Technical Memorandum

City of San Jose - South Bay Water Recycling Salinity Study

Subject: Task 2 Source Loading Technical Memorandum (TM)

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Date: August 12, 2011

Reference: 0057-006

This TM presents the results of the field monitoring and salinity characterization used to develop estimates for the salt loading of the wastewater steam for the service area tributary to the San Jose/ Santa Clara Water Pollution Control Plant (WPCP). The TM is organized as follows:

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1 Executive Summary

Water salinity is a growing area of interest and understanding where salt is introduced is the first step in developing effective salinity management measures. The average Total Dissolved Solids (TDS) concentration of the San Jose Water Pollution Control Plant (WPCP) effluent/recycled water supply was 719 mg/l (August 2005 to May 2011– weekly composite data) and the average effluent flow (from collection system models) was 116 mgd, resulting in a baseline total effluent salt load of **126,500 tons per year (baseline)**.

Salinity concentrations of recycled water supplies are a function of many different contributions including:

- source water salinity;
- residential consumptive use;
- water softener additions;
- commercial use additions;
- industrial use additions;
- seawater or brackish water infiltration and inflow (I&I); and
- wastewater treatment process addition.

To develop an understanding of salinity contributions, data were collected and analyzed to further understand the salt loading by use category. Table 1 shows the summary results of the three salt loading estimates that were completed for the study taking into consideration three alternative estimates of residential water softening loads. The total salt load estimates range from **133,600 tons per year (5.8% above baseline) to 151,600 tons per year (20% above baseline)**. All three estimates exceeded the baseline salt load of 126,500 tons per year. In addition, it is expected that commercial water softener use and additional brackish water I&I load, which has not been accounted for in the evaluation, would likely further increase the total salt load estimates. This data gap highlights the need for further data collection and field investigation on various salt contributions.

Table 1: Salt Load Summary

Sector	Source of TDS	Flow (mgd)	Minimum TDS Load (Tons/yr)	Maximum TDS Load (Tons/yr)	Average TDS Load - Alt 1 WS (Tons/yr)	Average TDS Load - Alt 2 WS (Tons/yr)	Average TDS Load - Alt 3 WS (Tons/yr)	Alt 1 WS - Percent of Total Effluent Load	Alt 2 WS - Percent of Total Effluent Load	Alt 3 WS - Percent of Total Effluent Load
Source Water	Source Water	115.6	38,300	76,800	54,400	54,400	54,400	36%	41%	41%
Residential	Alternative 1 - Water Softeners				22,200			15%	0%	0%
	Alternative 2 - Water Softeners					4,200		0%	3%	0%
	Alternative 3 - Water Softeners						4,400	0%	0%	3%
	Human Consumptive Use	81.7	24,700	27,300	26,000	26,000	26,000	17%	17%	17%
Commercial	High TDS Commercial Businesses	8.6			15,600	15,600	15,600	10%	12%	12%
	Commercial Consumptive Use	15.2			4,800	4,800	4,800	3.2%	3.6%	3.6%
	Commercial Water Softeners[1]				Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Industrial	Industrial Use (Monitored)	5.2			18,600	18,600	18,600	12%	14%	14%
	Industrial Use (Unmonitored)	4.8			1,500	1,500	1,500	1.0%	1.1%	1.1%
Other Sources	Alviso Inflow and Infiltration	0.1			1,250	1,250	1,250	0.8%	0.9%	0.9%
	WPCP Treatment Process	115.6			7,200	7,200	7,200	4.7%	5.4%	5.4%
	Other Inflow and Infiltration and Undefined Sources[1]				Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
	Total Estimate Effluent Load				151,600	133,600	133,800			
	Total Estimate Effluent TDS (mg/l)				**863**	**761**	**762**			
	Average Final Effluent TDS (mg/l)				**719**	**719**	**719**			
	% Difference from Average Final Effluent				**20%**	**5.8%**	**6.0%**			

Notes:

1. Source water minimum and maximum values were developed based on TDS ranges provided in consumer confidence reports. Water source TDS variability is thought to occur over varying hydrologic cycles especially for surface water supplies and may have seasonal variations.
2. The human consumptive use maximum and minimum were estimated assuming plus or minus 5% of the estimated average 209 mg/l TDS.
3. Human consumptive use average TDS of 209 mg/l was used to estimate total load.
4. Commercial consumptive use and industrial (unmonitored) loads are based on the estimated residential use loads of 209 mg/l.
5. These sources are considered to be likely contributors of additional salinity to the treatment plant salt load; however, additional data are needed to define and validate these loads.
6. Alternative 1 (Alt 1) was based on a survey of bags of salt used per month.
7. Alt 2 was based on collection system monitoring performed for this study.
8. Alt 3 was based on an estimated 35.3 mg/l TDS added area wide by softeners.

Data collection and investigations that would help to further refine the salt load evaluation include:

- Additional industry monitoring as part of the source control program. Collect sewer flow data for industries. Conduct field survey with industries to gain understanding of operations and variations in operations. Appendix C shows industries where two samples were measured. Results indicated that there is significant variability in the salinity levels of the industrial users that were monitored multiple times during the study period. Additional studies should include continuous monitoring for the industries that are suspected of being the largest salt loaders.
- Study on residential water softeners use and discharge. Conduct additional sewer monitoring at additional residential sites in all the various water source zones. Field surveys on water softener use in various zones would also be useful.
- Regular monitoring of source water TDS and conductivity to understand daily or seasonal variations. Check with retailers/wholesalers on available salinity data.
- TDS sampling at the influent and effluent of the WPCP.
- I&I sampling in Santa Clara, Milpitas, and in the pipelines near the WPCP. Investigate I&I through conductivity monitoring or other salinity measurement means in northern Santa Clara and west Milpitas, where seawater or brackish water I&I is suspected due to the proximity to the Bay. Also, investigate other areas of Alviso that were not directly upstream of the Spreckles Pump Station and interceptor lines near the WPCP.
- In conjunction with the Fats, Oils and Grease (FOG) program, check to see if restaurants have water softeners.
- Conduct additional commercial sites studies to develop an understanding of water softener use and the variations between different source water areas. Conduct field surveys with commercial businesses (i.e., laundry businesses) to understand water softener use and other operations that contribute to salt load.
- Field survey of hotels to see if they do laundry on-site or off-site and if water softeners are present.

It is important to note that the salt load estimates are preliminary and not based on a large data set. However, the data collected and analyzed, and the mass balance, provides valuable insight and is a critical first step in understanding the contributions of salt source categories that can be used to investigate possible salt mitigation measures and costs, and to prioritize areas for future study. Although refinement of the source load is necessary to develop meaningful results, the preliminary mass balance is used in subsequent tasks to evaluate the initial feasibility and cost-benefit for source control measures.

2 Background

Salinity management is becoming an increasing priority for water resource managers to protect existing water supplies and resources, including water reclamation. The South Bay Water Recycling (SBWR) Salinity Study is an effort to investigate the sources and quantities of salt coming into the WPCP, identify the major contributors, and identify and evaluate potential salt control strategies as appropriate. The SBWR is a regional program that provides tertiary- treated wastewater from the WPCP for non-potable uses, including landscape irrigation, industrial cooling and other industrial processes in the cities of San Jose, Milpitas and Santa Clara. Salinity is one of the key water quality considerations affecting the feasibility and suitability of recycled water for these types of uses.

The SBWR Salinity Study is one aspect of the City of San Jose’s (City’s or SJ) salinity management plan to control and manage salinity in order to maintain the quality of its recycled water.

The goals for the study included:

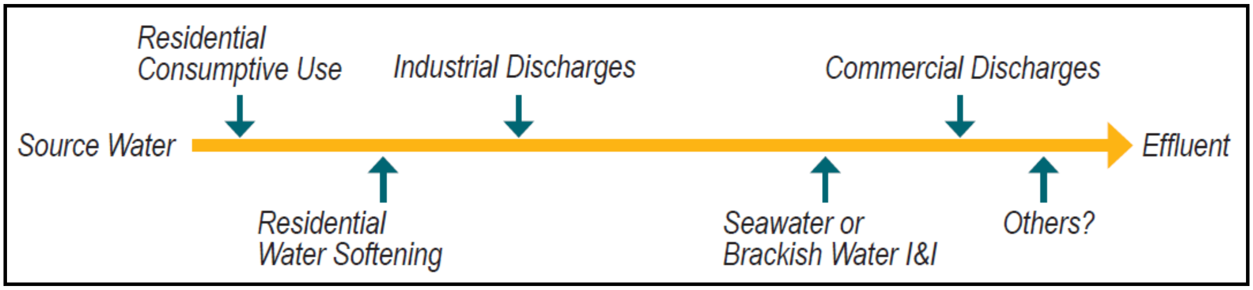
- Developing an understanding of salt sources and loadings to the WPCP

- Identifying and developing salt control strategies that can reduce salt loading (if appropriate)
- Developing cost estimates for achieving salt reductions

At the macro scale, salt contributions to the WPCP can be broken down into the following major categories:

- Source water (e.g., drinking water)
- Residential addition
- Commercial addition
- Industrial addition
- I&I flow in to the sewer collection system addition
- Addition through the wastewater treatment process

Figure 1: Salt Loading Contributors



Salt loading from these major categories vary depending on source water quality, type of industry and commercial uses in the service area, and treatment processes used for industrial and commercial uses. I&I into the collection system has been a significant salt load in some communities especially where collection systems may be in close proximity to seawater influenced groundwater.

The following sections summarize the analysis and evaluation preformed to identify and define the salt loads from each category.

3 Data Collection and Field Investigation

To build an understanding of the salt load balance across the various salt contributing categories, the team collected and reviewed existing data, performed strategic flow and conductivity monitoring in the sanitary sewer system, and collected industrial use data.

3.1 Data Collection

The project team consulted with City staff from SBWR, the WPCP, Environmental Services Department (ESD), and Public Works as well as staff from the City of Milpitas (Milpitas), City of Santa Clara (SC), Santa Clara Valley Water District (SCVWD), and West Valley Sanitation District (WVSD) to collect existing data on water quality, sewer flows, sewer models, pump station flows, and other pertinent information.

Table 2 provides a summary of key data and information sources that were collected and how the data/information was used in the analysis.

Table 2: Data/Information Collection and Use of Data

Data Collected	Source	How data was used
Sewer Hydraulic Models (2006-2010)	SJ, SC, WVSD, Milpitas	Models were used to calculate the total residential, trade (industrial and commercial), and large user flows for the tributary area. Model data were from the latest calibrated version of each agency's model: from 2006-2010.
WPCP effluent water quality data for (August 2005 – May 2011)	WPCP	Conductivity and TDS data for the effluent were compared to field conductivity data collected for the influent; the data were used to calculate a salt mass balance.
Results of residential water softener rebate program, including reports and excel sheets (May 2006)	SCVWD	Created a Geographical Information System (GIS) file from the addresses of residential water softener participants to create a user density map; used quantities of salt purchased by participants for their water softeners as one method to calculate load.
Survey on residential water softener use in Santa Clara County (August 2004)	SCVWD	Used results of survey to quantify water softener use in tributary area
Permitted indirect dischargers: large industrial dischargers and suspected high salinity dischargers (2010)	SJ-ESD	Used information to determine which industries should be targeted for sample collection and analysis.
Flow and operational data from Spreckles Pump Station in Alviso (April 2006- June 2006)	SJ- Public Works	Used to calculate one example of I&I salt loading in Alviso, in conjunction with samples collected by SJ-ESD at the pump station.
Number of key commercial salt contributors in tributary area. (2007)	US Census Data- Economic Census	Used to calculate commercial salt loading, in conjunction with measured values from sewer monitoring.
Water quality data for each drinking water source; GIS map showing drinking water source areas (2010)	SBWR	Used to calculate source water salt load, in conjunction with total flows from each source water area (from sewer master plans).
Monitoring data collected from sewer sampling in 2006 for residential and commercial areas in the tributary area	SJ-ESD (Watershed)	Used to refine estimates of residential human consumptive use.

Note:

1. SJ – San Jose
2. SC - Santa Clara
3. WVSD – West Valley Sanitation District

3.1.1 Baseline Flow and WPCP Effluent Salinity

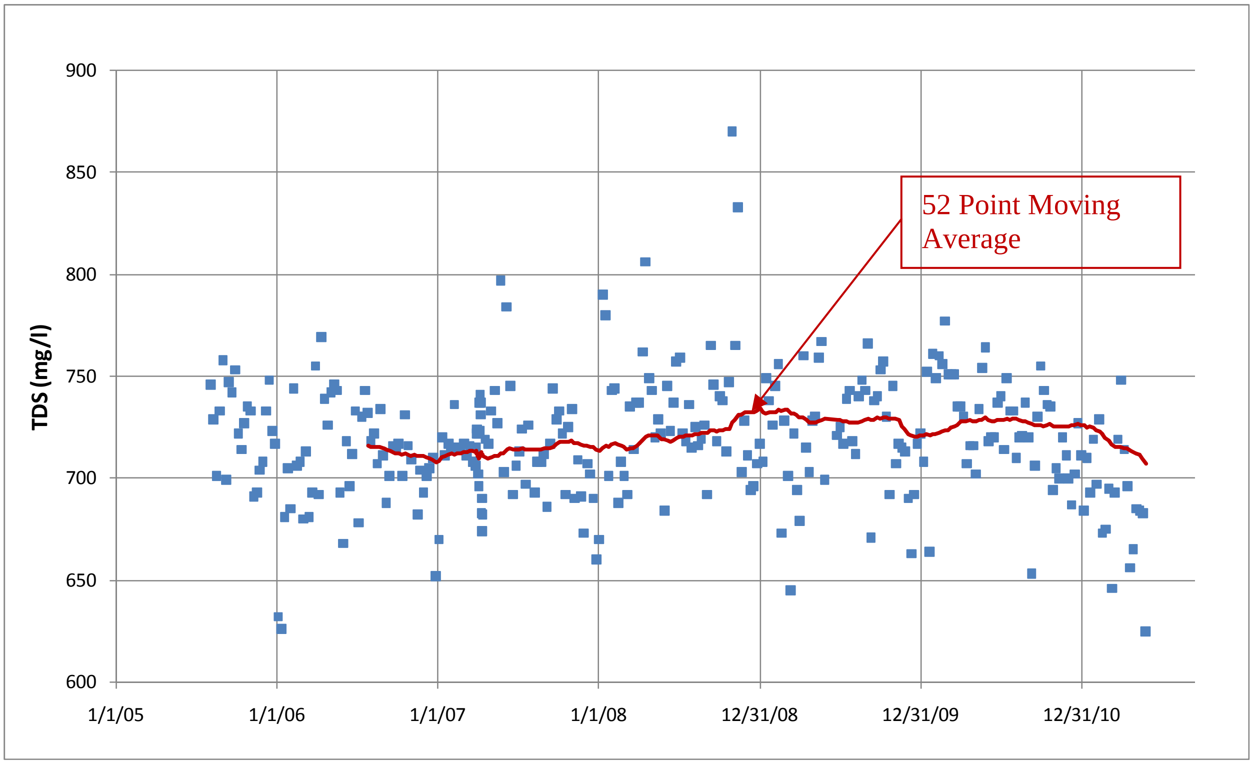
A mass balance approach is the basis for developing an understanding of salinity contributions. Weekly composite sampling and salinity data for the WPCP effluent with flow data provides a baseline for the mass balance. Table 3 and Figure 2 summarize the WPCP final effluent data set used.

Table 3: WPCP Final Effluent TDS (mg/l) Summary

	2005	2006	2007	2008	2009	2010	2011	All Data
Average	725	708	714	733	722	726	690	719
Median	728	709	715	726	722	729	693	718
Min	691	626	660	670	645	653	625	625
Max	758	769	797	870	767	777	748	870
Stdev	20	28	24	36	28	25	29	30
Count	22	51	64	53	49	52	21	312

Note:
1. Data set from August 2, 2005 to May 24, 2011. Values are for composite samples of final effluent.

Figure 2: WPCP Final Effluent TDS data



Although flow data are readily available from meters at the WPCP, the collection system models for the region include a breakdown of use type which is beneficial for developing loads from various water uses. Total flow from the collection system models was 115.6 mgd, which is about 10% higher than current influent flows to the plant. The breakdown of flows by use type is:

- Residential = 81.7 mgd (70.7% of Total Flow)
- Trade Flow (Commercial and Industrial) = 23.8 mgd (20.6% of Total Flow)
- Large User (Typically Industrial) = 10.1 mgd (8.7% of Total Flow)

As resolving the difference between the model flows and WPCP data would have required significant effort, for purposes of consistency, the baseflow of 115.6 mgd was used for both the baseline salt load estimate and the detailed analysis from various contributors. The baseline salt load of the WPCP final effluent assuming an average TDS of 719 mg/l (entire data set) is **126,500 tons per year.**

3.2 Field Investigation

A field investigation was conducted to further the understanding of salinity contributions in the tributary area. It included:

- Sample collection (composite samples) and laboratory analysis of key industrial dischargers with high flows and/or suspected high salinity discharges. (December 2010-February 2011) (SJ-ESD)
- Continuous conductivity monitoring of the influent flows at the WPCP for a one month period. (January 21, 2011-March 3, 2011) (Consultant team)
- Continuous conductivity and flow monitoring (in the collection system) of representative residential and commercial sites around the tributary area to better understand residential consumptive use, residential water softener use, and the commercial contribution of key commercial categories. Conductivity monitors were installed for a one week period at each site during December 2010-February 2011. (Consultant team)
- Hourly composite sample collection and laboratory analysis of TDS at the Spreckles Pump Station in Alviso, using a 24-hour sample collector. Hourly samples were collected for a four day period at the site. (SJ-ESD)

3.2.1 Collection System Conductivity and Flow Monitoring

Strategic monitoring in the collection system was completed to collect data and build further understanding of salinity loads. Locations were selected to isolate a residential or commercial use within a target water source area. The locations of the collection system monitoring sites are presented in Figure 3 and the reason for the monitoring is described in Table 4.

