drain line near Filter # 1. This valve is normally closed to protect the storm drain system from possible chemical spills but will be open during rain events. All floor drains in the basement and the filter gallery are connected to the storm water drainage system. At the south end of the filter gallery a two-foot square opening vents to atmosphere near the base of the filtered water tank. This special drain was installed to accept flows of deluge proportion that might occur within the Treatment Plant. All drains on the ground floor are connected to the sanitary sewer system.

Heating and Ventilation

The mild climate of the Santa Cruz area, free from extremes of either heat or cold, permits the use of a reasonably simple heating and ventilating system. The few complexities built into the system are necessary because of the varied heating and ventilating requirements of the different functions performed in the operations building.

The hot water used to operate all the heating devices is produced in a gas-fired boiler in the boiler room. The boiler is equipped with standard controls. The controls consist of a water temperature controller, low water cut-off, and gas firing controls, including gas safety shutoff.

Hot water is pumped from the boiler to the heating coil system in the basement and to the suction of a second circulating pump, which delivers water to unit heaters and convectors throughout the building. Make-up water is added automatically to the hot water return to the boiler.

A heating and ventilating unit is used to deliver warm air to most of the building. Heating for rooms without ventilation is provided by hot water coils in the air ducts and is controlled by individual thermostats in the rooms being served. Approximately 65 percent of the output is taken from the lobby and basement and returned to the unit where it is mixed with fresh air and reheated. Air from the washrooms, locker room, and feeder room is continuously exhausted outside the building to ensure that no air from these sources is returned to the heating and ventilating system.

A wall mounted convector maintains temperature in the anionic polymer feed room 5 to 10 degrees F above that in the ACH feed room. This unit is equipped with a manually set thermostat. Ventilation in the anionic feed room is provided by an exhaust fan. No provisions have been made for heating the ACH feed room room.

CHEMICAL FEED SYSTEMS

Disinfection

The primary disinfectant at the GHWTP is sodium hypochlorite (NaOCL). It is delivered in 2,500 to 5,000 gallon bulk tankers at 12.5%. From the GHWTP 6,500 gallon storage tank, it is run through a dilution panel where it is diluted to 0.8% and transferred to a 5,580 gallon day tank. Both the Pre and the Post sodium hypochlorite feed systems have two positive displacement pumps for redundancy. The pumps can be operated by a 4-20 mA flow paced signal or manually at the MCC. There are two hypochlorite injection points available at the plant; the pre-chlorination solution is added at rapid mixer #2 (FM#2), with the post-chlorination solution added at the filtered water clear well.

Chlorine Residual Analyzer

Residual chlorine is monitored throughout the treatment process. Pre-chlorine is added to flashmixer #2 and the residual is measured in the flocculators and displayed in real time on the SCADA interface. Two-thirds of the way through the sedimentation basins, the residual is measured again, and also displayed in real time on the SCADA interface. The residual of the combined sedimentation basins effluent is measured upstream of the filtration process by an online residual analyzer and displayed in real time via the SCADA interface. After the water has been filtered and post-chlorinated, the residual in the clearwell is measured with an online analyzer and displayed in real time on the SCADA interface. Each display on SCADA has multi-level alarm settings to alert the Treatment Plant Operator of any changes in chlorine residual.

Activated Carbon

Powdered activated carbon (PAC) is very effective in removing most tastes and odors in raw water. It is generally used in dosages ranging from 5 to 10 mg/L. PAC is delivered in bulk shipments of 20 to 25 thousand pounds. The carbon is unloaded by air pressure into a 50,000 gallon carbon slurry tank. A carbon dust collector is on the top of the carbon slurry tank to prevent carbon dust from venting to atmosphere. The carbon is mixed immediately with water creating a slurry. Air spargers and mechanical mixing devices are used to keep the carbon in suspension during prolonged periods of storage and to minimize the plugging of carbon feed lines during carbon treatment of the water.

A TSS analysis is used to determine the concentration of carbon in pounds per gallon of slurry. The plant operators establish carbon feed rates from taste and odor (T & O) testing and other data.

Carbon Slurry Feeder

The carbon feeder includes a day tank that is fed through a solenoid valve off the recirculation piping from the carbon slurry storage system. A rotary dipper wheel is utilized for transferring carbon slurry from the day tank over a baffle wall into a gravity discharge section. The feed rate is flow paced and adjusted by values set in SCADA or manually at the carbon feeder control panel. An electric mixer is provided along with an air sparging system to keep the carbon in suspension while in the day tank.

Carbon slurry's primary function is to quench any residual $KMnO_4$ leaving the taste and odor contactors. It is also used during periods of extreme odor scenarios when feeding $KMnO_4$ isn't sufficient.

Liquid Alum (Acidified) Feed System

Acidified Aluminum sulfate (Alum) is the primary coagulant used at the WTP. Alum feed equipment consists of two double walled 6,500 gallon storage tanks and two chemical metering pumps mounted on a stainless steel skid. Included is a 300 gallon plastic day tank with a calibration cylinder. The metering pumps are hydraulically actuated positive displacement diaphragm type. The pump and accessories are corrosion resistant. The metering pumps are flow paced from values entered into SCADA or can be manually controlled by using a Dart motor control unit located in the Chemical feed room. Alum is injected without the use of process water at either flash mixer #1 or #2. Normal mode of operation is to feed Alum at flash mixer #2, however in times of extreme raw turbidity, the Alum can be moved to flash mixer #1 and the taste and odor control mixers used as primary flocculators. Flash mixer #2 should be turned off when operating in this mode.

Liquid Aluminum Chlorohydrate

Liquid Aluminum Chlorohydrate (ACH) is used as a primary coagulant to achieve high quality settled water when high dosages of alum are prohibited due to the treated water pH limits set in the Corrosion Control Program permit. ACH is currently fed directly from 275 gallon totes into FM#1 via a positive displacement pump. The system can be run manually or flow paced through SCADA. The dose is calculated every two hours by the Water Treatment Operator.

Cationic Polymer Feed System

Cationic polymer is fed as a coagulant aide to the Alum. 250 gallon totes of cationic polymer are ordered. The totes are mixed in a 2250 gallon storage tank and mixed with an equal amount of process water. The cationic polymer is pumped from the storage tank by a positive displacement flow-paced diaphragm pump. It is injected into a process water stream that goes through a static inline mixer and is fed just upstream of the Alum at flash mixer #2.

Filter Polymer Feed System

A nonionic polymer system feeds from a 500 gallon storage tank. The feed system consists of two flow paced positive displacement metering pumps and an inline static mixer. The feed rate is controlled by a 4-20 mA signal, proportional to flow. It also has a HAND-OFF-AUTO switch for manual override. The injection point is located in the settled water channel, just before the separation point for the east and west filters.

Corrosion Control System

Monosodium phosphate (MSP) is used at the GHWTP for distribution system corrosion control. Bulk deliveries of MSP are received and stored in a six thousand (6,000) gallon tank. A day tank in the GHWTP chemical feed room is filled, via float valve, from the bulk storage tank. Positive displacement metering pumps feed the MSP from the day tank into the treatment plant clearwell. The MSP metering pumps normally operate in a SCADA controlled, flow paced, auto mode. Pumps may be set in manual mode for maintenance operations. The MSP is fed continuously. In the distribution system, available orthophosphate (PO_4) forms a barrier film (copper phosphate and lead phosphate) on the pipe wall surface thus preventing further corrosion. Water Quality Section staff report PO_4 sampling results and feed rates to the State on a quarterly basis.

Potassium Permanganate

The potassium permanganate ($KMnO_4$) feed system includes a dust collector and hopper, hopper vibrator, and an Acrison volumetric feeder with wetting cone. The feeder is utilized to meter the dry $KMnO_4$ into the wetting cone. The metered $KMNO_4$ is continuously washed down into the outlet of the wetting cone where an eductor is used to turbulently mix the chemical with process water and convey the solution to flashmixer #1. The simplex storage hopper is a one piece welded steel unit with a closed hinged top access for filling. The loading area for the $KMnO_4$ has an atmosphere filtration unit that keeps the air clean for the operator loading the hopper. In addition to this, operators are required to wear respirators while loading $KMnO_4$.

The dust collector within the hopper itself is a Unimaster UMA 40 H dust control unit. The collector has a capacity of 300 cuft per minute and a polypropylene filter cloth area of 40 sqft. The collector discharge fan is filtered with a removable transition piece. Exhaust for the dust collection unit is located outside the building in the rear parking lot.

LABORATORY PROCEDURES

The GHWTP treatment operators perform process control lab reads every two hours. Via a centralized sample station, raw water sources, settled water, and finished water grab samples are monitored for turbidity, temperature, pH, alkalinity, color, odor, and disinfectant residuals. In addition to the bi-hourly gab sample analysis, operators perform jar tests, $KMnO_4$ demand tests, UV analysis for surfactants, suspended solids and BOD, and process TOC samples.
Treatment operators preform checks of their bench top NTU meter and chlorine residual colorimeter against secondary standards daily as well as pH meter calibrations. Primary standards are used to calibrate the bench top NTU meter on a bi-monthly basis (or in accordance with manufacturer recommendations) and/or when it is determined to be out of range of the secondary standards by more than five percent. Raw water, Recycled water, Settled water, Individual filter effluent, and the combined filter effluent turbidity meters are calibrated with primary standards at least every three months (or in accordance with manufacture recommendations) and/or if they become out of secondary standards range by more than five percent.
GHWTP treatment operators are responsible for handling chemical deliveries. Bulk chemical deliveries are received and analyzed by the operators for chemical strength and/or specific gravity with hydrometers. Results are compared with certificates of analysis before authorization of offloading. Operators are trained on and required to use personal protective equipment (PPE) when dealing with hazardous chemicals. Material Safety Data Sheets (MSDS) are kept on site for all chemicals used at the GHWTP and supervisory staff preforms annual hazardous communication training for employees. Eyewashes and safety showers are located in the chemical feed room, the bulk chemical storage area, and the bulk chemical offloading station with an additional eyewash in the operators' lab. Standard operating procedures (SOP) are made readily available, reviewed regularly, and updated as needed for laboratory procedures.

In addition, the City of Santa Cruz Water Department Water Quality section operates a State certified water quality laboratory with qualified staff. The Water Quality staff perform regulatory sampling at the GHWTP and in the Distribution System. Their procedures and sampling plans are separate from this GHWTP operations plan.

PROCEDURES USED TO DETERMINE CHEMICAL DOSE RATES

Acidified Aluminum Sulfate (Alum) is the primary coagulant used at the GHWTP. The dose rate is determined through jar testing and plant performance monitoring. A streaming current detector (SCD) samples the charge of the flocculation basin and is displayed on the operator's SCADA screen. The SCD will alarm the treatment plant operator, via the SCADA system, when the charge of the flocculation basin is out of the desired range.

Both pounds per hour and mg/L are calculated and recorded every two hours by the treatment plant operators. The alum feed rate, the flow pacing signal, as well as the RPMs of the feed pumps are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems. Alum is typically fed into the treatment process at Flash Mixer #2, directly upstream of the flocculation basins.

The Alum dose is calculated on a neat product basis for lbs/hr and mg/L using the following formulas:

(ml/min x 60 min/hr)(0.00282 lbs/ml) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Liquid Aluminum Chlorohydrate (ACH) is used as a primary coagulant to achieve high quality settled water when high dosages of alum are prohibited due to the treated water pH limits set in the Corrosion Control Program permit. ACH is currently fed directly from 275 gallon totes into FM#1 via a positive displacement pump. The system is run either manually or flow paced through SCADA with the dose calculated every two hours by the Water Treatment Operator.

The ACH dose is calculated on a neat product basis for lbs/hr and mg/L using the following formulas:

(ml/min x 60 min/hr)(0.00295 lbs/ml) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Liquid Cationic Polymer is used as a coagulant aid at the GHWTP. The dose rate is determined through jar testing and plant performance monitoring. A streaming current detector (SCD) samples the charge of the flocculation basin and is displayed on the operator's SCADA screen. The SCD will alarm the treatment plant operator, via the SCADA system, when the charge of the flocculation basin is out of the desired range.

Both pounds per hour and mg/L are calculated and recorded every two hours by the treatment plant operators. The cationic polymer feed rate, the flow pacing signal, as well as the RPMs of the feed pumps are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems.

The neat polymer is diluted one-to-one with potable water into a feed tank then pumped into the treatment process at Flash Mixer #2.
The cationic polymer dose is calculated on a neat basis using the following formulas:

(diluted polymer ml/min) x (60 min/hr) x (0.0011 lbs/ml of polymer in dilute solution) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Liquid Anionic Polymer is used as a recycled water coagulant aid at the GHWTP. The dose rate is determined by monitoring the combination of the raw recycled water quality, and the recycled water clarifier performance. Over feeding anionic polymer could affect the downstream coagulation process of the GHWTP. The streaming current detector (SCD) in the flocculation basin is used to monitor for such events and to alert the treatment operator to respond.
The anionic polymer scale is read and recorded every two hours by the treatment plant operators. The anionic polymer flow pacing signal, as well as the polymer scale are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems.
The neat polymer is pumped into potable water fed delivery lines that feed into the treatment process upstream of the recycled water clarifiers.
The anionic polymer dose is calculated on a neat basis using the following formula:

(lbs/hr x 24hrs) / (Recycled water MGD x 8.34 lbs/gal) = mg/L

Liquid Filter Aid Polymer is used at the GHWTP. The dose rate is determined by monitoring the combination of filter break-in times, filter headloss, and the filtered water quality.
Both pounds per hour and mg/L are calculated and recorded every two hours by the treatment plant operators. The filter aid polymer feed rate, the flow pacing signal, as well as the RPMs of the feed pumps are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems. The neat filter aid polymer is diluted with potable water to a 0.5% solution (0.042 lbs/gal or 0.000011 lbs/ml).
The diluted polymer solution is pumped into potable water fed delivery lines that feed into the treatment process upstream of the filters.
The filter aid polymer dose is calculated on a neat basis using the following formula:

(filter aid ml/min) x (60 min/hr) x (filter aid lbs/ml) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Monosodium Phosphate (MSP) is used at the GHWTP for distribution system corrosion control. The MSP does rate is set at 0.50 mg/L and is fed directly into the GHWTP clearwell. The City of Santa Cruz Water Quality Lab (WQL) monitors the available orthophosphate (as PO4) in the distribution system. Feed rate may be adjusted based on WQL results.
Both pounds per hour and mg/L are calculated and recorded every two hours by the treatment plant operators. The MSP flow pacing signal and the feed pump speeds are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems.
The MSP dose is calculated based on available PO4 using the following formulas:

(MSP ml/min) x (60 min/hr) x (MSP lbs/ml) x (% available PO4) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Powdered Activated Carbon (PAC) is used for taste and odor control at the GHWTP. Treatment operators perform odor tests every four hours, more regularly if needed, to determine the appropriate dose rate.
Both pounds per hour and mg/L are calculated and recorded every two hours by the treatment plant operators. The PAC flow pacing signal and feed system speed are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems.
The PAC is liquefied with potable water and kept in a suspended slurry. The slurry is fed into the treatment process at either Flash Mixer # 1 or Flash Mixer # 2, dependent on the raw water quality and the effectiveness of the potassium permanganate for taste and odor control.
The PAC dose is calculated on a pounds-of-carbon basis using the following formulas:

(slurry gal/min) x (60 min/hr) x (pound of carbon/gal of slurry) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Potassium Permanganate (KMnO4) is used as a pre-oxidizer and for taste and odor control at the GHWTP. Treatment operators perform permanganate demand tests routinely as well as odor and color tests every four hours, more regularly if needed, to determine the appropriate dose rate. An online permanganate residual analyzer monitors the KMnO4 residual of Carbon Contactor #6, next to Flash Mixer # 2.
Both pounds per hour and mg/L are calculated and recorded every two hours by the treatment plant operators. The KMnO4 flow pacing signal and feed system speed are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems.
The KMnO4 dose is calculated using the following formulas:

(KMnO4 gm/min) x (60 min/hr) / (454 gm/lbs) = lbs/hr

(lbs/hr x 24hrs) / (MGD x 8.34 lbs/gal) = mg/L

Sodium Hypochlorite (NaOCl) is used at the GHWTP for pre and post disinfection. Bulk 12.5% NaOCl is stored onsite and is diluted to a 0.8% feed solution. Treatment operators sample each diluted batch to determine the strength for use in their dosing calculations. The NaOCl dose changes throughout each shift based on raw water quality, weather conditions, and changes to other chemical dosages. Operators calculate the CT ratio through the GHWTP to ensure adequate disinfection and to avoid unnecessary over dosing which could lead to higher disinfection byproduct formation. Online free chlorine residual analyzers sample the GHWTP flocculation stage, settled water, combined settled water, and clearwell.

Both pounds per day and mg/L are calculated and recorded every two hours by the treatment plant operators. The NaOCl feed rates and dosing pumps status are monitored through the SCADA system at all times with alarm levels set to notify the shift operator of problems.

The pre and post NaOCl doses are calculated using the following formulas:

$$(\text{gal/min}) \times (1{,}440\ \text{min/day}) \times (\text{lbs/gal}) \times (\%\ \text{strength}) = \text{lbs/day}$$

$$(\text{lbs/day}) / (\text{MGD} \times 8.34\ \text{lbs/gal}) = \text{mg/L}$$

RECORDS

The GHWTP's SCADA system records and archives treatment plant performance data for regulatory reporting, trending, and process review. Individual filter turbidity, combined filter effluent turbidity, settled and filtered water disinfectant residuals, and plant flow rates are all monitored continuously.

All filter turbidity performance triggers and required actions will be recorded by the Water Treatment Operators in the Operator's logbook, the Filter Log Sheets, and the GHWTP monthly report to the California Department of Public Health (CDPH). Filter runtimes, hours of operation, and backwash volumes will be recorded in the Filter Log Sheets. Dates of filter maintenance and inspections will be maintained at the GHWTP by the Chief Plant Operator. All records will be retained for a minimum of three (3) years and no records will be discarded or deleted without the consent of the Water Department's Operations Manager.

Adequate records of operation and maintenance procedures are retained to evaluate plant performance and minimize expenditures for labor, power, and replacement parts. Daily records provide a detailed reporting of operations and events, which are used to evaluate plant performance. Record for preventive maintenance services for each item of equipment is also a necessity. Such a record reduces the possibility of oversight or neglect and serves as a guide in determining causes of abnormal wear and breakdown. Preventive maintenance is discussed in detail in the maintenance section of these instructions.

Operators Log

The Operators Log contains all data pertaining to the operation of the plant and related stations. It must be kept in mind that the daily report might be used as a legal record of plant operation and performance. This report includes such items as the operator responsible for running the plant for the specified shift, facilities and equipment in service, sources of supply in use, any test or duty performed by personnel, description of maintenance work accomplished, accidents, and any unusual occurrence. Changes in water quality should be noted, as well as equipment malfunctions.

Quality Control Record

Entries are made in the daily lab reads record every two hours. Measurements of turbidity, chlorine residual, pH, alkalinity, temperature, color and odor, are made on raw, settled, and filtered water. Chemical dosage readings are also logged and compared with the information presented on SCADA.

Daily Production Report

This report includes storage volumes of distribution reservoirs, Loch Lomond volume, daily source production, daily consumption and Felton diversion pumping volume. Also included are precipitation data measured at the GHWTP.

Filter Wash Record

Each time a filter is washed operators will record the time, date, final turbidity, head loss and filter run time at termination of the filter run, which is designated at the closing of the effluent valves. The volume of wash water used will be determined by the difference in the wash water tank level after the backwash. When placing a filter in service, which is designated at the opening of the effluent valves, the operator will record filtering duration needed for the filter turbidity to stabilize below 0.10 NTU. Also, any unusual conditions related to the filters should be noted.

RESPONSE TO PLANT AND WATERSHED EMERGENCIES

From time to time conditions may occur that will require emergency action on the part of the plant operator to keep the public and coworkers safe. If such a condition exists, the operator should not hesitate to call for backup in the form of supervisors, on call personnel and other operators.

Power Loss

Another emergency condition that may occur is a loss of power. As previously indicated the emergency generator will start automatically and provide power. Whenever a power outage occurs, even though momentary in nature, all electrical equipment might shut off during the lag time in which the generator is reaching full operation. When power is restored either by the emergency generator or by the resumption of normal service, all automatically controlled equipment will restart in response to normal control signals. Manually controlled equipment which is started by means of maintained contactor selector switches will restart on resumption of power if it was running at the time of the outage. Flash mixers, carbon contact mixers, flocculators, and the reclaim mixer pump may need to be restarted by the plant operator. The plant processes should all be checked for abnormalities following any power interruption.

Earthquakes

The City of Santa Cruz Water Department Earthquake Response Inspection Procedure Policy is available at the WTO's main work station (the Ops stage). This policy establishes a uniform procedure regarding the investigation of critical facilities after locally-felt earthquakes and compliments the department-wide General Emergency Plan. The GHWTP WTO is responsible for the completion of the Earthquake Response Inspection and will implement the procedures outlined in the policy.

Water Department General Emergency Plan

The City of Santa Cruz Water Department General Emergency Plan and Emergency Response Plan for Terrorist Activity and Natural Disasters is also kept at the Ops stage. This plan describes the role and operation of the Water Department during the course of major emergencies. This plan provides response procedures for earthquakes, tsunami sea waves, floods, fires, contamination of water supplies, civil disturbances, terrorist activities, and natural disasters and will be implemented during such incidents.

Chemical Safety

Operators handle the off-loading of chemicals, operation of chemical feed equipment, and the daily chemical inventory. All operators are familiar with material safety data sheets, personal protection equipment (PPE), and chemical leak response procedures. Operators are provided safety awareness training through our Target Safety Program and at biweekly safety/tailgate meetings.

Chemical Spills

Chemical releases are controlled in accordance with the GHWTP Spill Prevention Control and Countermeasures (SPCC) plan. Secondary spill containment is provided for all bulk chemical tanks, day tanks, chemical feed systems, and the emergency generator fuel tank. Each containment structure conforms to the County of Santa Cruz Hazardous Material Storage Ordinance. Storage areas provide for separation of incompatible materials. Weekly above ground storage inspections (WAGSI) are performed and recorded. Bulk tanks, overflow alarms, and secondary containment areas are checked and follow-up action is taken when necessary.

Neither the carbon slurry re-circulation pumping system nor the chemical unloading station has secondary containment. Therefore, the storm drain isolation valve was installed and will remain normally closed unless rain is expected. Accordingly, any spill requires that the operator isolate the storm drain system with the storm drain isolation valve at Filter # 1 and notify the proper authorities.

Watershed Spill Response Procedure

In the event that the GHWTP Water Treatment Operator (WTO) receives notification that there has been a serious contaminant spill in or near any of the City of Santa Cruz Water Department raw water sources, they must discontinue use of that source and begin a log of the incident by gathering the following information:

- Time of notification
- Name, phone number and affiliation of calling party
- Time, composition and quantity of spill
- Whether or not County Com. has been notified (if not call them)
- Contact information for follow-up, and ask to be notified with updates

If alternate sources are available, the GHWTP WTO will switch raw water sources and continue normal plant operation while noting any new information received about the incident. As soon as possible the WTO will notify a supervisor (CPO, Production Superintendent, Operations Manager, Water Quality Manager) and the Watershed Compliance Manager. A decision will them be made as to what actions should take place prior to continued use of the affected sources.

If the WTO should need any help during such an incident that takes place after-hours, they will call the after-hours duty person as well as notifying a supervisor and the Watershed Compliance Manager. Ultimately, County Com. should be the main contact for incidents.

DISINFECTION MONITORING (CT VALUES)

At the GHWTP, CT calculations are used to determine the log inactivation of Giardia Lamblia Cysts by free chlorine. The GHWTP is required by the California Department of Public Health (CDPH) to achieve 1.5 log inactivation of Giardia Lamblia Cysts through free chlorine disinfection. GHWTP CT is calculated by multiplying the effective contact time through the flocculators and sedimentation basins in minutes by the chlorine residual of the Settled water. The CDPH supplied CT Data Excel spreadsheet will calculate the required CT value, the calculated CT value, the CT Ratio, and free chlorine log inactivation when the operator enters the Plant flow, number of basins online, and Settled water temperature, pH, and free chlorine residual. A CT Ratio of one (1) or higher must be maintained at all times to reliably ensure the minimum log removal required by the CDPH. A CT ratio of less than one (1) compromises the GHWTP's mulitbarrier treatment process required by section 64652, Title 22 California Code of Regulations.

- **The operator on shift is responsible for maintaining the CT ratio above one (1) at all times.**
- The CT Ratio is to be calculated and entered every two hours on the Operator Lab Reads sheet.
- In an attempt to lower DBP formations through the treatment process, our target CT Ratio is between 1.5 and 2.0.
- **The Operator will ensure the free chlorine residual of the Settled water is maintained above the goal of 0.20 mg/L entering the filters.**
- The Graveyard shift Operator is responsible for filling out the CT Data Excel Spreadsheets for the previous day using the highest daily flow and the corresponding Settled water temperature, pH, and chlorine residual. See instructions on CT Data spreadsheet.
- Operators are expected to understand the effects of changes in disinfectant contact time, temperature, pH, and chlorine residual in relation to CT Ratio calculations, and will operate the GHWTP in anticipation of such changes.
- Operators are expected to understand the effects of changes in source water quality, weather, and chemical feed dosages in relationship to the variables used to calculate the CT Ratio.
- Operators will calculate the anticipated CT Ratio prior to flow changes to ensure flow changes will not result in a CT Ratio of less than one (1).
- Operators will monitor the chlorine residual analyzers throughout the treatment process and will verify the reading with grab samples during the Lab Reads every two hours.
- Operators will pay close attention when taking a basin off-line or putting a basin on-line. And will calculate the anticipated CT Ratio before making a change.

On March 17, 2014, the City received a letter from the CDPH accepting a proposed permit amendment to increase the Giardia log removal credit for the GHWTP from 2.5-log to 3.5-log based on filter performance, and to reduce the Giardia log inactivation achieved through disinfection from 1.5-log to 0.5-log. The approval to reduce Giardia log inactivation achieved through disinfection is conditional on meeting the 95th percentile turbidity standard of 0.15 NTU of the CFE and the IFE each month with no IFE turbidity measurements greater than 0.3 NTU in two consecutive measurements taken 15 minutes apart.

DISINFECTION FAILURE

The State of California Surface Water Filtration and Disinfection Treatment Regulations have been adopted and are effective as of June 5, 1991. Section 64660 (c)(2) requires all water suppliers to develop an emergency plan to be implemented in the event of a disinfection failure in order to prevent the delivery of un-disinfected or inadequately disinfected water to the distribution system. The plan must be posted in the treatment plant and a copy submitted to the State Office of Drinking Water. To meet this requirement our existing procedure has been updated and expanded. This plan should be read and understood by all operating personnel.

EMERGENCY PLAN FOR DISINFECTION FAILURE

The operator will not allow improperly disinfected water to enter the distribution system. Improperly disinfected water is defined as treated water that not been disinfected to a CT Ratio of one (1.0) or higher or plant effluent having a free chlorine residual less than a 0.2 mg/L. When the operator has determined that this condition exists or can be expected to exist, the operator will take the following actions:

1. Verify that the condition exists and determine the source of the failure.

2. If a **disinfection pumping failure** has occurred, inspect all disinfection feed pumps and drives for proper function and switch over to backup equipment as needed.

    a. Both the Pre and the Post disinfection systems have backup dosing pumps standing by. Each pump is on its own drive and can be used by opening the suction and discharge valves at the pump head and switching the HOA selector to H or A for manual or SCADA control.
    b. If a problem develops with the Pre or Post backup pump, ball valves located in the Clarifier polymer feed room will be positioned to allow Pre disinfectant to be fed into the Post feed line (or vice versa). In this scenario the valves will be throttled to distribute the desired disinfectant flow to the Pre and Post application points. Running both Pre or both Post pumps together may be needed to meet demands.

3. If a **disinfection piping failure** has occurred, inspect piping to locate the failure.

    a. PVC pipe and fittings are stored on site. Call in maintenance staff as needed to repair piping and notify the Water Treatment Supervisor.
    b. Manually disinfect with one gallon jugs of 12.5% bleach while repairs are underway.
    c. For manually dosing Pre disinfectant, bleach will be added initially to FM#2. Additional bleach may be added to the flocculators and/or the sedimentation basins to maintain a CT ratio above one (1.0).
    d. For manually dosing the Post disinfectant, bleach should be added directly upstream of the tube settlers to allow for mixing in the settled water channels.

Formula for manually dosing with 12.5% bleach:

$$\text{ml/min} = \frac{(\text{MGD})(\text{mg/L})(8.34)(3785\ \text{ml/gal})}{(.125)(10\ \text{lbs/gal})(1440\ \text{min/day})}$$

4. If a **disinfection storage tank failure** has occurred, immediately notify the Water Treatment Supervisor, the Maintenance Supervisor, and the Water Production Superintendent.

    a. If needed, manually disinfect with one gallon jugs of 12.5% bleach as stated in the piping failure instructions above.
    b. Maintenance staff and Supervisors will set up temporary storage and call for emergency delivery of disinfectant if needed.
    c. Empty 275 gallon totes are stored near the GHWTP Filtered Water tank for emergency chemical spill recovery and can be plumbed into existing hypo feed system dilution panel if needed.

5. If repair time will exceed one (1) hour, and manually dosing with one gallon jugs of bleach is not possible, effect a plant shut down. Inform the Treatment Supervisor, Production Superintendent, and Water Quality Manager of the situation. Call in maintenance staff as needed to make repairs. Call County Comm (9-1-1) to notify the Fire Department of the plant shutdown.

6. If access to the plant is restricted due to emergency conditions such as a serious chlorine leak, or other major problem and plant shut down is necessary, shut down the sources of supply manually. A loss of flow to the Treatment Plant will effectively shut off flow from the Treatment Plant to the distribution system.

RELIABILITY FEATURES

Power Supply

In the event of power outage in the Pacific Gas & Electric system, the 1500 K.W. emergency diesel generator starts automatically and provides power for plant functions. In the event of a power outage an automatic switchover device engages the power from the emergency generator. When power is restored from Pacific Gas & Electric, the automatic switchover device engages the main lines to PG & E power.

The uninterruptible power supply system (UPS) is a solid-state power supply system. The UPS consists of a rectifier/charger, battery bank, inverter, synchronizing equipment, protective devices, static bypass, and accessories to provide regulated uninterruptible electrical power to the programmable logic controller (PLC) and other equipment.

The GHWTP SCADA system also has redundant PLCs for maintenance and/or failures.

Chemical Feed Systems

All vital GHWTP chemical feed systems are required to have backup dosing pumps for redundancy and are able to operate both through flow-proportional SCADA control (auto) and by local manual settings (manual).

Alarms

SCADA alarms are set at multiple set points for coagulation, filtration, and disinfection failures. The SCADA alarms will notify the GHWTP WTO of problems. The WTO will then take corrective action or shut the GHWTP down (if necessary to protect public health) until corrective action can be taken.