Sites were selected based on the following:

- **Land Use**: The site was in a part of the sewer system where there was uniform land use so that the category (residential, commercial, etc.) could be isolated. For example, the sewer modeling system and land use maps for each residential area were examined to make sure that no commercial flow (from a local grocery store or restaurant) was included in the monitoring data. For commercial sites, the location was selected that best captured just the flow from the commercial site in question.
- **Location in Sewer Basin**: Sites were chosen that were located at the "top" of a sewer basin so as to not include flow from other basins that might be from an unknown or mixed land use.
- **Traffic/Safety/Vehicle Access**: Sites were selected based on land use and location. However, once sites were visited in person, some sites could not be used based on safety or accessibility. Due to traffic and accessibility constraints, Site C6 was not monitored and the alternative site Alt C6 was monitored instead. Alternative sites Alt R2 and Alt R3 were not monitored since R2 and R3 were accessible.

Figure 3: Residential (R) and Commercial (C) Sewer Monitoring Locations

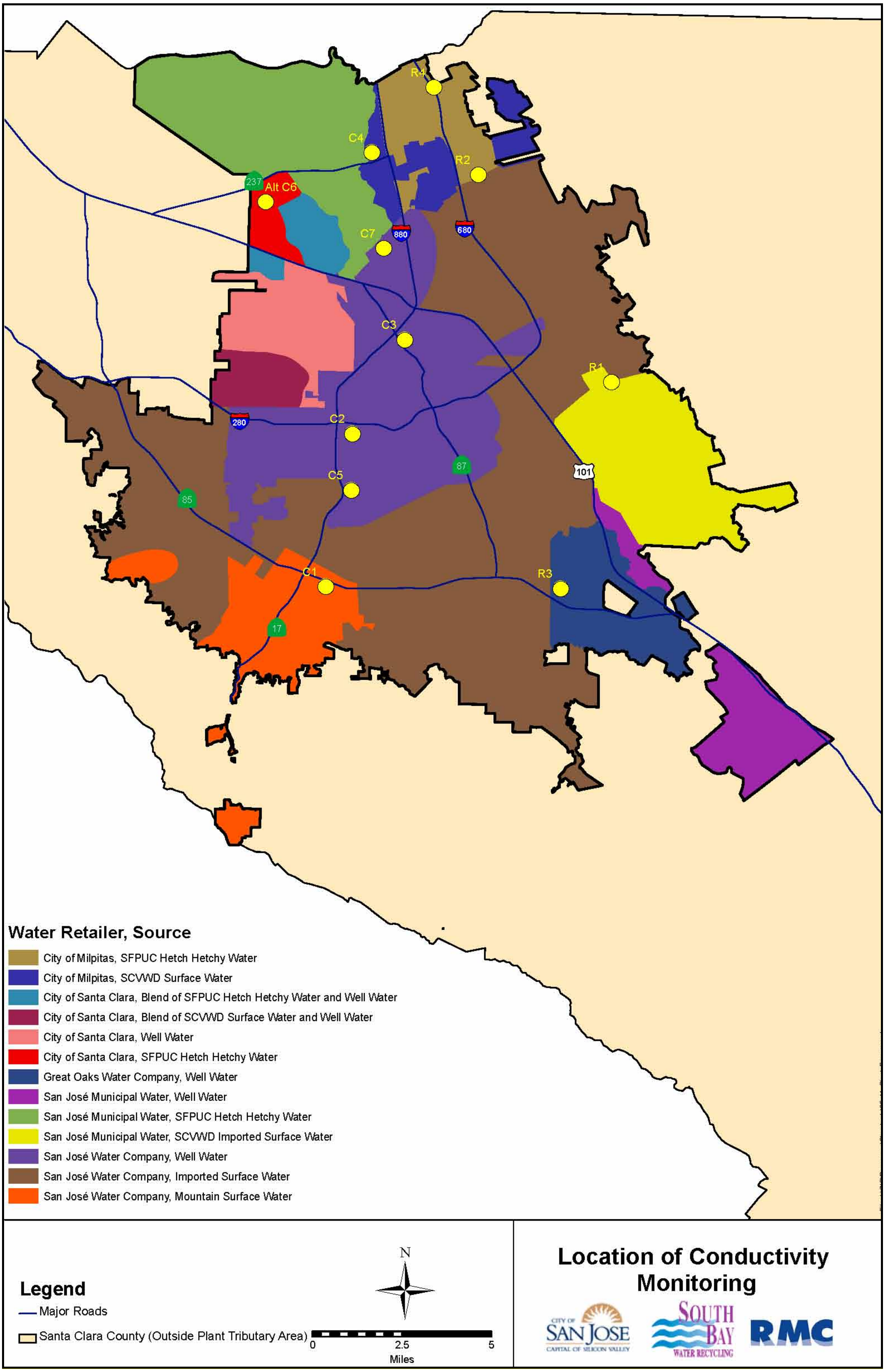


Table 4: Residential and Commercial Monitoring Locations

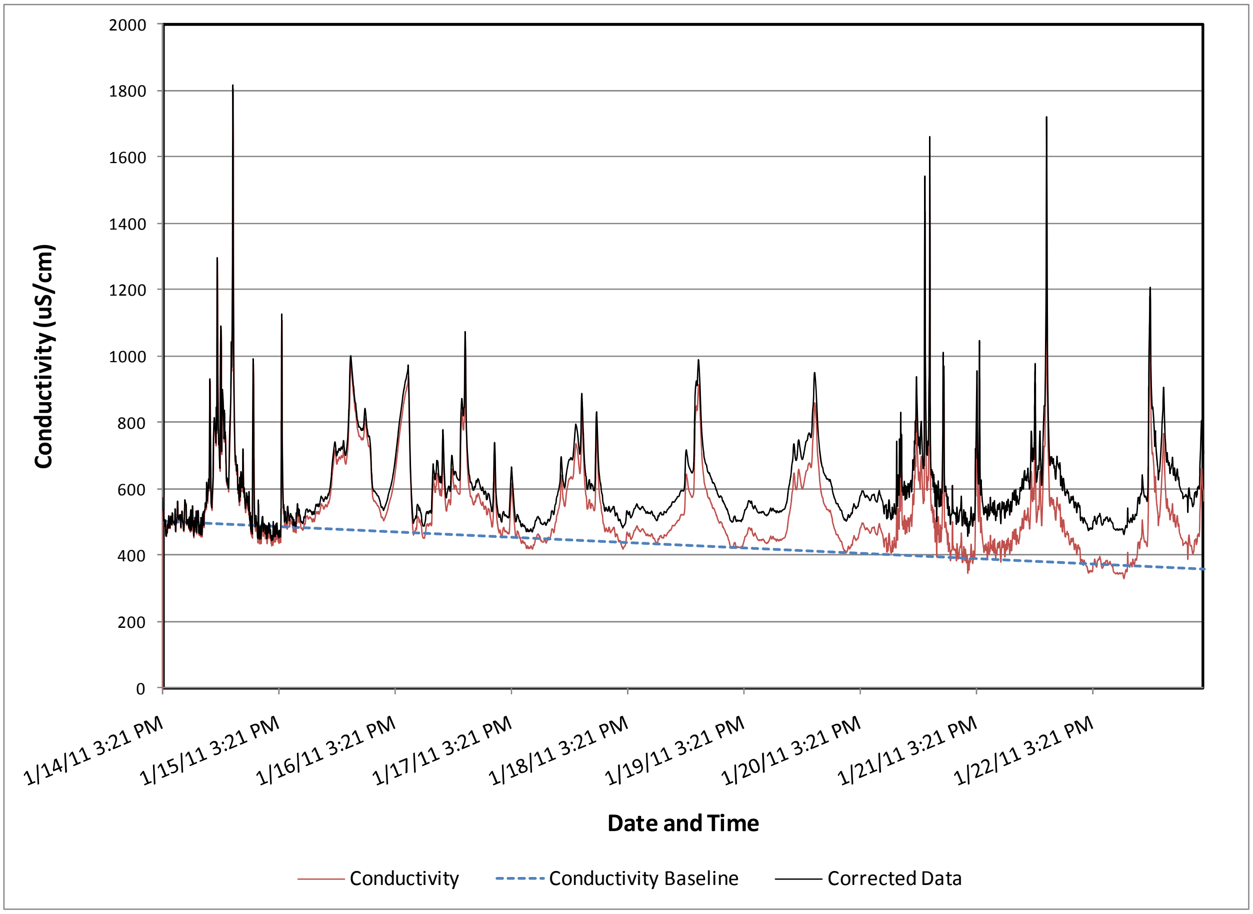
Site No.	Site Name	City	Reason for Monitoring	Water Source
C1	Commercial - Hospital	San Jose	Estimate hospital flows and TDS loading pattern.	SJ WC, Mountain Surface Water
C2	Commercial - Hospital	San Jose	Estimate hospital flows and TDS loading pattern.	SJ WC, Groundwater
C3	Commercial - Jail	San Jose	Estimate jail flows and TDS loading pattern.	SJ WC, Imported Surface Water
C4	Commercial - Mall	Milpitas	Estimate mall flows and TDS loading pattern.	SCVWD, Imported Surface Water
C5	Commercial - Mall	Campbell	Estimate mall flows and TDS loading pattern.	SJ WC, Groundwater
Alt C6	Commercial - Hotel	Santa Clara	Estimate hotel flows and TDS loading pattern.	SFPUC
C7	Commercial - Laundry	San Jose	Estimate laundry flows and TDS loading pattern.	SJ WC, Groundwater
R1	Residential - East SJ	San Jose	Estimate residential flows, water softener use, and human consumptive use.	SCVWD, SJ Muni, Treated Well
R2	Residential - North SJ	San Jose	Estimate residential flows, water softener use, and human consumptive use.	SJWC-Imported Surface Water
R3	Residential- South SJ	San Jose	Estimate residential flows, water softener use, and human consumptive use.	Great Oaks Well Water
R4	Residential- Milpitas SFPUC	Milpitas	Estimate residential flows, water softener use, and human consumptive use.	SFPUC

Notes:

1. See Section 4.1 for further explanation of water source areas and the water quality of each supply.
2. Monitoring sites C6 were not monitored as an appropriate monitoring site could not be found. Alt C6 was monitored as a replacement to C6.

The collection of continuous conductivity data in a sewer environment is challenging due to grease build up, ragging, and low sewage velocities in several of the locations. Instrument failure and drift were experienced at several of the monitoring sites. Drift adjustments were made where appropriate as demonstrated in the figure below. The raw data are shown in red and the corrected data are shown in black. The blue dashed line shows the slope of the drift from the conductivity baseline. Conductivity instrument failures occurred at several locations and data sets were truncated to isolate the usable data. Conductivity instruments also had periodic trouble when sewer flows were low (i.e. conductivity data were below realistic values). In these cases, low conductivity data were eliminated from the statistical analysis completed.

Figure 4: Conductivity Plot Corrected for Drift (Site R1)



3.2.2 Results of Conductivity and Flow Monitoring

Table 5 summarizes the statistics, findings, and observations from the data analysis. Data graphs and additional commentary, findings, and results are summarized in Appendix A and B. Monitoring results are also used in Section 4 to estimate loads.

Table 5: Collection System Monitoring Statistic, Commentary and Observations

A Site Number	B Average Flow (mgd)	C Min Flow (mgd)	D Max Flow (mgd)	E Water Supply Average TDS (mg/l)	F Water Source	G Average TDS (mg/l)	H Median TDS (mg/l)	I Min TDS (mg/l)	J Max TDS (mg/l)	K Stdev TDS (mg/l)	L TDS Increase Above Source (Average) (G-E) (mg/l)	M TDS Increase Above Source (Median) (H-E) (mg/l)	Commentary and Observations
C1: Hospital 1 (1/8/11 to 1/12/11)	0.004	0.001	0.041	245	SJWC Mountain SW	468	457	197	842	94	**223**	**212**	Slight peaks in salinity were observed on 1/11 and 1/12 around 6:00 am. Sustained increase in salinity occurred on 1/11 during business hours. As these spikes appeared smaller and lower than other data sets it is unknown if these were really a result of water softener regeneration cycles. On site water softener investigation is needed to confirm.
C2: Hospital 2 (1/15/11 to 1/22/11)	0.027	0.005	0.170	397	SJWC GW	680	604	19	4,587	432	**283**	**207**	High salinity spikes were observed on four mornings. Several other spikes were observed at other times throughout the day. These spikes are an indication of water softener regeneration cycles. The magnitudes of salinity spikes vary and there are occasional spikes that occur throughout the day. The diurnal flow pattern on the weekend (1/15 and 1/16) appears to be fairly flat. Weekday diurnal flow patterns showed an increase in flow during typical work hours.
C3: Jail (1/15/11 to 1/18/11)	0.225	0.052	1.266	326	SJWC Import SW	502	406	20	9,056	582	**176**	**80**	On 1/17 and 1/18 high salinity spikes were observed at about 2:00 am. These spikes reached conductivity levels of about 15,000 µS/cm. Several other spikes were observed at other times throughout the day. These spikes are an indication of water softener regeneration cycles. These EC spikes had the highest values seen with the exception of the industrial laundry site. The diurnal flow pattern was highly variable and erratic. It was unclear if low flows from the jail inhibited the collection of good data.
C4: Restaurants 1 (2/4/11 to 2/9/11)	0.057	0.007	0.150	263	Milpitas SCVWD SW	753	681	423	4,604	400	**490**	**418**	High salinity spikes appear to be occurring on a regular basis, which indicates the presence of water softeners. On the final day of monitoring an EC spike reached a level of about 16,000 µS/cm. This level of conductivity was seen at the Jail and the laundry. The diurnal flow pattern appears to be fairly regular which would be expected for this area. Sunday flow (2/6) appears to be slightly lower than other days.
C5: Restaurants 2 (2/4/11 to 2/9/11)	0.012	0.002	0.139	397	SJWC GW	370	322	183	1,982	135	**(27)**	**(75)**	Limited usable data set due to instrument failure that was thought to be caused by grease buildup. Salinity spikes occurred on a regular basis at 8:20 pm. This indicates the presence of water softeners that are regenerating on a daily basis at the same time. Source water for SJWC GW has higher TDS than what was measured. Potential explanation instrument calibration issue, lower salinity SJWC GW, or the water source may be different than that as indicated on the supply water map. Source water sampling and other field investigation is needed to understand the current data set.
Alt C6: Hotel (1/23/11 to 2/2/11)	0.096	0.009	0.507	92	Santa Clara Hetch Hetchy	298	304	9	2,653	129	**206**	**212**	Water supply hardness is at a level where water softener use would not be expected. However, a few high salinity spikes were observed, which are likely due to water softener regeneration. Considering the water supply hardness, confirmation of hotel water softener use is recommended.
C7: Laundry (1/25/11 5:20 to 1/25/11 13:25)	0.173	0.002	0.339	397	SJWC GW	1,866	1,508	25	9,388	154	**1,469**	**1,111**	Flows and conductivity indicate the laundry operates from about 5:00 to 2:00. High salinity spikes generally observed daily at different times. These spikes reached conductivity levels around 16,000 µS/cm (9,440 mg/l TDS). These spikes are thought to be an indication of water softener regeneration cycles.

A	B	C	D	E	F	G	H	I	J	K	L	M	
Site Number	**Average Flow (mgd)**	**Min Flow (mgd)**	**Max Flow (mgd)**	**Water Supply Average TDS (mg/l)**	**Water Source**	**Average TDS (mg/l)**	**Median TDS (mg/l)**	**Min TDS (mg/l)**	**Max TDS (mg/l)**	**Stdev TDS (mg/l)**	**TDS Increase Above Source (Average) (G-E) (mg/l)**	**TDS Increase Above Source (Median) (H-E) (mg/l)**	**Commentary and Observations**
R1: Residential (1/15/11 to 1/22/11)	0.171	0.019	0.338	331	SJ Muni Treated SW	537	496	331	2,492	136	**206**	**165**	R1 is in an import surface water area where water hardness is generally at levels where a water softener is not necessary. Results of the softener rebate program suggest that there are significant water softeners in this source area. Salinity spikes were observed every morning during the 7 day monitoring period. Salinity spikes were also observed beyond the morning hours; although these other spikes did not appear to occur on a regular scheduled basis.
R2: Residential (1/24/11 to 1/27/11)	0.022	0.000	0.087	326	SJWC Import SW	271	294	40	1,463	114	**(55)**	**(32)**	R2 is in an import surface water area where water softener use would be expected to be minimal. However, results of the softener rebate program suggest that there are significant water softeners in this source area. Due to grease plugging only 3 days of out of the 7-day data set appear to generate useable data. Two significant spikes in salinity were observed which may be an indication of softener regeneration. Source water for SJWC Import surface water (SW) has higher conductivity than what was measured. Potential explanation could be instrument calibration issues, low salinity SJWC Import SW, or the water source may be different than that indication on the supply water map. Source water sampling at this site should be completed.
R3: Residential (1/8/11 to 1/13/11)	0.077	0.028	0.154	399	Great Oaks Well Water	604	538	389	2,224	189	**205**	**139**	R3 is in a groundwater (GW) zone with high hardness. This GW area is expected to have significant water softener use due to hardness levels. A distinct salinity spike between 3 am and 6 am occurred during the duration of the monitoring period and is an indication of water softener discharges.
R4: Residential (1/24/11 to 2/9/11)	0.015	0.000	0.080	92	Milpitas Hetch Hetchy	155	142	61	2,576	113	**63**	**50**	R4 is an area that receives Hetch Hetchy water supply. Hardness is very low and water softeners are not expected to be prevalent in the area. There was a single spike in salinity over the monitoring period which may be an indication of a water softener regeneration. Flows were very irregular during the monitoring period, which is thought to be a function of the small tributary area to the sewer. Conductivity was also irregular and it is unclear if the data were impacted by low flow conditions. Generally, the estimated average TDS increase is significant lower than expected. Source water salinity may have been lower than the average from the consumer confidence report.

Notes:

1. TDS to EC factor of 0.59 mg/l TDS per µS/cm used to convert EC to TDS.
2. Max TDS values were based on the conductivity instrument "Full Range" measurement. Other statistics were based on "Low Range" measurements which had an increased level of accuracy.
3. Minimum TDS values that are below source water TDS are thought to indicate conductivity instrument failure or where the instrument was not able to properly monitor flow.

4 Salt Loading Analysis

Each of the key source categories—Source Water, Residential, Commercial, Industrial, I&I, and Wastewater Treatment—were evaluated to estimate their contribution of salt to the WCPC effluent. The following sections detail the analysis for each of the categories.

4.1 Source Water Load

The salinity levels of the water sources used in the tributary area is a significant part of the salt balance of the system. This load is a "pass-though" as all of the salt that is in the source water eventually makes its way to the WPCP once it is used by homes, businesses, and industries. Figure 5 illustrates the water retailers within the tributary area and the sources of the drinking water each distributes.

The wide range of source water qualities and the boundary delineation of source water use increased the complexity of the study. Upon review of the source water zones, there was not always a clearly defined boundary between one source of water supply and the next. Some retailers also blend supplies or use multiple supplies in a designated area. A complete understanding of retailer operations and boundary, and fluctuations over seasons and hydrologic years was beyond the scope of the project. Therefore, the evaluation generally relies on water quality data provided in consumer confidence reports (CCRs).

To estimate the source water salinity load, sewer flow data from collection system master plans were used in conjunction with TDS data from CCRs from 2009 and 2010. Table 6 provides a summary of the TDS and hardness in each of the source water basins.

Sewer hydraulic model data (i.e., flow subbasins) from Santa Clara, San Jose, Milpitas, and WVSD were overlaid in GIS with the source water service area boundaries to develop a sewer flow per source water service area. The sewer models included trade (i.e., industrial and commercial), larger users, and residential flow types. Table 7 summarizes the estimated flows for the various use categories that will be use in estimating load due to consumptive use.

Figure 5: Source Water Area Map

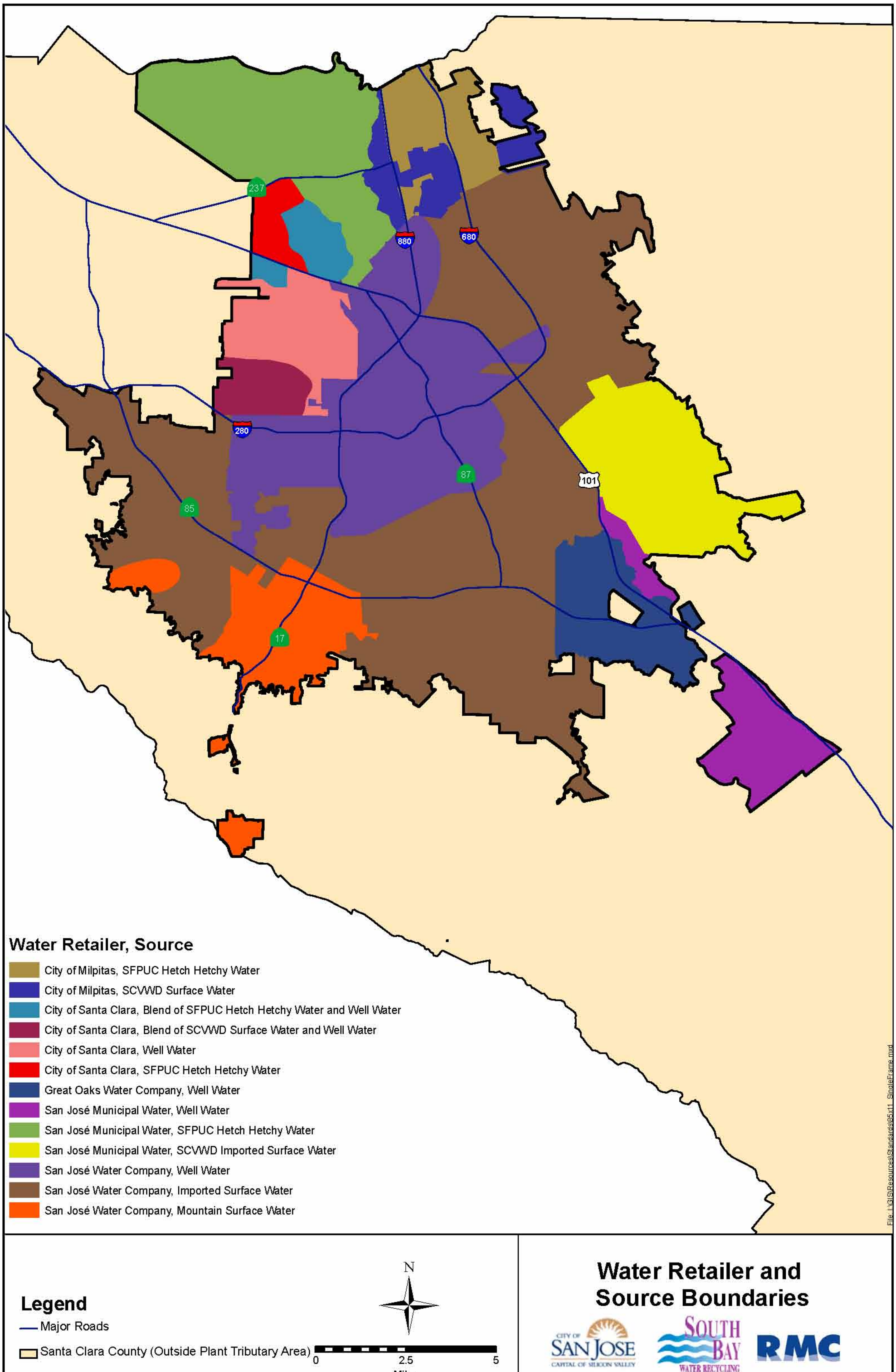


Table 6: Source Water Summary

Retailer and Source	TDS Concentration (mg/L)		Hardness (mg/L CaCO3)	
	Average	Range	Average	Range
City of Milpitas, San Francisco Public Utilities Commission (SFPUC) Hetch Hetchy Water	92	39-203	55	14-100
City of Milpitas, Santa Clara Valley Water District (SCVWD) Surface Water	263	234-292	101	79-126
City of Santa Clara, Blend of SFPUC Hetch Hetchy Water and Well Water	224.5	153-363	117	78-256
City of Santa Clara, Blend of SCVWD Surface Water and Well Water	326	264-421	179	122-267
City of Santa Clara, City of Santa Clara Well Water	357	266-522	246	142-411
City of Santa Clara, SFPUC Hetch Hetchy Water	92	39-203	55	14-100
Great Oaks Water Company, Well Water	399	320-508	300	233-400
San José Municipal Water Coyote Valley, Well Water	347	330–360	280	255–308
San José Municipal Water Edenvale, Well Water	385	370-400	311	301-320
San José Municipal Water, SFPUC Hetch Hetchy Water	92	39-203	55	14-100
San José Municipal Water Evergreen, SCVWD Treated Water	331	262-370	136	116-167
San José Water Company, Well Water	397	230-540	288	119-467
San José Water Company, Imported Surface Water	326	242-470	116	79-138
San José Water Company, Mountain Surface Water	245	220-270	194	181-210

Notes:

1. TDS and Hardness levels shown are from the 2009 or 2010 CCRs published by each water retailer.
2. For blend water area in the City of Santa Clara, TDS and Hardness were assumed to be the average of the two source supplies.

Table 7: Flow by Use and Water Source

Retailer and Source	Residential (mgd)	Trade (mgd)	Large User (mgd)
City of Milpitas, San Francisco Public Utilities Commission (SFPUC) Hetch Hetchy Water	8.5	0.9	0.0
City of Milpitas, Santa Clara Valley Water District (SCVWD) Surface Water	0.4	2.2	4.3
City of Santa Clara, Blend of SFPUC Hetch Hetchy Water and Well Water	1.3	0.8	0.4
City of Santa Clara, Blend of SCVWD Surface Water and Well Water	2.2	0.0	0.0
City of Santa Clara, City of Santa Clara Well Water	3.7	1.2	1.3
City of Santa Clara, SFPUC Hetch Hetchy Water	0.2	0.5	0.6
Great Oaks Water Company, Well Water	4.3	0.7	0.1
San José Municipal Water Coyote Valley, Well Water	0.0	0.0	0.8
San José Municipal Water Edenvale, Well Water	0.04	0.1	0.3
San José Municipal Water, SFPUC Hetch Hetchy Water	1.2	1.2	1.3
San José Municipal Water Evergreen, SCVWD Treated Water	5.8	0.7	0.0
San José Water Company, Well Water	17.7	7.9	0.7
San José Water Company, Imported Surface Water	33.8	6.8	0.2
San José Water Company, Mountain Surface Water	2.4	0.8	0.1
Totals	**81.7**	**23.8**	**10.1**

Notes:

1. Flows by source were determined by overlaying source water maps over collection system models subbasins.

Table 8 summarizes the source water was estimate range and the average contribution of **54,400 tons of salt per year** using average TDS levels. The TDS ranges in the CCRs were used to estimate the minimum and maximum load levels. Sources water quality does change seasonally and also varies with hydrologic conditions. Therefore, the source water load contribution varies accordingly. If the low TDS concentrations values are used for all water supplies, the source water load is **38,300 tons of salt per year.** If the high TDS concentrations values are used, the source water load is **76,800 tons of salt per year**. As this represents a potential significant difference in source water load, additional monitoring would likely provide further insight into seasonal and hydrologic variations.

Table 8: Source Water Load Summary

Source of TDS	Flow (mgd)	Minimum Salt Load (Tons/yr)	Maximum Salt Load (Tons/yr)	Average TDS Load (Tons/yr)
Residential	81.7	27,300	54,600	39,000
Trade	23.8	7,800	15,900	11,400
Large Discharger	9.1	2,100	5,200	2,900
Recycled Water - Industrial	1.0	1,058	1,058	1,058
Total Source Water	**115.6**	**38,300**	**76,800**	**54,400**

Notes:

1. Source water Minimum and Maximum values were developed based on TDS ranges provided in CCRs. Minimum TDS values from the CCRs were used for all supplies for the minimum estimate and Maximum TDS values were used for the maximum TDS estimate.

4.2 Residential Load

There are two key components of the salt load from residential use: typical residential human consumptive use and residential water softener use. The following section documents how these loads were evaluated for the tributary area.

4.2.1 Residential Human Consumptive Use

Salt is added to the waste stream through normal residential human consumptive use including toilet flushing, bathing, laundry, and dish washing. The typical mineral increases from residential uses (Metcalf and Eddy, Inc. *Wastewater Engineering: Treatment, Disposal, and Reuse*, Forth Edition, 2003) are:

- Chloride (Cl): 20-50 mg/L
- Sodium (Na): 40-70 mg/L
- TDS: 150-380 mg/L

Residential consumptive use was also estimated based on composite sampling data completed by the City in 2006. Twenty-four hour composite samples were collected over a 2-3 month period at three different residential sewer locations in the tributary area. Table 9 summarizes the results of the study, which indicated an average TDS addition of about 209 mg/l.

Table 9: Results of 2006 Residential Sewer Sampling

Monitoring Location	Average TDS of samples (mg/l)	Water Supply Source	TDS of Water Source (mg/l)	Hardness of Water Supply (mg/l as CaCO3)	Estimated Residential TDS addition (mg/l)
San Felipe Rd. at Yerba Buena, San Jose	553	Muni Water Evergreen Area- Well water	331	136	222
Florence Dr., Cupertino	522	SJWC Import Water (SCVWD)	326	118	196
Carnegie Dr., Milpitas	301	SF2 Zone (Hetch-Hetchy)	92	55	209
				Average TDS Addition:	**209 mg/l**

Notes:

1. TDS sampling was performed by the City of San Jose in 2006.

Table 9 results are assumed to be representative of residential consumption in areas without water softeners because the sampling points were specifically located in water source areas that have low to moderate hardness, and thus were believed to not have water softener penetration.

As part of this study, continuous flow and conductivity monitoring (see Section 3.2) were completed at four residential sewer locations—two in source areas believed to have very little water softener use (based on low water hardness from drinking water) and two areas with suspected high use (based on higher hardness from drinking water). Table 10 summarizes the various statistics and estimates of consumptive use and water softener additions. Generally, the R1 data set resulted in values that would be expected giving the source water quality. Statistics were done for both the original R1 data set and the drift corrected R1 data set. The drift corrected R1 estimated water softener addition and was over 5 times higher than the original R1 estimate. This provides some indication of the implications of the drift correction that were made to the data set.

The R3 data set demonstrated patterns that were expected. However, the consumptive use estimate of 139 mg/l TDS was lower than typical expected values above 209 mg/l. R2 and R4 were fouled with debris and grease and had limited data that were usable for analysis. R2 and R4 consumptive use TDS estimates were below reasonable values. However, the water softener estimates (difference between "Flow weighted average TDS" and "median TDS") were thought be valid.

Figure 6 shows the drift corrected R1 data with the results of the analysis. The R1 corrected data shows an approximate residential consumptive use value of 237 mg/l. Conductivity data were converted to TDS using a 0.59 conversion factor, which was estimated based on the weekly composite WPCP final effluent TDS and conductivity data from August 2007 to August 2010. The TDS value of 237 mg/l is slightly above the 2006 average value of 209 mg/l shown above in Table 9.

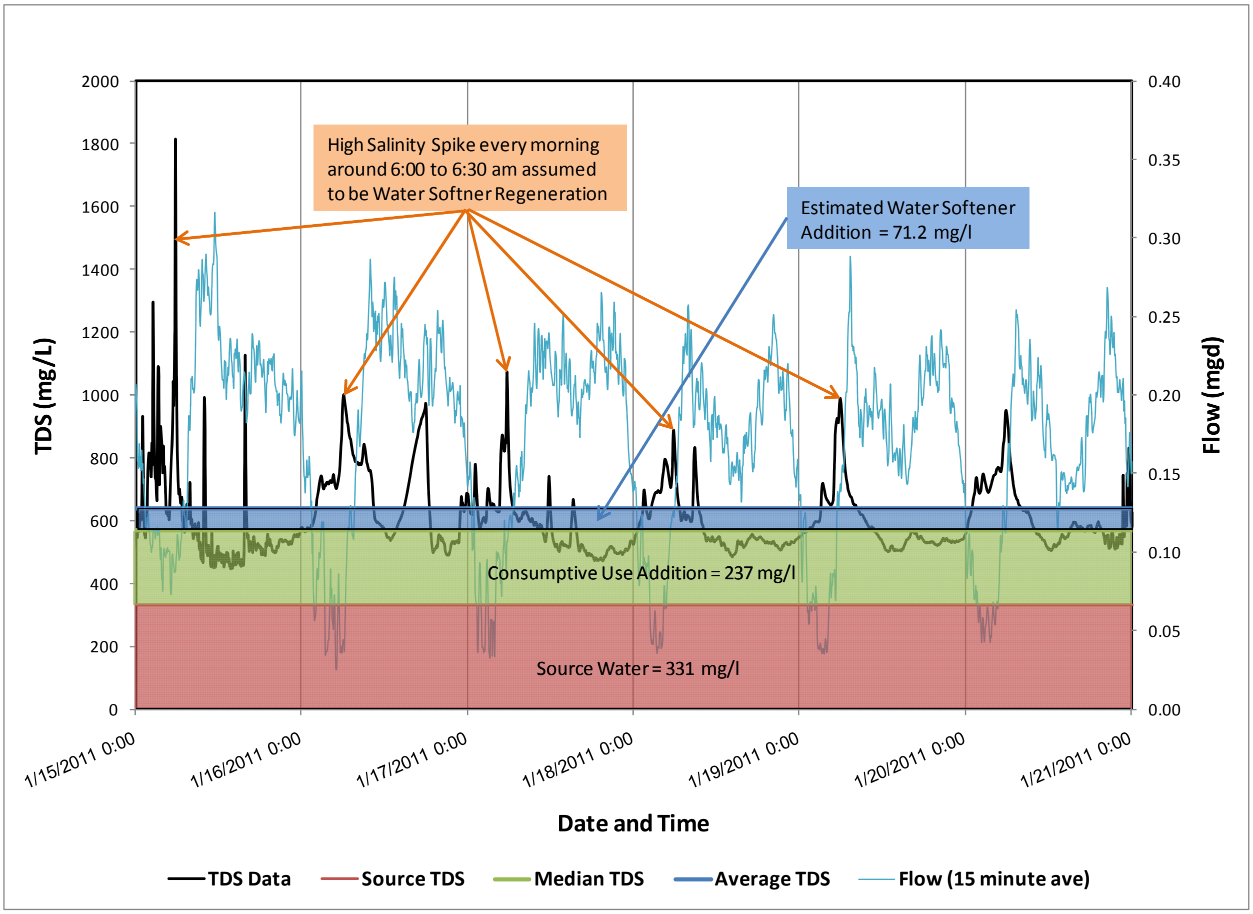
Table 10: Results of Residential Sewer Conductivity and Flow Monitoring

Site Number	Flow Weighted Average TDS (mg/l)	Median TDS (mg/l)	Water Softener TDS Addition (mg/l) [D-E]	Softener TDS % of Total	Water Source	Average Source Water TDS (mg/l)	Est. Consumptive Use TDS addition (mg/l) [E-I]	Commentary
R1: Residential (1/15/11 to 1/22/11)	552.8	538.8	13.9	2.5%	SJ Muni Treated SW	331	208	R1 had regular salinity spikes every morning. This daily occurrence was generally in line with the expectation of water softener regeneration occurring in early morning hours.
Drift Corrected R1: Residential (1/15/11 to 1/22/11) –	639.7	568.5	71.2	11.1%	SJ Muni Treated SW	331	237	R1 (drift corrected) showed a significantly higher water softener TDS addition than the estimate on the original data set. Estimated consumptive use also increased by about 13% over the original data set.
R2: Residential (1/24/11 to 1/27/11)	340.3	317.1	23.1	6.8%	SJWC Import SW	326	-9	Conductivity data were much lower than expected. Data were not appropriate for estimating consumptive use. However, the difference between the “Flow Weighted Average” and “Median TDS” is thought to be a reasonable estimate of water softener addition.
R3: Residential (1/8/11 to 1/13/11)	586.6	538.0	48.6	8.3%	Great Oaks Well Water	399	139	R3 had regular salinity spikes every morning. This daily occurrence was generally in line with the expectation of water softener regeneration occurring in early morning hours.
R4: Residential (1/24/11 to 2/9/11)	150.2	141.9	8.2	5.5%	Milpitas Hetch Hetchy	92	50	The estimated consumptive use TDS addition is below the expected typical value above 200 mg/l. The reasons for this result are not fully understood. Potential reasons could be 1) inadequate flows as this was a small sewer subbasin; 2) instrument calibration issues; 3) TDS addition may be lower than typical in this low hardness/low TDS water area.