Standby Replacement Equipment

The GHWTP will have standby replacement equipment available to assure continuous operation and control of the coagulation, filtration, and disinfection unit processes.

Continuous Turbidity Monitoring and Recording

The GHWTP has low range turbidity meters on each side of each of its six (6) bifurcated filters. These twelve meters, as well as the combined filter effluent low range turbidity meter, are monitored continuously and recorded by the SCADA system.

Multiple Filter Units

The GHWTP has six (6) dual media filters with 715 square feet of surface area each. Operating procedures call for all six filters to be in service when the GHWTP is filtering at a rate above fifteen (15) MGD. Because the annual average filter rate for the GHWTP is ten (10) MGD, one or two filters are usually backwashed and ready to be put online when another filter is taken offline. When all six filters are in service, a filter requiring backwash will be backwashed with the filter effluent valves closed but the influent valve open. This still provides the same quality backwash but does send more water to the Reclaim Tank.

Appendix D: Modeling Support of the Water Quality Blending Study; Supply Trace and Water Age

SOQUEL CREEK WATER DISTRICT

HYDRAULIC MODELING
ANALYSIS FOR WATER QUALITY

WATER QUALITY AND TRACE ANALYSIS

FINAL

May 2016

AKEL
ENGINEERING GROUP, INC.

Soquel Creek Water District
Hydraulic Modeling Analysis for Water Quality

TABLE OF CONTENTS

Table 1 Water Quality Modeling Assumptions

Modeling Support of the Water Quality Blending Study

Soquel Creek Water District

Modeling Assumptions

- Minimum Month Demands, 2.153 MGD. (Observed December 2015)
- Shoretrails PRV to be turned off for intertie scenarios
- Wells to be turned OFF in the following priority:
  1. Ledyard and Madeline
  2. Estates
  3. Tannery
  4. Aptos Creek and T-Hopkins
  5. Country Club
  6. Rosedale
- Seascape, Altivo, and Sells wells are assumed out of service due to no CR6 Treatment
- Water Age scenarios to be ran for 120 days (To match planned intertie operation)
- City of Santa Cruz: Beltz Wells Turned OFF
- Aptos pump station (500 - 600 gpm) to be inactive in Scenarios 1 and 2 and active in Scenario 3
- Aptos Village pipeline improvements in place
- Vista Mar Pump Station operating under Time of Use Controls

Modeling Scenarios

Aptos Pump Station Inactive

- Scenario 1: Water Age analysis for the Existing System
- Scenario 2: Water Age analysis for the O'Neill intertie

Aptos Pump Station Active

- Scenario 3: Water Age analysis for the O'Neill intertie

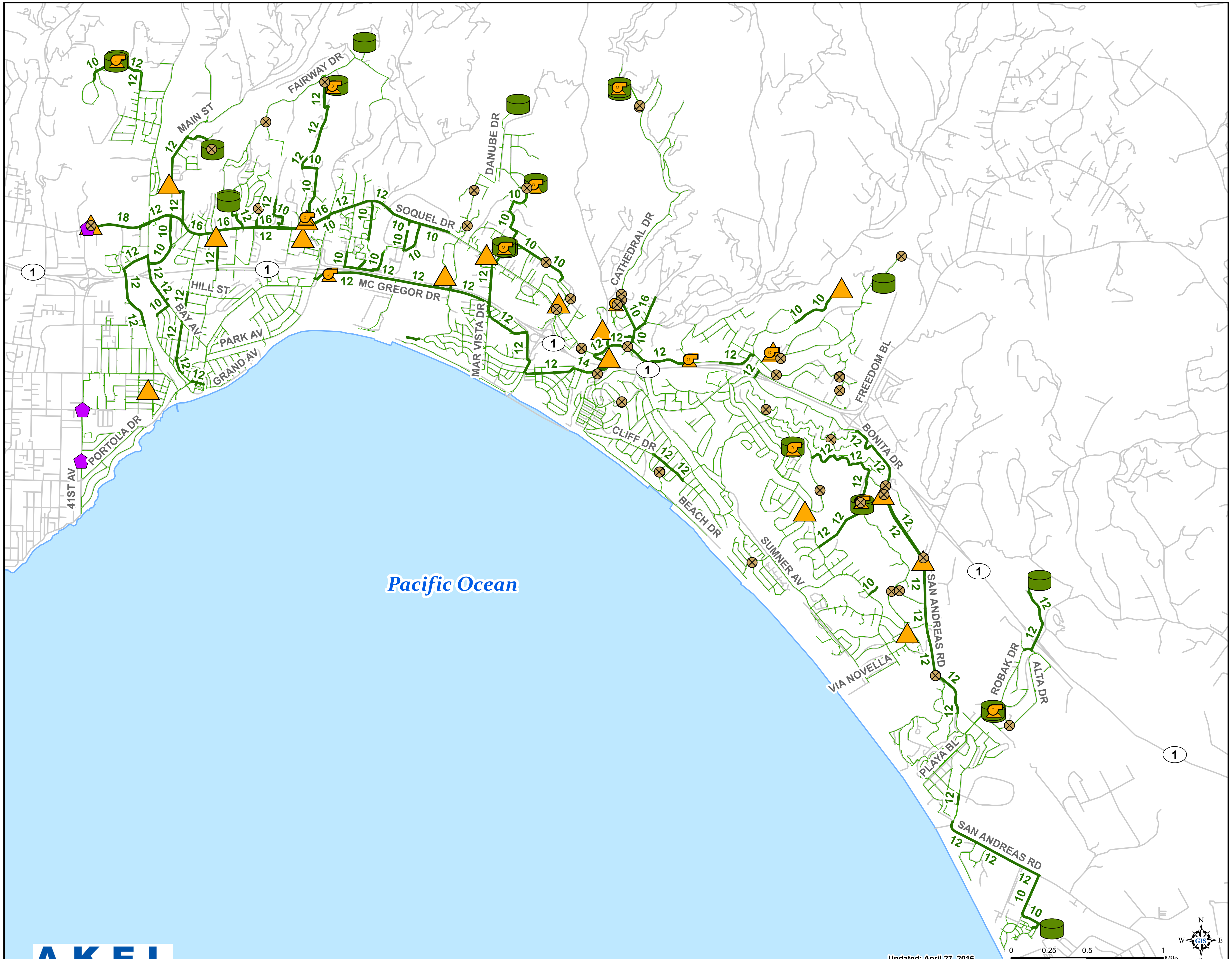
5/4/2016

Table 2 Maximum Tank Water Age

Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

Tank	Maximum Water Age		
	Scenario 1 (days)	Scenario 2 (days)	Scenario 3 (days)
Sub Area 1			
Ironwood	42	40	39
Pringle	49	16	16
Crestline 1 & 2	7	6	6
Fairway	35	33	32
Cornwell	14	10	10
Austrian Way	16	16	15
Sub Area 2			
Monte Toyon	90	65	65
Mar Vista 1 & 2	13	8	5
Park Wilshire	48	41	40
Sub Area 3			
Rio del Mar Estates	12	12	15
Seascape	35	35	39
Vista del Mar	11	11	13
Sub Area 4			
Aqua View 1 & 2	9	9	9
Canon del Sol	18	18	18
Larkin Valley	36	36	36

5/4/2016



Legend

Existing

- Tanks
- Wells
- Pump Stations
- Interties
- Valves

Pipes by Size

- 8" or Smaller
- 10" or Larger
- Streets
- Ocean

Figure 1
Existing Water System
Hydraulic Modeling Analysis for Water Quality

SOQUEL CREEK WATER DISTRICT

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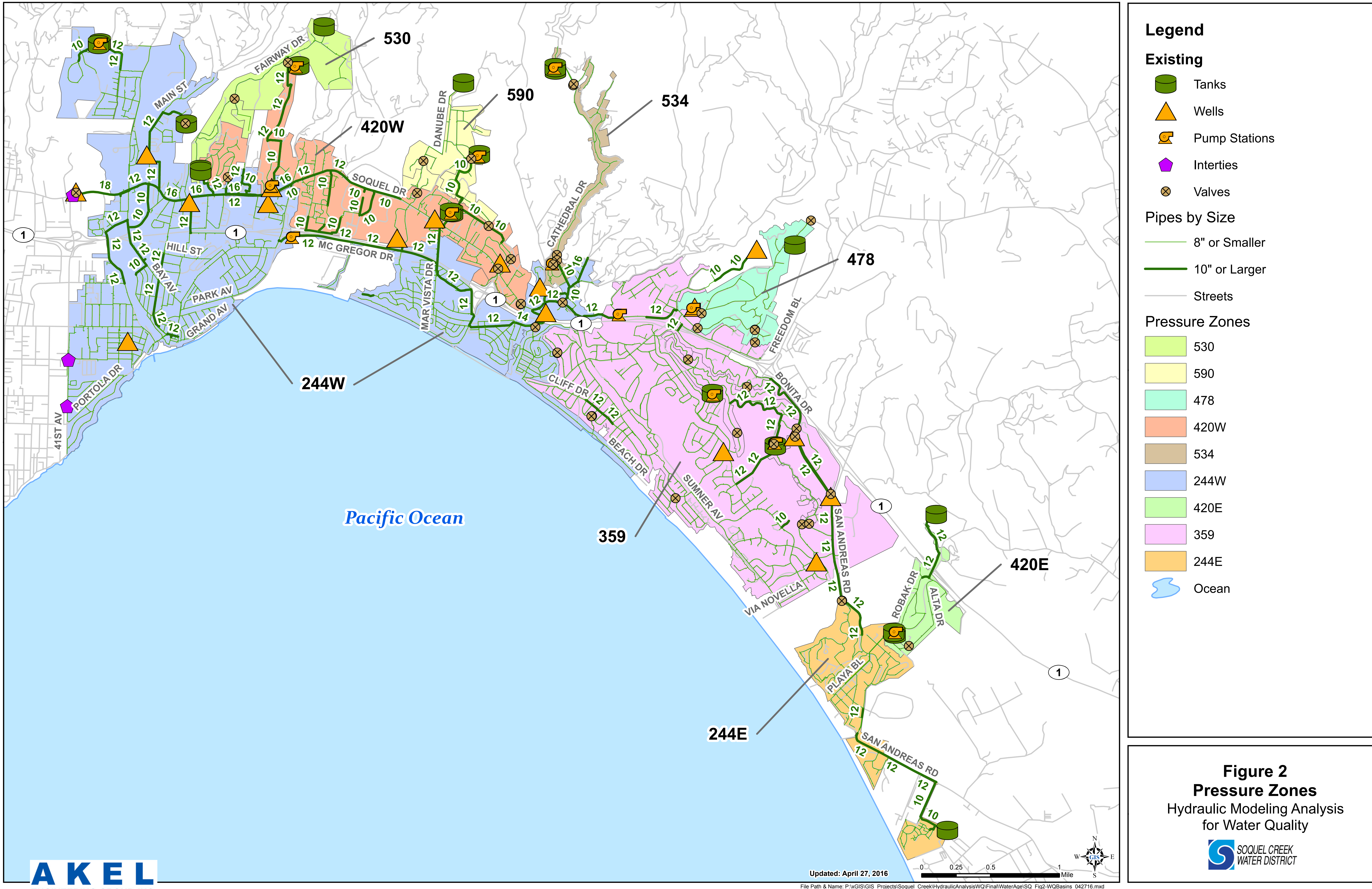
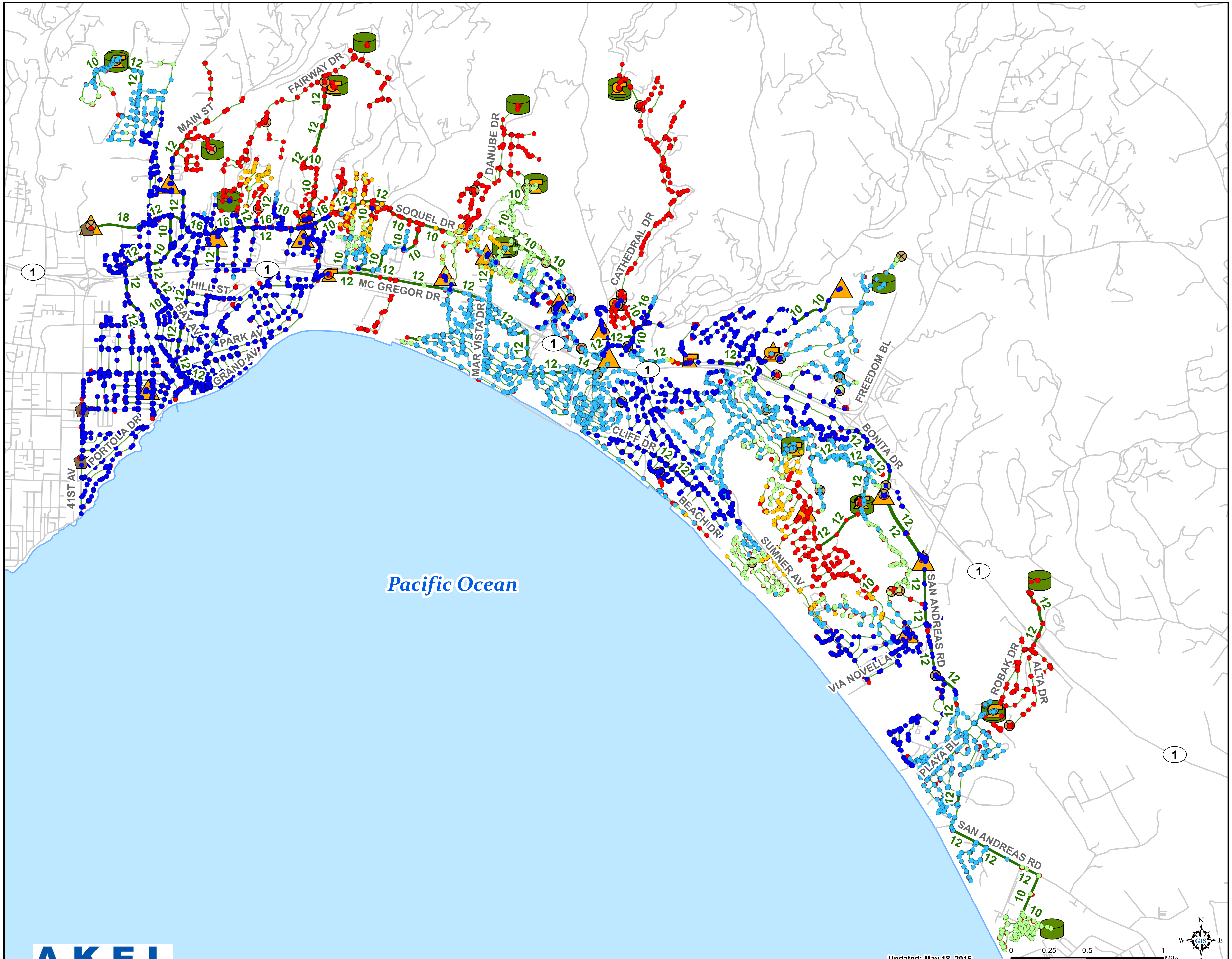


Figure 2
Pressure Zones
Hydraulic Modeling Analysis for Water Quality



Legend

Water Age (days)

- 0 - 7
- 7 - 14
- 14 - 21
- 21 - 28
- > 28

Existing

- Tanks
- Wells
- Pump Stations

Interties

- Active
- Inactive
- Valves

Pipes by Size

- 8" or Smaller
- 10" or Larger
- Streets
- Ocean

Figure 3
Scenario 1 – Water Age
No Interties Active
Hydraulic Modeling Analysis
for Water Quality

SOQUEL CREEK WATER DISTRICT

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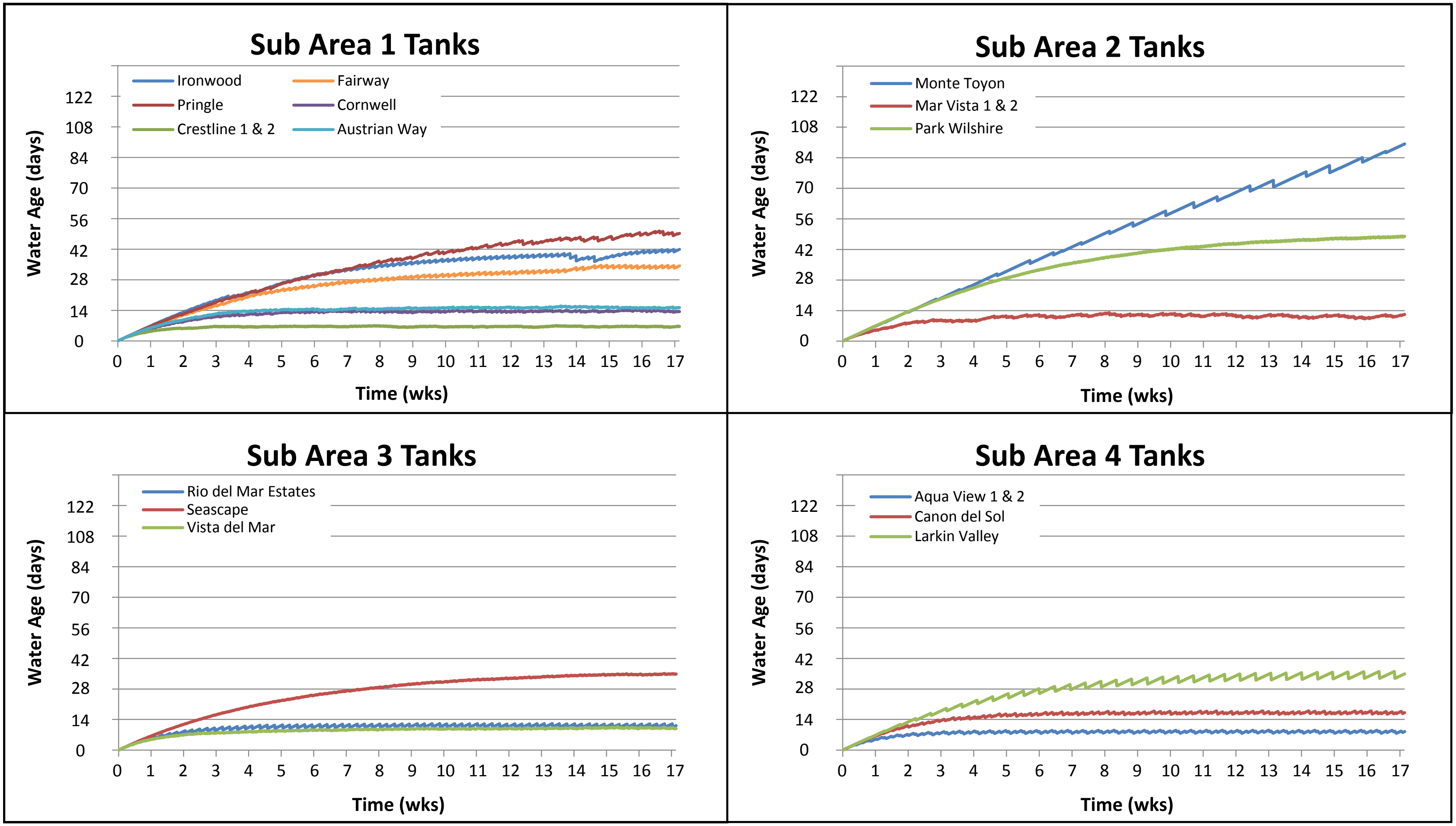

Notes:

1. No interties active
2. Minimum Month Demand = 2.2 MGD

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Figure 4

Scenario 1 - Water Age

No Interties Active

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

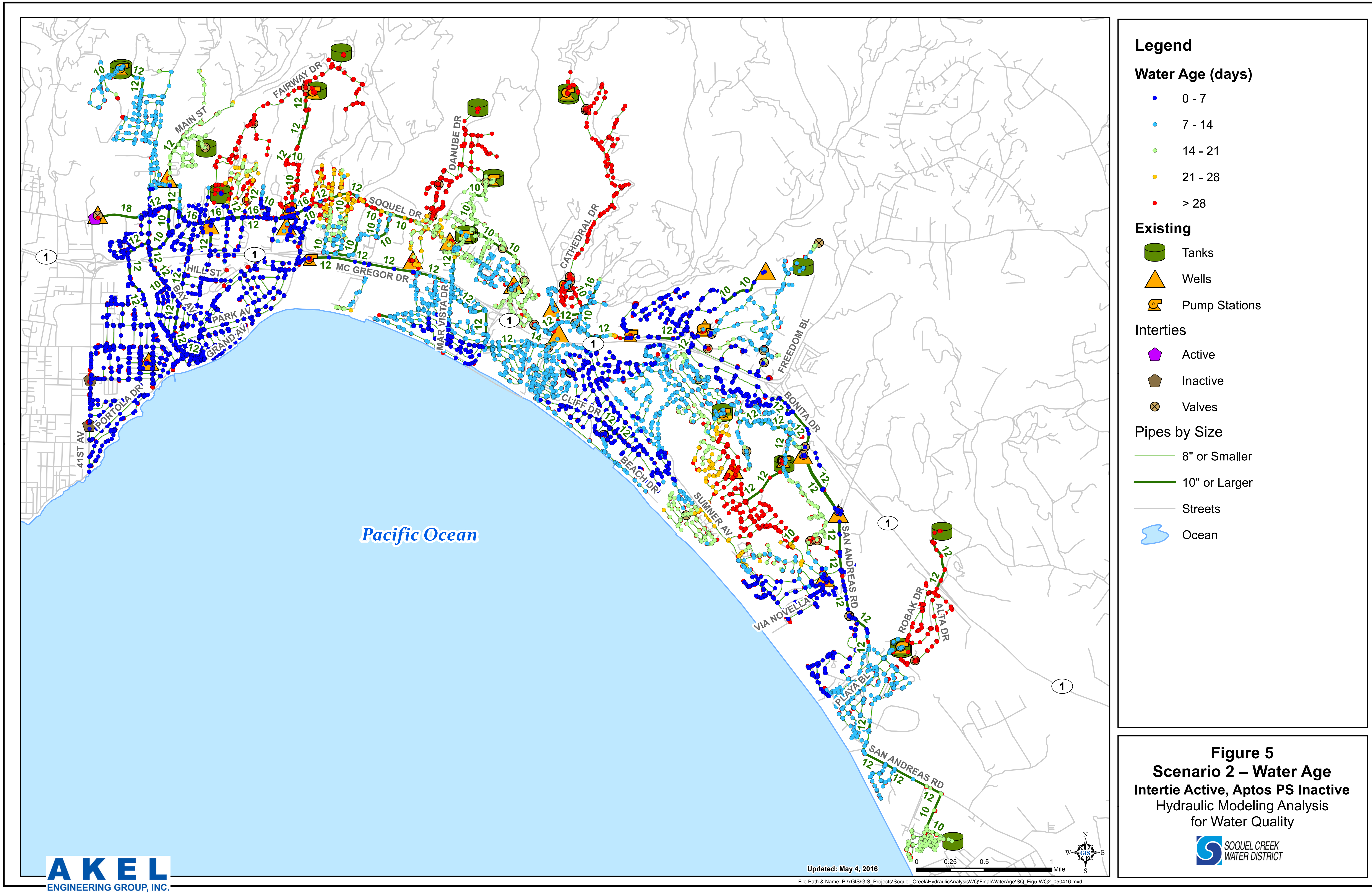
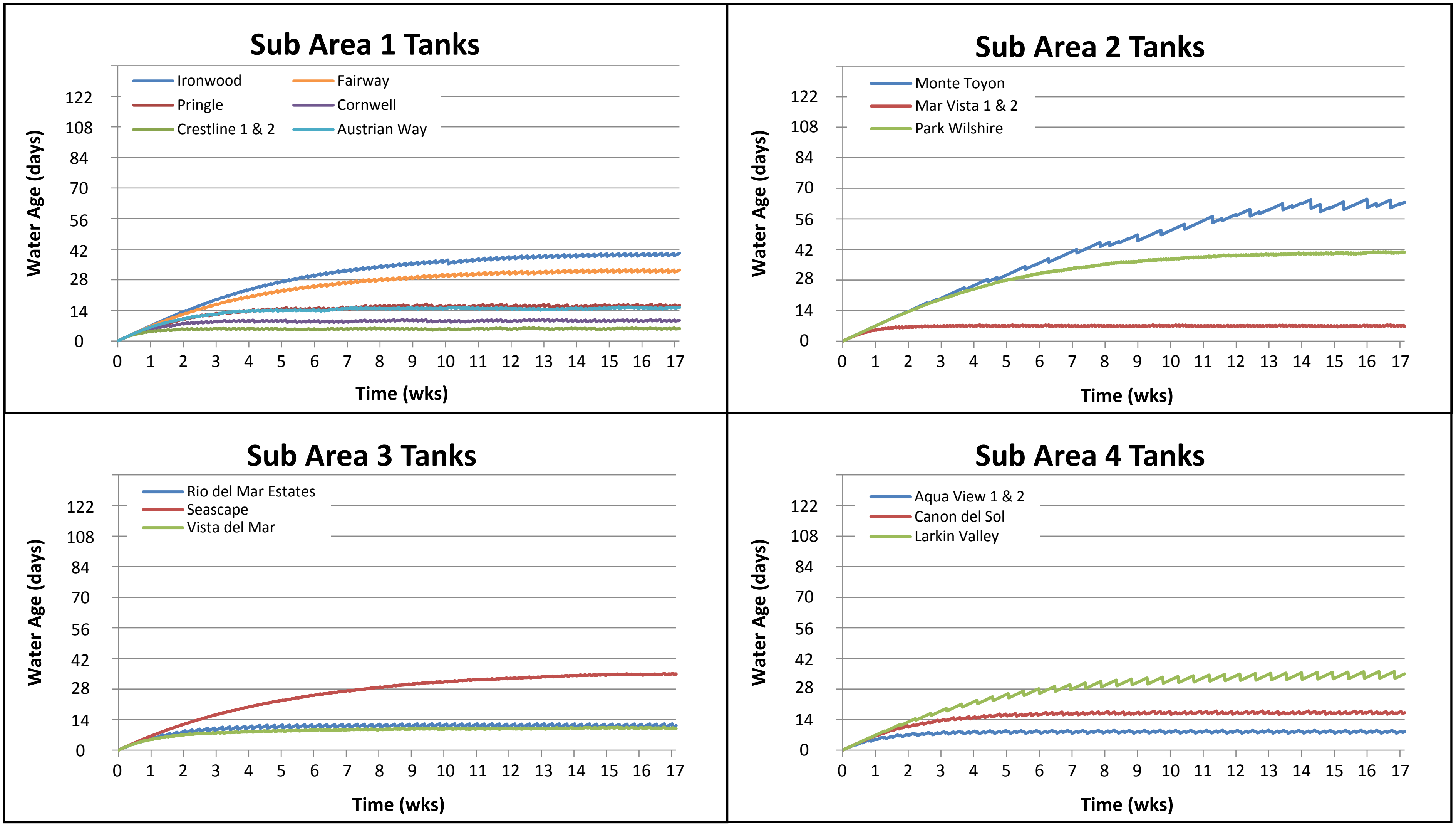


Figure 5
Scenario 2 – Water Age
Intertie Active, Aptos PS Inactive
Hydraulic Modeling Analysis
for Water Quality



Notes:

1. O'Neill intertie active
2. Aptos PS inactive
2. Minimum Month Demand = 2.2 MGD

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Figure 6

Scenario 2 - Water Age

O'Neill Interie Active,
Aptos Pump Station Inactive

Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

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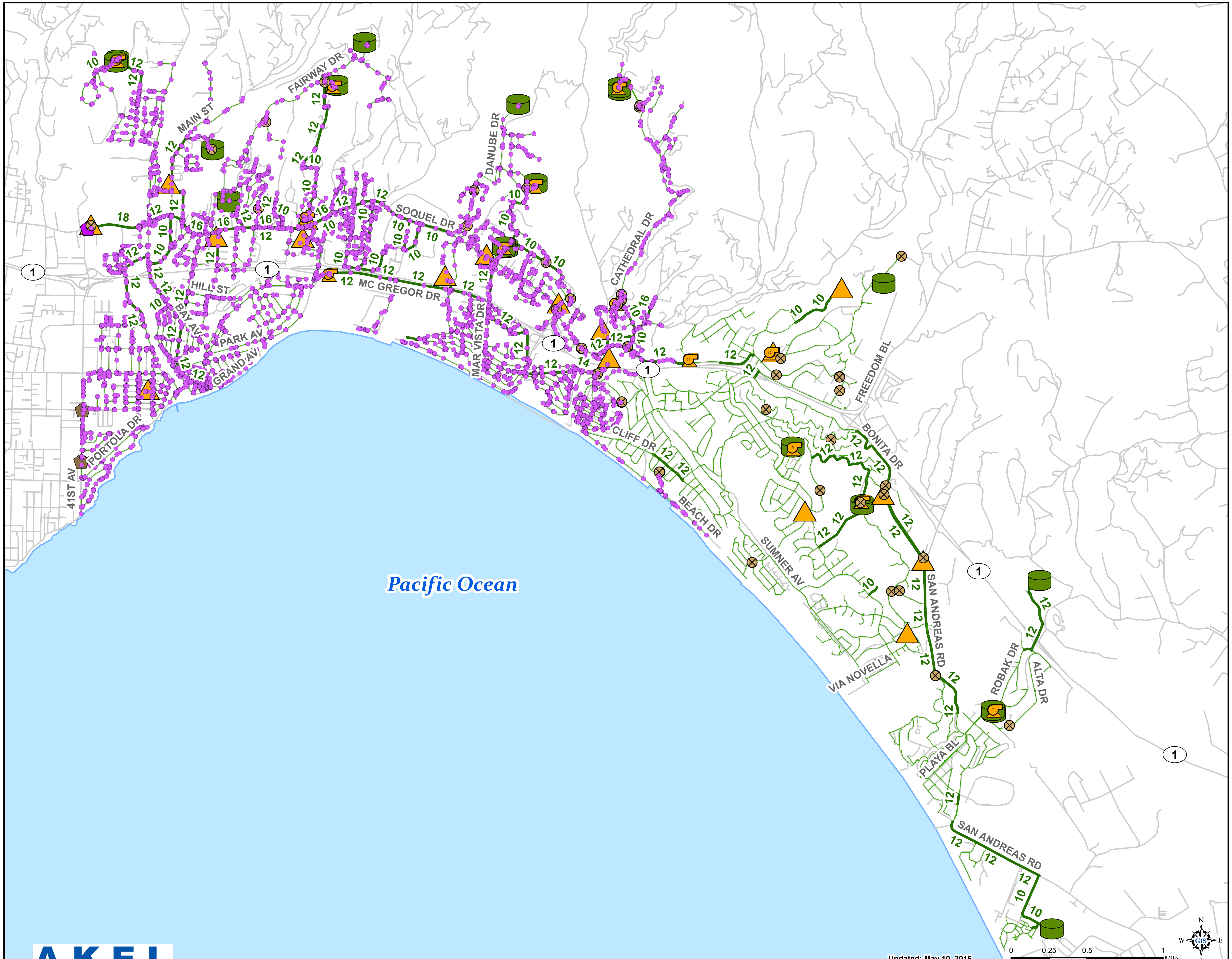