Notes:

1. The Water Softener TDS addition was assumed to be the difference between the "Flow Weighted Average TDS" and the "Median TDS." These estimated values are used in the residential water softener load estimate.
2. The "Estimated Consumptive Use TDS Addition" is determined by taking the “Median TDS” value minus the "Average Water Source TDS".
3. Average water source TDS was based on CCRS from water retailers. Potential seasonal or hydrologic year variations in TDS are unknown.

Figure 6: Site R1 (Drift Corrected) Data and Analysis Result



Considering the range of data and results, the average residential consumptive use of 209 mg/l from the 2006 City of San Jose data set was used to estimate average load. This value was used for the salt loading mass balance in conjunction with the residential sewer flow data shown in Table 11. Residential consumptive use was estimated to contribute **26,000 tons per year** into the wastewater.

Table 11: Residential Sewer Flow, by Source Area

Retailer and Source	Residential Flow[1] (MGD)
City of Milpitas, (SFPUC) Hetch Hetchy Water	8.5
City of Milpitas, SCVWD Surface Water	0.3
City of Santa Clara, Blend of SFPUC Hetch Hetchy and Well Water	1.3
City of Santa Clara, Blend of SCVWD Surface Water and Well Water	2.2
City of Santa Clara, City of Santa Clara Well Water	3.1
City of Santa Clara, SFPUC Hetch Hetchy Water	0.2
Great Oaks Water Company, Well Water	3.9
South Bay Water Recycling, Recycled Water	1.0
San José Municipal Water, Well Water	0.0
San José Municipal Water, SFPUC Hetch Hetchy Water	1.2
San José Municipal Water, SCVWD Treated Water	5.8
San José Water Company, Well Water	17.7
San José Water Company, Imported Surface Water	33.8
San José Water Company, Mountain Surface Water	2.4
Total	**81.7**

Notes:

1. Based on wastewater master plans completed for Santa Clara, Milpitas, West Valley Sanitation District, and San Jose from 2007-2011.

4.2.2 Residential Water Softener Use

Residential self regenerating water softener use can be a major salt load to the WPCP. Self regenerating water softeners load depends on water hardness, efficiency (i.e. grain of hardness removed per pound of salt), type of softener (i.e., old timer based water softener or demand based softener), and the prevalence of softener use in the region.

Water softener contribution is typically very challenging to determine as the numerous factors described above can impact the outcome. In addition, the tributary area of the WPCP is served by a wide range of water supplies with varying levels of hardness. Water softener prevalence can be greatly affected by the amount of marketing that a water softener company has done in an area—in some cases residents have probably been sold automatic water softeners that are not needed based on the source water quality.

To estimate the salinity contribution from residential water softeners in each water supply area, survey data from *Santa Clara County Residential Water Use Baseline Survey* was used in conjunction with *SCVWD 2010 Residential Water Softener Program* data. The *Santa Clara County Residential Water Use Baseline Survey* found that 17% of single family residences and 3% of multifamily residence had water softeners. Of the single family residence, 71.4% were self-regenerating while 40% were self regenerating for the multifamily residence. In conjunction with housing metrics (i.e., single family and multifamily dwelling units) for the City, an estimated 10% of the households in the tributary area are assumed to have self regenerating water softeners.

To assess water softener load, the following three alternative estimates were completed.

- Alternative 1: Water Softener Load Based on Survey of Bags of Salt Used Per Month
- Alternative 2: Water Softener Additions Estimated from R1 to R4 Collection System Monitoring
- Alternative 3: Water Softener Worksheet Estimate of 35.3 mg/l TDS added area wide

Alternative 1 – Water Softener Load Based on Survey of Bags of Salt Used per Month

SCVWD 2010 Residential Water Softener Program survey data were used to estimate the average daily loading of salt into the sewer system from each estimated water softener. Each program participant was asked how many 40 pound bags of salt they used on a monthly basis for each softener. From the survey data, an average salt load of 2.97 lbs/day were estimated per softener. In combination with dwelling unit data, indicating about 410,500 occupied households, an estimate of the salt load by source area was identified (see Table 12). The Alternative 1 water softener load was estimated to contribute **22,200 tons of salt per year** into the wastewater system.

Alternative 2 – Water Softener Additions Estimated from R1 to R4 Collection System Monitoring

Water softener TDS additions for different source areas were estimated from the collection system monitoring data. These water softener TDS addition values were used in combination with the estimated number of water softeners in each water source area to develop a salt load. As monitoring was not completed in each source water area, the values estimates for R1 to R4 were assigned to other area of similar water source. The Alternative 2 water softener load estimated a contribution of **4,200 tons of salt per year**.

Alternative 3 – Water Softener Addition Based on Efficiency Estimate and Average Hardness

Alternative 3 uses an assumed water softener average efficiency and average hardness to estimate TDS addition based on the following assumptions:

- Percent of houses with water softeners = 10%
- Hardness of the water supply = 166.4 mg/l $CaCO_3$ area wide (See Table 14 for flow weight average)
- Assumed Average water softener efficiency = 3,300 grains of salt removed per pound of hardness (no available data on average efficiency)

There is no known data on the average water softener efficiency in the WPCP service area and the assumed value above is used for estimate purposes. The water softener addition with these parameters was estimated to be 35.3 mg/l TDS which equates to an estimated contribution of **4,400 tons of salt per year.** This estimate has no accounting for increased prevalence of water softeners in water source areas with high hardness.

Water Softener Commentary

The load estimates from Alternative 2 and 3 are about the same while a significantly higher load was estimated for Alternative 1. However, the confidence level in all three estimates are low due to the variability of source water, the number of variables that impact water softener regeneration, and the lack of available data. Additional study and data are necessary to further understand the salt load from water softeners and potential trends (i.e., proliferation of water softener installations with time).

Table 12: Alternative 1- Water Softener Load Based on Survey of Bags of Salt Used per Month

Water Retailer and Water Source	Hardness (mg/L)	Residential Flow (MGD)	Occupied Houses	Estimated Number of Houses with Water Softeners[2]	Pounds of Salt per year per Housing Unit	Salt Load due to Water Softeners (Tons/yr)[3]
City of Milpitas, SFPUC Hetch Hetchy Water	55	8.5	15,090			
City of Milpitas, SCVWD Surface Water	101	0.4	3,580			
City of Santa Clara, Blend of SFPUC Hetch Hetchy Water and Well Water	117	1.3	6,348			
City of Santa Clara, Blend of SCVWD Surface Water and Well Water	179	2.2	11,577			
City of Santa Clara, Well Water	246	3.7	22,201			
City of Santa Clara, SFPUC Hetch Hetchy Water	55	0.2	2,524			
Great Oaks Water Company, Well Water	300	4.3	22,838			
San José Municipal Water, Well Water	295.5	0.1	717			
San José Municipal Water, SFPUC Hetch Hetchy Water	55	1.2	5,956			
San José Municipal Water, SCVWD Treated Water	128	5.8	22,256			
San José Water Company, Well Water	288	17.7	103,460			
San José Water Company, Imported Surface Water	116	33.8	179,161			
San José Water Company, Mountain Surface Water	194	2.4	14,839			
Total		**81.6**	**410,546**	**41,073**	**1,084**	**22,237**

Notes:

1. Based on data provided in the 2010 SCVWD Pilot Water Softener Rebate Program.
2. The number of households with water softeners per basin is estimated as the product of the percent of households in the basin receiving rebates (based on full and pilot scale rebate program data) and the number of households service area-wide with water softeners (10%).
3. The salt load was calculated on a per household basis using data from the SCVWD 2004 water softener survey report. The salt load was estimated to be 2.97 lbs/day per water softener.

Table 13: Alternative 2- Water Softener Additions Estimated from R1 to R4 Collection System Monitoring

Water Retailer and Water Source	Hardness (mg/L)	Residential Flow (MGD)	Water Softener TDS Addition (mg/l)[1]	Salt Load due to Water Softeners (lbs/day)	Salt Load due to Water Softeners (tons/yr)
City of Milpitas, SFPUC Hetch Hetchy Water	55	8.5	8.24	583	106.43
City of Milpitas, SCVWD Surface Water	101	0.4	71.25	237	43.31
City of Santa Clara, Blend of SFPUC Hetch Hetchy Water and Well Water	117	1.3	28.40	307	56.10
City of Santa Clara, Blend of SCVWD Surface Water and Well Water	179	2.2	59.90	1,097	200.27
City of Santa Clara, Well Water	246	3.7	48.56	1,496	273.03
City of Santa Clara, SFPUC Hetch Hetchy Water	55	0.2	8.24	14	2.50
Great Oaks Water Company, Well Water	300	4.3	48.56	1,739	317.30
San José Municipal Water, Well Water	295.5	0.1	48.56	24	4.30
San José Municipal Water, SFPUC Hetch Hetchy Water	55	1.2	8.24	82	15.02
San José Municipal Water, SCVWD Treated Water	128	5.8	71.25	3,441	627.99
San José Water Company, Well Water	288	17.7	48.56	7,157	1306.09
San José Water Company, Imported Surface Water	116	33.8	23.14	6,513	1188.70
San José Water Company, Mountain Surface Water	194	2.4	23.14	462	84.40
Total		**81.6**		**23,153**	**4,225**

Notes:

1. The salt load due to water softeners is estimated based on estimates from Residential conductivity monitoring data. The water softener load was estimated as the difference between the "Flow Weighted Average TDS" and the "Median TDS."

Table 14: Alternative 3 - Water Softener Addition Based on Efficiency Estimate and Average Hardness

Water Retailer and Water Source	Hardness (mg/L)	Residential Flow (MGD)	Water Softener TDS Addition (mg/l)[1]	Salt Load due to Water Softeners (lbs/day)	Salt Load due to Water Softeners (tons/yr)
City of Milpitas, SFPUC Hetch Hetchy Water	55	8.5			
City of Milpitas, SCVWD Surface Water	101	0.4			
City of Santa Clara, Blend of SFPUC Hetch Hetchy Water and Well Water	117	1.3			
City of Santa Clara, Blend of SCVWD Surface Water and Well Water	179	2.2			
City of Santa Clara, Well Water	246	3.7			
City of Santa Clara, SFPUC Hetch Hetchy Water	55	0.2			
Great Oaks Water Company, Well Water	300	4.3			
San José Municipal Water, Well Water	295.5	0.1			
San José Municipal Water, SFPUC Hetch Hetchy Water	55	1.2			
San José Municipal Water, SCVWD Treated Water	128	5.8			
San José Water Company, Well Water	288	17.7			
San José Water Company, Imported Surface Water	116	33.8			
San José Water Company, Mountain Surface Water	194	2.4			
Total		**81.6**	**35.3**	**23,968**	**4,374**
Average Hardness (mg/l CaCO3)	**166.4**				

4.3 Commercial Load

The commercial salt loading for the tributary area was broken into two parts: the load from high salt contributing commercial categories and the load from all other commercial categories.

4.3.1 Commercial Categories with High Salinity Discharge

From the WateReuse Study entitled *Characterizing and Managing Salinity Loadings in Reclaimed Water Systems*, 2006 and data from the *SCVJSS Chloride Source Report*, the project team identified several key commercial categories that have a high salinity discharge. These commercial categories are shown in Table 15.

Data from the 2007 US Economic Census were used to determine the number of each of these commercial businesses that are located in the tributary area. Water use data from each type of business were obtained from the 2006 City of Santa Clara Sewer Capacity Analysis, to estimate average commercial sewer flows by type. Finally, TDS values for each of the types of commercial businesses were added from 2011 sewer monitoring data, if available, or from the 2006 WateReuse Report: *Characterizing and Managing Salinity Loadings in Reclaimed Water Systems*.

Table 15: High Salinity Discharge Commercial Categories Summary

Business Sector	Number of Businesses in WPCP Tributary Area[1]	Flow per Business		Total Flow (MGD)	TDS		Total Load (Tons/yr)
		Estimated Flow per Business (MGD)	Data Source		Estimated TDS per Business (mg/L)	Data Source	
Dry cleaning and laundry services (except industrial launderers)	149	0.03870	Santa Clara[2]	5.77	1,200	Conductivity Monitoring	**10,518**
Car washes	37	0.00224	Santa Clara[2]	0.08	744	Previous Salinity Study in Santa Clarita[3]	**94**
Pet care (except veterinary) services	11	0.00018	Santa Clara[2]	0.00	843	Previous Salinity Study in Santa Clarita[3]	**3**
Fitness and recreational sports centers	125	0.00224	Santa Clara[2]	0.28	1,140	Previous Salinity Study in Santa Clarita[3]	**485**
Full-service restaurants	973	0.00191	Santa Clara[2]	1.86	1,190	Previous Salinity Study in Santa Clarita[3]	**3,367**
Grocery stores	303	0.00161	Santa Clara[2]	0.49	1,467	Previous Salinity Study in Santa Clarita[3]	**1,084**
Hospitals	7	0.01619	Conductivity Monitoring	0.11	559	2006 Watereuse Report[4]	**96**
Total				**8.59**			**15,646**

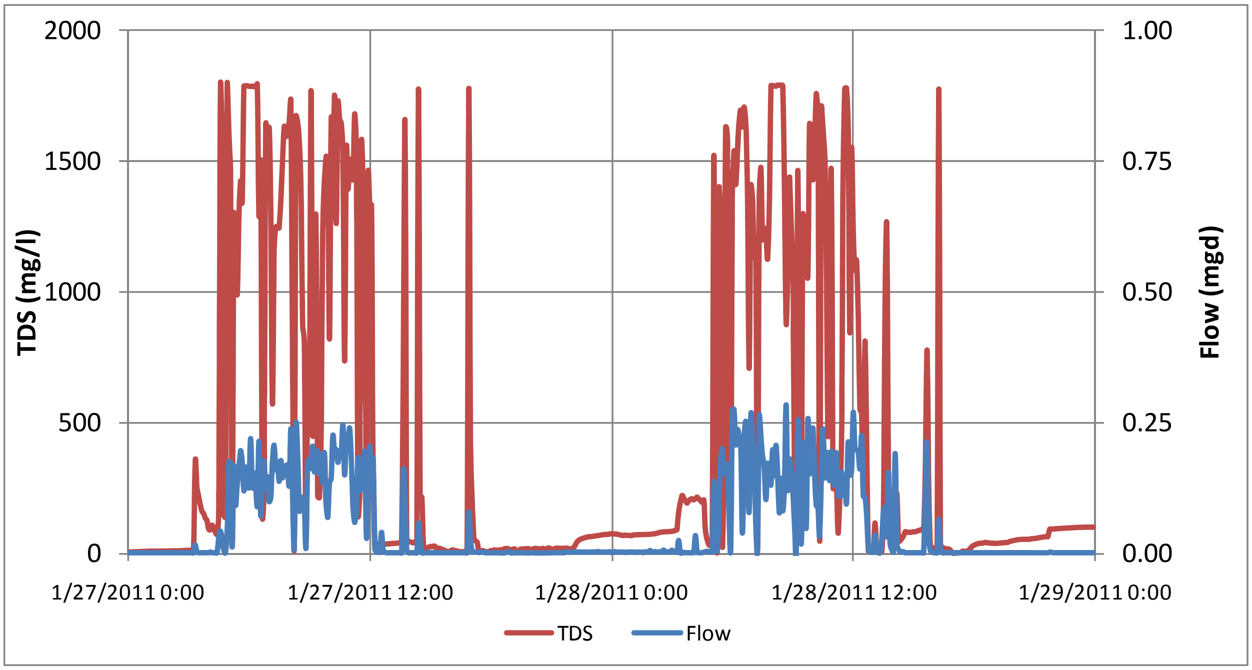
Notes:

1. From 2007 US. Economic Census.
2. Water billing records from the City of Santa Clara 2007 Santa Clara Sanitary Sewer Capacity Assessment.
3. Los Angeles County Sanitary District, *SCVJSS Chloride Source Report*, 2002.
4. WaterReuse, *Characterizing and Managing Salinity Loadings in Reclaimed Water Systems*, 2006.

Figure 7 presents the results from a commercial laundry facility that was monitored as part of this study. (Conductivity data collected in the field was converted to TDS using a 0.59 conversion factor.) Average values for TDS levels (calculated during laundry operation, which averages 10 hours a day) were taken from this data and used to calculate the TDS load for the other 149 dry cleaners and laundry facilities in the tributary area.

The overall estimated salt load from commercial uses with high salt loading was about **15,600 tons per year**.

Figure 7: Commercial Laundry Flow and Conductivity Monitoring Results (Site C7)



4.3.2 Other Commercial Categories

The project team focused conductivity and flow monitoring resources on commercial categories with suspected high salt loads. All other remaining commercial categories were grouped together and the estimate of 209 mg/l of salinity addition due to commercial use was assumed, as much of the commercial business in the tributary area is worker-based, it was assumed that these levels were in line with human consumption levels measure in the tributary area. The total commercial flows were calculated from the sewer master plans that were recently conducted for all of the tributary agencies. Each of these sewer master plans conducted extensive sewer flow monitoring as part of model calibration process. The flow from the high salt commercial businesses detailed in Section 4.3.1 was subtracted out of the flow from other commercial categories, to avoid double counting.

The total salt load from other commercial categories is estimated to be **4,800 tons per year**.

4.4 Industrial Load

Industrial salt load into the sewer system varies greatly across the tributary area and even across similar industries. Salt load is added through various industrial processes, which include the addition of chemicals and detergents as well as the addition of salts through food and beverage processing.

To determine which industries should be sampled, industrial data from the Sewer Master Plans were reviewed. In addition, the SJ-ESD Watersheds Department, which is the control authority for the regional pretreatment program, provided a list of permitted industrial users and industrial users considered to potentially be high salinity dischargers. The list of industrial users from the sewer master plans was crossreferenced to the Watersheds list and a list of 43 suspected high flow-high salinity dischargers were identified. The SJ-ESD Watersheds group collected 24-hour composite samples or grab sample at each industrial site from December 2010 to February 2011 as part of their routine monitoring program.

The WPCP Laboratory determined the TDS value for each sample. For each industry, the source water area and TDS were identified. Table 16 shows the source water TDS, the industry-specific monitored TDS, the estimated consumptive use salinity increase, and the total salt load. Average TDS values were used for the industries that were sampled multiple times over the monitoring period.

The total salt load from the sampled industries is about **18,600 tons per year**. Almost half of this salt load is added by four industrial users: a paper mill: 1,195 tons per year, a water treatment/softening company: 1,477 tons per year, a second paper mill: 2,027 tons per year, and a sausage and meat processing company: 2,944 tons per year.