Legend

Percent Supplied Through Interties (%)

- 75 - 100
- 50 - 75
- 25 - 50
- 5 - 25
- 0 - 5

Existing

- Tanks
- Wells
- Pump Stations

Interties

- Active
- Inactive
- Valves

Pipes by Size

- 8" or Smaller
- 10" or Larger
- Streets
- Ocean

Figure 7
Scenario 2A – Supply Trace
Intertie Active, Aptos PS Inactive
Hydraulic Modeling Analysis
for Water Quality

SOQUEL CREEK WATER DISTRICT

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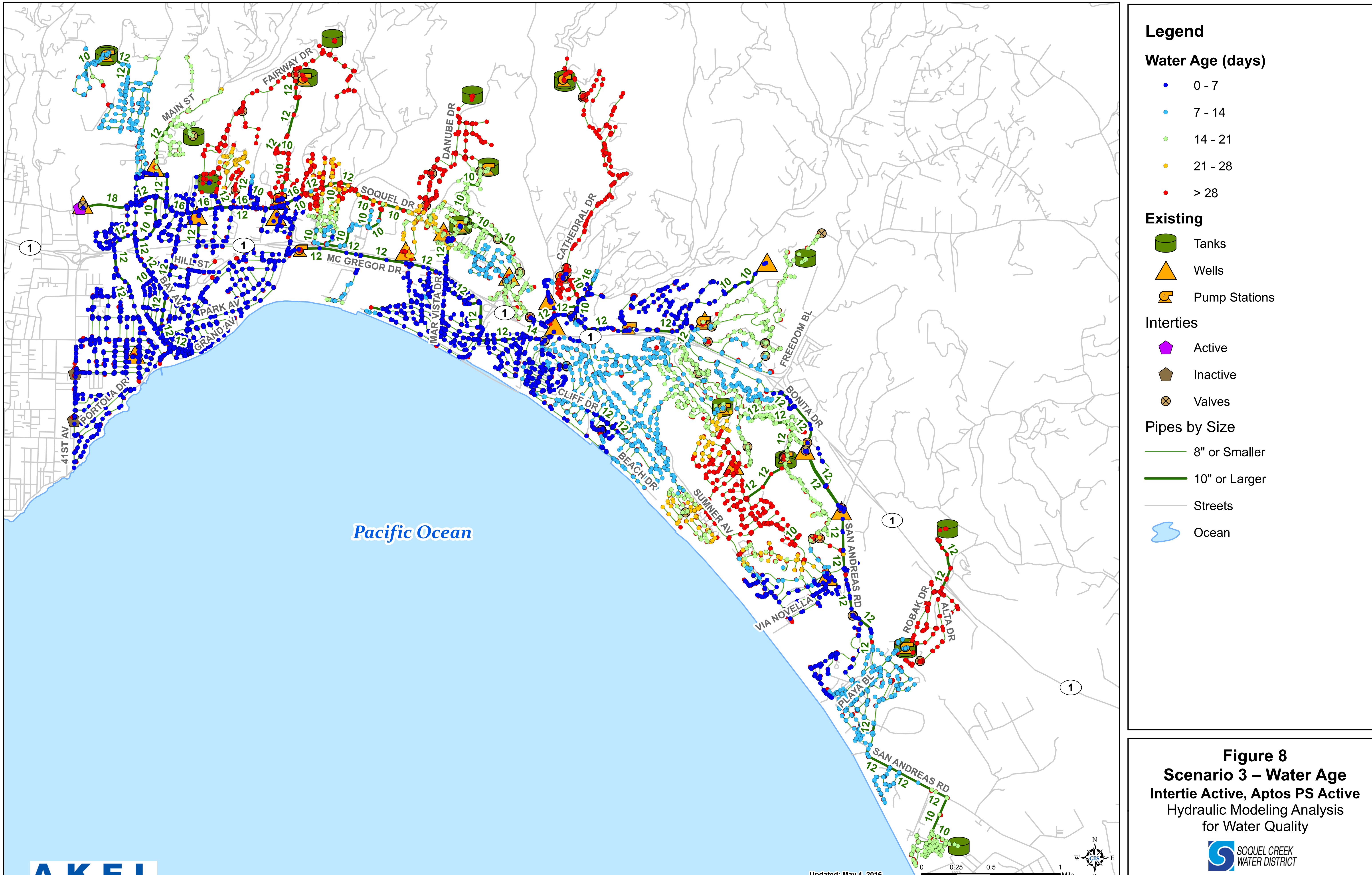

Figure 8
Scenario 3 – Water Age
Intertie Active, Aptos PS Active
Hydraulic Modeling Analysis
for Water Quality

SOQUEL CREEK WATER DISTRICT

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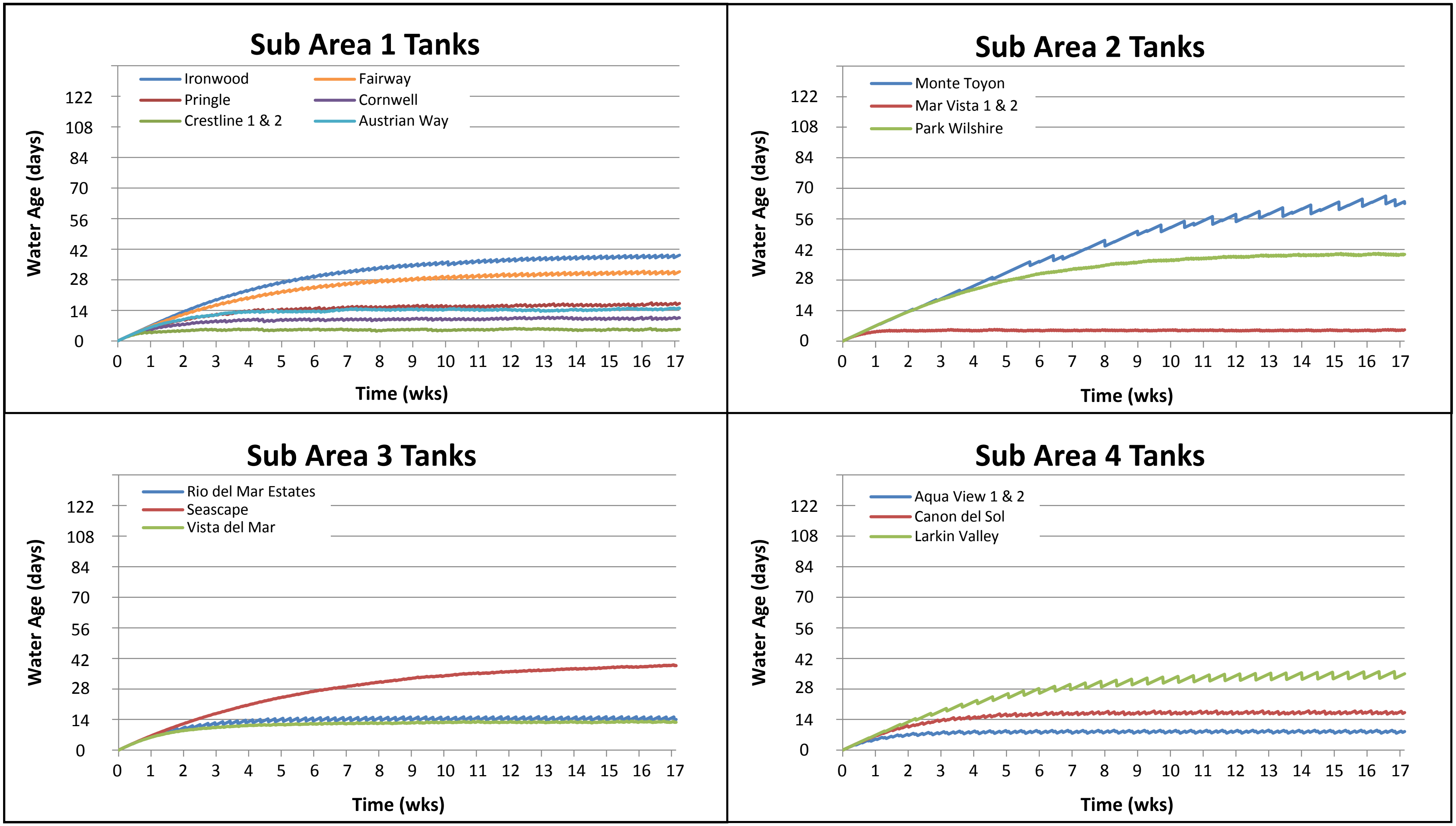

Notes:

1. O'Neill intertie active
2. Aptos pump station active
2. Minimum Month Demand = 2.2 MGD

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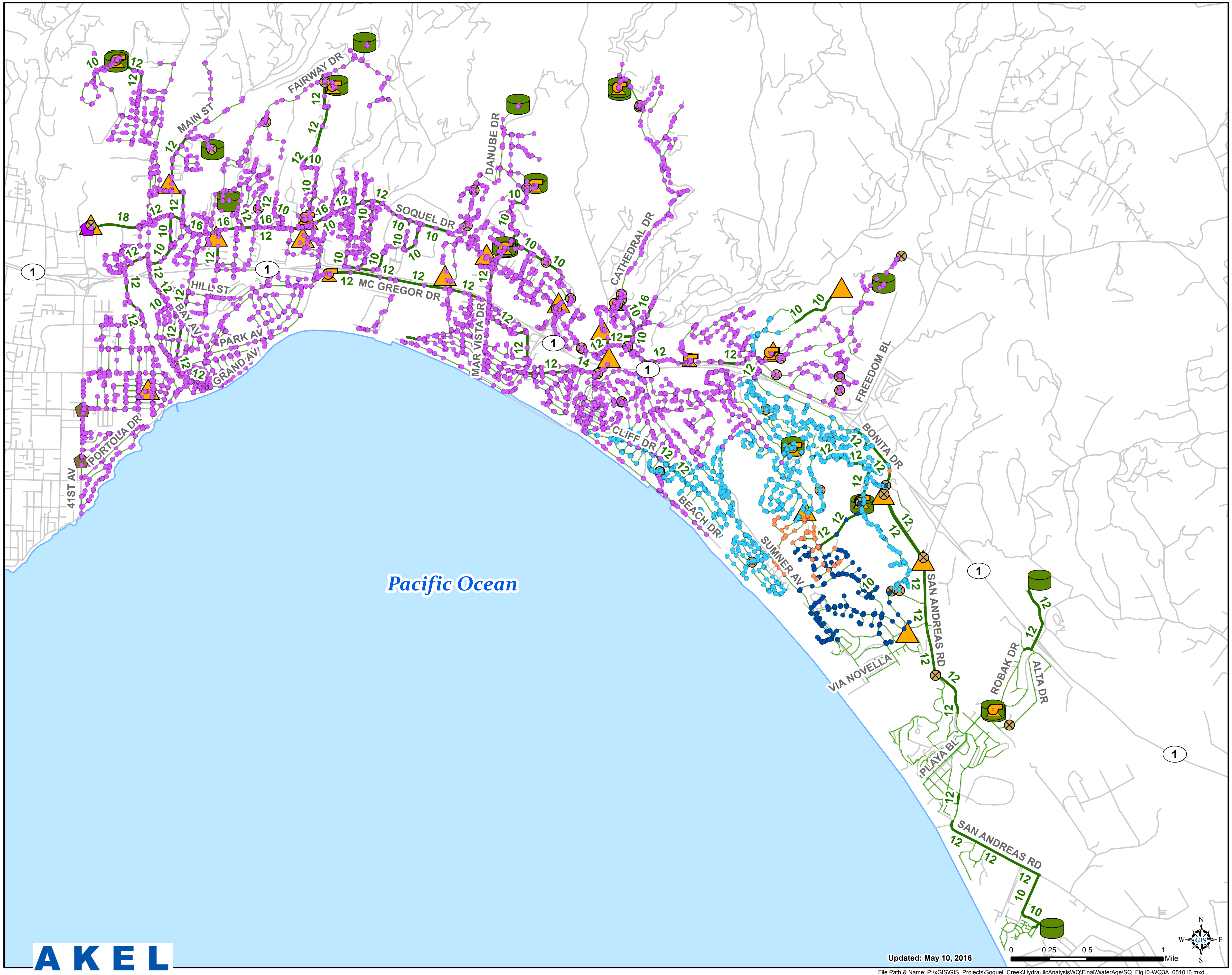
Figure 9

Scenario 3 - Water Age

O'Neill Intertie Active, Aptos Pump Station Active

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District



Legend

Percent Supplied Through Interties (%)

- 75 - 100
- 50 - 75
- 25 - 50
- 5 - 25
- 0 - 5

Existing

- Tanks
- Wells
- Pump Stations

Interties

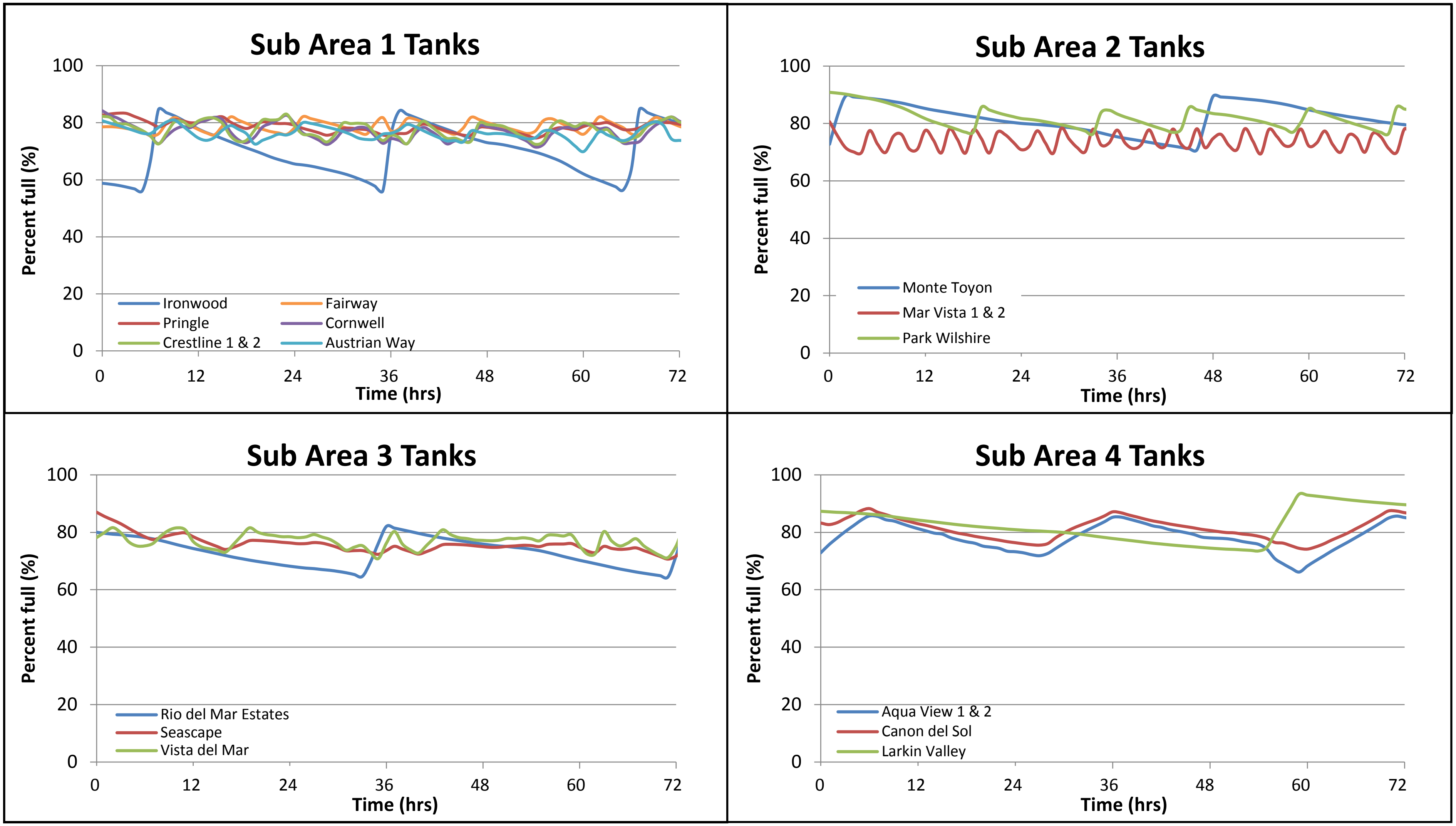
- Active
- Inactive
- Valves

Pipes by Size

- 8" or Smaller
- 10" or Larger
- Streets
- Ocean

Figure 10
Scenario 3A – Supply Trace
Intertie Active, Aptos PS Active
Hydraulic Modeling Analysis
for Water Quality

SOQUEL CREEK WATER DISTRICT



Notes:

1. O'Neill intertie active
2. Aptos pump station inactive
3. Minimum Month Demand = 2.2 MGD

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Figure 11
Tank Operations
Scenario 1

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

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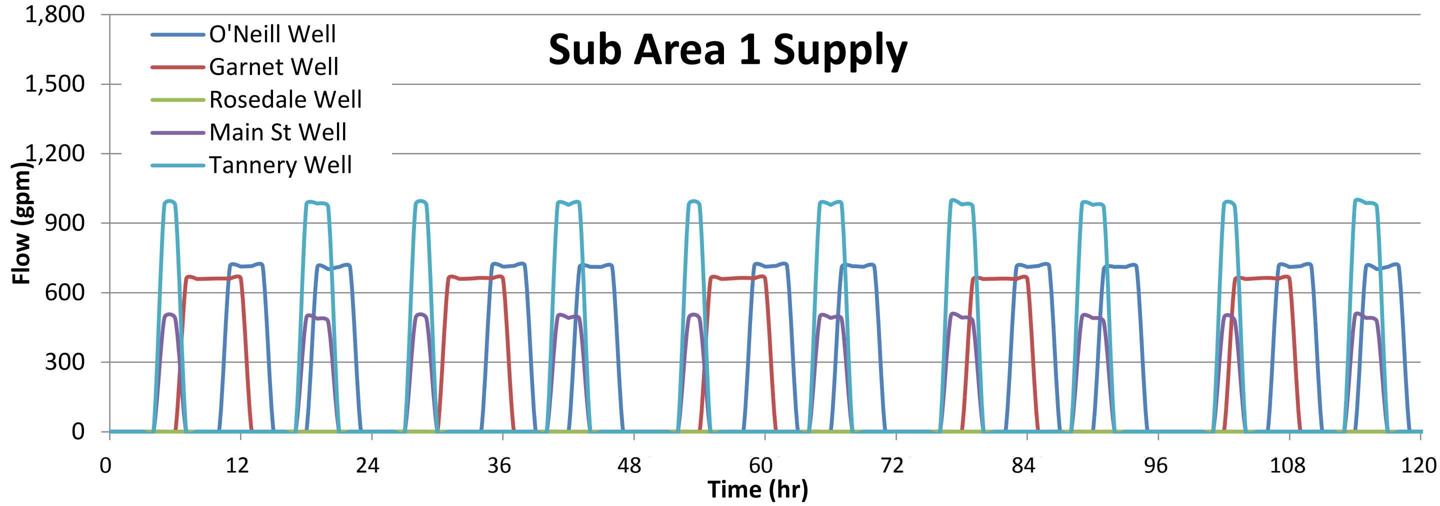

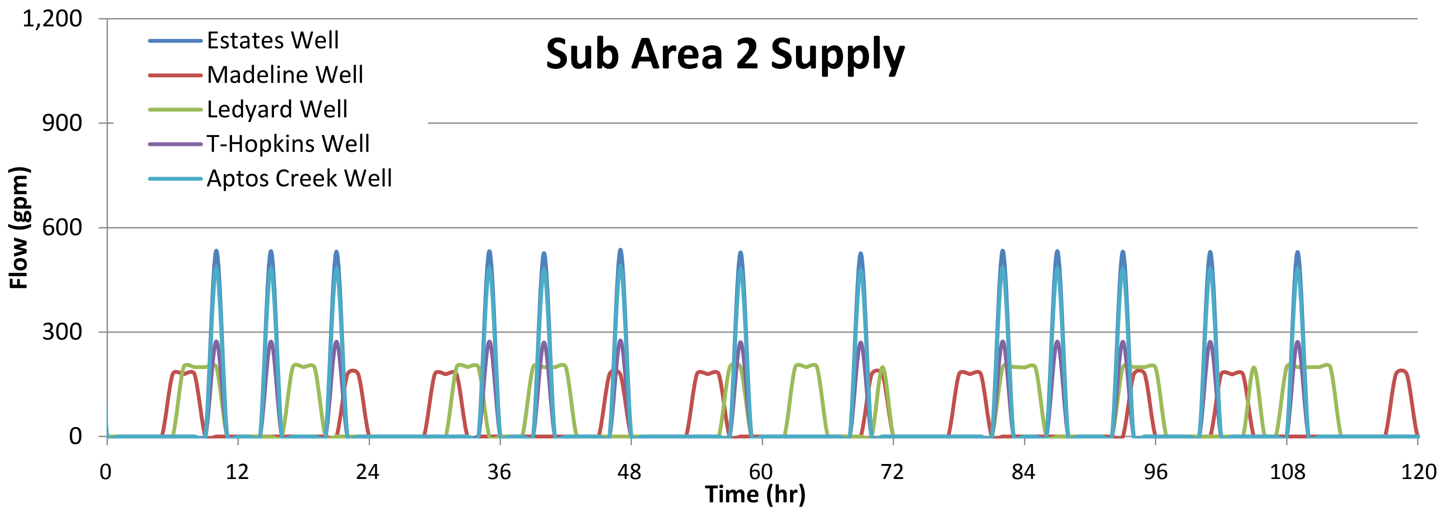

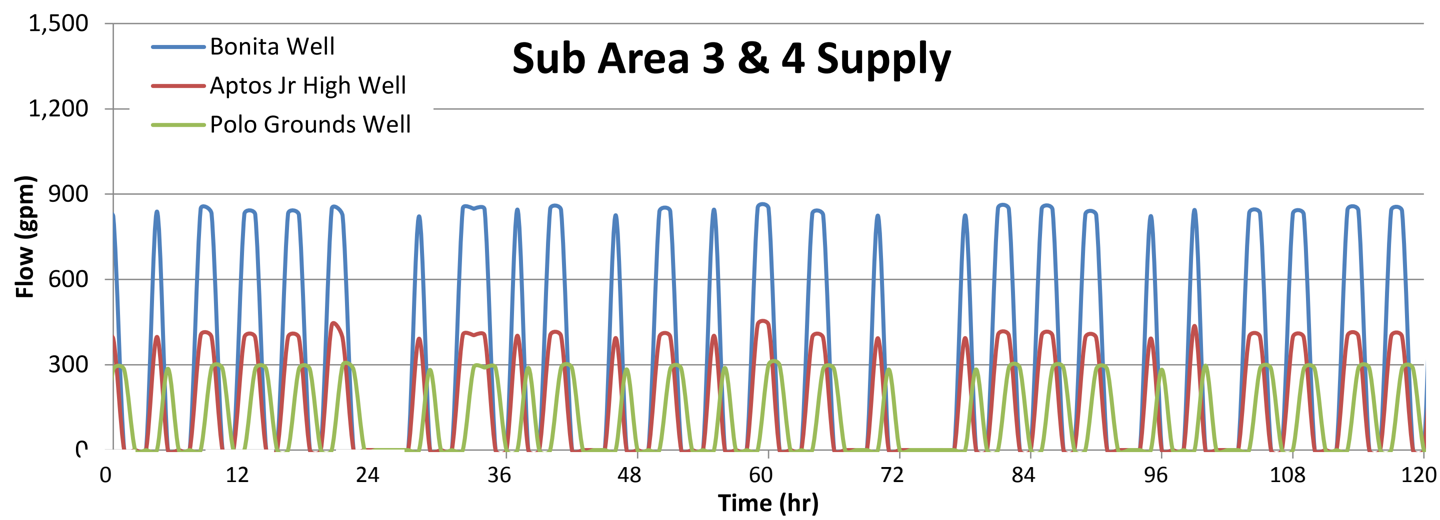

Notes:
1. O'Neill intertie active
2. Aptos pump station inactive
3. Active Sub Area 1 Wells: O'Neill, Garnet, Rosedale, Main St, Tannery
4. Active Sub Area 2 Wells: Estates, Madeline, Ledyard, T-Hopkins, Aptos Creek
5. Active Sub Area 3 & 4 Wells: Bonita, Aptos Jr. High, Polo Grounds
6. Minimum Month Demand = 2.2 MGD

May 4, 2016

Figure 12

Well, Intertie, Pump Station Flows
Scenario 1
Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

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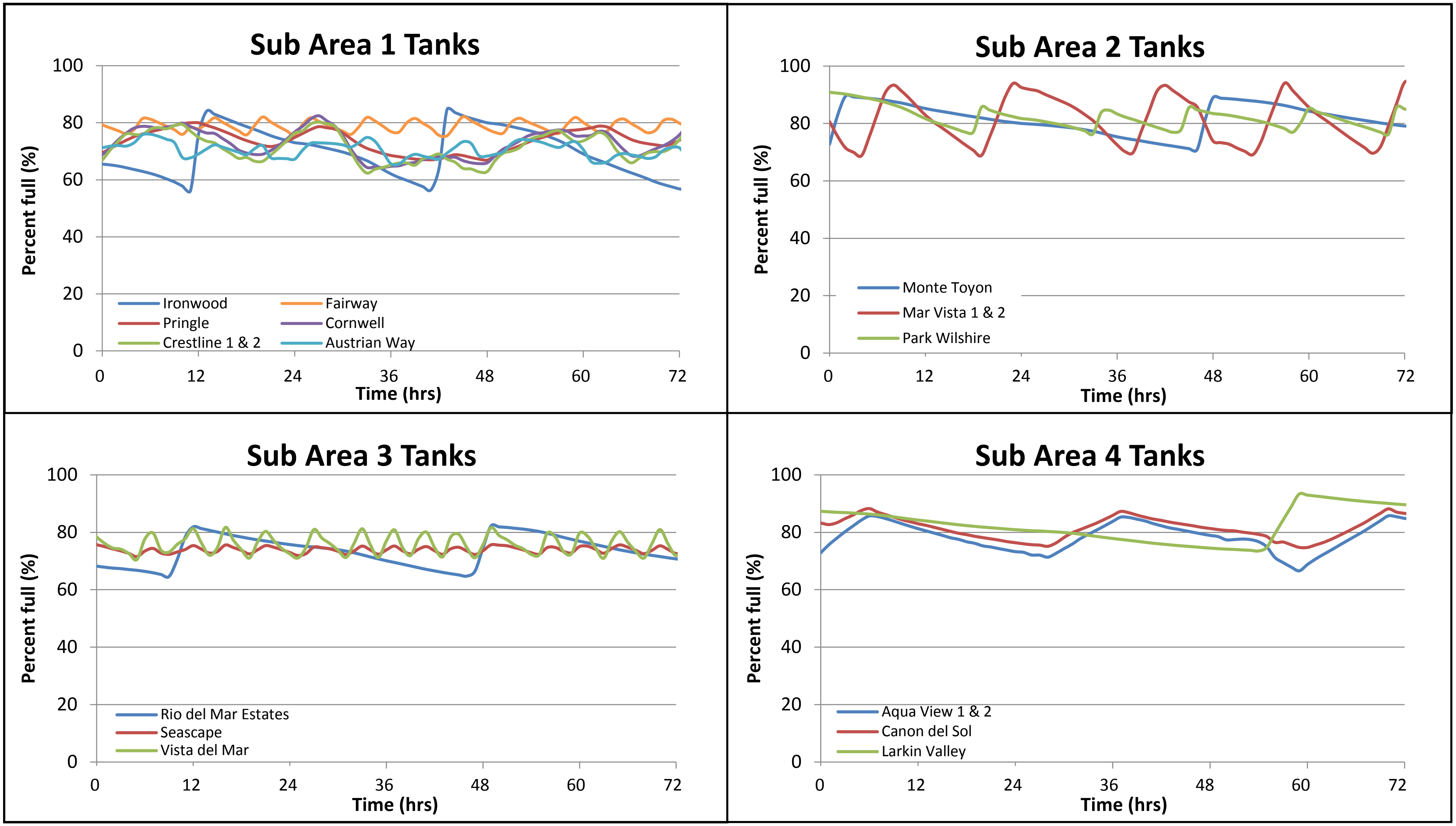


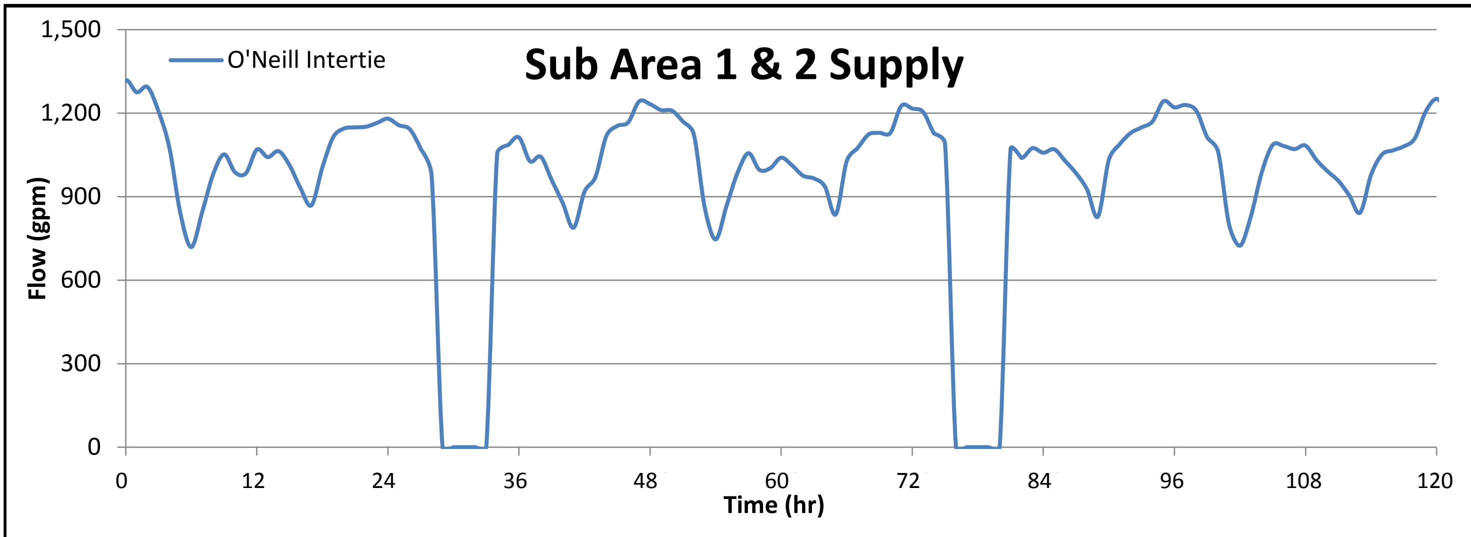
Notes:
1. O'Neill intertie active
2. Aptos pump station inactive
3. Minimum Month Demand = 2.2 MGD

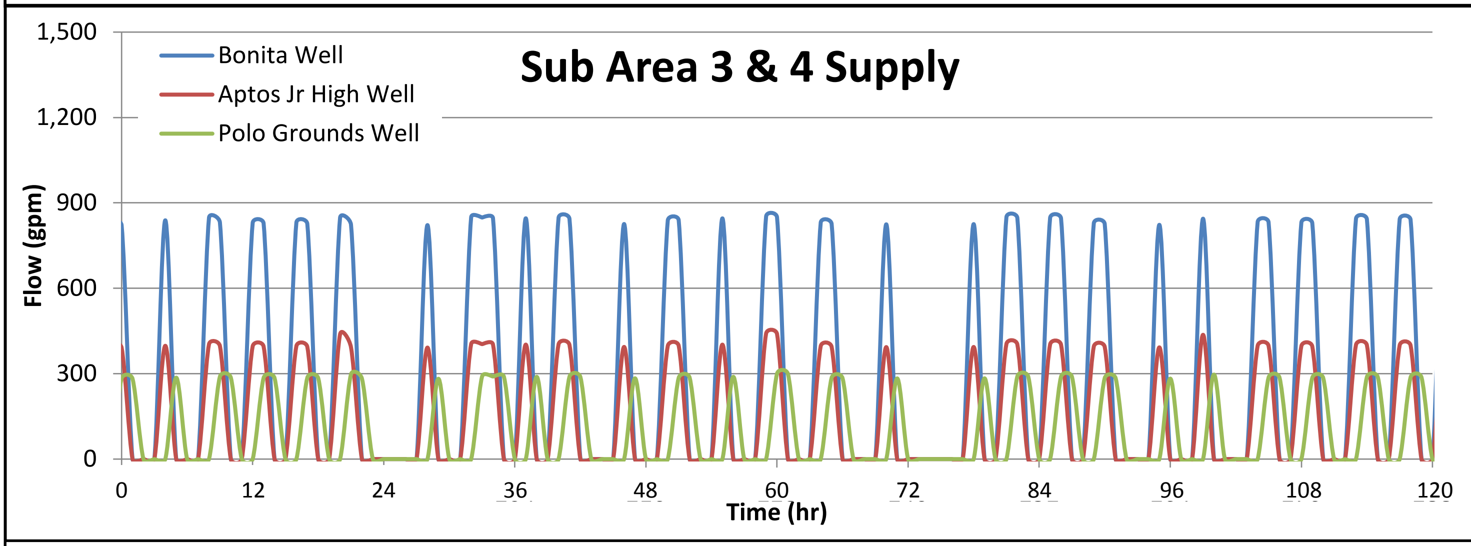
May 4, 2016

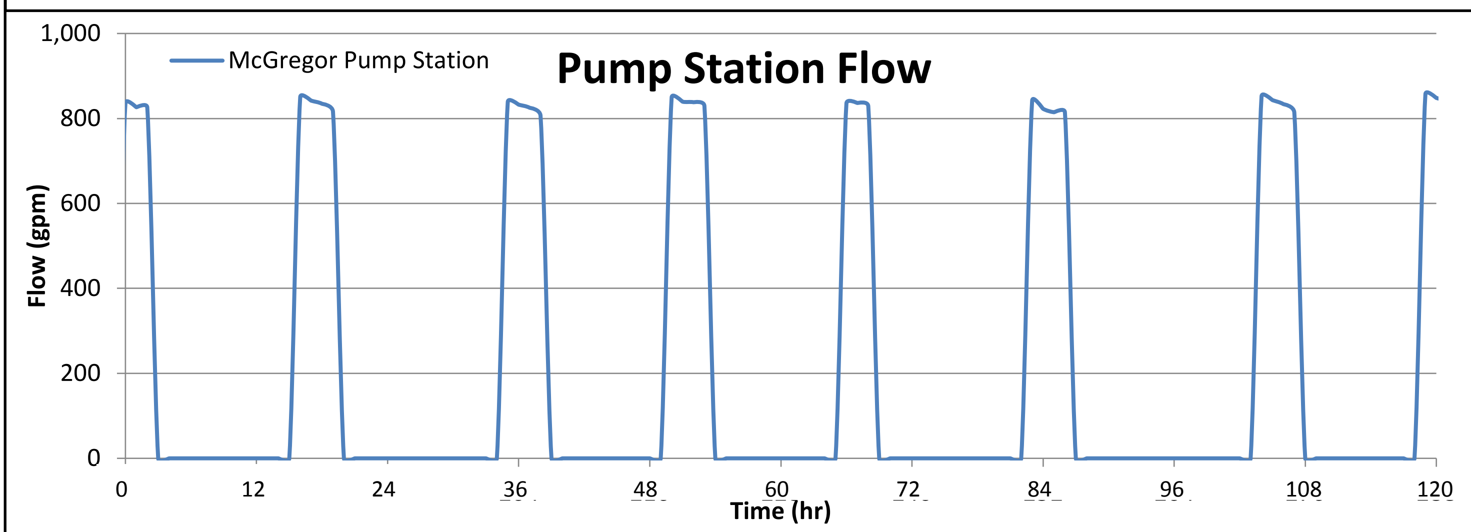
AKEL ENGINEERING GROUP, INC.

Figure 13
Tank Operations
Scenario 2
Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT







Notes:

1. O'Neill intertie active
2. Aptos pump station inactive
3. Active Sub Area 1 & 2 Wells: None
4. Active Sub Area 3 & 4 Wells: Bonita, Aptos Jr. High, Polo Grounds
3. Minimum Month Demand = 2.2 MGD

May 4, 2016

Figure 14

Well, Intertie, Pump Station Flows

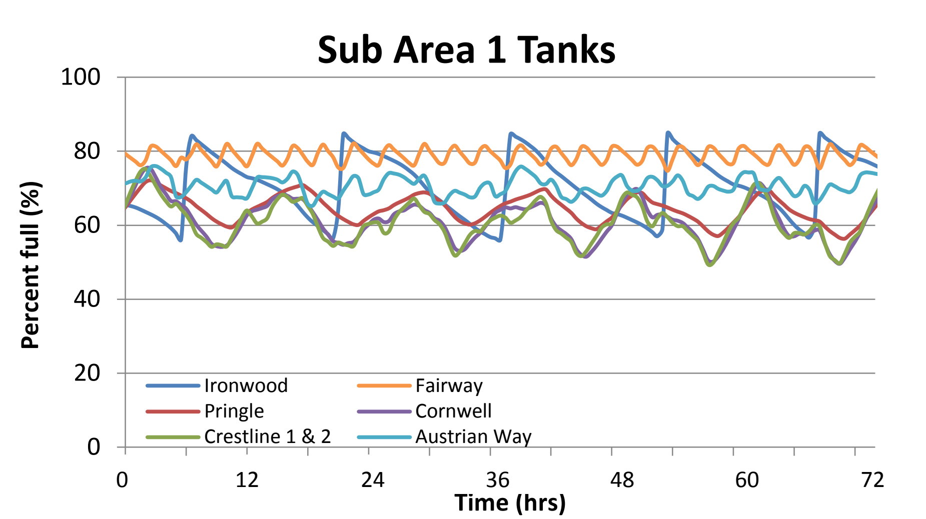
Scenario 2

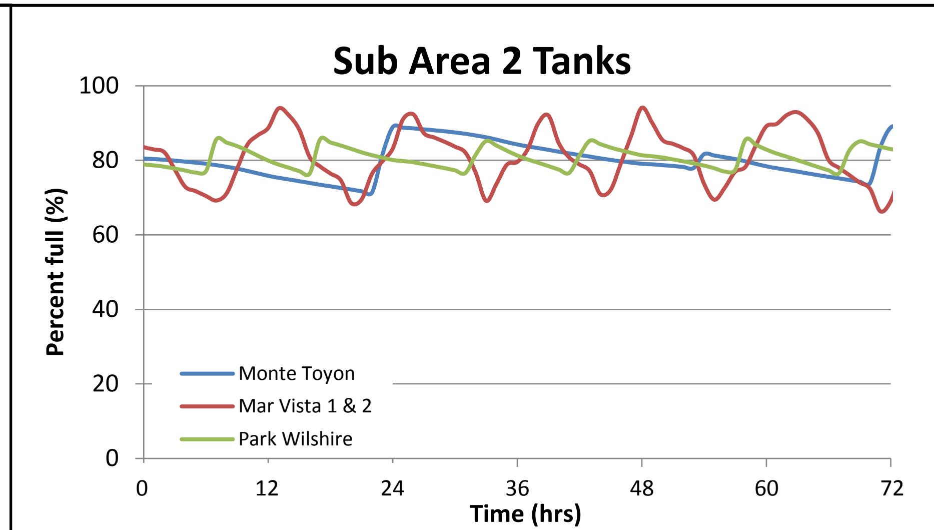
Hydraulic Modeling Analysis for Water Quality

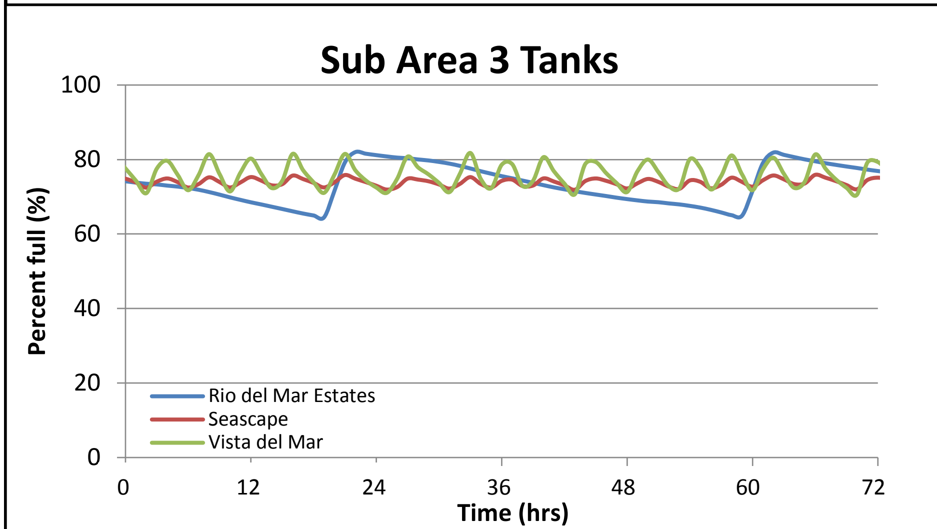
Soquel Creek Water District

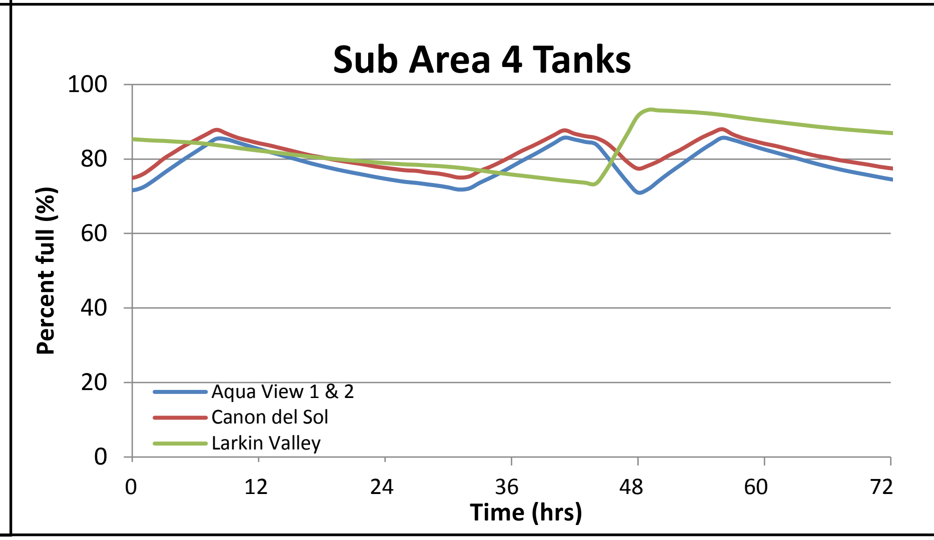
SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.









Notes:

1. O'Neill intertie active
2. Aptos pump station active
3. Minimum Month Demand = 2.2 MGD

May 4, 2016

Figure 15

Tank Operations

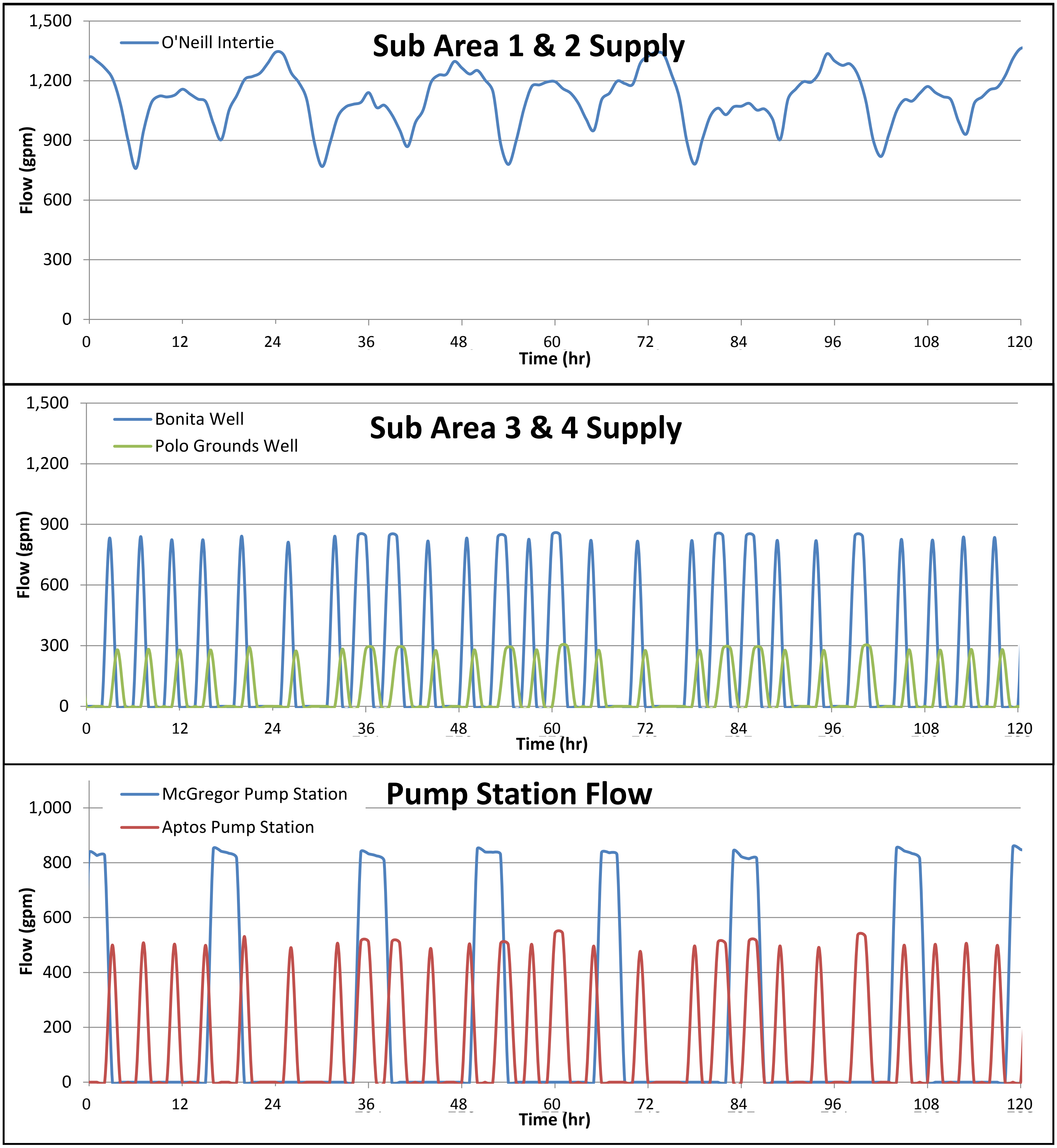
Scenario 3

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.



Notes:

1. O'Neill intertie active
2. Aptos pump station active
3. Active Sub Area 1 & 2 Wells: None
4. Active Sub Area 3 & 4 Wells: Bonita, Polo Grounds
3. Minimum Month Demand = 2.2 MGD

May 4, 2016

Figure 16

Well, Intertie, Pump Station Flows

Scenario 3

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.

SOQUEL CREEK WATER DISTRICT

HYDRAULIC MODELING
ANALYSIS FOR WATER QUALITY

WATER QUALITY ANALYSIS

ADJUSTED TANK OPERATIONS

FINAL

May 2016

AKEL ENGINEERING GROUP, INC.

Soquel Creek Water District
Hydraulic Modeling Analysis for Water Quality

TABLE OF CONTENTS

Table 1 Storage Facilities and Operational Capacities

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

Name	Elevation	Tank Information						Existing Minimum Operation Levels		Adjusted Minimum Operation Levels[3]	
		Min Tank Level (Pipe Outlet Height) (ft)	Dead Storage Volume (MG)	Tank Height (ft)	Overflow Elevation[2] (ft)	Diameter (ft)	Net Total Capacity[1] (MG)	Minimum Operation Level (ft)	Operational Capacity[2] (MG)	Minimum Operation Level (ft)	Operational Capacity[4] (MG)
Crestline #1 Tank	222.2	1.5	0.03	25	24.5	60.0	0.49	17	0.33	-	-
Crestline #2 Tank	222.2	1.5	0.04	25	24.5	70.0	0.66	17	0.45	11	0.27
Cornwell Tank	222.2	1.5	0.03	24	24.0	60.0	0.47	18.5	0.36	-	-
Pringle Tank	222.2	1.5	0.02	30	27.3	44.0	0.29	20	0.21	-	-
Mar Vista #1 Tank	227.2	1.5	0.03	18	19.5	54.0	0.31	12.5	0.19	12.5	0.19
Mar Vista #2 Tank	227.2	1.5	0.03	18	18.8	54.0	0.30	12.5	0.19	-	-
Austrian Way	407.2	1.66	0.05	16	15.1	72.0	0.41	12.4	0.33	10	0.25
Fairway Tank	407.2	2	0.08	16	16.6	80.0	0.55	12.6	0.40	10	0.30
Ironwood Tank	511.2	0	0.00	30	21.8	30.8	0.12	13.2	0.07	18	0.10
Park Wilshire Tank	570.2	2	0.02	23	23.0	38.0	0.18	18	0.14	17.6	0.13
Monte Toyon Tank	519.2	1.66	0.02	18	18.5	50.0	0.25	13.5	0.17	9	0.11
Seascape Tank	340.2	2	0.11	22	22.1	96.0	1.09	17.5	0.84	14	0.65
Vista Del Mar Tank	338.2	2	0.04	24	24.0	60.0	0.47	17.5	0.33	14	0.25
Rio Del Mar Estates Tank	458.2	2	0.03	24	22.1	50.0	0.30	16	0.21	14	0.18
Canon Del Sol Tank	231.2	2	0.02	26	24.1	46.0	0.27	18.5	0.21	12	0.12
Aqua View #1 Tank	231.2	2	0.06	16	16.6	72.0	0.44	12	0.30	12	0.30
Aqua View #2 Tank	231.2	2	0.01	16	16.6	25.0	0.05	12	0.04	12	0.04
Larkin Valley Tank	407.2	2	0.05	16	16.8	64.0	0.36	12	0.24	9.5	0.18
Total							**7.00**		**4.99**		**3.08**

Notes:

5/24/2016

1. Net volume calculated using the tank diameter and the overflow elevation less the dead storage volume (height to pipe outlet)
2. Overflow elevation per District staff
3. Adjusted low tank levels per District staff
4. Operational volume calculated using the tank diameter and the minimum operation level less the dead storage volume (height to pipe outlet)

Table 2 Hydraulic Model Verification of Tank Drainage

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

Pressure Zone	Existing Minimum Month Demands (MGD)	Total Existing Storage (MG)	Comparison of Tank Drainage: Method 1: Calculated Value (Days)	Comparison of Tank Drainage: Method 2: Hydraulic Model[1] (Days)	Percent Difference (%)
Service Areas 1 and 2					
Crestline, Cornwell, Pringle Tanks		1.92			
SA1 - 244W	0.82				
SA1 - 420W	0.25				
SA1 - 530	0.02				
SA1 - 590	0.04				
Total	**1.13**	1.92	1.7	1.7	-0.8%
Mar Vista Tanks		0.61			
SA2 - 244W	0.24				
SA2 - 534	0.03				
Total	**0.26**	0.61	2.3	2.4	3.2%
Fairway and Austrian Tanks		0.96			
SA1 - 420W	0.25				
SA1 - 530	0.02				
SA1 - 590	0.04				
Total	**0.31**	0.96	3.1	3.2	3.7%
Ironwood Tank - SA1 - 530	**0.02**	0.12	5.9	6.2	5.2%
Park Wilshire Tank - SA1 - 590	**0.04**	0.18	5.0	5.1	2.3%
Monte Toyon Tank - SA2 - 534	**0.03**	0.25	9.3	9.6	3.0%
Service Areas 3 and 4					
Seascape and Vista del Mar Tanks		1.55			
SA3 - 359	0.60				
SA3 - 478	0.04				
SA4 - 244E	0.10				
SA4 - 420E	0.02				
Total	**0.76**	1.55	2.0	2.1	2.9%
Aqua View and Cannon del Sol Tanks		0.77			
SA4 - 244E	0.10				
SA4 - 420E	0.02				
Total	**0.12**	0.77	6.3	6.3	-0.7%
Larkin Valley - SA4 - 420E	**0.02**	0.36	15.3	15.8	3.7%
Rio Del Mar - SA3 - 478	**0.04**	0.30	7.5	7.6	0.5%

Note: 5/24/2016

1. This table was initially based on storage volumes provided by the District on 5/9/16. On 5/24/16 the district provided revised storage volumes and this table was updated accordingly for Method 1. It should be noted the hydraulic analysis was not re-run and the Method 2 tank drainage days were updated based on the percent difference from the initial analysis.

Table 3 Tank Storage Capacity Analysis with Current Minimum Operation Levels

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

Pressure Zone	Existing Water Demands	Minimum Month Demand Water Storage Requirements			Tank Storage Volume with Current Minimum Operation Levels																		Total Storage	Pressure Zone Surplus / Deficiency
	Minimum Month Demand (MGD)	25% MinMD Oper. + 25% MinMD Emerg. (MG)	Fire Protection (1,500 gpm for 2 Hours)[1] (MG)	**Total Storage Requirement** (MG)	Crestline #1 Tank (MG)	Crestline #2 Tank (MG)	Cornwell Tank (MG)	Pringle Tank (MG)	Mar Vista #1 Tank (MG)	Mar Vista #2 Tank (MG)	Austrian Way (MG)	Fairway Tank (MG)	Ironwood Tank (MG)	Park Wilshire Tank (MG)	Monte Toyon Tank (MG)	Seascape Tank (MG)	Vista Del Mar Tank (MG)	Rio Del Mar Estates Tank (MG)	Canon Del Sol Tank (MG)	Aqua View #1 Tank (MG)	Aqua View #2 Tank** (MG)	Larkin Valley Tank (MG)	(MG)	(MG)
Service Areas 1 and 2																								
SA1 - 244W (Crestline, Cornwell, Pringle)	0.82	0.41	0.18	0.59	0.33	0.45	0.36	0.21															1.34	0.75
SA1 - 420W (Fairway, Austrian)	0.25	0.13	0.18	0.31							0.33	0.40											0.73	0.42
SA1 - 530 (Ironwood)	0.02	0.01	0.08	0.09									0.07										0.07	-0.02
SA1 - 590 (Park Wilshire)	0.04	0.02	0.13	0.15										0.14									0.14	-0.01
SA2 - 244W (Mar Vista)	0.24	0.12	0.18	0.30					0.19	0.19													0.38	0.08
SA2 - 534 (Monte Toyon)	0.03	0.01	0.07	0.09											0.17								0.17	0.09
Service Areas 3 and 4																								
SA3 - 359 (Vista Del Mar, Seascape)	0.60	0.30	0.18	0.48												0.84	0.33						1.17	0.69
SA3 - 478 (Rio Del Mar)	0.04	0.02	0.18	0.20														0.21					0.21	0.01
SA4 - 244E (Aqua View, Cannon Del Sol)	0.10	0.05	0.18	0.23															0.21	0.30	0.04		0.55	0.32
SA4 - 420E (Larkin Valley)	0.02	0.01	0.18	0.19																		0.24	0.24	0.05
Town Wide																								
Totals	2.15	1.1		2.62																			4.99	2.36

Notes:

5/24/2016

1. Fire flow storage per District staff. Fire flow = 1,500 gpm for 2 hours. The fire flow volume was reduced in some zones by allowing booster pumps to account for a portion of the fire flow.

Table 4 Tank Storage Capacity Analysis with Adjusted Minimum Operation Levels

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

Pressure Zone	Existing Water Demands	Minimum Month Demand Water Storage Requirements			Tank Storage Volume with Adjusted Minimum Operation Levels																				
	Minimum Month Demand (MGD)	25% MinMD Oper. + 25% MinMD Emerg. (MG)	Fire Protection (1,500 gpm for 2 Hours)[1] (MG)	**Total Storage Requirement** (MG)	Crestline #1 Tank (MG)	Crestline #2 Tank (MG)	Cornwell Tank (MG)	Pringle Tank (MG)	Mar Vista #1 Tank (MG)	Mar Vista #2 Tank (MG)	Austrian Way (MG)	Fairway Tank (MG)	Ironwood Tank (MG)	Park Wilshire Tank (MG)	Monte Toyon Tank (MG)	Seascape Tank (MG)	Vista Del Mar Tank (MG)	Rio Del Mar Estates Tank (MG)	Canon Del Sol Tank (MG)	Aqua View #1 Tank (MG)	Aqua View #2 Tank (MG)	Larkin Valley Tank (MG)	**Total Existing Storage** (MG)	Pressure Zone Surplus / Deficiency (MG)
Service Areas 1 and 2																								
SA1 - 244W (Crestline, Cornwell, Pringle)	0.82	0.41	0.18	0.59	-	**0.27**	-	-															0.27	-0.32
SA1 - 420W (Fairway, Austrian)	0.25	0.13	0.18	0.31							**0.25**	**0.30**											0.55	0.25
SA1 - 530 (Ironwood)	0.02	0.01	0.08	0.09									**0.10**										0.10	0.01
SA1 - 590 (Park Wilshire)	0.04	0.02	0.13	0.15										**0.13**									0.13	-0.02
SA2 - 244W (Mar Vista)	0.24	0.12	0.18	0.30					**0.19**	-													0.19	-0.11
SA2 - 534 (Monte Toyon)	0.03	0.01	0.07	0.09											**0.11**								0.11	0.02
Service Areas 3 and 4																								
SA3 - 359 (Vista Del Mar, Seascape)	0.60	0.30	0.18	0.48												**0.65**	**0.25**						0.90	0.42
SA3 - 478 (Rio Del Mar)	0.04	0.02	0.18	0.20														**0.18**					0.18	-0.02
SA4 - 244E (Aqua View, Cannon Del Sol)	0.10	0.05	0.18	0.23															**0.12**	**0.30**	**0.04**		0.47	0.24
SA4 - 420E (Larkin Valley)	0.02	0.01	0.18	0.19																		**0.18**	0.18	-0.01
District Wide																								
Totals	2.15	1.1		2.62																			3.08	0.46

Notes:

5/24/2016

1. Fire flow storage per District staff. Fire flow = 1,500 gpm for 2 hours. The fire flow volume was reduced in some zones by allowing booster pumps to account for a portion of the fire flow.