The salt load from other industries not monitored as part of the study account for an **additional 1,500 tons per year**, using the assumption that these industries add about 209 mg/l of load.

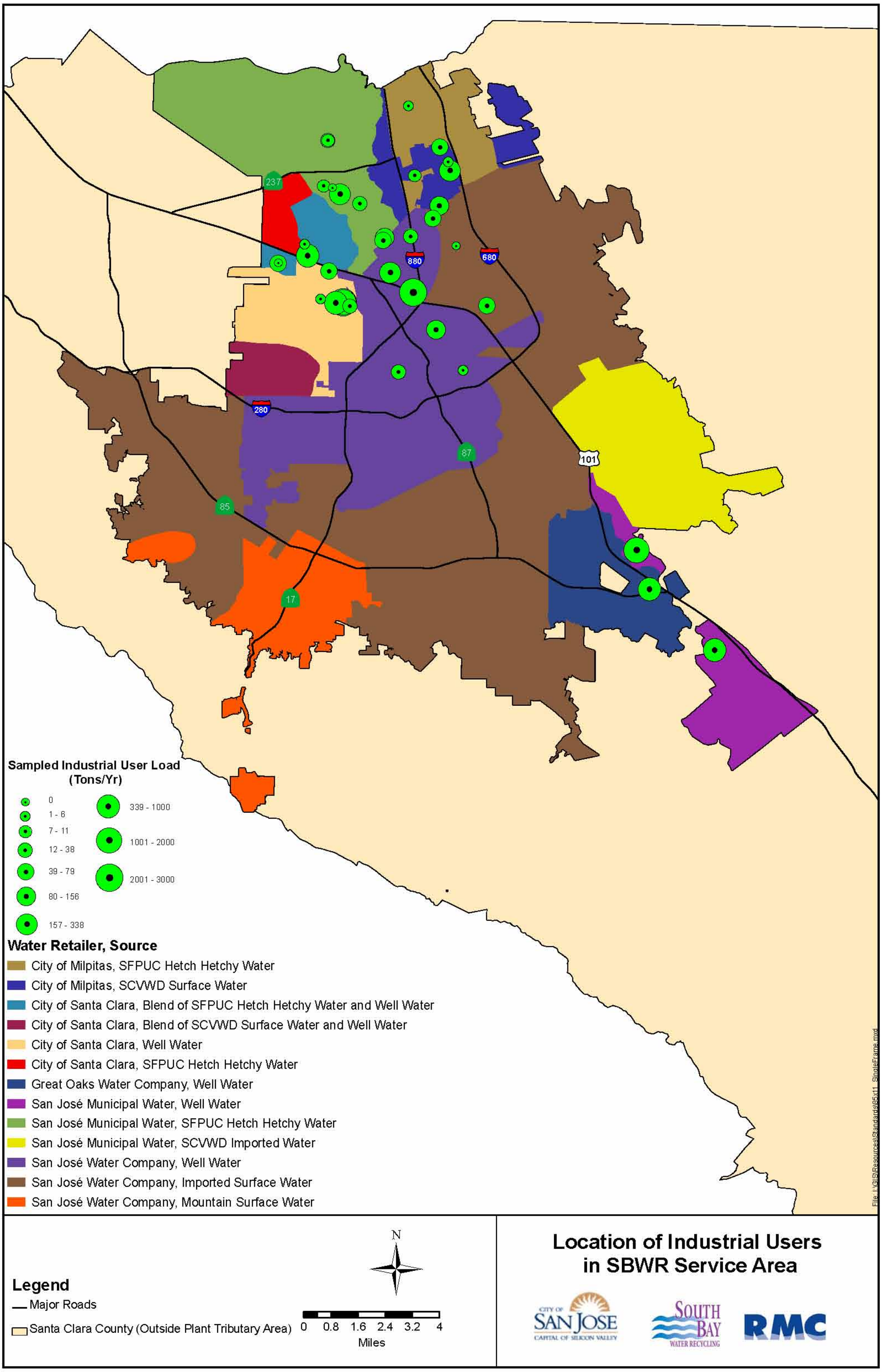
Table 16: Salt Loading of Key Industrial Users

Industry Type	Source Water[1]	Source Water TDS[1] (mg/l)	Monitored TDS (mg/l)	Consumptive Use TDS[3] (mg/l)	Ave. Flow[4] (mgd)	Total Salt Load (tons/yr)
Industrial laundries	San José Water Company: Well Water	397	1,800	1,403	0.07	155.8
Special industry machinery	City of Santa Clara: Blend of SFPUC Hetch Hetchy and Well Water	225	569	345	0.14	73.0
Paperboard mills	Recycled Water	700	2,425	1,725	0.46	1,194.8
Electric services	Recycled Water	700	2,740	2,040	0.04	129.1
Canned fruits and vegetables	City of Santa Clara: City of Santa Clara Well Water	357	5,460	5,103	0.08	658.1
Electric services	Recycled Water	700	4,890	4,190	0.07	426.9
Printed circuit boards	City of Milpitas: SCVWD Surface Water	263	2,460	2,197	0.14	467.8
Correctional institutions	City of Milpitas: SCVWD Surface Water	263	334	71	0.21	23.1
Distilled and blended liquors	San José Water Company: Imported Surface Water	326	3,079	2,753	0.01	45.0
Water supply	San José Municipal Water: Well Water	385	7,875	7,490	0.13	1,477.4
Brewery	San José Water Company: Well Water	397	3,870	3,473	0.02	119.6
Paperboard mills	City of Santa Clara: City of Santa Clara Well Water	357	3,820	3,463	0.38	2,027.1
Computer storage devices	Great Oaks Water Company: Well Water	399	832	433	0.87	570.1
Refuse Systems	San José Municipal Water: SFPUC Hetch Hetchy Water	92	12,400	12,308	0.04	679.1
Wines, brandy, and brandy spirits	San José Water Company: Well Water	397	1,440	1,043	0.01	20.3
Semiconductors and related devices	City of Milpitas: SCVWD Surface Water	263	1,740	1,477	0.13	284.1
Semiconductors and related devices	San José Municipal Water: SFPUC Hetch Hetchy Water	92	1,139	1,047	0.20	318.3
Electric services	Recycled Water	700	4,100	3,400	0.34	1,760.7
Semiconductors and related devices	San José Water Company: Imported Surface Water	326	635	309	0.17	78.8
Sausages and other prepared meats	San José Water Company: Well Water	397	58,600	58,203	0.03	2,944.4
Plating and polishing	City of Santa Clara: SFPUC Hetch Hetchy Water	92	140	48	0.01	0.7
Electric services	Recycled Water	700	3,250	2,550	0.06	226.3
Semiconductors and related devices	City of Santa Clara: SFPUC Hetch Hetchy Water	92	401	309	0.08	38.2
Semiconductors and related devices	San José Municipal Water: SFPUC Hetch Hetchy Water	92	483	391	0.13	77.3
Industrial laundries	City of Milpitas: SFPUC Hetch Hetchy Water	92	1,430	1,338	0.03	70.9
Electric services	Recycled Water	700	2,090	1,390	0.03	66.0
Printed circuit boards	San José Water Company: Well Water	397	1,620	1,223	0.11	204.9
Printed circuit boards	San José Water Company: Well Water	397	1,685	1,288	0.17	337.3
Business services	City of Milpitas: SCVWD Surface Water	263	11,000	10,737	0.11	1,796.2
Printed circuit boards	City of Santa Clara: City of Santa Clara Well Water	357	762	405	0.08	47.5
Semiconductors and related devices	San José Municipal Water: SFPUC Hetch Hetchy Water	92	3,430	3,338	0.03	152.1
Semiconductors and related devices	San José Municipal Water: SFPUC Hetch Hetchy Water	92	136	44	0.08	5.1
Pickles, sauces, and salad dressings	City of Milpitas: SCVWD Surface Water	263	1,890	1,627	0.03	82.8
Printed circuit boards	City of Santa Clara: City of Santa Clara Well Water	357	1,490	1,133	0.09	159.6
Semiconductors and related devices	City of Santa Clara: SFPUC Hetch Hetchy Water Water	92	4,260	4,168	0.28	1,759.0
Water Softener Co.[5]	NA	NA	NA	NA	0.13	40.0
Water Softener Co.[5]	NA	NA	NA	NA	0.13	40.0
Magnetic and optical recording media	San José Water Company: Imported Surface Water	326	334	8	0.09	1.1
				Totals:	**5.22**	**18,600**

Notes:

1. Source water is shown as "Retailer: Source".
2. Source water TDS value is based on the average TDS data from 2009-2010 CCRs published by the corresponding water retailers.
3. Consumptive use TDS is determined as the difference between the TDS sample value and the source water TDS.
4. Average flows for each user are based on self-reported average discharge in industrial permits.
5. Data provided by Ray Wong, SCVWD, for water softener company salt loads. These users are not permitted and were not monitored.
6. Appendix C includes TDS data for industries where two samples were taken. The table shows how there is significant variability in samples and illustrates how more data are necessary to develop an understanding of average salt loads from industry.

Figure 8: Location and Salt Loading of Industrial Users in Tributary Area



4.5 Seawater/Brackish Water Infiltration and Inflow Load

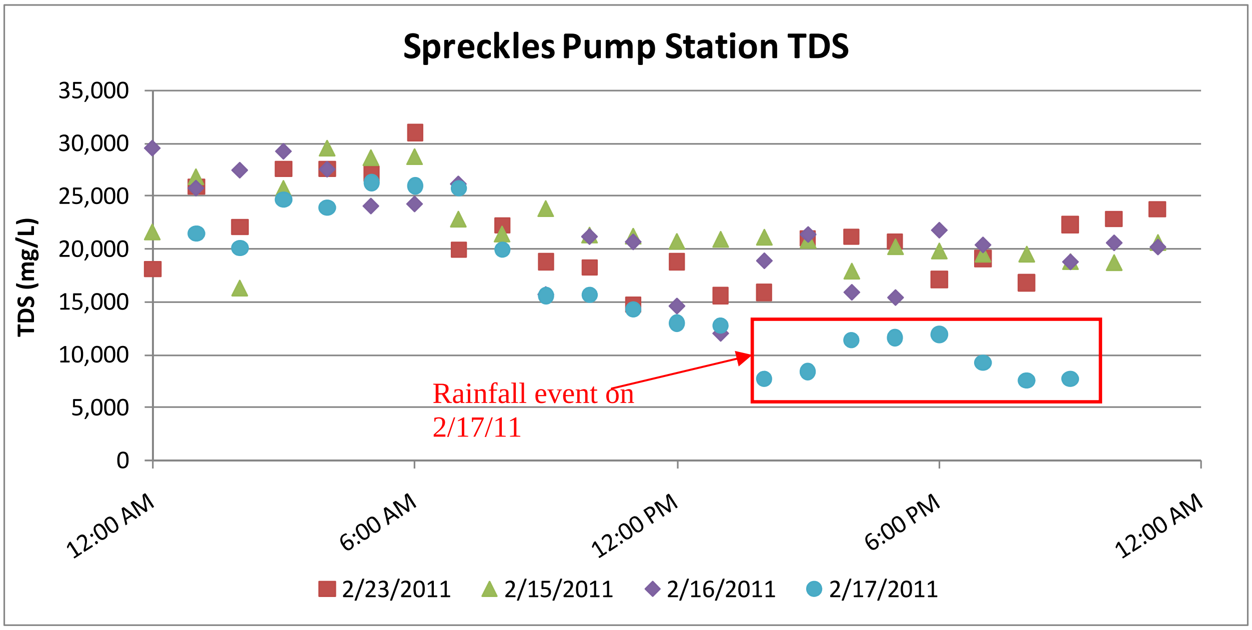
Infiltration and inflow occur in all sewer systems as cracks, offset joints, and breaks in the sewer pipes and laterals allow this flow to enter the collection system. For the purposes of this study, the project team focused on seawater/brackish water I&I because of the potential for extremely high salinity loading into the system as the TDS of seawater is 35,000 mg/l.

The northern parts of the City and the City of Santa Clara have areas of very shallow groundwater that are influenced by brackish water from San Francisco Bay (Bay). Due to the limited scope of the study, sewer monitoring of the entire area suspected to have brackish I&I was not possible. Instead, the project team focused on the Alviso area of northern San Jose where the combination of older sewer pipes (50-100 years old) and proximity to the Bay make it a probable area for brackish water I&I.

The project team also consulted groundwater maps which show areas of high groundwater and probable high levels of brackish water infiltration, which further confirmed that Alviso would be one of the key areas where brackish water infiltration into the sewer system could occur. Areas of in the north part of the City of Santa Clara also have high groundwater that are influenced by brackish water from the Bay, but the sewer pipelines in this area are much newer and it is expected that less brackish water infiltration is occurring in this area. The manhole just upstream of the Spreckles Pump Station in Alviso was selected for monitoring as it collects flows from a large part of the Alviso area.

The ESD Watersheds group and WPCP Laboratory collected and analyzed samples for TDS for a period of five days in February 2011. Samples were taken each hour during this time. Results from the sampling are shown in the Figure 9. It should be noted that the San Jose-ESD team noted visible infiltration into the sewer when they are installing the samplers.

Figure 9: Results from TDS monitoring at Spreckles Pump Station in Alviso



Notes:

1. The influence of rain water on the TDS at Spreckles Pump Station can be seen as the TDS drops off during the final day of the study when a rain event occurred.

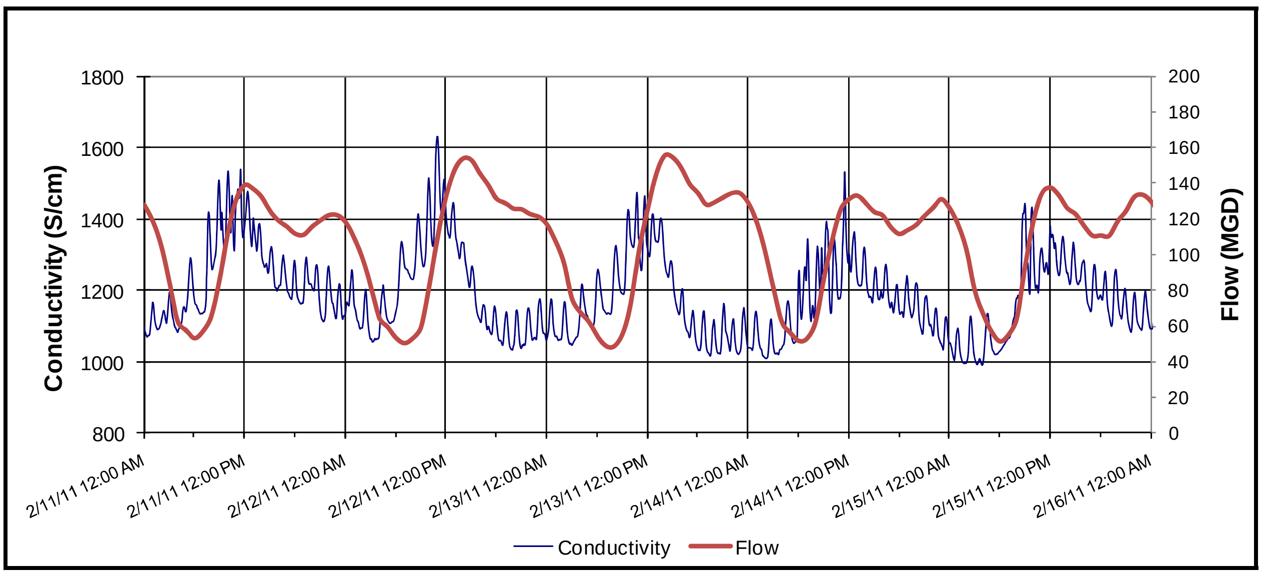
In order to calculate the load from brackish water I&I, the salt load from the source water (Hetch Hetchy, 111 mg/l) and from human consumptive use (209 mg/l) were subtracted from the average TDS measured in the monitoring period (21,280 mg/l). The result was an estimated brackish water I&I TDS concentration of 20,960 mg/l. Since flow monitoring was not performed during the TDS sample collection at Spreckles Pump Station, SJ-Public Works provided the project team with historic data for average flows at the pump station. From April to June 2006, the average flow at the pump station was 0.067 mgd. Since no major developments or changes have occurred to land use in the last four years in this area, it was assumed that the average dry weather flow was comparable. The total salt load from the seawater/brackish water I/I flows from the Spreckles Pump Station was estimated to be **1,250 tons/year**.

It is not possible to extrapolate this information to other parts of the service area to derive an estimated loading from brackish water I/I, as brackish water infiltration varies by a number of factors, including soil type, pipe type, age of pipe, construction methods, proximity to brackish groundwater, time of year, etc. Additional flow and conductivity monitoring in other areas with suspected seawater/brackish water infiltration is necessary to understand this total load.

4.6 WPCP Salt Addition

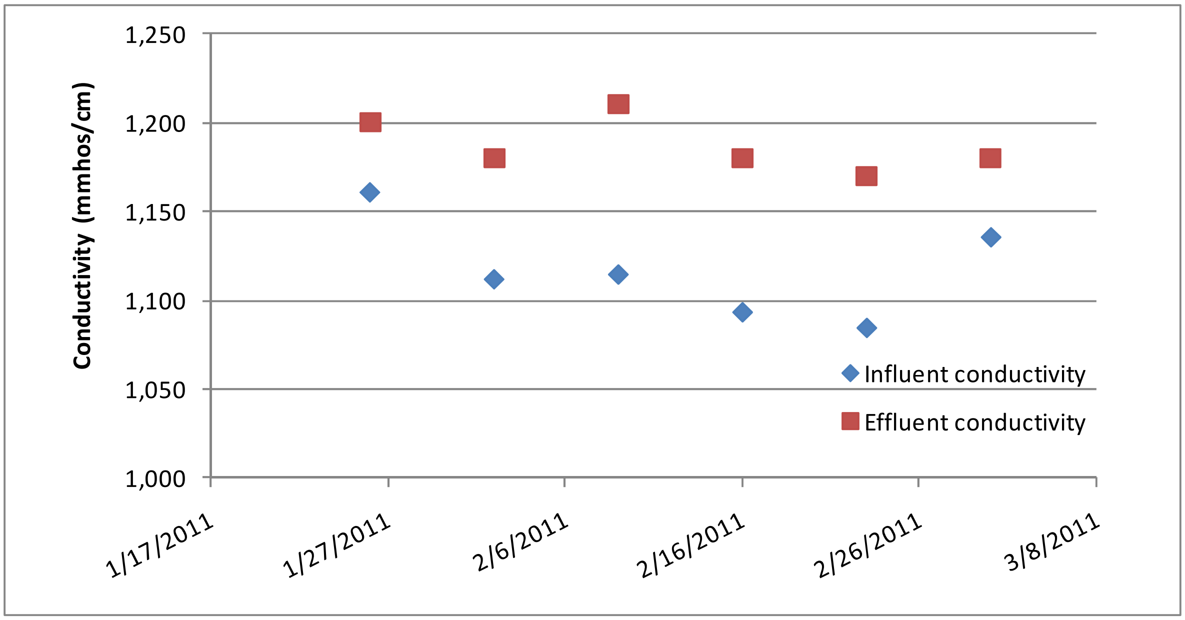
To determine the salinity contribution from wastewater treatment, conductivity monitoring was conducted on a continuous basis for the WPCP influent for a 6 week period (See Figure 10). Influent conductivity varies by about 200 to 300 S/cm throughout the day and exhibits cyclical variation on a shorter hourly time scale. This may be an indication of a high salinity discharge that turns on and off throughout the day.

Figure 10: Influent Conductivity and Flow at WPCP



Average daily conductivity data were estimated compared to weekly effluent data collected by the WPCP composite monitoring. Figure 11 shows the conductivity increase by the WPCP treatment processes varies from about 39 to 96 μmhos/cm (23 to 56 mg/l TDS) during the study period, with an average value of 70 μmhos/cm (41 mg/l TDS). The average flow of the WPCP effluent was 116 mgd during the study period, which means that the WPCP contributes about **7,700 tons of salt per year** into the effluent.

Figure 11: Influent and Effluent Conductivity at WPCP



5 Conclusions

The WPCP services a wide range of uses and is supplied by a variety of water sources that varies seasonally and over different hydrologic cycles. This adds a significant level of complexity in developing a salt load estimate that can be the justification for implementing salt management measures. The data collected and analyzed for this study highlights the variability of salt loading from the various sources and categories. It is important to understand that salt loading is dynamic and changes will occur over time with changes in land use, economic changes, and other factors. The estimates below are based on the available information at the time of this study.

The WPCP effluent average TDS of 719 mg/l (August 2005 to May 2011 – weekly composite data) combined with an estimated effluent flow was 116 mgd, results in a total effluent salt load of **124,600 tons per year**.

Table 17 shows the summary results of the salt loading estimates that were completed for the study taking into consideration the three alternatives used to develop estimates of residential water softening load. The load estimates range from **133,600 tons per year (5.8% above baseline) to 151,600 tons per year (20% above baseline)**. All three estimates exceeded the baseline salt load of 126,500 tons per year. In addition, it is expected that commercial water softener use and additional brackish water I&I load, which has not been accounted for in the evaluation, would like further increase the total salt load estimates. This highlights the need for further data collection and field investigation on various salt contributions.

Table 17: Salt Load Summary

Sector	Source of TDS	Flow (mgd)	Minimum TDS Load (Tons/yr)	Maximum TDS Load (Tons/yr)	Average TDS Load - Alt 1 WS (Tons/yr)	Average TDS Load - Alt 2 WS (Tons/yr)	Average TDS Load - Alt 3 WS (Tons/yr)	Alt 1 WS - Percent of Total Effluent Load	Alt 2 WS - Percent of Total Effluent Load	Alt 3 WS - Percent of Total Effluent Load
Source Water	Source Water	115.6	38,300	76,800	54,400	54,400	54,400	36%	41%	41%
Residential	Alternative 1 - Water Softeners				22,200			15%	0%	0%
	Alternative 2 - Water Softeners					4,200		0%	3%	0%
	Alternative 3 - Water Softeners						4,400	0%	0%	3%
	Human Consumptive Use	81.7	24,700	27,300	26,000	26,000	26,000	17%	17%	17%
Commercial	High TDS Commercial Businesses	8.6			15,600	15,600	15,600	10%	12%	12%
	Commercial Consumptive Use	15.2			4,800	4,800	4,800	3.2%	3.6%	3.6%
	Commercial Water Softeners[1]				Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
Industrial	Industrial Use (Monitored)	5.2			18,600	18,600	18,600	12%	14%	14%
	Industrial Use (Unmonitored)	4.8			1,500	1,500	1,500	1.0%	1.1%	1.1%
Other Sources	Alviso Inflow and Infiltration	0.1			1,250	1,250	1,250	0.8%	0.9%	0.9%
	WPCP Treatment Process	115.6			7,200	7,200	7,200	4.7%	5.4%	5.4%
	Other Inflow and Infiltration and Undefined Sources[1]				Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
	Total Estimate Effluent Load				151,600	133,600	133,800			
	Total Estimate Effluent TDS (mg/l)				**863**	**761**	**762**			
	Average Final Effluent TDS (mg/l)				**719**	**719**	**719**			
	% Difference from Average Final Effluent				**20%**	**5.8%**	**6.0%**			

Notes:

1. Source water minimum and maximum values were developed based on TDS ranges provided in consumer confidence reports. Water source TDS variability is thought to occur over varying hydrologic cycles especially for surface water supplies and may have seasonal variations.
2. The human consumptive use maximum and minimum were estimated assuming plus or minus 5% of the estimated average 209 mg/l TDS.
3. Human consumptive use average TDS of 209 mg/l was used to estimate total load.
4. Commercial consumptive use and industrial (unmonitored) loads are based on the estimated residential use loads of 209 mg/l.
5. These sources are considered to be likely contributors of additional salinity to the treatment plant salt load; however, additional data are needed to define and validate these loads.
6. Alternative 1 (Alt 1) was based on a survey of bags of salt used per month.
7. Alt 2 was based on collection system monitoring performed for this study.
8. Alt 3 was based on an estimated 35.3 mg/l TDS added area wide by softeners.

Data collection and investigations that would help to further refine the salt load evaluation include:

- Additional industry monitoring as part of the source control program. Collect sewer flow data for industries. Conduct field survey with industries to gain understanding of operations and variations in operations. Appendix C shows industries where two samples were measured. Results indicated that there is significant variability in the salinity levels of the industrial users that were monitored multiple times during the study period. Additional studies should include continuous monitoring for the industries that are suspected of being the largest salt loaders.
- Study on residential water softeners use and discharge. Conduct additional sewer monitoring at additional residential sites in all the various water source zones. Field surveys on water softener use in various zones would also be useful.
- Regular monitoring of source water TDS and conductivity to understand daily or seasonal variations. Check with retailers/wholesalers on available salinity data.
- TDS sampling at the influent and effluent of the WPCP.
- I&I sampling in Santa Clara, Milpitas, and in the pipelines near the WPCP. Investigate I&I through conductivity monitoring or other salinity measurement means in northern Santa Clara and west Milpitas, where seawater or brackish water I&I is suspected due to the proximity to the Bay. Also, investigate other areas of Alviso that were not directly upstream of the Spreckles Pump Station and interceptor lines near the WPCP.
- In conjunction with the Fats, Oils and Grease (FOG) program, check to see if restaurants have water softeners.
- Conduct additional commercial sites studies to develop an understanding of water softener use and the variations between different source water areas. Conduct field surveys with commercial businesses (i.e., laundry businesses) to understand water softener use and other operations that contribute to salt load.
- Field survey of hotels to see if they do laundry on-site or off-site and if water softeners are present.

It is important to note that these salt load estimates are preliminary and not based on a large data set. However, the data collected and analyzed, and the mass balance, provides valuable insight and is a critical first step in understanding the contributions of salt source categories that can be used to investigate possible salt mitigation measures and costs, and to prioritize areas for future study. Although refinement of the source load is necessary to develop meaningful results, the preliminary mass balance is used in subsequent tasks to evaluate the initial feasibility and cost-benefit for source control measures.

6 Next Steps

The next steps in the project are to look at possible salt mitigation measures and evaluate potential solutions to reduce the amount of salt load in the recycled water system. A cost-benefit analysis and feasibility study will be performed to evaluate the potential mitigation measures and determine the best path forward in reducing—or maintaining—salt levels.

7 References

City of Santa Clara. *Santa Clara Sanitary Sewer Capacity Assessment*. 2007.

Los Angeles County Sanitary District. *SCVJSS Chloride Source Report*. 2002.

M. Cubed, Farrand Research, Inc., Western Wats, Inc., ConserVision Consulting, LLC. *Santa Clara County Residential Water Use Baseline Survey*. SCVWD. August 2004.

Santa Clara Valley Water District. *Pilot Water Softener Rebate Program.* May 2006

U.S. Economic Census. 2007.

WaterReuse. *Characterizing and Managing Salinity Loadings in Reclaimed Water Systems*. 2006.

Wong, R. Telephone Correspondence.

Appendix A – Residential Conductivity Monitoring Results

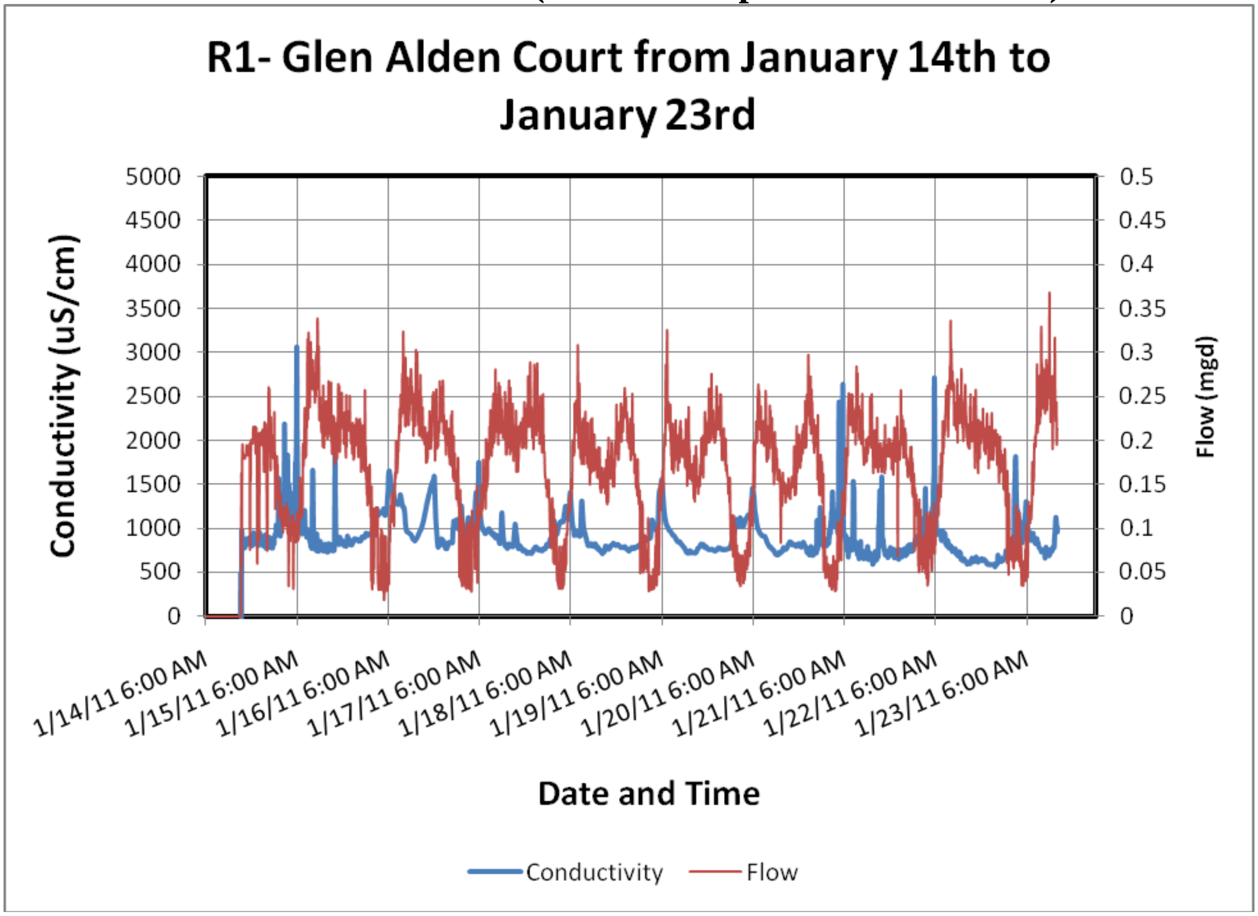
Residential Monitoring Summary

Site Number	Flow Weighted Average TDS (mg/l)	Median TDS (mg/l)	Water Softener TDS Addition (mg/l)	Softener TDS % of Total	Average Source Water TDS (mg/l)	Est. TDS addition (mg/l)	Commentary
R1: Residential (1/15/11 to 1/18/11) [RAW DATA]	552.8	538.8	13.9	2.5%	331(SJ Muni Treated SW)	208	R1 had regular salinity spikes every morning. Water softener regeneration it thought to be the reason for this daily occurrence in early morning hours.
R1: Residential (1/15/11 to 1/18/11) [CORRECTED DATA]	639.7	568.5	71.2	11.1%	331(SJ Muni Treated SW)	237	R1 (drift corrected) showed a significantly higher water softener TDS addition than the estimate on the original data set. Estimated consumptive use also increased by about 13% over the original data set.
R2: Residential (1/24/11 to 1/27/11)	340.3	317.1	23.1	6.8%	326 (SJWC Import SW)	-9	Conductivity data were much lower than expected. Data were not appropriate for estimating consumptive use. However, the difference between the “Flow Weighted Average” and “Median TDS” is thought to be a reasonable estimate of water softener addition.
R3: Residential (1/8/11 to 1/13/11)	586.6	538.0	48.6	8.3%	399 (Great Oaks Well Water)	139	R3 had regular salinity spikes every morning. This daily occurrence was generally in line with the expectation of water softener regeneration occurring in early morning hours.
R4: Residential (2/4/11 to 2/9/11)	150.2	141.9	8.2	5.5%	92 (Milpitas Hetch Hetchy)	50	The Average TDS is below the expected typical consumptive use of about 200. The reason for this result is not full understood. Potential reason could be 1) inadequate flows as this was a same sewer subbasin; 2) instrument calibration issues; 3) TDS addition may be lower than typical in this low hardness/low TDS water area.

Notes:

1. The Water Softener TDS addition was assumed to be the difference between the "Flow Weighted Average TDS" and the "Median TDS." These estimated values are used in the residential water softener load estimate.
2. The "Estimated Consumptive Use TDS Addition" is determined by taking the “Median TDS” value minus the "Average Water Source TDS".
3. Average water source TDS was based on CCRS from water retailers. Potential seasonal or hydrologic year variations in TDS are unknown.

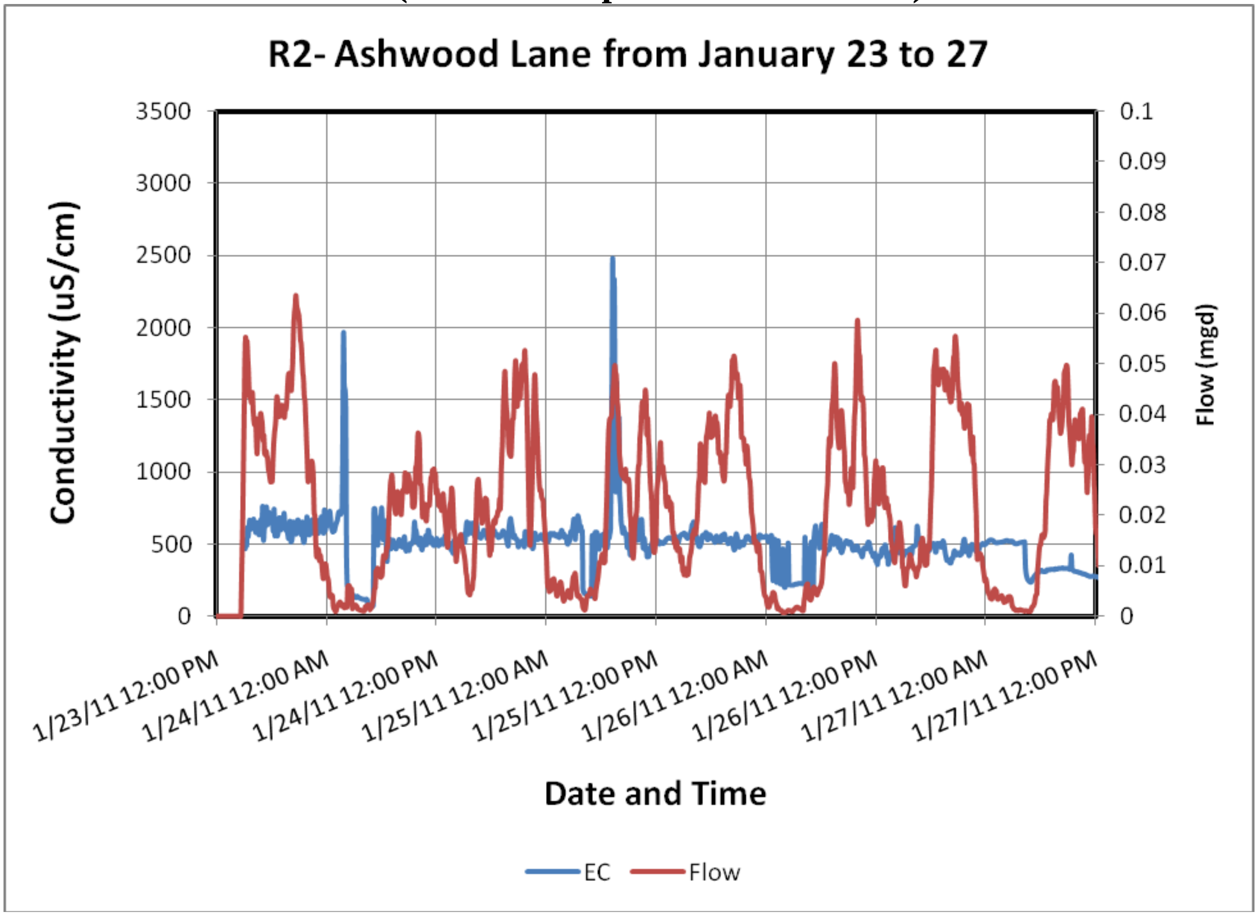
R1 – Residential SJ Muni-Water (SCVWD Import Surface Water)



<u>Observation and Commentary:</u>

- Average Water Supply TDS is 331 mg/l and Hardness is 136 mg/l CaCO3.
- High salinity spikes observed in the early morning hours are an indication of water softener regeneration cycles.
- The magnitudes of salinity spikes vary and there are occasional spikes that occur throughout the day.
- The R1 diurnal flow pattern was fairly regular and distinguishable compared to other residential locations.
- The Median TDS of 538.8 mg/l is an increase of 207.8 mg/l over the source water TDS. This corresponds well with the typically expected residential TDS addition of about 209 mg/l.
- A "Flow Weighted Average" TDS of 552.8 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Therefore, the difference between the "Flow Weighted Average" and the Median TDS of 13.9 mg/l is thought to be a reasonable estimate of the overall water softener contribution.