Table 5 Maximum Tank Water Age Comparison

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

Tank	Maximum Water Age Scenario 1 Current Minimum Levels (days)	Scenario 1A Adjusted Minimum Levels (days)	Percent Difference	Comments
Sub Area 1				
Ironwood	42	30	-27%	
Pringle	49	-	-	
Crestline 2	7	4	-45%	
Fairway	35	22	-38%	
Cornwell	14	7	-54%	
Austrian Way	16	12	-26%	
Sub Area 2				
Monte Toyon	90	24	-73%	
Mar Vista 1	13	10	-20%	
Park Wilshire	48	35	-27%	
Sub Area 3				
Rio del Mar Estates	12	12	-1%	The water age remains constant due to higher water age at the suction side of the Aptos PS. The age does not get higher due to increased cycling of the tank.
Seascape	35	11	-69%	
Vista del Mar	11	6	-45%	
Sub Area 4				
Aqua View 1 & 2	9	11	22%	The water age increase is due to the SA3 wells cycling less resulting with higher water age at the PRV to SA4.
Canon del Sol	18	20	11%	
Larkin Valley	36	28	-22%	

5/24/2016

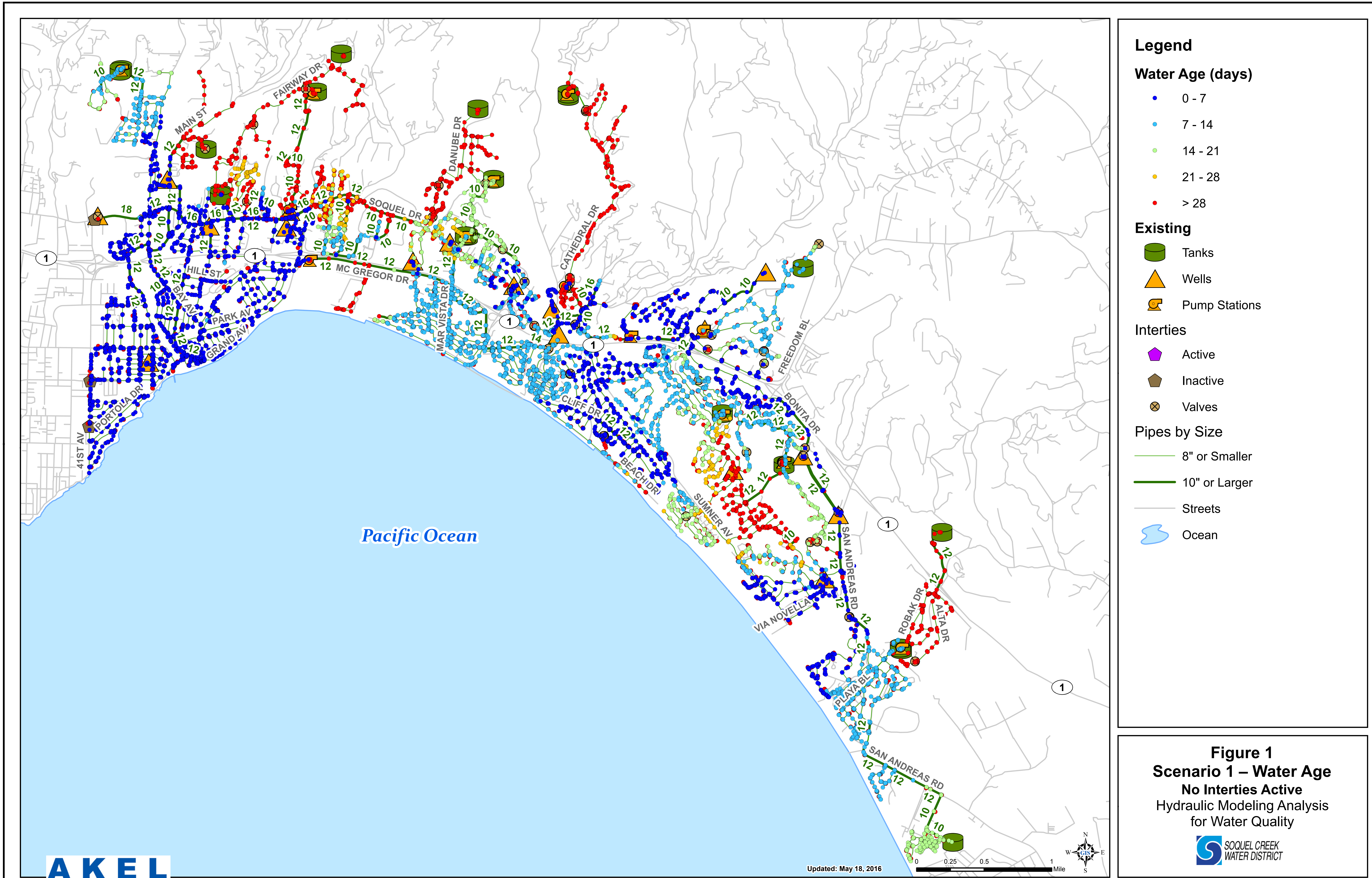
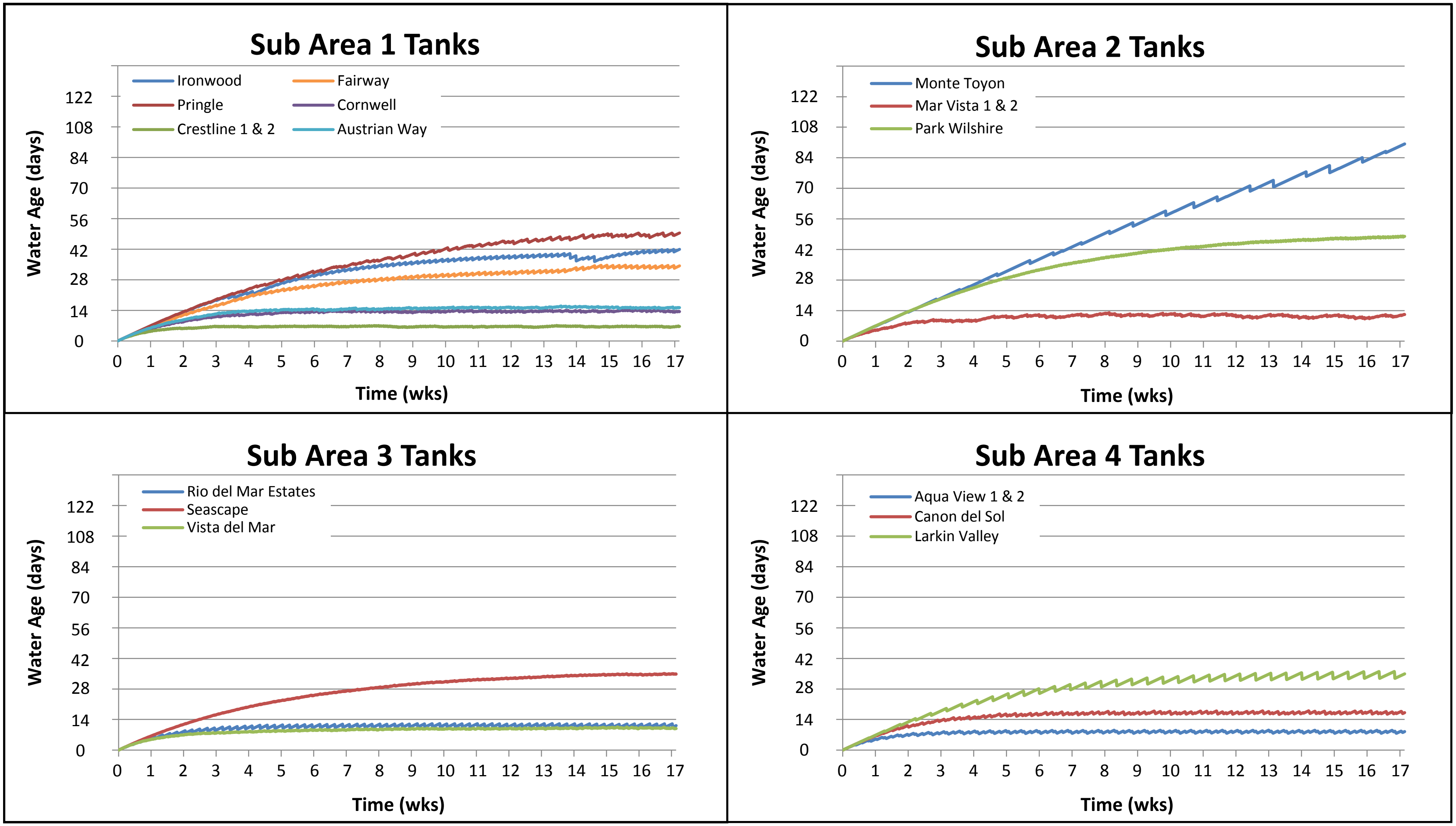


Figure 1
Scenario 1 – Water Age
No Interties Active
Hydraulic Modeling Analysis
for Water Quality



Notes:

1. No interties active
2. Minimum Month Demand = 2.2 MGD

May 18, 2016

Figure 2

Scenario 1 - Water Age

No Interties Active

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.

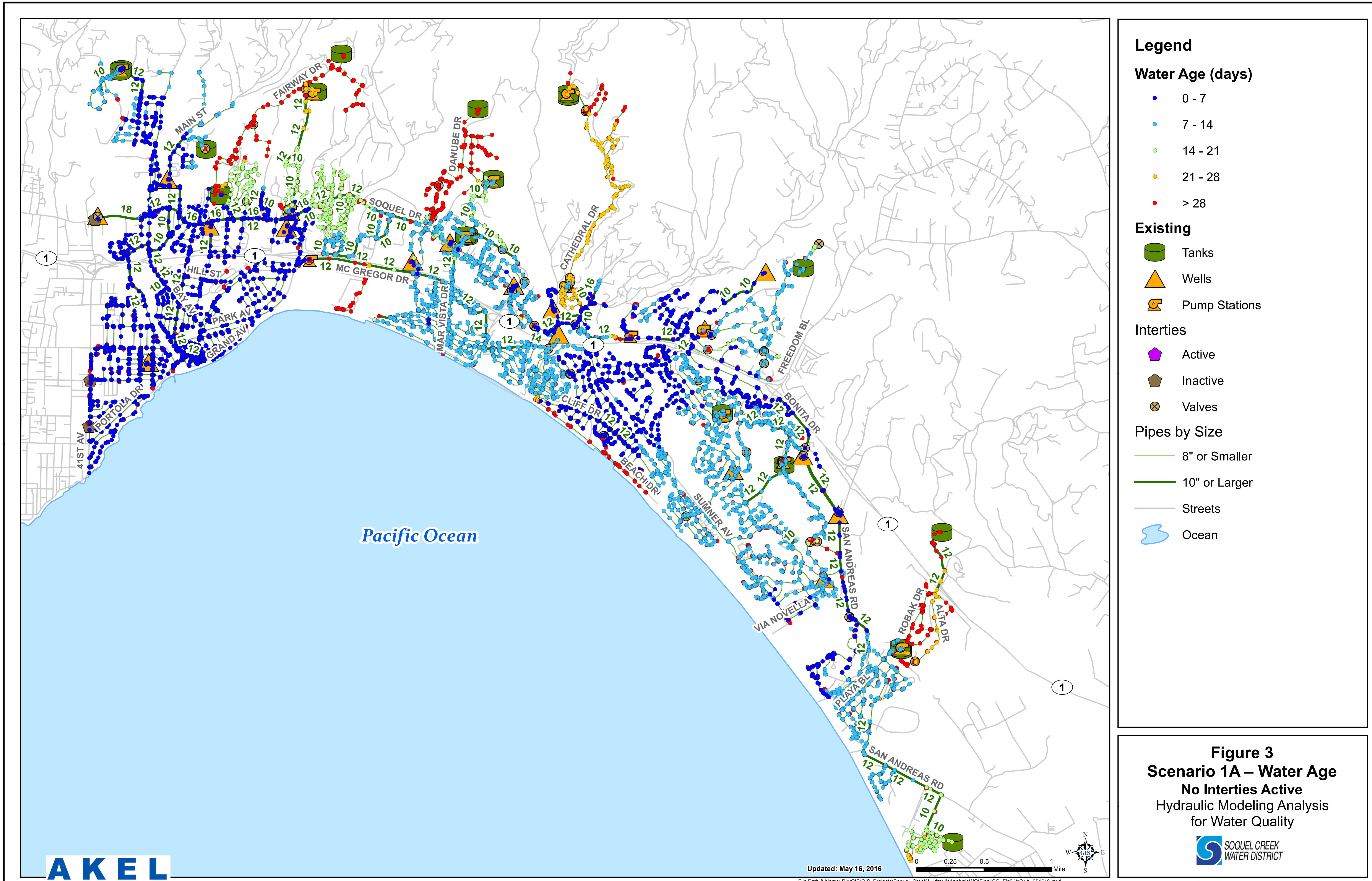
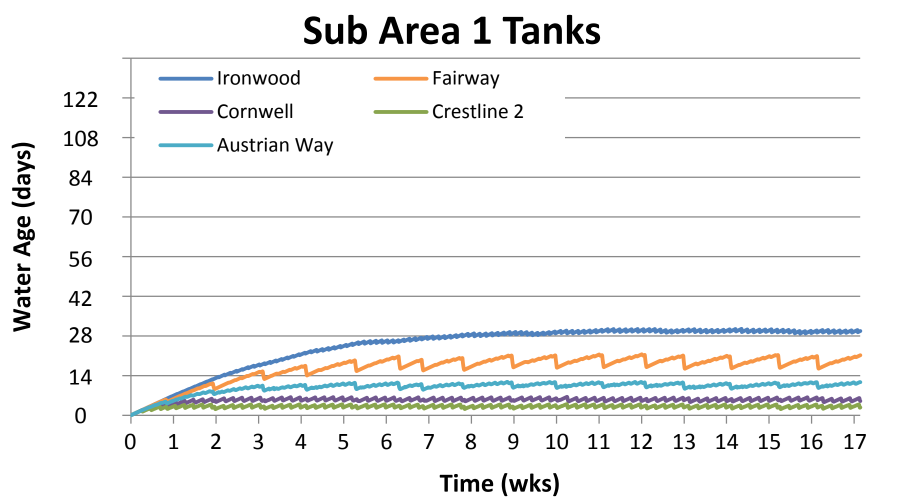
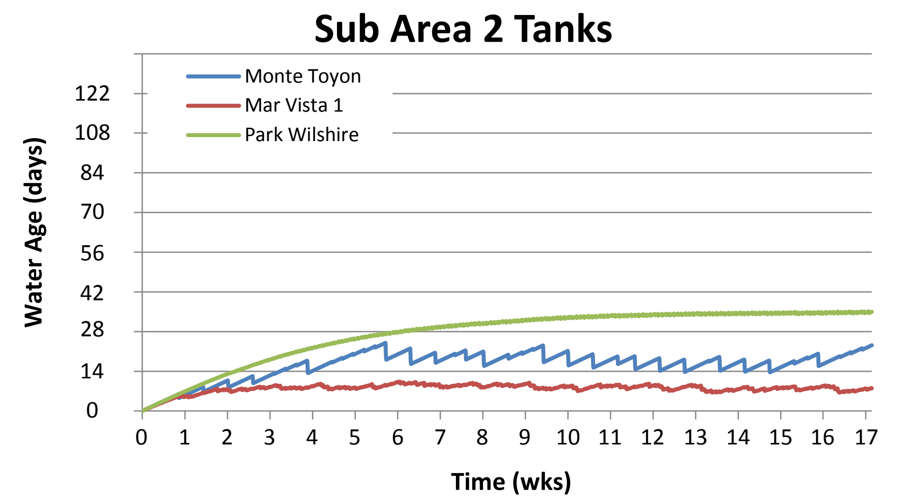
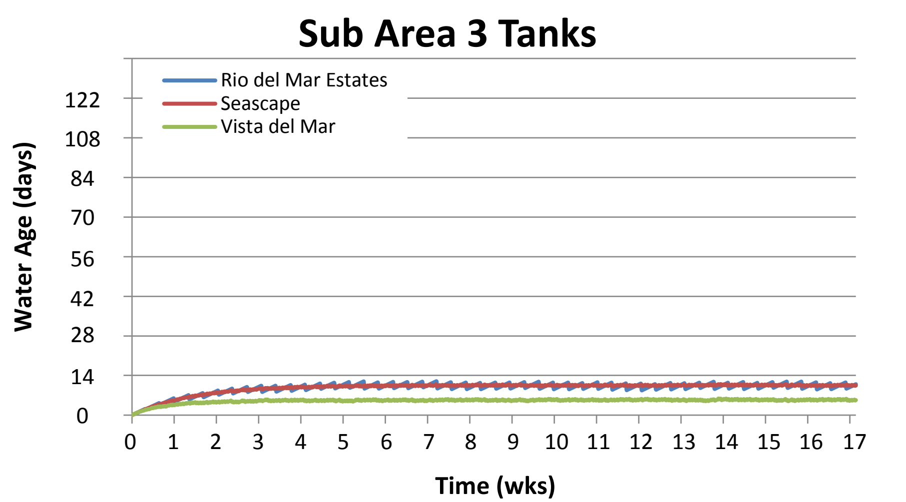
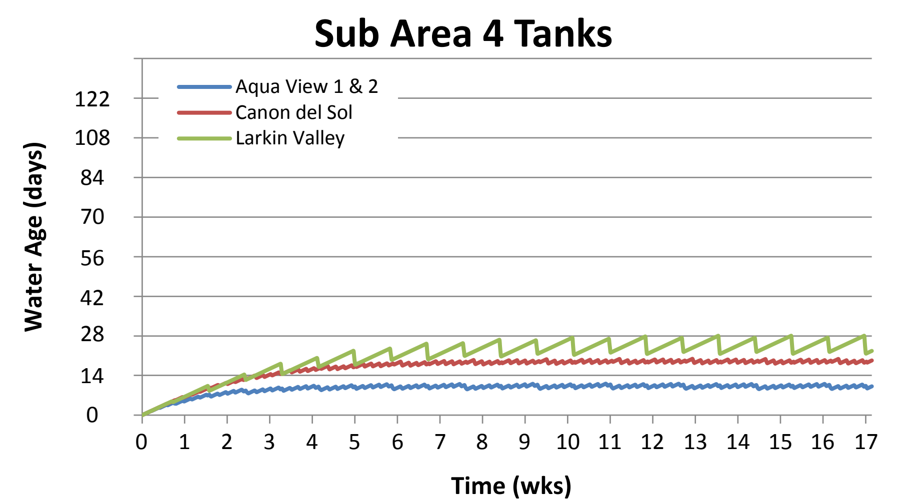


Figure 3
Scenario 1A – Water Age
No Interties Active
Hydraulic Modeling Analysis
for Water Quality









Notes:

1. No interties active
2. Aptos pump station inactive
2. Minimum Month Demand = 2.2 MGD

May 18, 2016

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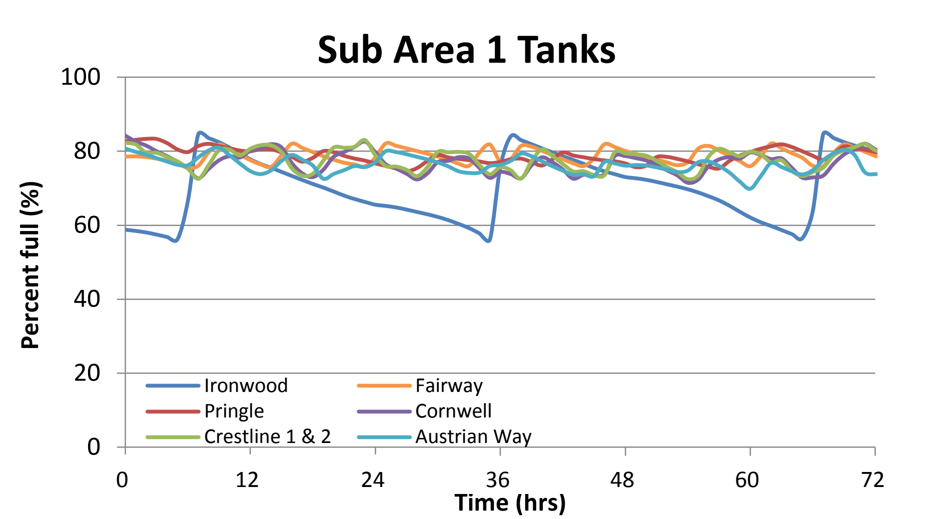
Figure 4

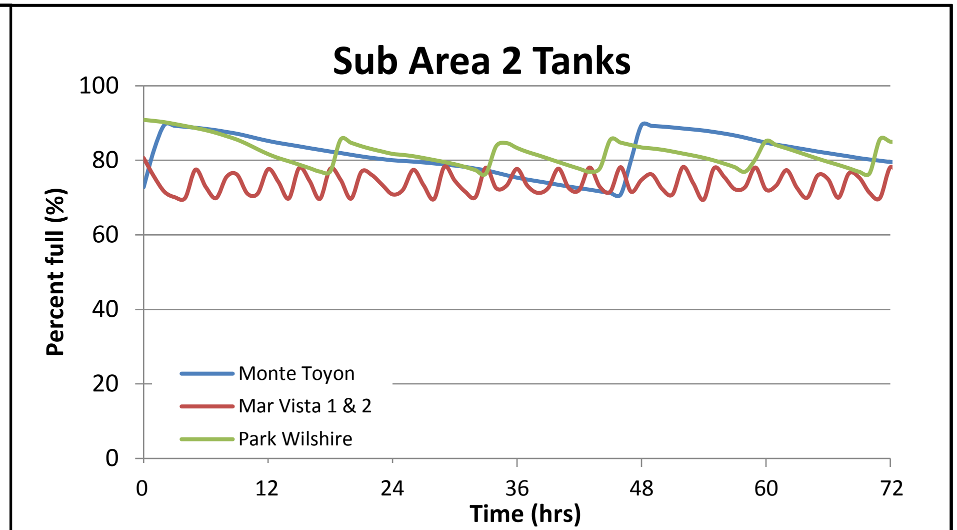
Scenario 1A - Water Age

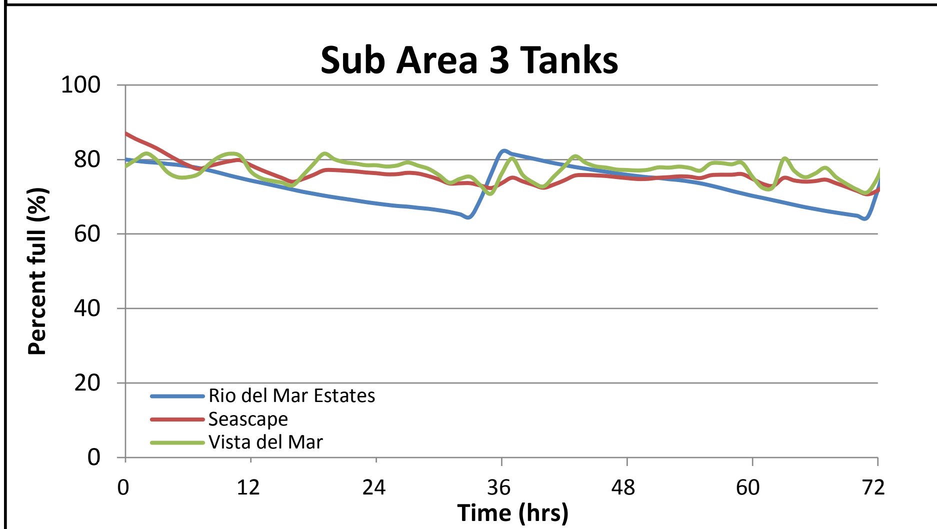
No Interties Active

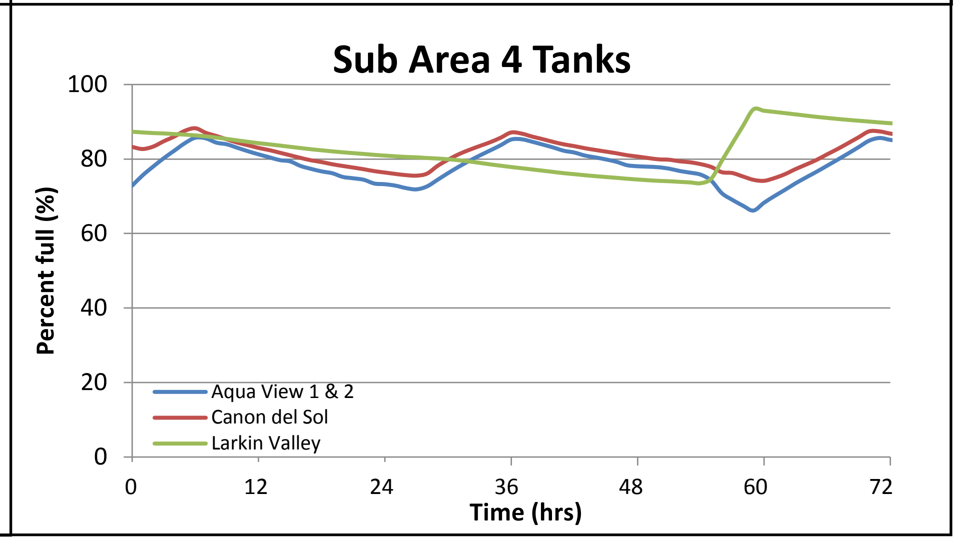
Hydraulic Modeling Analysis for
Water Quality
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT









Notes:

1. No interties active
2. Aptos pump station inactive
3. Minimum Month Demand = 2.2 MGD

May 18, 2016

Figure 5

Tank Operations

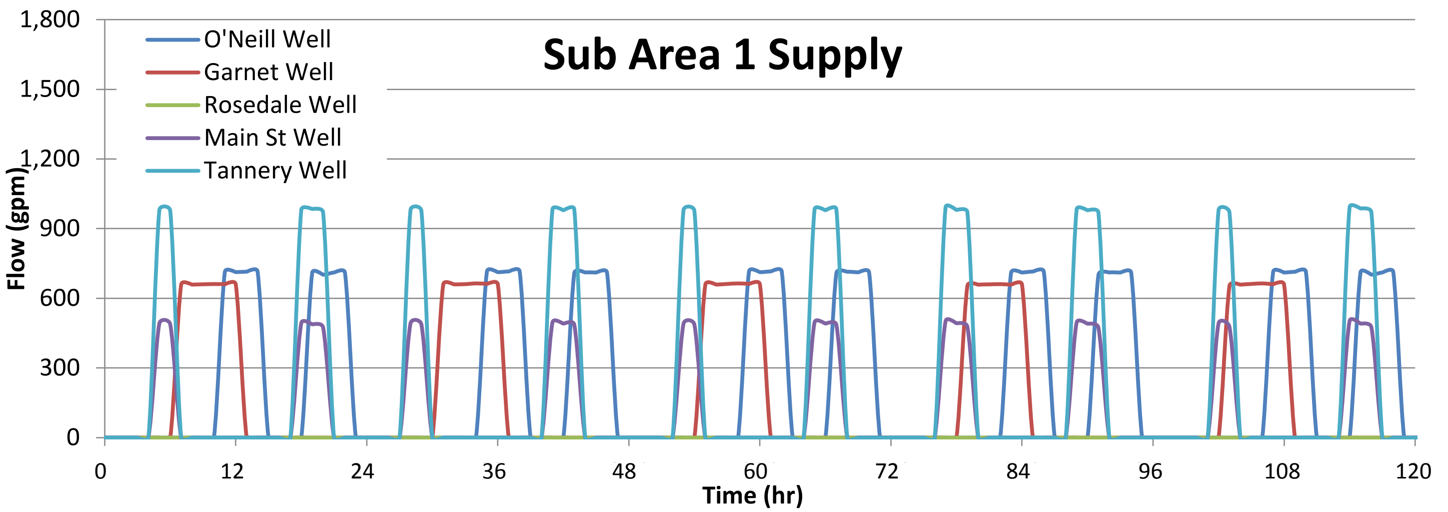
Scenario 1

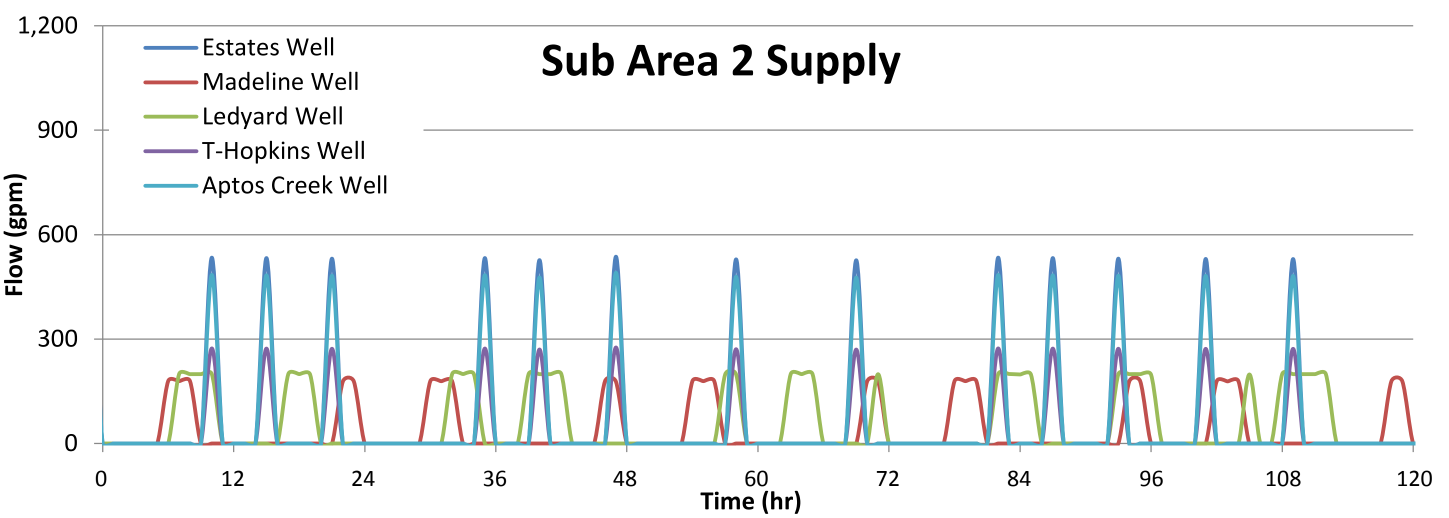
Hydraulic Modeling Analysis for Water Quality

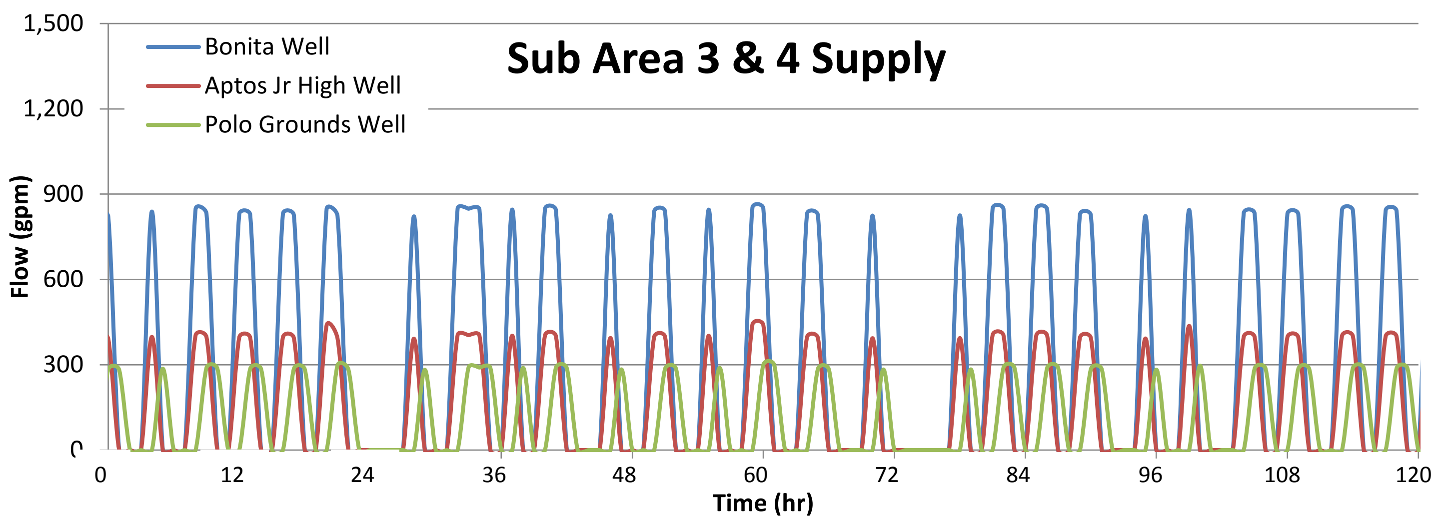
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.







Notes:

1. O'Neill intertie active
2. Aptos pump station inactive
3. Active Sub Area 1 Wells: O'Neill, Garnet, Rosedale, Main St, Tannery
4. Active Sub Area 2 Wells: Estates, Madeline, Ledyard, T-Hopkins, Aptos Creek
5. Active Sub Area 3 & 4 Wells: Bonita, Aptos Jr. High, Polo Grounds
6. Minimum Month Demand = 2.2 MGD

May 18, 2016

Figure 6

Well Operations

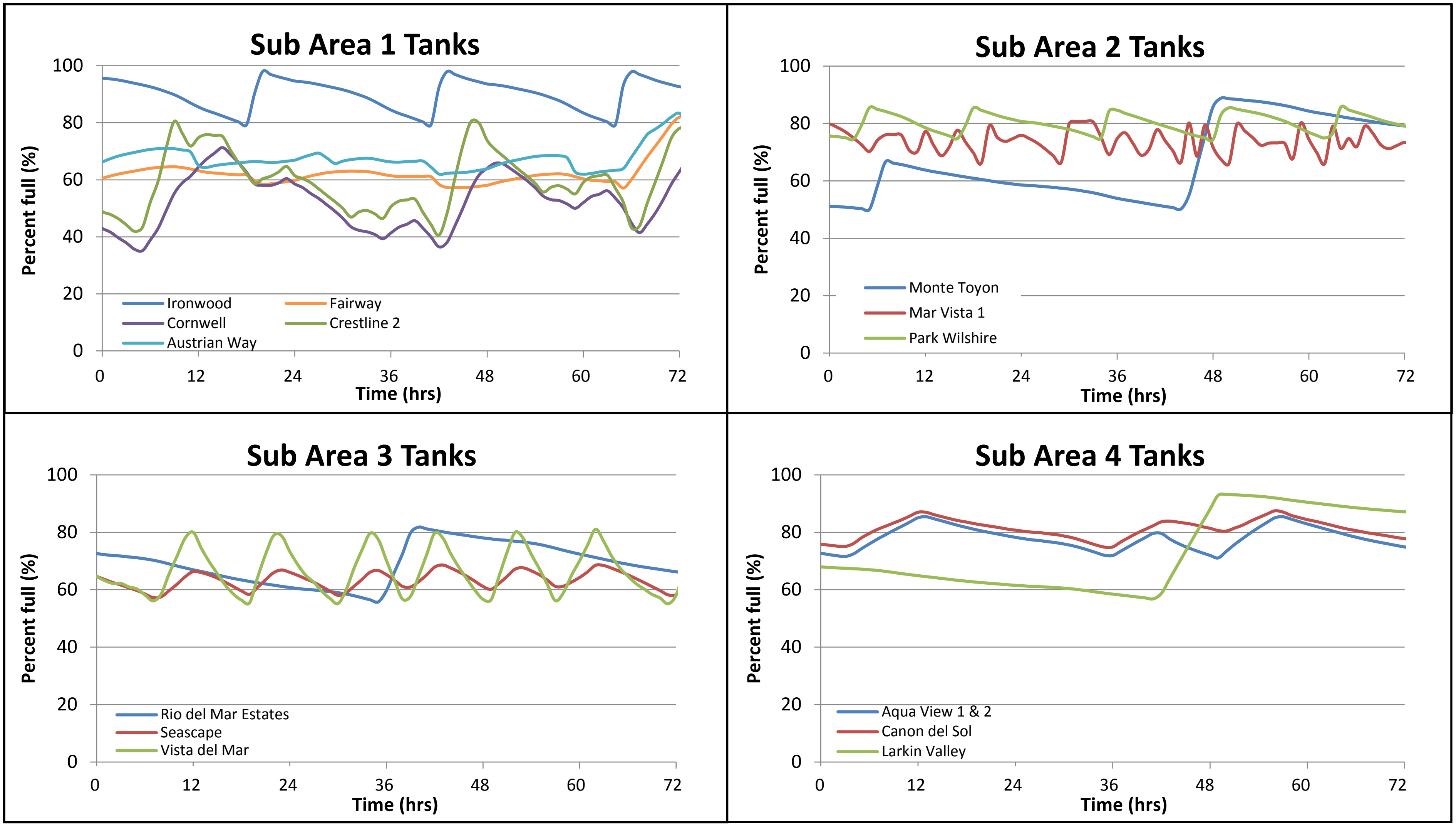
Scenario 1

Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.



Notes:

1. No interties active
2. Aptos pump station inactive
3. Minimum Month Demand = 2.2 MGD

May 18, 2016

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Figure 7

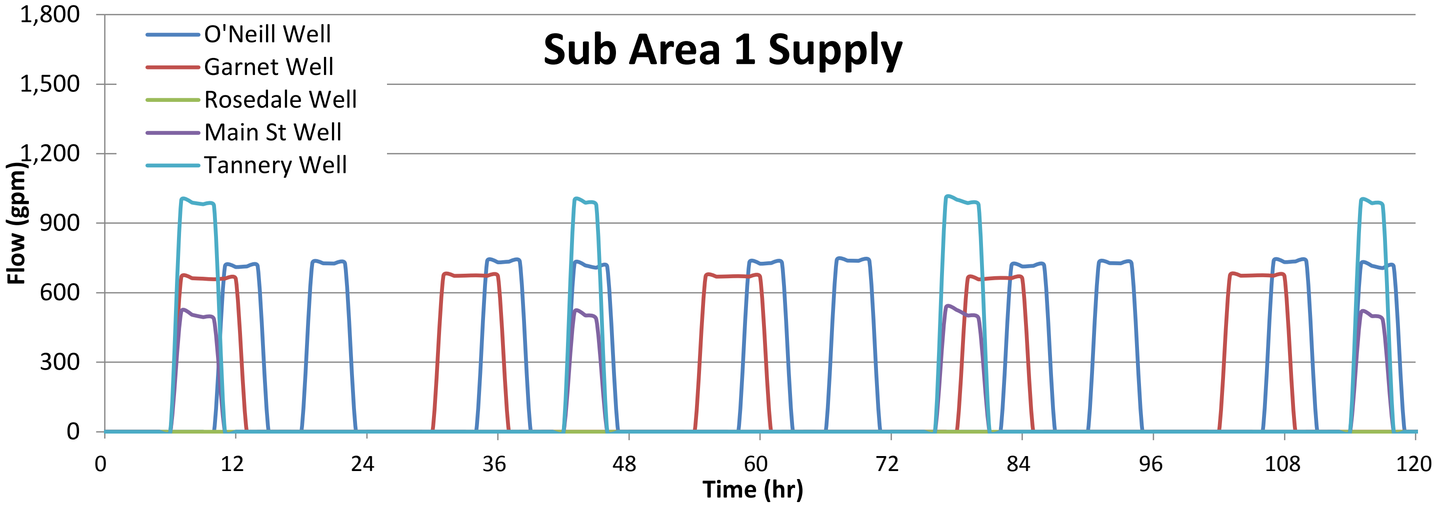
Tank Operations

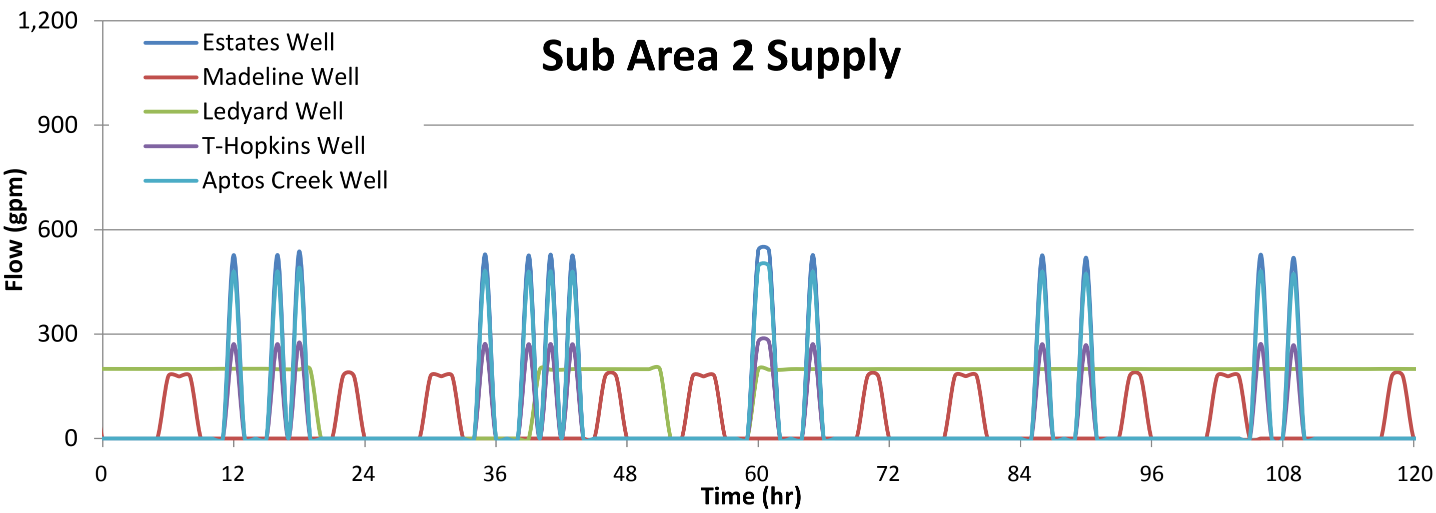
Scenario 1A

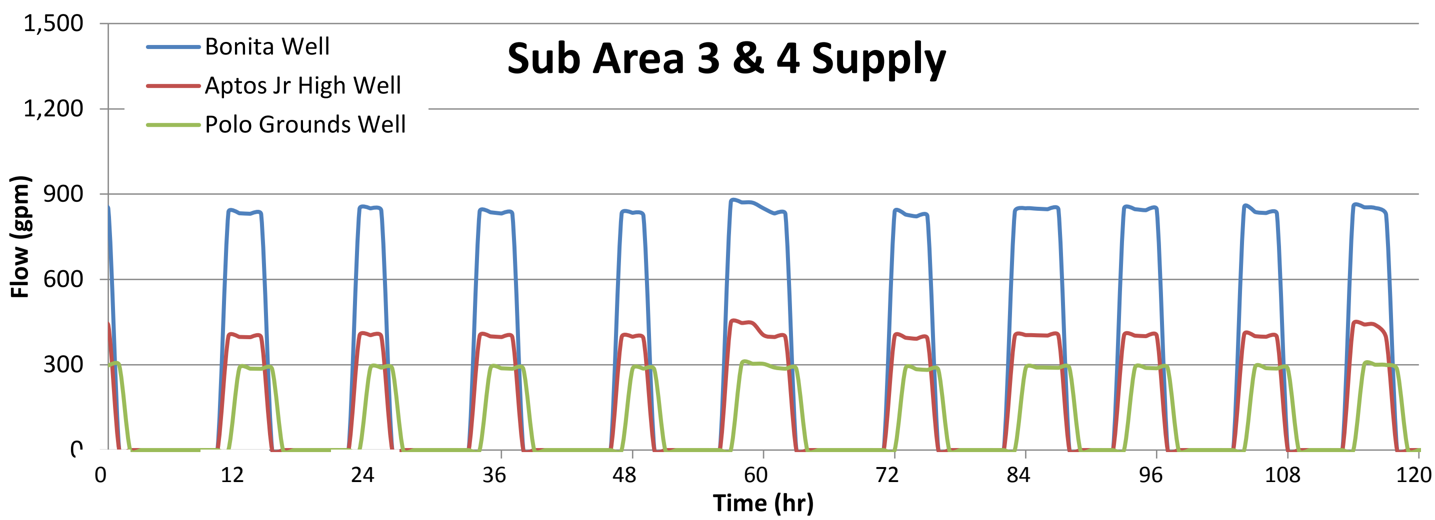
Hydraulic Modeling Analysis for Water Quality

Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT







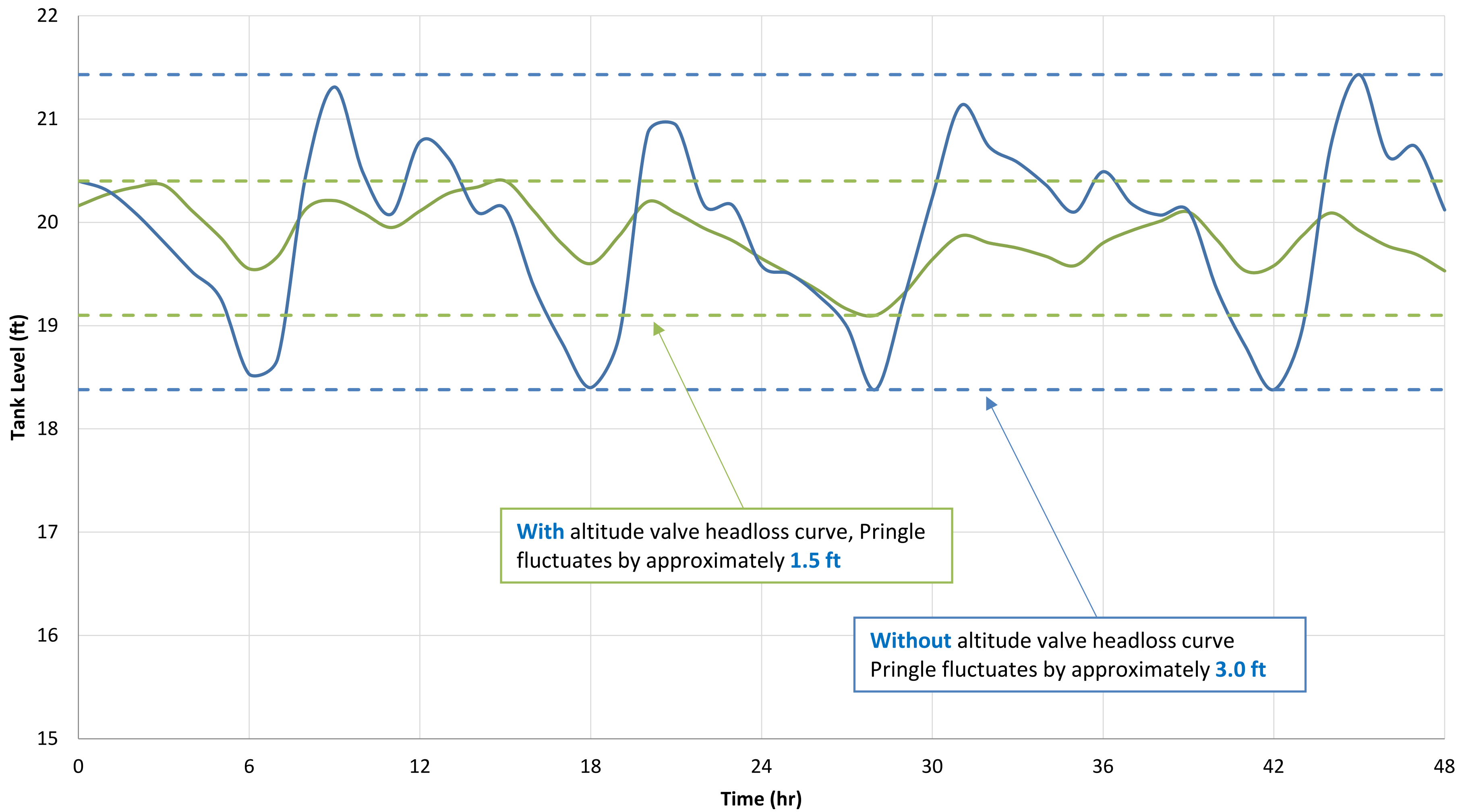
Notes:
1. No interties active
2. Aptos pump station inactive
3. Active Sub Area 1 Wells: O'Neill, Garnet, Rosedale, Main St, Tannery
4. Active Sub Area 2 Wells: Estates, Madeline, Ledyard, T-Hopkins, Aptos Creek
5. Active Sub Area 3 & 4 Wells: Bonita, Aptos Jr. High, Polo Grounds
6. Minimum Month Demand = 2.2 MGD

May 18, 2016

Figure 8
Well Operations
Scenario 1A
Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC.



LEGEND

With Altitude Valve Curve
Without Altitude Valve Curve

Notes:
1. No interties active
2. Aptos pump station inactive
3. Minimum Month Demands = 2.2 MGD
4. Current tank level controls

May 18, 2016

Figure 9
Pringle Tank Levels
Altitude Valve Analysis

Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

SOQUEL CREEK WATER DISTRICT

AKEL ENGINEERING GROUP, INC

Table 6 Well Inventory and Current Controls (Scenario 1)

Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

Service Area - HGL	Well Name	Current Well Capacity (gpm)	Control Type	Tank Name	Open (ft)	Closed (ft)
SA1 - 244W						
	Garnet	580	Clock Time	-	7:00 AM	12:30 PM
	Main Street	785	Tank Level	Crestline #2	18.5	20.5
	Rosedale	800	Tank Level	Crestline #2	18	20.5
	Tannery II	950	Tank Level	Crestline #2	18.5	20.5
	O'Neill Ranch	525	Clock Time	-	11:00 AM 7:00 PM	3:00 PM 11:00 PM
	Sub-Total	3,640				
SA2 - 244W						
	Aptos Creek	400	Tank Level	Mar Vista #2	13	14.85
	Estates	530	Tank Level	Mar Vista #2	13	14.85
	Madeline	175	Clock Time	-	6:00 AM 9:30 PM	9:00 AM 12:00 AM
	T-Hopkins	225	Tank Level	Mar Vista #2	13	14.85
	Sub-Total	1,330				
SA2 - 420W						
	Ledyard	230	Tank Level	Austrian Way	12.3	12.7
	Sub-Total	230				
SA3 - 359						
	Bonita	-	Tank Level	Vista del Mar	17.5	20
	San Andreas	-	Tank Level	Vista del Mar	17.5	20
	Seascape	-	Standby	-	-	-
Max Treatment Capacity for Bonita, San Andreas, and Seascape		2,000				
	Aptos Jr High	425	Tank Level	Vista del Mar	17.5	20
	Country Club	400	Clock Time	-	7:00 AM 4:00 PM	11:00 AM 7:00 PM
	Polo Grounds	270	Tank Level	Vista del Mar	17.5	20
	Sub-Total	3,095				
SA4 - 244E						
	Altivo	-	Inactive	-	-	-
	Sells	-	Inactive	-	-	-
	Sub-Total	0				
	Total	8,295				

5/18/2016

Table 7 Pump Station Inventory and Current Operational Controls (Scenario 1)

Hydraulic Modeling Analysis for Water Quality
Soquel Creek Water District

Pump Station	Pump From	Pump To	Pump Station Control	Pump Number	Open (ft)	Closed (ft)	Design Head (ft)	Design Flow (gpm)
Maplethorpe								
	SA1 - 244W	SA1 - 420W	Fairway Tank (ft)	1	12.6	13.5	190	650
	SA1 - 244W	SA1 - 420W	Fairway Tank (ft)	2	8	12	190	600
Mar Vista								
	SA2 - 244W	SA1 - 420W	Austrian Way Tank (ft)	1	7	12.3	184	555
	SA2 - 244W	SA1 - 420W	Austrian Way Tank (ft)	2	10	12.3	184	555
Fairway								
	SA1 - 420W	SA1 - 530	Ironwood Tank (ft)	1	13.2	18	114	400
	SA1 - 420W	SA1 - 530	Ironwood Tank (ft)	2	12.25	17	114	400
Austrian Way								
	SA1 - 420W	SA1 - 590	Park Wilshire Tank (ft)	1	18	20	230	250
	SA1 - 420W	SA1 - 590	Park Wilshire Tank (ft)	2	16	19	230	250
McGregor Pump Station								
	SA1-244W	SA2 - 244W	Mar Vista #2 Tank (ft)	1	13	17	57	1400
	SA1-244W	SA2 - 244W	Mar Vista #2 Tank (ft)	2	11.8	14.85	57	1400
Vista Mar								
	SA2 - 244W	SA2 - 534	Monte Toyon Tank (ft)	1	6 am - 10 pm: 10 10 pm - 6 am: 14	6 am - 10 pm: 12 10 pm - 6 am: 16	306	535
	SA2 - 244W	SA2 - 534	Monte Toyon Tank (ft)	2	6 am - 10 pm: 8 10 pm - 6 am: 8	6 am - 10 pm: 12 10 pm - 6 am: 16	370	505
Aptos Pump Station								
	SA2 - 244W	SA3 - 359	Vista del Mar Tank (ft)	1	17.5	20	194	221
	SA2 - 244W	SA3 - 359	Vista del Mar Tank (ft)	2	17.5	20	196	220
	SA2 - 244W	SA3 - 359	Vista del Mar Tank (ft)	3	12	14	194	225
Aptos								
	SA3 - 359	SA3 - 478	Rio del Mar Tank (ft)	1	16	20	180	375
	SA3 - 359	SA3 - 478	Rio del Mar Tank (ft)	2	15	18	160	400
Aqua View								
	SA4 - 244E	SA4 - 420E	Larkin Valley Tank (ft)	1	12	15	188	300
	SA4 - 244E	SA4 - 420E	Larkin Valley Tank (ft)	2	8	13	188	300

Appendix E: Additional Compliance Data

CITY OF
SANTA CRUZ
WATER DEPARTMENT
Water Quality Laboratory, 715 Graham Hill Road, Santa Cruz, CA 95060
Phone (831) 420-5480 • Fax (831) 420-5481 • waterquality@cityofsantacruz.com

COPY

December 14, 2015

Ms. Querube Moltrup
SWRCB Division of Drinking Water
Monterey District
1 Lower Ragsdale, Building 1, Suite 120
Monterey, CA 93940

Re: Lead and Copper Study 2015

Dear Ms. Moltrup:

Enclosed is the City of Santa Cruz Water Department's Lead and Copper Consumer Tap Monitoring Report for 2015. Customer tap sampling was conducted from September 8, 2015 through September 17, 2015.

Lead and Copper letters to all participating households were mailed on October 28, 2015, within 30 days of receiving all of the completed lead and copper results from Eurofins Eaton Analytical Laboratory.

If you have any questions, please call me at (831) 420-5484.

Sincerely,

Hugh Dalton

Hugh Dalton
Water Quality Manager

CITY OF
SANTA CRUZ

Water Department
Water System No. 4410010
ELAP Certification No. 1875

Lead and Copper Tap Monitoring Report 2015

Contents

Prepared by

City of Santa Cruz
Water Quality Laboratory
715 Graham Hill Road
Santa Cruz, CA 95060
Phone: (831) 420-5480 ♦ Fax: (831) 420-5481

SAMPLE SITE IDENTIFICATION AND CERTIFICATION

System's Name: City of Santa Cruz Water Department   Type: ✓ CWS ___ NTNCWS

Address: Graham Hill Water Treatment Plant
715 Graham Hill Road
Santa Cruz, CA 95060

Size:
___ >100,000
✓ 10,001 to 100,000
___ 3,301 to 10,000
___ 501 to 3,300
___ 101 to 500
___ ≤100

Telephone Number: (831) 420-5480
System ID#: CA 4410010
Contact Person: Hugh Dalton, Water Quality Manager

CERTIFICATION OF SAMPLING SITES

LEAD SOLDER SITES

# of single-family structures with copper pipes with lead solder installed after 1982 or lead pipes and/or lead service lines (Tier 1)	34
# of multi-family structures with copper pipes with lead solder installed after 1982 or lead pipes and/or lead service lines (Tier 1)	
# of buildings containing with copper pipes with lead solder installed after 1982 or lead pipes and/or lead service lines (Tier 2)	
# of sites that contain copper pipes with lead solder installed before 1983 (to be used only if other conditions have been exhausted) (Tier 3)	
TOTAL	34

The following sources have been explored to determine the number or structures which have Interior lead pipe or copper pipe with lead solder.

___ Plumbing and/or building codes
✓ Plumbing and/or building permits
___ Contacts within the building department, municipal clerk's office, or state regulatory agencies for historical documentation of the service area development
___ Water Quality Data

Other Resources Which PWS May Utilize

___ Interviews with building inspectors
___ Survey of service area plumbers about when and where lead solder was used from 1982 to present
✓ Survey residents in sections of the service area where lead pipe and/or copper pipe with lead solder is suspected to exist
___ Interviews with local contractors and developers

Explanation of Tier 2 and Tier 3 sites (attach additional pages if necessary)

____

SAMPLE SITE IDENTIFICATION AND CERTIFICATION

CERTIFICATION OF SAMPLING SITES

LEAD SERVICE LINE SITES

# of samples required to be drawn from lead service line sites	0
# of samples actually drawn from lead service line sites	0
Difference (explain differences other than zero)	0

The following sources have been explored to determine the number or lead service lines in the distribution system.

_____ Distribution system maps and record drawings

_____ Information collected for the presence of lead and copper as required under §141.42 of the Code of Federal Regulations

_____ Capital improvement plans and/or master plans for distribution system development

_____ Current and historical standard operating procedures and/or operation and maintenance (O&M) manuals for the type of materials used for service connections

_____ Utility records including meter installation records, customer complaint investigations and all historical documentation which indicate and/or confirm the location of lead service connections

_____ Existing water quality data for indications of 'troubled areas'

Other Resources Which PWS Utilized

_____ Interviews with senior personnel

_____ Conduct service line sampling where lead service lines are suspected to exist but their presence is not confirmed

_____ Review of permit files

_____ Community survey

_____ Review of USGS maps and records

_____ Interviews with pipe suppliers, contractors, and/or developers

Explanation of fewer than 50% LSL sites identified (attach additional pages if necessary):

____

CERTIFICATION OF COLLECTION METHODS

I certify that:

Each first draw tap sample for lead and copper is one liter in volume and has stood motionless in the plumbing system of each sampling site for at least six hours.

Each first draw sample collected from a singe-family residence has been collected from the cold water kitchen tap or bathroom sink tap.

Each first draw sample collected from a non-residential building has been collected at an interior tap from which water is typically drawn for consumption.

Each first draw sample collected during an annual or triennial monitoring period has been collected in the months of June, July, August or September.

Each resident who volunteered to collect tap water samples from his or her home has been properly Instructed by (insert water system's name) City of Santa Cruz Water Department in the proper methods for collecting lead an copper samples. I do not challenge the accuracy of those sampling results. Enclosed is a copy of the material distributed to residents explaining the proper collection methods and a list of the residents who performed sampling.

SAMPLE SITE IDENTIFICATION AND CERTIFICATION

RESULTS OF MONITORING

THE RESULTS OF LEAD AND COPPER TAP WATER SAMPLES MUST BE ATTACHED TO THIS DOCUMENT

# of samples required 30 # of samples submitted 34 90th Percentile Pb ND
90th Percentile Cu 0.40mg/l

THE RESULTS OF WATER QUALITY PARAMETER SAMPLES MUST BE ATTACHED TO THIS DOCUMENT

# of samples required 14 # of tap samples submitted 14
# of entry point samples required 1 # of entry point samples submitted 2

CHANGE OF SAMPLING SITES

Original site address:
No new sampling sites were added this year. Of the 34 sites, 27 were used in the 2012 study and 33 were sampled in the original study in 1992.

New site address:

Distance between sites (approximately):

Targeting Criteria: NEW: OLD:

Reason for change (attach additional pages if necessary):

SIGNATURE [signature]

Hugh Dalton	Water Quality Manager	November 17, 2015
NAME	TITLE	DATE

CITY OF SANTA CRUZ
Water Quality Laboratory
715 Graham Hill Road, Santa Cruz, CA 95060
Phone (831) 420-5480

Sampling Instructions for Lead and Copper Tap Monitoring

Thank you for participating in our Lead and Copper Tap Monitoring Program. Sampling for this study is very simple and will require a minimal amount of time. In order to insure that acceptable samples are collected, participants must closely adhere to the following guidelines.

PLEASE COLLECT YOUR SAMPLE ON [DATE]

1. To participate in this study, your house must have been built or plumbed between January of 1983 and December of 1987 and the plumbing must be constructed of soldered copper pipe. Also, you must **not** have a water softener system connected to your home. If your home does not meet these criteria, do not collect the sample. Please return the sample bottle with a note explaining the reason.

2. **Water must stand unused throughout the entire household plumbing for at least six hours prior to sampling. Toilets must not be flushed nor faucets run during this period.** The evening before sampling, please discontinue using any water in the entire house before midnight. You may want to place plastic bags over your faucets to remind you that the water is not to be used until after the sample is collected.

3. **After 6:00am on the morning following delivery of the sample bottle, please fill the container from your kitchen cold water faucet. Do not allow the water to run into the drain prior to sampling and do not rinse the container.** Collect the first water out of the cold water faucet. The bottle MUST be filled completely. It is very important that we obtain the first water leaving the tap. Note: If a drinking water filter system has been attached to the kitchen faucet and an unfiltered sample is not obtainable, please select another cold water faucet inside your home.

4. **Please fill out the entire label on the bottle in pencil or waterproof ink and place the sample on the front porch by 8:00am the same morning for collection by a Water Department employee.**

Once analyses are completed, we will send you a report of the lead and copper results for your sample. Please call the Water Quality Laboratory at 420-5480 with any questions regarding sample collection or sample pickup.

Thank you again for your cooperation and assistance in this important study.

Participant List
2015 City of Santa Cruz Water Department
Lead and Copper Tap Monitoring Project

		Sample ID	Sample Date/Time
		AA45931	9/17/2015 6:55
		AA45932	9/17/2015 5:35
		AA45815	9/10/2015 7:35
		AA45933	9/17/2015 7:30
		AA45934	9/17/2015 6:58
		AA45935	9/17/2015 5:34
		AA45936	9/17/2015 6:04
		AA45937	9/17/2015 6:55
		AA45938	9/17/2015 5:00
		AA45816	9/10/2015 7:45
		AA45839	9/11/2015 6:00
		AA45821	9/10/2015 6:00
		AA45822	9/10/2015 6:35
		AA45817	9/10/2015 7:02
		AA45818	9/10/2015 6:00
		AA45819	9/10/2015 6:30
		AA45939	9/15/2015 6:20
		AA45940	9/17/2015 5:08
		AA45941	9/17/2015 7:20
		AA45942	9/17/2015 6:07
		AA45823	9/10/2015 6:00
		AA45943	9/17/2015 6:00
		AA45824	9/10/2015 6:15
		AA45825	9/10/2015 6:00
		AA45841	9/11/2015 5:06
		AA45840	9/11/2015 7:00
		AA45820	9/10/2015 7:30
		AA45944	9/17/2015 6:57
		AA45826	9/10/2015 6:05
		AA45827	9/10/2015 7:44
		AA45945	9/17/2015 7:30
		AA45946	9/17/2015 6:40
		AA45947	9/17/2015 6:00
		AA45828	9/10/2015 6:05

CITY OF SANTA CRUZ WATER DEPARTMENT
LEAD AND COPPER STUDY

Discussion of 2015 Monitoring

This 2012 customer tap monitoring for lead and copper is the tenth such monitoring since the addition of orthophosphate for corrosion control treatment in March of 2001. In each of these studies, all lead and copper 90th percentile concentrations have been below the action levels.

Study Year	Lead, ug/L 90th Percentile	Lead, ug/L Action Level	Copper, mg/L 90th Percentile	Copper, mg/L Action Level
2001	ND	15	0.65	1.3
2002	ND	15	0.66	1.3
2003	ND	15	0.65	1.3
2004	ND	15	0.59	1.3
2005	ND	15	0.40	1.3
2006	ND	15	0.34	1.3
2007	ND	15	0.49	1.3
2008	ND	15	0.49	1.3
2009	ND	15	0.33	1.3
2012	ND	15	0.25	1.3
2015	ND	15	0.40	1.3

Lead Detection Limit for Reporting (DLR) = 5 ug/L

Also noteworthy in each of these studies; the highest concentrations tested for lead and copper were well below the action levels. That is, as shown in the table below, no individual sample exceeded the action levels.