R2 – Residential SJ WC (SCVWD Import Surface Water)



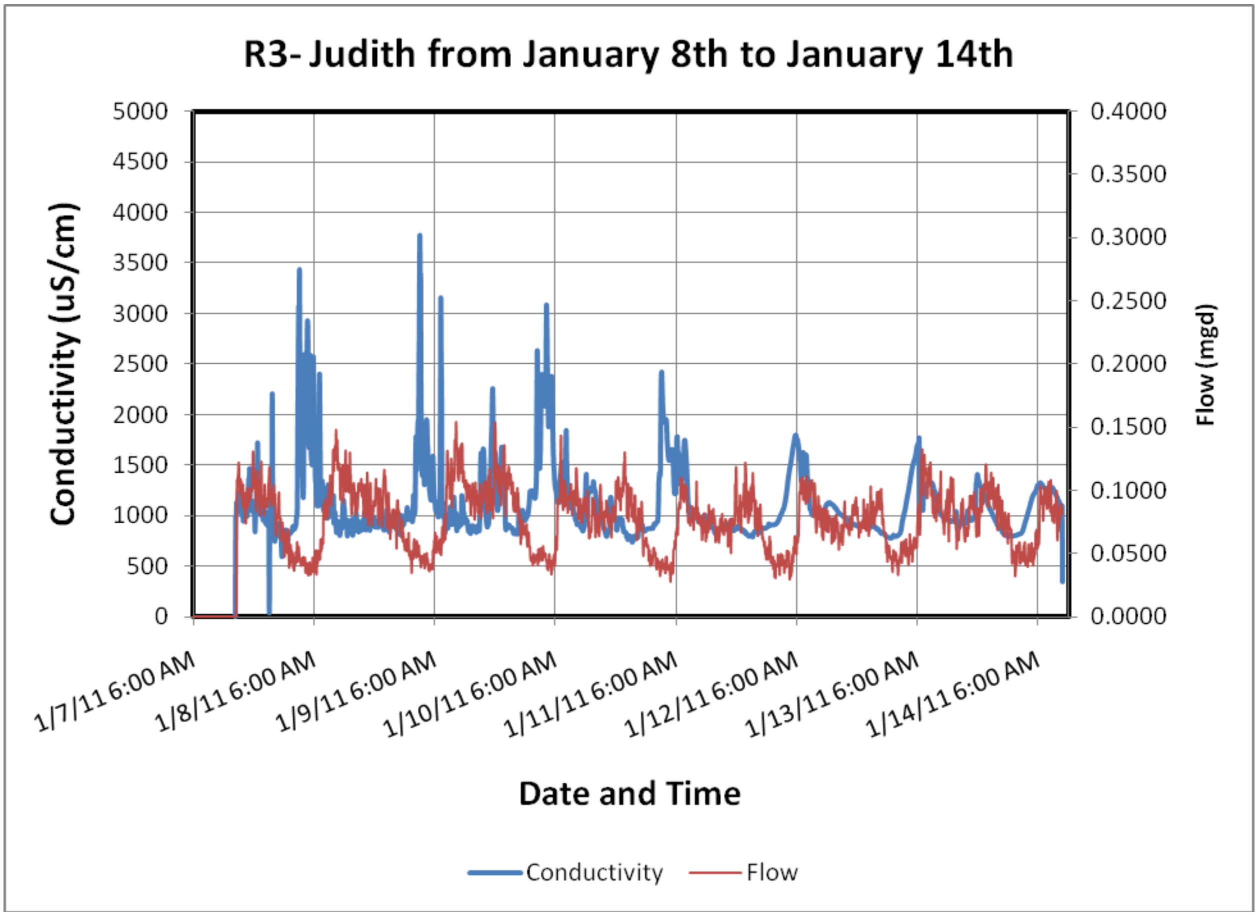
Notes:

1. The lower 5th percentile of conductivity data analyzed were exclude from the statistic evaluation as the levels generally appeared to be outside to range of realistic values relative to source water supply.

Observation and Commentary:

- Average Water Supply TDS is 326 mg/l and Hardness is 116 mg/l CaCO3. Hardness is generally at a level where water softening is not necessary.
- Salinity spikes were observed in the early morning hours which are thought to be related to water softener regenerations. Spikes were not regular as in R1 which may be a function of the small tributary flow area. This may also be an indication of a lower number of installed water softeners.
- Relative to R1, R2 had a more variable day time flow pattern which may be a function of the smaller tributary flow area.
- The median TDS of 317 mg/l is below the source water TDS. This could be an indication of a meter calibration issue or could indicate that the source water TDS during the monitoring period was lower. R2 also appears to be near or within the Hetch Hetchy water supply area which would be a significant difference in salinity.
- The conductivity instrument appeared to stop reading every morning from the 1/24 to 1/26 which was thought to be a result of to low flows. The instrument failed on 1/27 and was fouled with grease when removed on February 2.

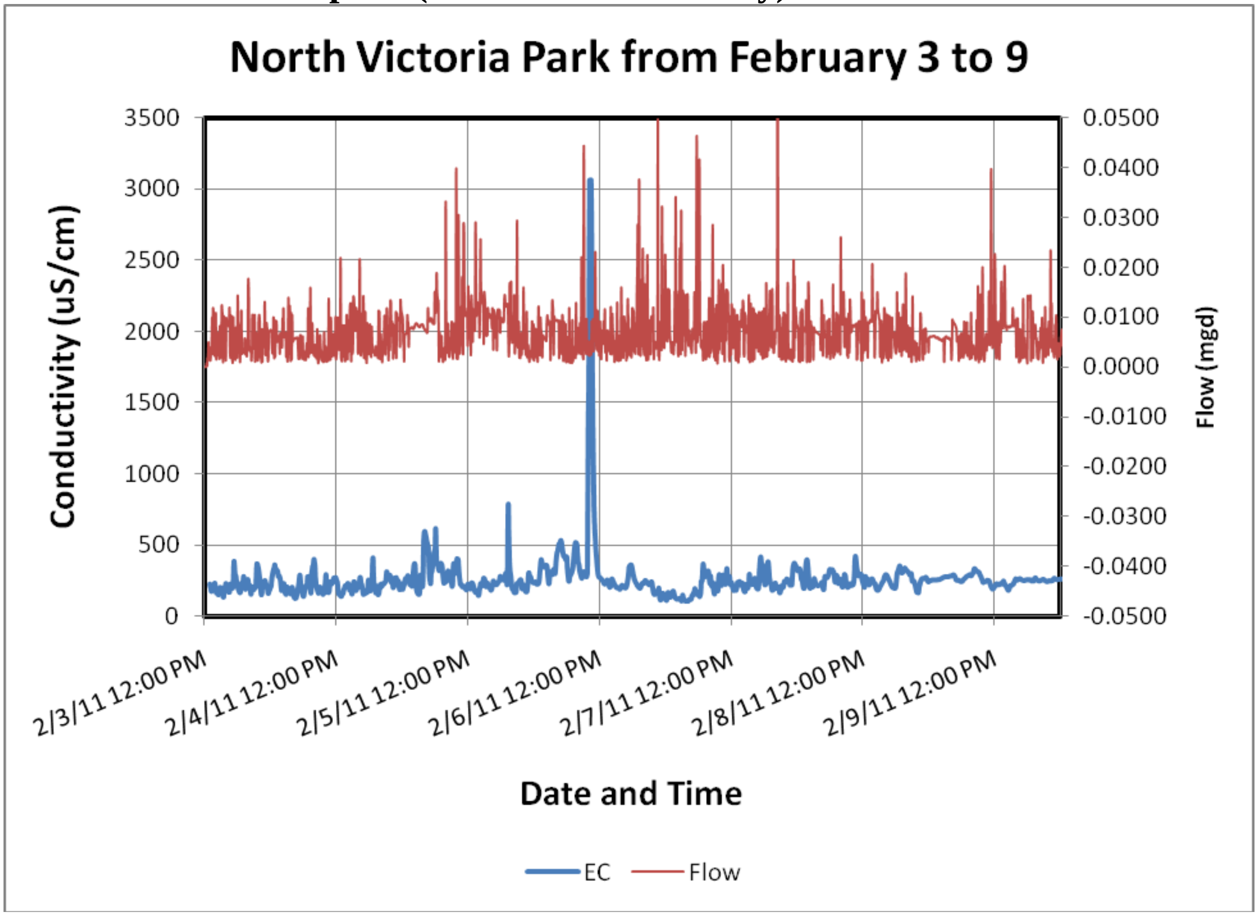
R3 – Residential Great Oaks Well Water



Observation and Commentary:

- Average Water Supply TDS is 399 mg/l and Hardness is 300 mg/l $CaCO_3$.
- Water supply hardness is at a level where water softener use would be expected. On demand softeners would also regenerate more often than water softeners in the import surface water area where hardness is significantly lower.
- High salinity spikes observed in the early morning hours are an indication of water softener regeneration cycles.
- The R3 diurnal flow pattern was fairly regular and distinguishable.
- The median TDS of 538 mg/l is an increase of 139 mg/l over the source water TDS. This is well below the typically expected residential TDS addition of about 209 mg/l.
- A "Flow Weighted Average" TDS of 586.6 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Therefore, the difference between the "Flow Weighted Average" and the Median TDS of 48.6 mg/l is thought to be a reasonable estimate of the overall water softener contribution.
- Over the monitoring period, the conductivity spikes reduced and data fluctuations also seemed to decrease. It is unknown is instrument grease fouling or calibration issues may have impacted the data set.

R4 – Residential Milpitas (SFPUC Hetch Hetchy)



Observation and Commentary:

- Average Water Supply TDS is 92 mg/l and Hardness is 55 mg/l CaCO3.
- Water softeners would not be expected in this source water area. However, results of the SCVWD Water Softener Rebate Program indicate that water softeners are installed in the area.
- The monitored tributary area was small with low flows. A temporary dam was installed at the site to try and improve flow conditions, but no recognizable flow pattern was able to be collected.
- The median TDS of 141.9 mg/l is an increase of 49.9 mg/l over the source water TDS. This median value, which is comprised of source water and consumptive use addition, is well below the typically expected residential TDS addition of about 209 mg/l. This could be a result of the non-ideal flow conditions or an indication of a meter calibration issues. Source water TDS during the monitoring period may have been lower than the average. The TDS range for Hetch Hetchy water indicates a low value of 39 mg/l.
- One significant salinity spike was observed which is thought to be a water softener regeneration discharge. Spikes were not regular and this source area should have little to no water softeners.

Appendix B – Commercial Conductivity Monitoring Results

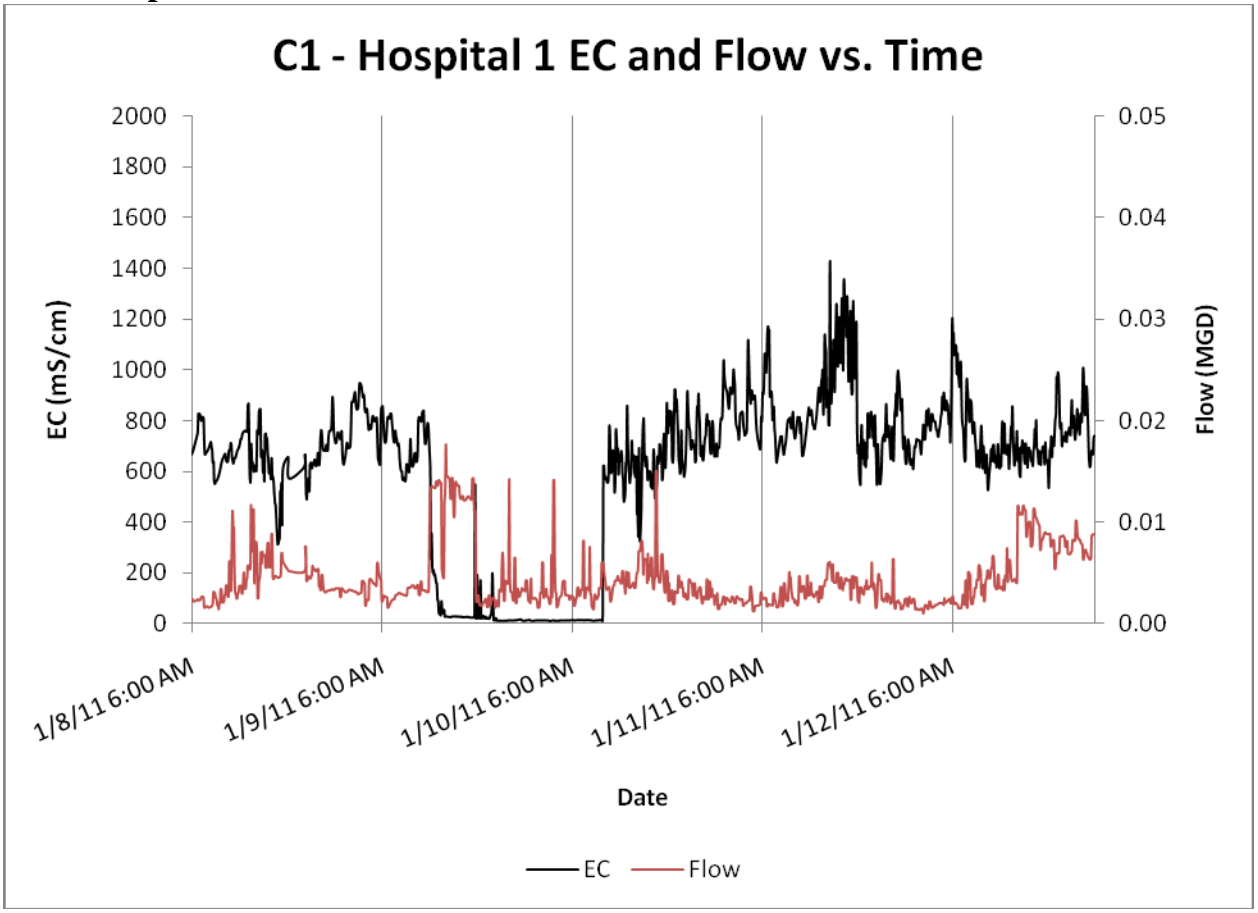
Commercial Monitoring Summary

A	B	C	D	E	F	G	H	I	J
Site Number	**Average Flow (mgd)**	**Flow Weighted Average TDS (mg/l)**	**Median TDS (mg/l)**	**Water Softener TDS Addition (mg/l)**	**Softener TDS % of Total**	**Est. TDS addition (mg/l)**	**Est. Source Water TDS (mg/l)**	**Average Source Water TDS (mg/l)**	**% difference from Average CCR**
C1: Hospital 1 (1/8/11 to 1/12/11)	0.004	468.1	457.2	11.1	2%	200	257.2	245 (SJWC Mountain SW)	5%
C2: Hospital 2 (1/15/2011 to 1/22/2011)	0.027	680.1	603.5	76.5	11%	200	403.5	397 (SJWC GW)	2%
C3: Jail (1/15/2011 to 1/18/2011)	0.225	501.9	405.7	96.1	19%	200	205.7	326 (SJWC Import SW)	-37%
C4: Restaurants 1 (2/4/2011 to 2/9/2011)	0.057	753.2	681.0	72.2	10%	200	481.0	263 (Milpitas SCVWD SW)	83%
C5: Restaurants 2 (1/11/2011 to 1/13/2011)	0.012	369.8	322.0	47.8	13%	200	122.0	397 (SJWC GW)	-69%
C7: Laundry (1/25/11 5:20 to 1/25/11 13:45)	0.173	1866.3	1507.8	358.5	19%	1,110	**397**	397 (SJWC GW)	Assumed Same
Alt C6: Hotel (1/24/2011 to 2/2/2011)	0.096	298.0	304.4	-6.4	-2%	200	104.4	92 (Santa Clara Hetch Hetchy)	13%

Notes:

2. The "Estimated Water Source TDS" is determined by taking the Median TDS value minus the "Estimated Typical TDS Addition".
3. For C7: Laundry, the "Estimated Water Source TDS" was set to match the "Average Source Water TDS" from the CCR.
4. The Water Softener TDS addition was assumed to be the "Flow Weighted Average TDS" minus the "Median TDS."
5. Generally, the lower 5th percentile of conductivity data sets analyzed were exclude from the statistic evaluation as the levels generally appeared to be outside to range of realistic values relative to source water supply.