Study Year	Lead, ug/L Highest Sample	Lead, ug/L Action Level	Copper, mg/L Highest Sample	Copper, mg/L Action Level
2001	5.2	15	1.0	1.3
2002	8.4	15	0.82	1.3
2003	5.7	15	0.75	1.3
2004	ND	15	1.1	1.3
2005	ND	15	0.54	1.3
2006	ND	15	0.46	1.3
2007	ND	15	0.66	1.3
2008	ND	15	0.68	1.3
2009	ND	15	0.55	1.3
2012	ND	15	0.56	1.3
2015	7.9	15	0.83	1.3

In summary, copper and lead concentrations at customer taps are meeting requirements by margins well below the action levels.

Water quality parameter (WQP) monitoring data is summarized in the table below and compared to the requirements of the February 15, 2001 Amendment to the City's Domestic Water Supply Permit. All WQP data in 2015 was within the required range, with the exception of the entry point to the distribution system pH value of 7.0 collected on 9/8/2015.

Monitored Parameter	pH	o-phosphate, mg/L	o-phosphate, mg/L
Sample Location	Entry point and Distribution system	Entry point	Distribution system
Requirement	7.1 to 7.8	0.40 to 1.5	0.05 to 1.5
2015 Data Range	7.0 to 7.5	0.49 to 0.58	0.33 to 0.60

Details of the data summarized in this discussion, as well as additional historical information, are contained in the remainder of this report.

- The section *Monitoring Requirements for 2015* details the requirements, citing the California Code of Regulations, that are intended to be met by this study and report.
- Tables 1 and 2 include all 2015 customer tap data collected for lead and copper. The data is in order of lowest to highest and ranked so that the 90^{th} percentile can be determined. The method used to calculate the 90^{th} percentile ranking is shown and the 90^{th} percentile value is selected.
- Table 3 includes the addresses and water quality parameter (WQP) data for the required fourteen distribution samples, as well as two sets of WQP data for the entry point, the Graham Hill Water Treatment Plant.
- Table 4 shows the addresses of all the lead and copper tap sampling sites and indicates which years they were sampled since 1999. Of the 34 sites used in the 2015 study, 27 were sampled in the 2012 study and 33 have data from the original study in 1992.
- Tables 5 and 6 show all the lead and copper data for each sampling site taken in these studies since 1999. The 90^{th} percentile values for each year are included for comparison.
- Lastly, the map shows the location of the lead and copper sampling sites and the water quality parameter sampling sites throughout the service area.

Monitoring Requirements for 2015

The following summarizes the lead and copper monitoring requirements with references to applicable California Code of Regulations (CCR) sections establishing the requirements. These monitoring requirements have been used since the reduced monitoring, from 60 to 30 sample locations, was approved for 2003.

- 30 tap samples for lead and copper shall be collected during the months of June, July, August, or September. CCR §64675(b)(2); CCR §64675.5(a)(1); Table 64675-A.
- A first-draw sample shall be one liter in volume and have stood motionless in the plumbing system of each site for at least six hours, but not more than twelve. Samples from residential housing shall be collected from the cold-water kitchen tap or bathroom sink tap. To avoid problems of residents handling nitric acid, acidification of samples may be done up to 14 days after collection. After acidification to resolubilize the metals, the sample shall stand in the original container for the time specified by the method used pursuant to section 64670(c) before it can be analyzed. CCR §64677(b)
- Water Quality Parameters (WQP) are pH, alkalinity and orthophosphate. CCR §64682.
- WQP monitoring shall be conducted at 7 distribution system sites. §64680(a)(1) and (2); Table 64680-A.
- Two samples shall be taken at each of the 7 WQP sites. §64680(a)(3).
- One sample shall be taken for WQPs at the entry point. §64680(b).

The 2015 lead and copper monitoring detailed in this report were conducted to meet these CCR requirements.

Table 1: 2015 Lead Data, Percentile Ranked

Sample ID	Date	Rank	Result	DLR	Unit	escri[illegible]
AA45839	9/11/15	1	ND	5	ug/L	
AA45826	9/10/15	2	ND	5	ug/L	
AA45933	9/17/15	3	ND	5	ug/L	
AA45934	9/17/15	4	ND	5	ug/L	
AA45935	9/17/15	5	ND	5	ug/L	
AA45819	9/10/15	6	ND	5	ug/L	
AA45816	9/10/15	7	ND	5	ug/L	
AA45822	9/10/15	8	ND	5	ug/L	
AA45823	9/10/15	9	ND	5	ug/L	
AA45947	9/17/15	10	ND	5	ug/L	
AA45941	9/17/15	11	ND	5	ug/L	
AA45937	9/17/15	12	ND	5	ug/L	
AA45938	9/17/15	13	ND	5	ug/L	
AA45931	9/17/15	14	ND	5	ug/L	
AA45939	9/15/15	15	ND	5	ug/L	
AA45940	9/17/15	16	ND	5	ug/L	
AA45932	9/17/15	17	ND	5	ug/L	
AA45824	9/10/15	18	ND	5	ug/L	
AA45827	9/10/15	19	ND	5	ug/L	
AA45841	9/11/15	20	ND	5	ug/L	
AA45817	9/10/15	21	ND	5	ug/L	
AA45820	9/10/15	22	ND	5	ug/L	
AA45936	9/17/15	23	ND	5	ug/L	
AA45943	9/17/15	24	ND	5	ug/L	
AA45944	9/17/15	25	ND	5	ug/L	
AA45821	9/10/15	26	ND	5	ug/L	
AA45815	9/10/15	27	ND	5	ug/L	
AA45825	9/10/15	28	ND	5	ug/L	
AA45942	9/17/15	29	ND	5	ug/L	
AA45945	9/17/15	30	ND	5	ug/L	
AA45840	**9/11/15**	**31**	**ND**	**5**	**ug/L**	
AA45818	9/10/15	32	ND	5	ug/L	
AA45946	9/17/15	33	ND	5	ug/L	
AA45828	9/10/15	34	7.90	5	ug/L	

90^{th} Percentile Rank = 0.9*34 = 31
90^{th} Percentile Value = ND

Table 2: 2015 Copper Data, Percentile Ranked

Sample ID	Date	Rank	Result	DLR	Unit	
AA45820	9/10/15	1	ND	0.05	mg/L	
AA45942	9/17/15	2	0.08	0.05	mg/L	
AA45937	9/17/15	3	0.08	0.05	mg/L	
AA45938	9/17/15	4	0.08	0.05	mg/L	
AA45933	9/17/15	5	0.09	0.05	mg/L	
AA45947	9/17/15	6	0.09	0.05	mg/L	
AA45939	9/15/15	7	0.10	0.05	mg/L	
AA45821	9/10/15	8	0.10	0.05	mg/L	
AA45822	9/10/15	9	0.10	0.05	mg/L	
AA45940	9/17/15	10	0.12	0.05	mg/L	
AA45945	9/17/15	11	0.13	0.05	mg/L	
AA45931	9/17/15	12	0.15	0.05	mg/L	
AA45823	9/10/15	13	0.15	0.05	mg/L	
AA45819	9/10/15	14	0.15	0.05	mg/L	
AA45817	9/10/15	15	0.16	0.05	mg/L	
AA45941	9/17/15	16	0.17	0.05	mg/L	
AA45944	9/17/15	17	0.17	0.05	mg/L	
AA45839	9/11/15	18	0.19	0.05	mg/L	
AA45841	9/11/15	19	0.21	0.05	mg/L	
AA45825	9/10/15	20	0.21	0.05	mg/L	
AA45827	9/10/15	21	0.21	0.05	mg/L	
AA45826	9/10/15	22	0.22	0.05	mg/L	
AA45824	9/10/15	23	0.23	0.05	mg/L	
AA45943	9/17/15	24	0.24	0.05	mg/L	
AA45935	9/17/15	25	0.25	0.05	mg/L	
AA45840	9/11/15	26	0.27	0.05	mg/L	
AA45936	9/17/15	27	0.28	0.05	mg/L	
AA45815	9/10/15	28	0.29	0.05	mg/L	
AA45818	9/10/15	29	0.30	0.05	mg/L	
AA45932	9/17/15	30	0.35	0.05	mg/L	
AA45946	**9/17/15**	**31**	**0.40**	**0.05**	**mg/L**	
AA45934	9/17/15	32	0.44	0.05	mg/L	
AA45816	9/10/15	33	0.82	0.05	mg/L	
AA45828	9/10/15	34	0.83	0.05	mg/L	

90^{th} Percentile Rank = 0.9*34 = 31

90^{th} Percentile Value = 0.40 mg/L

Table 3: 2015 Water Quality Parameters Data

Sample Number			Sample Date	pH	Alkalinity mg/L	Orthophosphate PO4 mg/L
AA45725			9/8/2015	7.2	110	0.55
AA45726			9/8/2015	7.2	110	0.60
AA45727			9/8/2015	7.4	112	0.60
AA45728			9/9/2015	7.5	115	0.60
AA45729			9/8/2015	7.1	112	0.60
AA45730			9/8/2015	7.2	132	0.47
AA45731			9/8/2015	7.1	118	0.56
AA45889			9/16/2015	7.2	110	0.55
AA45912			9/16/2015	7.3	110	0.59
AA45887			9/15/2015	7.3	112	0.58
AA45890			9/15/2015	7.4	112	0.59
AA45913			9/16/2015	7.2	112	0.58
AA45891			9/16/2015	7.5	142	0.33
AA45892			9/15/2015	7.2	110	0.57
AA45732			9/8/2015	7.0	111	0.58
AA45888			9/15/2015	7.2	112	0.49
			Ave	7.3	115	0.55
			Max	7.5	142	0.60
			Min	7.0	110	0.33

Table 4: Lead and Copper Sampling Location History
1999-2015
(Page 1 of 3)

=sampled =not sampled

	1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015

Table 4: Lead and Copper Sampling Location History
1999-2015
(Page 2 of 3)

■ =sampled □ =not sampled

	1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
		■	■									
	■	■	■	■	■	■	■	■	■	■	■	■
		■										
		■	■									
		■	■									
		■	■									
		■	■									
		■	■									
		■	■									
		■	■			■	■	■	■		■	
	■	■	■	■	■							
	■	■	■	■	■		■	■	■	■	■	■
	■	■	■	■	■	■	■	■	■			■
	■	■	■	■	■		■	■	■	■		■
		■										
			■									
	■	■	■	■	■	■		■	■	■	■	■
	■	■	■	■	■		■	■	■	■	■	■
		■	■									
		■	■									
	■	■	■	■	■	■	■	■	■	■		
	■	■	■	■	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■		■	■	■	■
	■										■	
	■		■									
		■	■			■		■	■	■	■	■
	■	■	■	■	■	■	■	■	■	■		■
	■	■	■	■	■							
		■	■				■	■	■	■	■	■
	■	■	■	■	■	■	■	■	■	■	■	■
	■	■	■	■	■	■	■	■	■		■	■
	■	■	■	■		■	■			■	■	■
	■	■										

Table 4: Lead and Copper Sampling Location History
1999-2015
(Page 3 of 3)

=sampled   =not sampled

	1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015

Total No. of Sites Sampled	42	60	62	32	31	31	31	30	31	30	31	34

Table 5:
Lead Complete Data 1999 – 2015
(Page 1 of 3)

		1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND									
		ND											
			ND	ND			ND	ND	ND	ND	ND	ND	
			ND	ND			ND	ND	ND	ND	ND	ND	ND
			ND	ND			ND		ND	ND	ND		
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND
			ND										
			ND	ND				ND		ND	ND		ND
			ND	ND									ND
		ND	ND	ND	ND	ND	ND		ND	ND	ND	ND	ND
			ND	ND									
		ND										ND	ND
				ND									
				ND									
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND						ND
				ND									
		ND	ND	ND	ND	ND	ND	ND	ND		ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
			ND	ND									
			ND	ND									
		ND	ND	ND						ND		ND	ND
		ND	ND	ND	ND	ND							
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND		ND				ND				ND	ND
			ND	ND									

Units are ug/L
DLR = 5 ug/L

Table 5:
Lead Complete Data 1999 – 2015
(Page 2 of 3)

		1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
			ND	ND									
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
			ND										
			ND	ND									
			ND	ND									
			ND	ND									
			ND	ND									
			ND	ND									
			ND	ND									
			ND	ND			ND	ND	ND	ND		ND	
		ND	ND	ND	ND	ND							
		ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND			ND
		ND	ND	ND	ND	ND		ND	ND	ND	ND		ND
			ND										
				ND									
		ND	ND	ND	5.7	ND	ND		ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND		ND	ND	ND	ND	ND	ND
			ND	ND									
			ND	ND									
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND		ND	ND	ND	ND
			ND									ND	
		5.9		8.4									
			ND	ND			ND		ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND		ND
		ND	ND	ND	ND	ND							
			ND	ND				ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
		ND	ND	ND	ND	ND	ND	ND	ND	ND		ND	ND
		5.8	ND	ND	ND		ND	ND			ND	ND	ND
		ND	ND										

Units are ug/L
DLR = 5 ug/L

Table 5:
Lead Complete Data 1999 – 2015
(Page 3 of 3)

		1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
		ND	ND	ND	ND	ND							
		ND		ND			ND	ND	ND				7.9
		13	5.2	ND	ND	ND	ND						
		ND	ND										
Number of Site Sampled		42	60	62	32	31	31	31	30	31	30	31	34
Lead 90th Percentile		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Units are ug/L
DLR = 5 ug/L

Table 6:
Copper Complete Data 1999 – 2015
(Page 1 of 3)

		1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
		0.23	0.16	0.12	0.14	0.12	0.38	0.37	0.12	0.11	0.11	0.10	
		0.14	0.11	0.10	0.08	0.08	0.11	0.10	0.10	0.09	0.09	0.06	0.15
		0.45	0.15	0.30	0.36	0.21	0.17	0.12	0.22	0.20	0.29	0.10	0.35
		1.05	0.76	0.62	0.66	0.46	0.36	0.36	0.31	0.31	0.32	0.23	0.29
		0.21	ND	0.18	0.20	0.12	0.21	0.21	0.27	0.09	0.05	0.10	0.09
		0.85	ND	0.44									
		0.61											
			0.29	0.37			0.07	0.17	0.21	0.20	0.15	0.18	
			0.48	0.44			0.31	0.32	0.33	0.49	0.33	0.25	0.44
			0.49	0.57			0.29	0.11		0.10	0.13		
		0.38	0.26	0.30	0.26	0.21	0.19	0.20	0.17	0.16	0.12	0.11	0.25
		0.59	0.34	0.46	0.33	0.28	0.33	0.28	0.25		0.20	0.20	0.28
			0.10										
			0.32	0.29				0.22		0.33	0.24		0.08
			0.11	0.12									0.08
		0.37	0.63	0.55	0.39	0.25	0.31	0.66		0.68	0.55	0.56	0.82
			0.10	0.07									
		0.17										0.09	0.19
				0.82									
				0.66									
		1.12	1.01	0.74	0.47	0.49	0.54	0.49	0.34	0.53	0.39	0.29	0.10
		0.21	0.24	0.25	0.33	0.34	0.21						0.10
				0.67									
		0.66	0.54	0.63	0.44	0.16	0.40	0.29	0.32		0.20	0.07	0.16
		0.69	0.49	0.65	0.36	0.31	0.36	0.32		0.38	0.26	0.22	0.30
		0.02	0.20	0.36	0.37	0.15	0.15	0.23	0.15	0.14	0.15	0.08	0.15
			0.21	0.27									
			0.13	0.16									
		0.21	0.10	0.26						0.09		0.09	0.10
		0.13	ND	0.08	0.46	ND							
		0.12	0.07	0.08	0.09	0.05	0.07	0.09	0.09	0.05	0.07	0.10	0.12
		0.58		0.46				0.16				0.07	0.17
			0.25	0.21									

Units are mg/L
DLR = 0.05 mg/L

Table 6:
Copper Complete Data 1999 – 2015
(Page 2 of 3)

		1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
			0.15	0.13									
		0.31	0.14	0.24	0.18	0.14	0.16	0.26	0.66	0.31	0.18	0.05	0.08
			0.26										
			0.27	0.27									
			0.31	0.25									
			0.28	0.18									
			0.16	0.16									
			0.32	0.24									
			0.32	0.39									
			0.25	0.33			0.37	0.24	0.19	0.21		0.07	
		1.02	0.50	0.68	0.47	0.59							
		0.19	0.52	0.62	0.34	0.43		0.33	0.40	0.29	0.28	0.18	0.15
		0.27	0.15	0.23	0.12	0.14	0.15	0.12	0.19	0.10			0.24
		0.70	0.40	0.34	0.32	0.22		0.23	0.22	0.24	0.21		0.23
			0.16										
				0.43									
		1.05	0.56	0.52	0.75	0.72	0.39		0.53	0.36	0.23	0.21	0.21
		1.30	0.66	0.70	0.13	0.37		0.43	0.36	0.43	0.24	0.26	0.21
			0.64	0.57									
			0.28	0.42									
		0.68	0.26	0.22	0.25	0.18	0.20	0.18	0.25	0.21	0.16		
		0.87	0.50	0.41	0.48	0.21	0.35	0.32	0.30	0.31	0.27	0.13	0.27
		0.11	0.17	0.75	0.09	0.09	0.12	0.07		0.28	0.13	0.17	ND
		0.25										ND	
		0.77		0.38									
			0.18	0.19			0.16		0.16	0.15	0.18	0.10	0.17
		0.92	0.70	0.54	0.46	0.47	0.51	0.40	0.43	0.51	0.17		0.22
		1.39	0.83	0.32	0.65	0.53							
			0.65	0.55				0.46	0.43	0.47	0.42	0.23	0.21
		0.34	0.15	0.19	0.14	0.09	0.11	0.10	0.08	0.06	0.07	0.06	0.13
		0.09	0.06	0.07	0.08	0.06	0.06	ND	ND	ND		0.21	0.40
		0.47	0.15	0.12	0.16		0.16	0.10			0.11	0.12	0.09
		0.38	0.08										

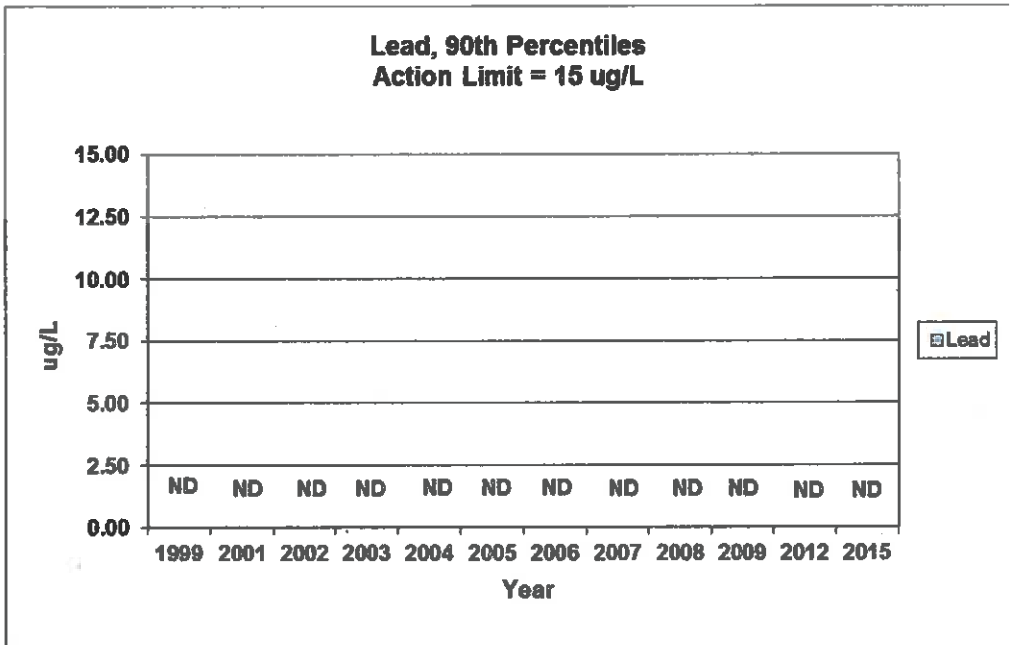
Units are mg/L
DLR = 0.05 mg/L

Table 6:
Copper Complete Data 1999 – 2015
(Page 3 of 3)

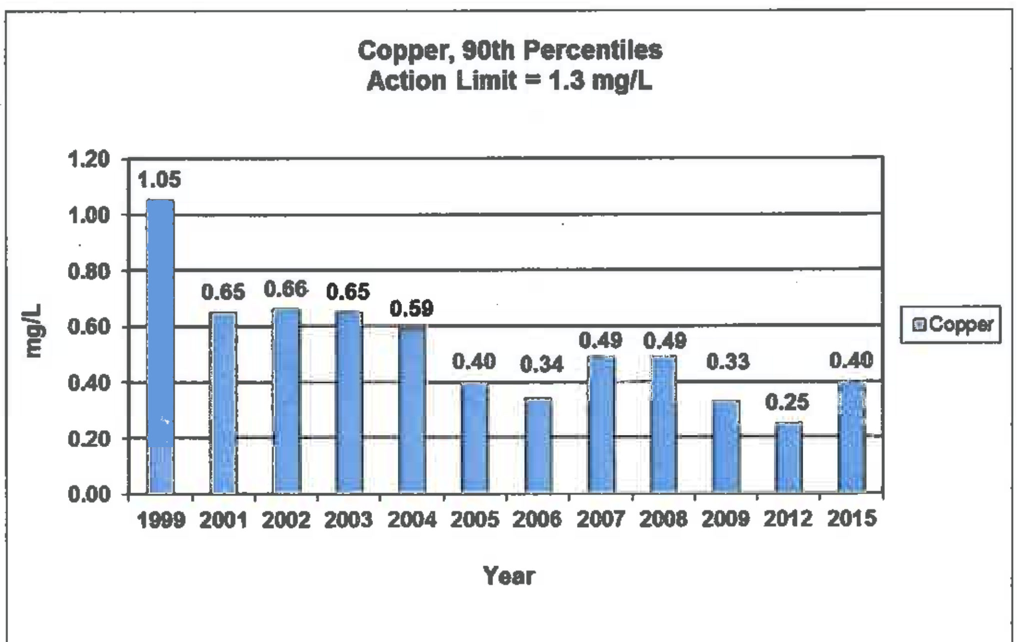
		1999	2001	2002	2003	2004	2005	2006	2007	2008	2009	2012	2015
[illegible]	[illegible]	0.64	0.33	0.55	0.74	1.10							
[illegible]	[illegible]	0.42		0.30			0.06	ND	0.05				0.83
[illegible]	[illegible]	0.70	0.45	0.34	0.30	0.26	0.41						
[illegible]	[illegible]	1.23	0.93										
Number of Site Sampled		42	60	62	32	31	31	31	30	31	30	31	34
Copper 90th Percentile		1.05	0.65	0.66	0.65	0.53	0.40	0.34	0.49	0.49	0.49	0.25	0.40

Units are mg/L
DLR = 0.05 mg/L

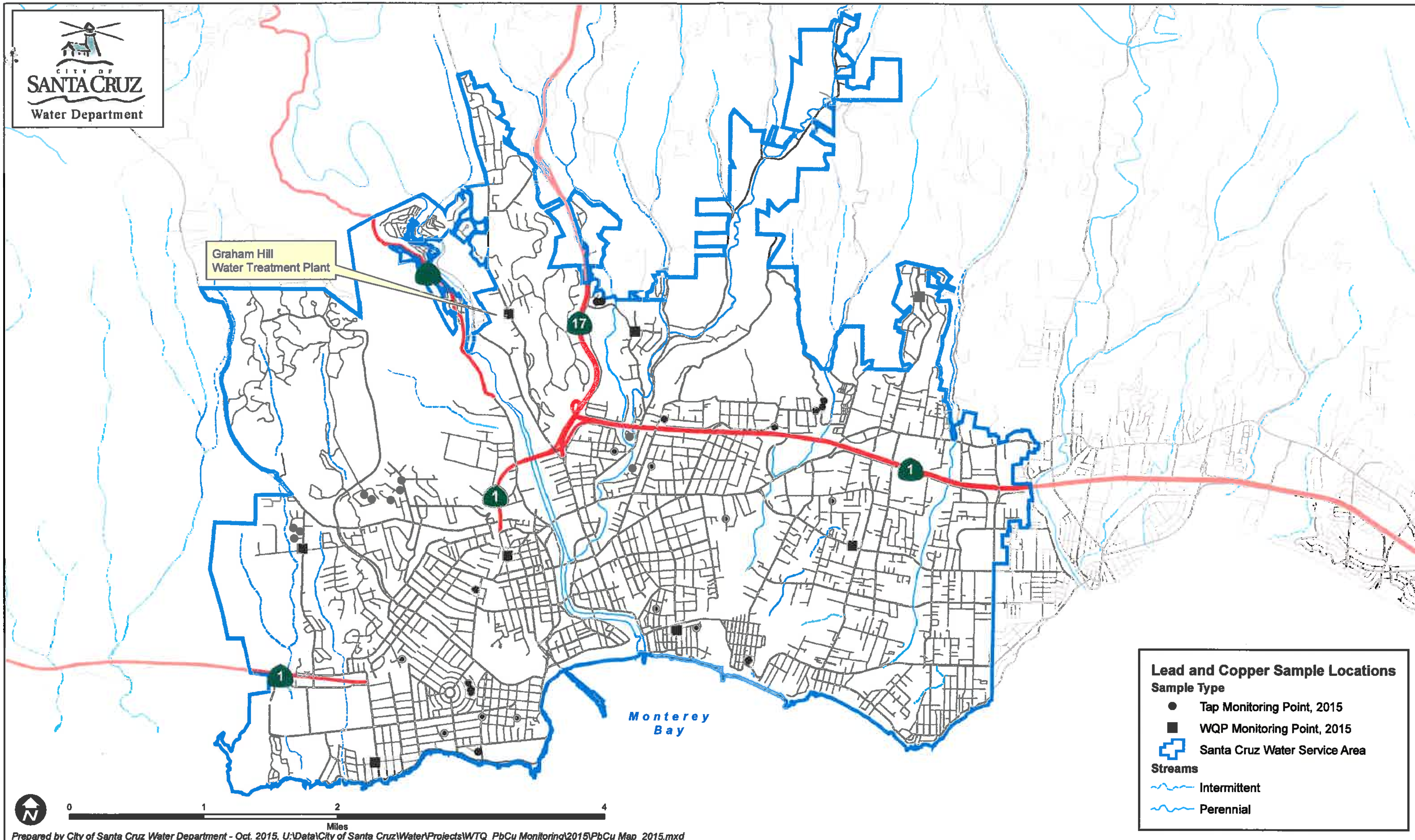
Lead and Copper 90th Percentile History Graphs
2015



Graph 1: Lead 90th Percentile History 1999 – 2015



Graph 2: Copper 90th Percentile History 1999-2015



Lead & Copper Tap Monitoring Locations - 2015

CITY OF SANTA CRUZ

WATER DEPARTMENT

Water Quality Laboratory, 715 Graham Hill Road, Santa Cruz, CA 95060
Phone (831) 420-5480 • Fax (831) 420-5481 • Email WaterQuality@cityofsantacruz.com
Water System No. 4410010

COPY

January 4, 2016

Ms. Querube Moltrup
SWRCB Division of Drinking Water-Monterey District
1 Lower Ragsdale Avenue, Building 1, Suite 120
Monterey, CA 93940

Re: Fourth Quarter 2015 D/DBP Reports

Ms. Moltrup:

Enclosed are the four reports required for D/DBP monitoring. D/DBP monitoring is conducted as described in the City of Santa Cruz Disinfection Byproduct Monitoring Plan as revised October 1st, 2012 to include approved sampling stations for the Stage II Disinfection By-Products Rule.

The enclosed reports are:

1. Quarterly Report for Disinfectant Residuals Compliance
2. Quarterly Report for Disinfection Byproduct Precursors Compliance
3. Quarterly TTHM Report of Disinfection Byproducts Compliance
4. Quarterly HAA5 Report for Disinfection Byproducts Compliance

Sincerely,

Hugh Dalton

Hugh Dalton
Water Quality Manager

State of California
Drinking Water Program

Department of Health Services

Quarterly Report for Disinfectant Residuals Compliance For Systems Using Chlorine or Chloramines

System Name: City of Santa Cruz Water Department **System No.:** 4410010

Calendar Year: 2015 **Quarter:** 4th

1st Quarter

	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Previous Year	April		0.73
	May		0.74
	June		0.75
	July		0.72
	August		0.79
	September		0.84
	October		0.80
	November		0.77
	December		0.70
Current Year	January	106	0.81
	February	106	0.84
	March	133	0.83
Running Annual Average (RAA):			0.78
Meets standard? (i.e. RAA ≤ MRDL of 4.0 mg/L as Cl_2)			Yes

2nd Quarter

	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Previous Year	July		0.72
	August		0.79
	September		0.84
	October		0.80
	November		0.77
	December		0.70
Current Year	January		0.81
	February		0.84
	March		0.83
	April	106	0.75
	May	106	0.83
	June	116	0.79
Running Annual Average (RAA):			0.79
Meets standard? (i.e. RAA ≤ MRDL of 4.0 mg/L as Cl_2)			Yes

3rd Quarter

	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Previous Yr	October		0.80
	November		0.77
	December		0.70
Current Year	January		0.81
	February		0.84
	March		0.83
	April		0.75
	May		0.83
	June		0.79
	July	122	0.68
	August	106	0.70
	September	133	0.96
Running Annual Average (RAA):			0.79
Meets standard? (i.e. RAA ≤ MRDL of 4.0 mg/L as Cl_2)			Yes

4th Quarter

	Month	Number of Samples Taken	Monthly Ave. Chlorine Level (mg/L)
Current Year	January		0.81
	February		0.84
	March		0.83
	April		0.75
	May		0.83
	June		0.79
	July		0.68
	August		0.70
	September		0.96
	October	106	0.85
	November	106	0.88
	December	132	0.89
Running Annual Average (RAA):			0.82
Meets standard? (i.e. RAA ≤ MRDL of 4.0 mg/L as Cl_2)			Yes

Comments:

Signature: [signature] Date: 1/07/16

State of California
Drinking Water Program

Department of Health Services

Quarterly Report for Disinfection Byproduct Precursors Compliance

For Systems Required to Meet the Enhanced Coagulation or Enhanced Softening Requirements

---

System Name: Santa Cruz Water Department **System Number:** 4410010

Calendar Year: 2015 **Source Water Sample Location:** Raw Blend

Quarter: 4th **Treated Water Sample Location:** Filter Composite

	Month	Sample Date[1]	Source Water Alkalinity (mg/L)	Source Water TOC (mg/L)	Treated Water TOC (mg/L)	TOC Percent Removal Achieved[2] (%)	TOC Percent Removal Required[3] (%)	Assigned Value [optional; complete box below if used]	TOC Percent Removal Ratio[4]
Current Year	January	1/7/2015	124	1.8	1.4	22.2	15.0		1.48
	February	2/4/2015	132	1.8	1.4	22.2	15.0		1.48
	March	3/4/2015	134	2.0	1.4	30.0	15.0		2.00
	April	4/1/2015	134	2.0	1.5	25.0	15.0		1.67
	May	5/6/2015	138	1.5	1.0	33.3	15.0		2.22
	June	6/3/2015	134	1.5	1.0	33.3	15.0		2.32
	July	7/1/2015	134	1.3	1.0	23.1	15.0		1.54
	August	8/5/2015	122	2.9	2.0	31.0	15.0		2.07
	September	9/2/2015	122	2.2	1.5	31.8	15.0		2.12
	October	10/7/2015	131	2.4	1.6	33.3	15.0		2.22
	November	11/4/2015	108	6.6	4.7	28.8	35.0		0.82
	December	12/2/2015	136	1.6	1.2	25.0	15.0		1.67
								Running Annual Average (RAA) of TOC Percent Removal Ratio:	1.79

In any month that one or more of the following six conditions are met, the system may assign a monthly value of 1.00 (in lieu of calculating the TOC percent removal ratio) when calculating compliance. <u>If this option is used during any month of this quarter</u>, then enter below the value of the parameter and the sample date for the condition that was met.

________ 1. Source water TOC < 2.0 mg/L. (may refer to results entered above)
________ 2. Treated water TOC < 2.0 mg/L. (may refer to results entered above)
________ 3. Source water SUVA ≤ 2.0 L/mg-m.
________ 4. Finished water SUVA ≤ 2.0 L/mg-m.
________ 5. System practicing softening removes at least 10 mg/L of magnesium hardness (as $CaCO_3$).
________ 6. System practicing enhanced softening lowers treated water alkalinity to < 60 mg/L (as $CaCO_3$).

Number of paired (source water and treated water) TOC samples taken during the quarter: 3

Is the system in compliance? (i.e. RAA ≥ 1.00) ~~YES~~

Signature: Hugh Dalton **Date:** 1/07/16

NOTES:

[1] If more than one set of samples is taken during a single month, then a separate sheet should be used for reporting the date, result, TOC percent removal achieved, TOC percent removal required, and TOC percent removal ratio of each sample set. The TOC percent removal ratios for the

[2] Actual monthly TOC percent removal $= \left(1 - \frac{\text{treated water TOC}}{\text{source water TOC}}\right) \times 100$

[3] The required monthly TOC percent removal is determined from the Step 1 TOC Percent Removal table (right) or from the Step 2 TOC Percent Removal method.

Step 1 Required Removal of TOC			
Source Water TOC (mg/L)	Source Water Alkalinity (mg/L as $CaCO_3$)		
	0-60	>60-120	>120
>2.0-4.0	**35.0%**	**25.0%**	**15.0%**
>4.0-8.0	**45.0%**	**35.0%**	**25.0%**
>8.0	**50.0%**	**40.0%**	**30.0%**

[4] TOC percent removal ratio $= \frac{\text{actual monthly TOC percent removal}}{\text{required monthly TOC percent removal}}$

Stage 2 DBP-Quarterly TTHM Report for Disinfection Byproducts Compliance and Operational Evaluation (in μg/L or ppb)

System Name: City of Santa Cruz System No.: 4410010 Year: 2015 Quarter: 4th

	Year:	2012				2013				2014				2015				2016			
	Quarter:	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
PS CODE	Sample Date (month/day):				11/15	2/21	5/23	8/15	11/21	2/20	5/12	8/21	11/20	2/12	5/21	8/20	11/19				
4410010-801	STA 119 (Morrisey & Marnell)				32	29	45	48	50	35	38	46	38	50	43	43	48				
4410010-802	STA 127 (Swift and Modesto)				40	37	54	59	52	50	50	56	54	59	54	48	74				
4410010-809	STA 134 (Thurber & Winkle)						69	71	53	70	56	59	60	62	57	72	70				
4410010-804	STA 139 (Upper Coast)				57	46	54	76	65	82	53	59	55	64	64	62	66				
4410010-805	ARV-12 (Branciforte Dr.)				60	49	59	80	58	72	63	61	60	66	60	67	83				
4410010-806	STA 123 (Ponderosa & Cress)				78	52	75	76	60	65	59	65	56	60	55	59	70				
4410010-807	STA 137 (Tanner Heights)				51	51	67	81	69	70	60	71	64	64	59	67	74				
4410010-808	STA 105 (Gross Road & 41st Ave.)				44	37	54	58	54	48	45	54	44	58	5	5	50				
	Number of Samples Taken				7	7	8	8	8	8	8	8	8	8	8	8	8				

STA 119 (Morrisey & Marnell)				32	29	45	48	50	35	38	46	38	50	43	43	48				
Running Annual Average				8	15	27	39	43	44	43	42	39	43	44	44	46				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						38	43	48	42	40	41	40	46	44	45	46				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 127 (Swift and Modesto)				40	37	54	59	52	50	50	56	54	59	54	48	74				
Running Annual Average				10	19	33	47	51	54	53	52	53	55	56	54	59				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						46	52	54	53	51	53	54	57	55	52	63				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 134 (Thurber & Winkle)						69	71	53	70	56	59	60	62	57	72	70				
Running Annual Average						17	70	64	66	63	60	61	59	60	63	65				
Meets MCL ?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL								62	66	59	61	59	61	59	66	67				
OEL≤MCL?								Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 139 (Upper Coast)				57	46	54	76	65	82	53	59	55	64	64	62	66				
Running Annual Average				14	26	39	58	60	69	69	65	62	58	61	61	64				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						53	63	65	76	63	63	56	61	62	63	65				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

ARV-12 (Branciforte Dr.)				60	49	59	80	58	72	63	61	60	66	60	67	83				
Running Annual Average				15	27	42	62	61	67	68	63	64	63	62	63	69				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						57	67	64	70	64	64	61	63	62	65	73				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 123 (Ponderosa & Cress)																				
Running Annual Average				20	32	51	70	66	69	65	62	61	60	59	58	61				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						70	70	68	67	61	64	59	60	57	58	64				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 137 (Tanner Heights)				51	51	67	81	69	70	60	71	64	64	59	67	74				
Running Annual Average				13	26	42	63	67	72	70	67	66	65	65	64	66				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						59	70	71	72	65	68	65	66	62	64	69				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 105 (Gross Road & 41st Ave.)				44	37	54	58	54	48	45	54	44	58	5	5	50				
Running Annual Average				11	20	34	48	51	54	51	50	48	50	40	28	29				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						47	52	55	52	48	50	47	54	28	18	27				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

Hugh Dalton

Signature

1/07/16

Date

State of California
Drinking Water Program

Department of Public Health
Monterey District

Stage 2 DBP-Quarterly HAA5 Report for Disinfection Byproducts Compliance and Operational Evaluation (in µg/L or ppb)

System Name: City of Santa Cruz System No.: 4410010 Year: 2015 Quarter: 4th

	Year:	2012				2013				2014				2015				2016			
	Quarter:	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.	1st Qtr.	2nd Qtr.	3rd Qtr.	4th Qtr.
PS CODE	Sample Date (month/day):				11/15	2/21	5/23	8/15	11/21	2/20	5/12	8/21	11/20	2/12	5/21	8/20	11/19				
4410010-801	STA 119 (Morrisey & Marnell)				18	25	23	23	45	28	15	16	16	42	14	18	34				
4410010-802	STA 127 (Swift and Modesto)				23	32	29	32	41	39	24	20	19	50	16	23	51				
4410010-809	STA 134 (Thurber & Winkle)						37	41	46	62	22	22	29	42	20	37	53				
4410010-804	STA 139 (Upper Coast)				30	36	31	46	51	82	20	31	32	34	30	33	47				
4410010-805	ARV-12 (Branciforte Dr.)				8	15	9	4	<2	9	<2	7	30	42	16	20	37				
4410010-806	STA 123 (Ponderosa & Cress)				26	37	47	44	51	62	27	26	27	35	20	18	63				
4410010-807	STA 137 (Tanner Heights)				19	30	34	41	35	67	24	23	28	42	16	22	45				
4410010-808	STA 105 (Gross Road & 41st Ave.)				24	29	34	30	48	40	16	17	21	52	<2	<2	38				
Number of Samples Taken					7	7	8	8	8	8	8	8	8	8	8	8	8				

STA 119 (Morrisey & Marnel)	2012 1st	2012 2nd	2012 3rd	2012 4th	2013 1st	2013 2nd	2013 3rd	2013 4th	2014 1st	2014 2nd	2014 3rd	2014 4th	2015 1st	2015 2nd	2015 3rd	2015 4th	2016 1st	2016 2nd	2016 3rd	2016 4th
				18	25	23	23	45	28	15	16	16	42	14	18	34				
Running Annual Average				5	11	17	22	29	30	28	26	19	22	22	23	27				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						22	24	34	31	26	19	16	29	22	23	25				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 127 (Swift & Modesto)	2012 1st	2012 2nd	2012 3rd	2012 4th	2013 1st	2013 2nd	2013 3rd	2013 4th	2014 1st	2014 2nd	2014 3rd	2014 4th	2015 1st	2015 2nd	2015 3rd	2015 4th	2016 1st	2016 2nd	2016 3rd	2016 4th
				23	32	29	32	41	39	24	20	19	50	16	23	51				
Running Annual Average				6	14	21	29	33	35	34	31	26	28	26	27	35				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						28	31	36	38	32	26	21	35	25	28	35				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 134 (Thurber & Winkle)	2012 1st	2012 2nd	2012 3rd	2012 4th	2013 1st	2013 2nd	2013 3rd	2013 4th	2014 1st	2014 2nd	2014 3rd	2014 4th	2015 1st	2015 2nd	2015 3rd	2015 4th	2016 1st	2016 2nd	2016 3rd	2016 4th
						37	30	48	62	22	22	29	42	20	37	53				
Running Annual Average						9	34	38	44	41	39	34	29	28	32	38				
Meets MCL ?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL								41	51	39	32	26	34	28	34	41				
OEL≤MCL?								Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 139 (Upper Coast)	2012 1st	2012 2nd	2012 3rd	2012 4th	2013 1st	2013 2nd	2013 3rd	2013 4th	2014 1st	2014 2nd	2014 3rd	2014 4th	2015 1st	2015 2nd	2015 3rd	2015 4th	2016 1st	2016 2nd	2016 3rd	2016 4th
				30	36	31	46	51	82	20	31	32	34	30	33	47				
Running Annual Average				7	16	24	36	41	52	50	46	41	29	32	32	36				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						32	40	45	65	43	41	29	33	32	33	39				
OEL≤MCL?						Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

ARV-12 (Branciforte)	2012 1st	2012 2nd	2012 3rd	2012 4th	2013 1st	2013 2nd	2013 3rd	2013 4th	2014 1st	2014 2nd	2014 3rd	2014 4th	2015 1st	2015 2nd	2015 3rd	2015 4th	2016 1st	2016 2nd	2016 3rd	2016 4th
				8	15	9	4	<2	9	<2	7	30	42	16	20	37				
Running Annual Average				2	6	8	9	9	7	3	8	15	26	24	27	29				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						10	8	3	6	2	6	17	30	26	25	28				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 123 (Ponderosa & Cress)				26	37	47	44	51	62	27	26	27	35	20	18	63				
Running Annual Average				6	16	27	38	45	51	46	42	36	29	27	25	34				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						39	43	48	55	42	35	27	31	26	23	41				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 137 (Tanner Heights)				19	30	34	41	35	67	24	23	28	42	16	22	45				
Running Annual Average				5	12	21	31	35	44	42	37	36	29	27	27	31				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						29	36	36	52	37	34	26	34	26	26	32				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

STA 105 (Gross Road & 41st Ave.)				24	29	34	30	48	40	16	17	21	52	<2	<2	38				
Running Annual Average				6	13	22	29	35	38	34	30	24	27	22	18	45				
Meets MCL ?				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				
Operational Evaluation Level OEL						30	31	40	40	30	23	19	36	18	13	19				
OEL≤MCL?						Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes				

Hugh Dalton   1/07/16

Signature   Date

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015

Sample ID No.: 201510220200 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler:

Employed by:

Date/Time Sample Collected: 11/19/2015 0830

Date/Time Received @Lab: 11/20/2015

Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT

System Number: 4410010

Variable ID:

COC ID: 123 - Ponderosa Dr

Name or Number of Sample Source: STA 123 (PONDEROSA & CRESS) STG 2 DBP

User ID: hen

Station number: 4410010-806

Date/Time of Sample: 15 11 19 0830
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton

Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	8.2		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	70	80	
551.1	Bromodichloromethane	ug/L	32101	20		1.0
551.1	Bromoform	ug/L	32104	<1.0		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	40		1.0
551.1	Dibromochloromethane	ug/L	32105	8.7		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	63	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	21		1.0
6251	Trichloroacetic Acid	ug/L	82723	40		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	2.0		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015

Sample ID No.: 201510220201 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler:

Employed by:

Date/Time Sample Collected: 11/19/2015 0853

Date/Time Received @Lab: 11/20/2015

Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT

System Number: 4410010

Variable ID:

COC ID: G-4 137 - Tanner Heights

Name or Number of Sample Source: STA 137 (TANNER HEIGHTS) STG 2 DBP

User ID: hen

Station number: 4410010-807

Date/Time of Sample: 15 11 19 0853
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton

Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	6.7		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	74	80	
551.1	Bromodichloromethane	ug/L	32101	24		1.0
551.1	Bromoform	ug/L	32104	1.3		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	37		1.0
551.1	Dibromochloromethane	ug/L	32105	12		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	45	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	13		1.0
6251	Trichloroacetic Acid	ug/L	82723	30		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	2.0		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015

Sample ID No.: 201510220202 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler:

Employed by:

Date/Time Sample Collected: 11/19/2015 1013

Date/Time Received @Lab: 11/20/2015

Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT

System Number: 4410010

Variable ID:

COC ID: G-4 127 Swift & Modesto

Name or Number of Sample Source: STA 127 (SWIFT & MODESTO) STG 2 DBP

User ID: hen

Station number: 4410010-802

Date/Time of Sample: 15 11 19 1013
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton

Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	4.4		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	74	80	
551.1	Bromodichloromethane	ug/L	32101	22		1.0
551.1	Bromoform	ug/L	32104	1.1		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	41		1.0
551.1	Dibromochloromethane	ug/L	32105	10		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	51	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	10		1.0
6251	Trichloroacetic Acid	ug/L	82723	40		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	1.2		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015

Sample ID No.: 201510220203 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler:

Employed by:

Date/Time Sample Collected: 11/19/2015 0936

Date/Time Received @Lab: 11/20/2015

Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT

System Number: 4410010

Variable ID:

COC ID: 139 - Upper Coast

Name or Number of Sample Source: STA 139 (UPPER COAST) STG 2 DBP

User ID: hen

Station number: 4410010-804

Date/Time of Sample: 15 11 19 0936
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton

Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	7.0		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	66	80	
551.1	Bromodichloromethane	ug/L	32101	22		1.0
551.1	Bromoform	ug/L	32104	1.0		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	33		1.0
551.1	Dibromochloromethane	ug/L	32105	10		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	47	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	15		1.0
6251	Trichloroacetic Acid	ug/L	82723	30		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	1.8		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015

Sample ID No.: 201510220204 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler:

Employed by:

Date/Time Sample Collected: 11/19/2015 0926

Date/Time Received @Lab: 11/20/2015

Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT

System Number: 4410010

Variable ID:

COC ID: ARV12 - Branciforte Drive

Name or Number of Sample Source: ARV-12 (BRANCIFORTE DR.) STG 2 DBP

User ID: hen

Station number: 4410010-805

Date/Time of Sample: 15 11 19 0926
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton

Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	<1.0		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	83	80	
551.1	Bromodichloromethane	ug/L	32101	25		1.0
551.1	Bromoform	ug/L	32104	<1.0		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	47		1.0
551.1	Dibromochloromethane	ug/L	32105	10		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	37	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	2.0		1.0
6251	Trichloroacetic Acid	ug/L	82723	35		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	<1.0		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015 | Sample ID No.: 201510220205 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler: | Employed by:

Date/Time Sample Collected: 11/19/2015 0901 | Date/Time Received @Lab: 11/20/2015 | Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT | System Number: 4410010

Variable ID: | COC ID: G-1 119 - Morrissey & Marnell

Name or Number of Sample Source: STA 119 (MORRISEY & MARNELL) STG 2 DBP

User ID: hen | **Station number: 4410010-801**

Date/Time of Sample: 15 11 19 0901
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton | Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	4.7		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	48	80	
551.1	Bromodichloromethane	ug/L	32101	17		1.0
551.1	Bromoform	ug/L	32104	1.1		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	19		1.0
551.1	Dibromochloromethane	ug/L	32105	11		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	34	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	7.8		1.0
6251	Trichloroacetic Acid	ug/L	82723	24		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	1.7		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015 Sample ID No.: 201510220206 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler: Employed by:

Date/Time Sample Collected: 11/19/2015 0956 Date/Time Received @Lab: 11/20/2015 Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT System Number: 4410010

Variable ID: **COC ID: 134 - Thurber & Winkle**

Name or Number of Sample Source: STA 134 (THURBER & WINKLE) STG 2 DBP

User ID: hen **Station number: 4410010-809**

Date/Time of Sample: 15 11 19 0956
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	7.0		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	70	80	
551.1	Bromodichloromethane	ug/L	32101	22		1.0
551.1	Bromoform	ug/L	32104	1.1		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	36		1.0
551.1	Dibromochloromethane	ug/L	32105	11		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	53	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	16		1.0
6251	Trichloroacetic Acid	ug/L	82723	35		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	1.9		1.0

ORGANIC CHEMICAL ANALYSIS (11/07)

Date of Report: 12/4/2015

Sample ID No.: 201510220207 - 559164

Laboratory Name: Eurofins Eaton Analytical

Name of Sampler:

Employed by:

Date/Time Sample Collected: 11/19/2015 1016

Date/Time Received @Lab: 11/20/2015

Date Analyses Completed. 12/2/2015

System Name: SANTA CRUZ WATER DEPARTMENT

System Number: 4410010

Variable ID:

COC ID: 105 - Gross Ave

Name or Number of Sample Source: STA 105 (GROSS RD & 41ST AVE) STG 2 DBP

User ID: hen

Station number: 4410010-808

Date/Time of Sample: 15 11 19 1016
YY MM DD TTTT

Laboratory Code: |9|5|9|0|

Date Analyses completed: 15 12 02
YY MM DD

Submitted by: Hugh Dalton

Phone# 831-420-5484

TEST METHOD	CHEMICAL ALL CHEMICALS EXCEPT 2,3,7,8 TCDD (DIOXIN) reported uG/L		ENTRY #	ANALYSES RESULTS	MCL ug/L	DLR ug/L
	UNREGULATED ORGANIC CHEMICALS					
6251	Bromochloroacetic acid	ug/L	A-038	5.3		1.0
	REGULATED ORGANIC CHEMICALS					
551.1	Total Trihalomethane(TTHMs)	ug/L	82080	50	80	
551.1	Bromodichloromethane	ug/L	32101	17		1.0
551.1	Bromoform	ug/L	32104	1.1		1.0
551.1	Chloroform(Trichloromethane)	ug/L	32106	22		1.0
551.1	Dibromochloromethane	ug/L	32105	10		1.0
6251	Haloacetic Acids (five)(HAA5)	ug/L	A-049	38	60	
6251	Monochloroacetic Acid	ug/L	A-042	<2.0		2.0
6251	Dichloroacetic Acid	ug/L	77288	9.7		1.0
6251	Trichloroacetic Acid	ug/L	82723	27		1.0
6251	Monobromoacetic Acid	ug/L	A-041	<1.0		1.0
6251	Dibromoacetic Acid	ug/L	82721	1.7		1.0

CITY OF
SANTA CRUZ
WATER DEPARTMENT

Water Quality Laboratory, 715 Graham Hill Road, Santa Cruz, CA 95060
Phone (831) 420-5480 • Fax (831) 420-5481 • Email WaterQuality@cityofsantacruz.com
CA Water System No. 4410010
ELAP Certification No. 1875

COPY

January 6, 2016

Ms. Querube Moltrup
SWRCB Division of Drinking Water-Monterey District
1 Lower Ragsdale Avenue, Building 1, Suite 120
Monterey, CA 93940

Re: 4th Quarter 2015 Corrosion Control Monitoring Report: October - December 2015

Ms. Moltrup:

Attached is the City of Santa Cruz Water Department's Quarterly Corrosion Control Monitoring Report for the months of October, November and December 2015.

If you have any questions or comments, please contact me at (831) 420-5484.

Sincerely,

Hugh Dalton

Hugh Dalton
Water Quality Manager

City of Santa Cruz
Corrosion Control Report
October 2015 through December 2015

Water System No. 4410010

Production and Chemical Use
October 2015 through December 2015

Date	Inhibitor Used gallons	Production Million Gallons (MG)	Inhib/Prod g/MG
October	265.3	216.4	1.23
November	259.4	190.1	1.36
December	200.5	176.5	1.13

Station 304, Finished Water, Graham Hill Treatment Plant

October 2015 through December 2015

Date	Time	Cl_2 mg/L	Temp °C	pH	Alk mg/L	PO_4 mg/L
10/13/15	1025	1.28	16.0	7.1	110	0.6
10/14/15	1146	1.27	16.1	7.2	110	0.6
10/27/15	1105	1.27	15.1	7.1	112	0.6
10/28/15	755	1.23	15.1	7.2	112	0.6
11/09/15	845	1.52	13.2	7.1	116	0.6
11/10/15	935	1.62	13.5	7.1	112	0.6
11/23/15	950	1.53	12.5	7.1	112	0.5
11/24/15	1100	1.05	12.0	7.2	114	0.6
12/08/15	1100	1.17	11.7	7.1	110	0.7
12/09/15	950	1.24	12.9	7.2	110	0.7
12/21/15	1035	1.55	12.4	7.1	110	0.6
12/22/15	850	1.66	12.8	7.2	110	0.7

City of Santa Cruz
Corrosion Control Report
October 2015 through December 2015

Water System No. 4410010

Station 125, Seabright and Marine Parade
October 2015 through December 2015

Date	Time	Cl_2 mg/L	Temp °C	pH	Alk mg/L	PO_4 mg/L
10/14/15	1112	1.07	19.1	7.1	110	0.6
10/28/15	1042	1.11	18.0	7.1	112	0.6
11/10/15	1024	1.13	15.6	7.1	114	0.6
11/23/15	1104	1.05	15.0	7.2	112	0.6
12/09/15	1117	0.98	12.7	7.1	110	0.6
12/21/15	1114	1.27	12.4	7.2	112	0.6

Station 127, Swift and Modesto

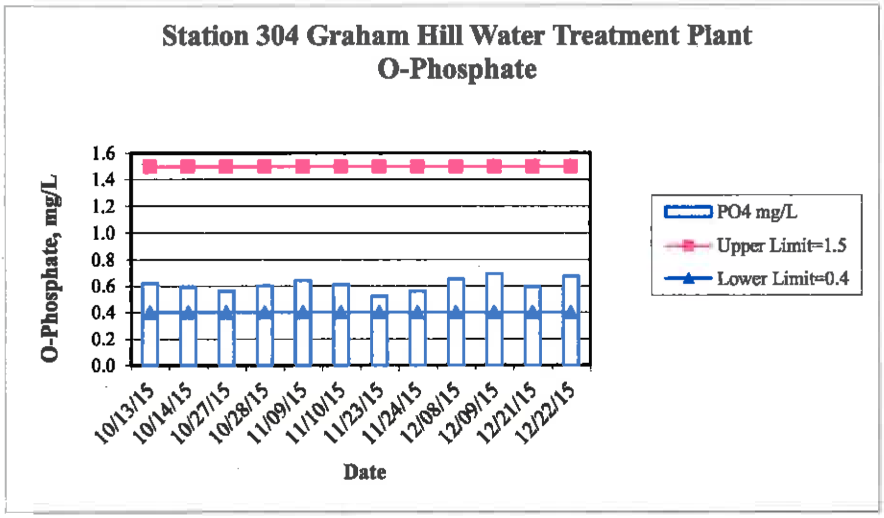
October 2015 through December 2015

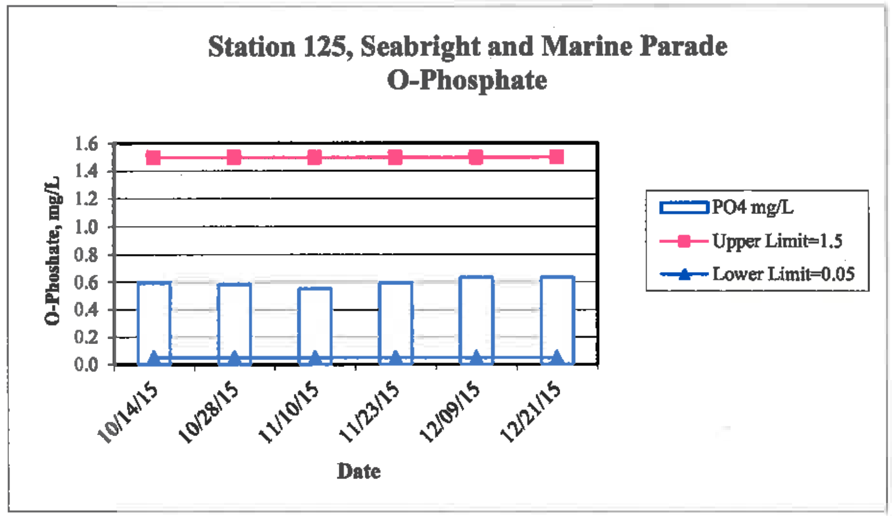
Date	Time	Cl_2 mg/L	Temp °C	pH	Alk mg/L	PO_4 mg/L
10/13/15	1042	0.62	23.2	7.2	110	0.6
10/27/15	1058	0.63	22.5	7.2	112	0.5
11/10/15	850	0.26	17.9	7.2	116	0.5
11/23/15	1126	0.62	17.8	7.3	114	0.6
12/08/15	1035	0.20	14.2	7.2	112	0.5
12/21/15	1027	1.20	14.5	7.3	110	0.6

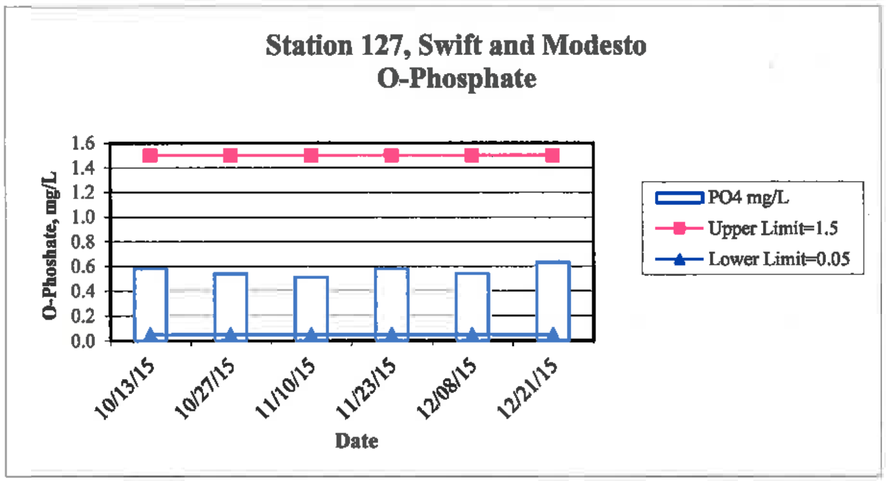
Station 133, 17th and Capitola

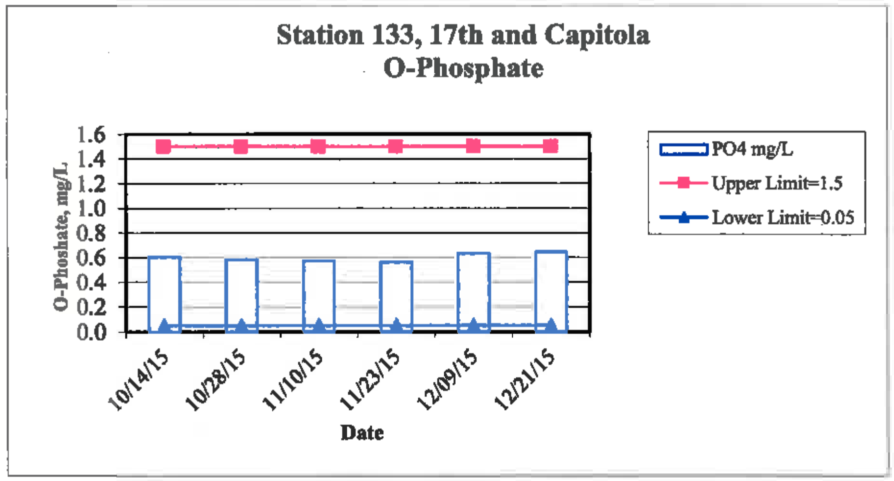
October 2015 through December 2015

Date	Time	Cl_2 mg/L	Temp °C	pH	Alk mg/L	PO_4 mg/L
10/14/15	910	1.08	20.0	7.1	110	0.6
10/28/15	853	1.09	18.8	7.1	110	0.6
11/10/15	950	1.22	16.2	7.1	112	0.6
11/23/15	906	1.08	15.4	7.2	114	0.6
12/09/15	919	0.94	13.1	7.1	108	0.6
12/21/15	910	1.27	12.7	7.2	110	0.6


Station 304 Graham Hill Water Treatment Plant
O-Phosphate
O-Phosphate, mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
10/13/15
10/14/15
10/27/15
10/28/15
11/09/15
11/10/15
11/23/15
11/24/15
12/08/15
12/09/15
12/21/15
12/22/15
Date
PO4 mg/L
Upper Limit=1.5
Lower Limit=0.4


Station 125, Seabright and Marine Parade
O-Phosphate
O-Phosphate, mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
10/14/15
10/28/15
11/10/15
11/23/15
12/09/15
12/21/15
Date
PO4 mg/L
Upper Limit=1.5
Lower Limit=0.05


Station 127, Swift and Modesto
O-Phosphate
O-Phosphate, mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
10/13/15
10/27/15
11/10/15
11/23/15
12/08/15
12/21/15
Date
PO4 mg/L
Upper Limit=1.5
Lower Limit=0.05


Station 133, 17th and Capitola
O-Phosphate
O-Phosphate, mg/L
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
10/14/15
10/28/15
11/10/15
11/23/15
12/09/15
12/21/15
Date
PO4 mg/L
Upper Limit=1.5
Lower Limit=0.05

City of Santa Cruz
Water Department

Corrosion Control Report Graphs
October 2015 through December 2015

System No. 4410010