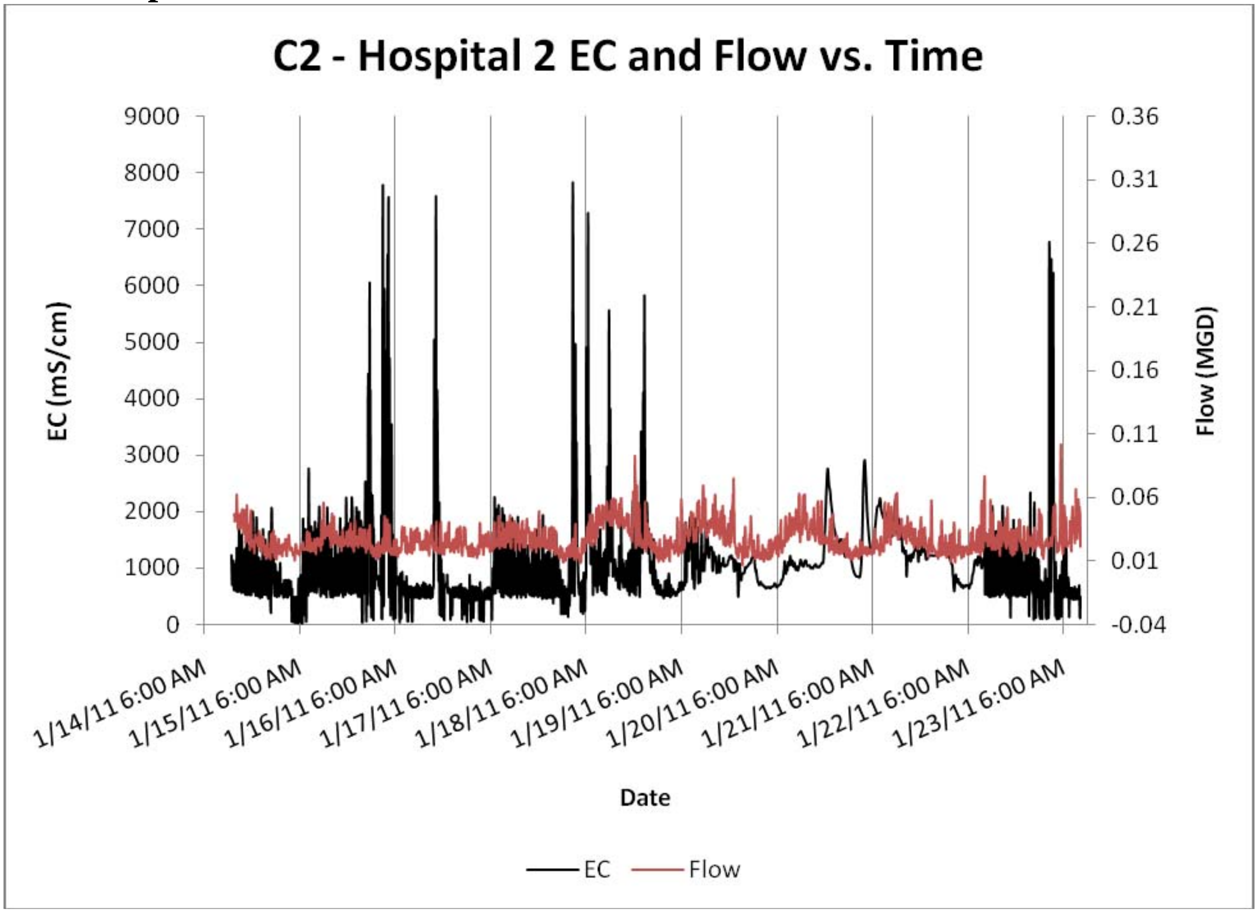
C1 – Hospital 1 SJWC Mountain Surface Water



Observation and Commentary:

- Average Water Supply TDS is 245 mg/l and Hardness is 194 mg/l CaCO3.
- Water supply hardness is moderate but at a level where water softener use would be expected.
- The median TDS of 457.2 mg/l is an increase of 212.2 mg/l over the source water TDS. This median value which is comprised of source water and consumptive use addition corresponds moderately well with a typically “residential” TDS addition of about 209 mg/l.
- Conductivity instrument appeared to have failed on 1/9. Data from 1/9 12:00 to 1/10 9:55 was not valid.
- Slight peaks in salinity were observed on 1/11 and 1/12 around 6:00 am. Sustained increase in salinity occurred on 1/11 during business hours. As these spikes appeared smaller and lower than other data sets it is unknown if these were really a result of water softener regeneration cycles. On site water softener investigation is needed to confirm.
- The diurnal flow pattern on Sunday, 1/9, had an unexpected jump in flow. It is unclear if this was an actual flow or if the meter malfunctioned.
- A “Flow Weighted Average” TDS of 468.1 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Assuming water softeners are present, the difference between the “Flow Weighted Average” and the Median TDS of 11.0 mg/l is thought to be a reasonable estimate of the overall water softener contribution.

C2 – Hospital 2 SJWC Groundwater



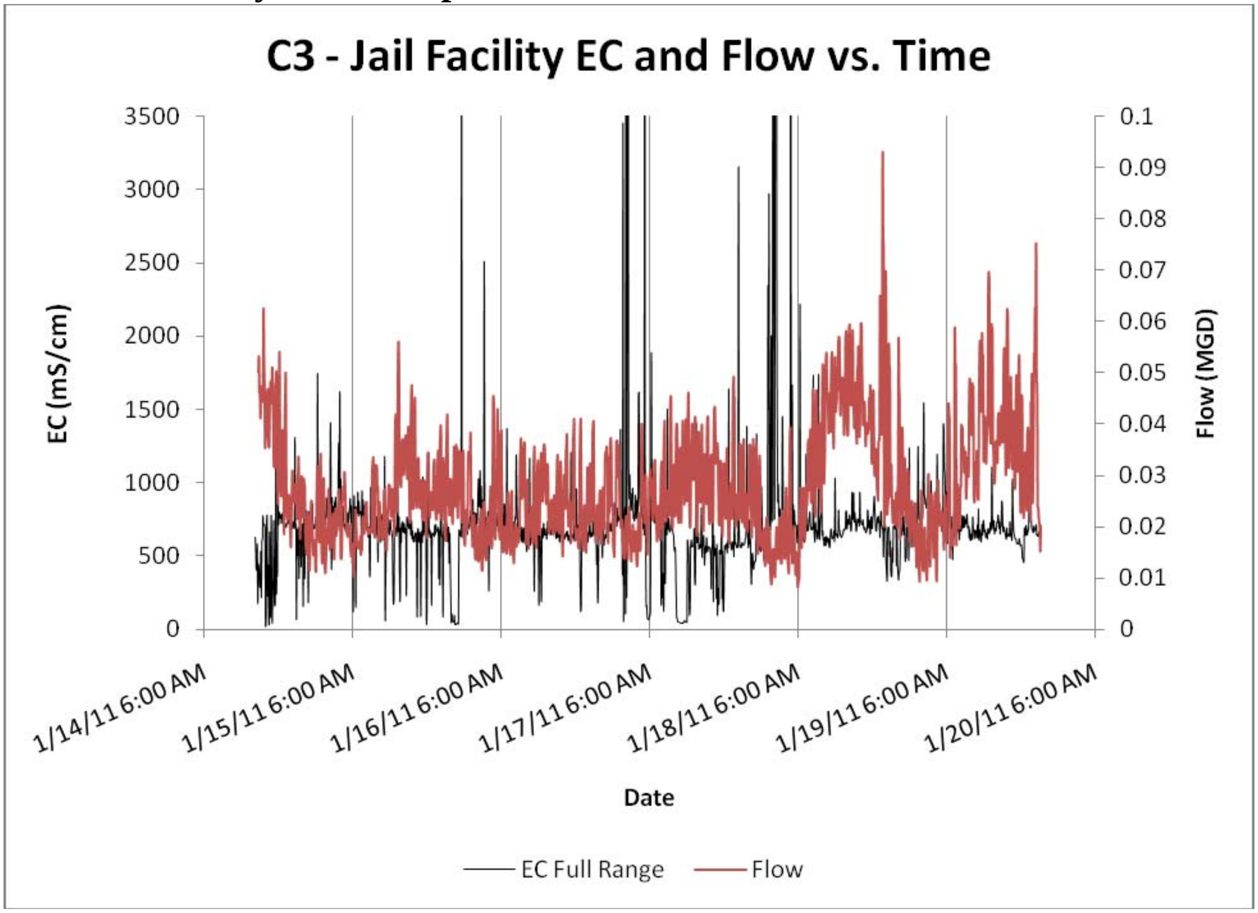
Notes:

1. Flow data were plotted as 15 minute averages to reduce the variability observed in the data set.

Observation and Commentary:

- Average Water Supply TDS is 397 mg/l and Hardness is 288 mg/l $CaCO_3$.
- Water supply hardness is at a level where water softener use would be expected.
- The median TDS of 603.5 mg/l is an increase of 206.5 mg/l over the source water TDS. This median value which is comprised of source water and consumptive use addition corresponds well with a typically "residential" TDS addition of about 209 mg/l.
- High salinity spikes were observed on four mornings. Several other spikes were observed at other times throughout the day. These spikes are an indication of water softener regeneration cycles.
- The magnitudes of salinity spikes vary and there are occasional spikes that occur throughout the day.
- The diurnal flow pattern on the weekend (1/15 and 1/16) appears to be fairly flat. Weekday diurnal flow patterns showed an increase in flow during typical work hours.
- A "Flow Weighted Average" TDS of 680.1 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Therefore, the difference between the "Flow Weighted Average" and the Median TDS of 76.5 mg/l is thought to be a reasonable estimate of the overall water softener contribution.

C3 – Jail Facility SJWC Import Surface Water



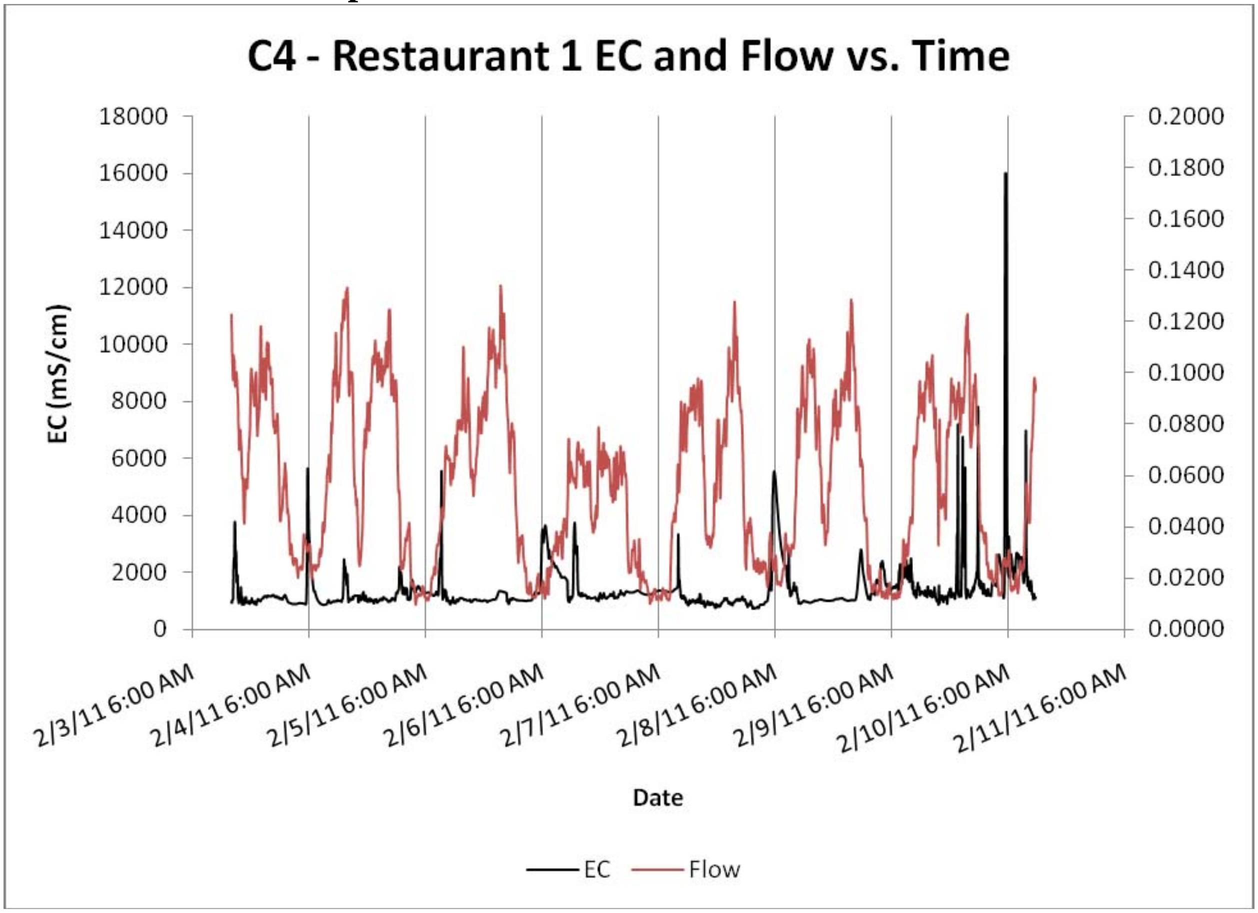
Notes:

1. Flow data were plotted as 15 minute averages to reduce the variability observed in the data set.
2. The EC axis was limited to 3,500 to show the conductivity range between 0 and 1,500 mS/cm.

Observation and Commentary:

- Average Water Supply TDS is 326 mg/l and Hardness is 116 mg/l CaCO3. Hardness is generally at a level where water softening is not necessary.
- The median TDS of 405.7 mg/l is an increase of 79.7 mg/l over the source water TDS. This median value which is comprised of source water and consumptive use addition is well below the typically "residential" TDS addition of about 209 mg/l.
- On 1/17 and 1/18 high salinity spikes were observed at about 2:00 am. These spikes reached conductivity levels of about 15,000 µS/cm. Several other spikes were observed at other times throughout the day. These spikes are an indication of water softener regeneration cycles. These EC spikes had the highest values seen with the exception of the industrial laundry site.
- The magnitudes of salinity spikes vary and there are occasional spikes that occur throughout the day.
- The diurnal flow pattern was highly variable and erratic. It was unclear if low flows from the jail inhibited the collection of good data.
- A "Flow Weighted Average" TDS of 501.9 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Therefore, the difference between the "Flow Weighted Average" and the Median TDS of 96.1 mg/l is thought to be a reasonable estimate of the overall water softener contribution.

C4 –Restaurant 1 Milpitas SCVWD Surface Water



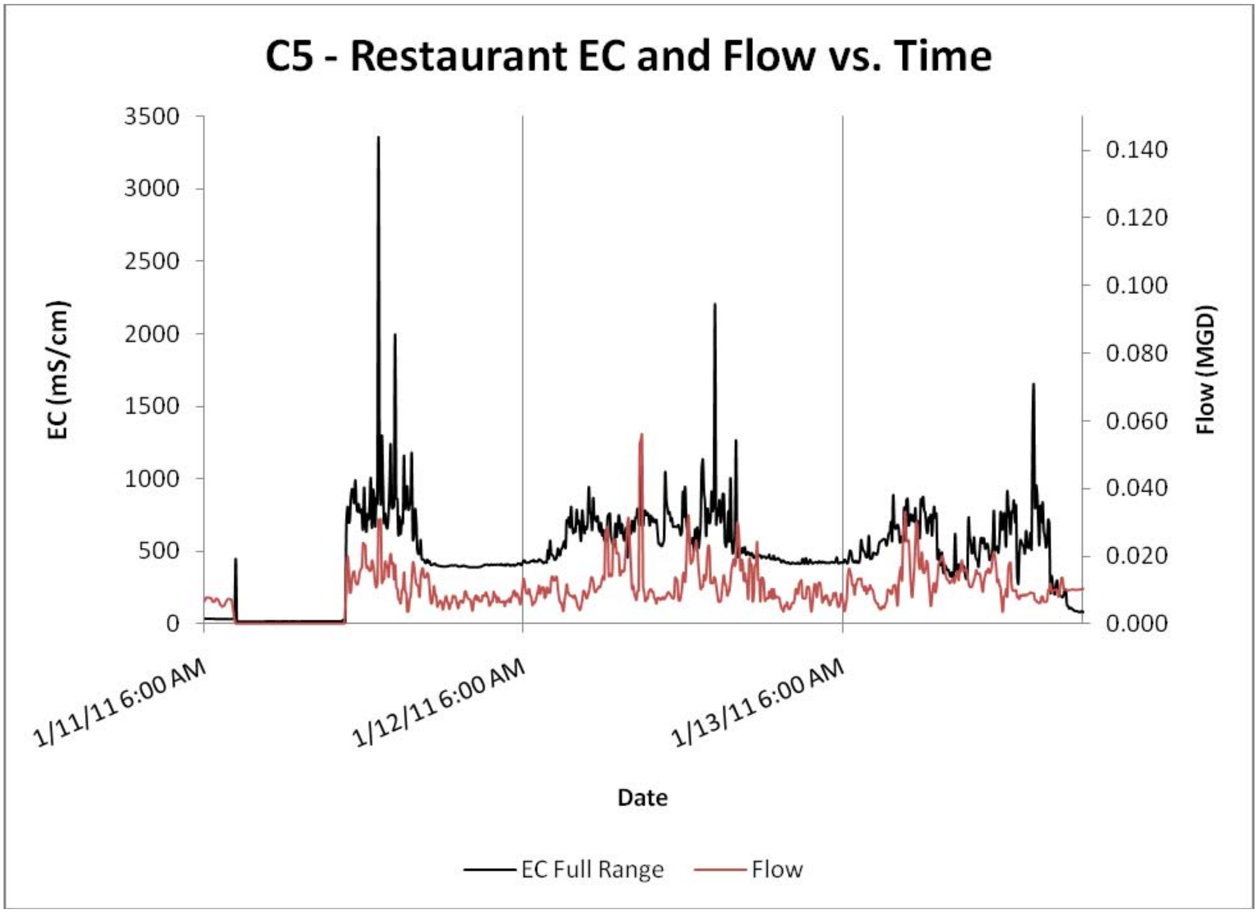
Notes:

1. Flow data were plotted as 15 minute averages to reduce the variability observed in the data set.

Observation and Commentary:

- Average Water Supply TDS is 263 mg/l and Hardness is 101 mg/l CaCO3. Hardness is generally at a level where water softening is not necessary.
- The median TDS of 681.0 mg/l is an increase of 418 mg/l over the source water TDS. This median value is assumed to be representative of the source water and consumptive use TDS addition.
- High salinity spikes appear to be occurring on a regular basis, which indicates the presence of water softeners. On the final day of monitoring an EC spike reached a level of about 16,000 μS/cm. This level of conductivity was seen at the Jail and the laundry.
- The diurnal flow pattern appears to be fairly regular which would be expected for this area. Sunday flow (2/6) appears to be slightly lower than other days.
- A “Flow Weighted Average” TDS of 753.2 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Therefore, the difference between the “Flow Weighted Average” and the Median TDS of 72.2 mg/l is thought to be a reasonable estimate of the overall water softener contribution.

C5 –Restaurant 2 SJWC Groundwater



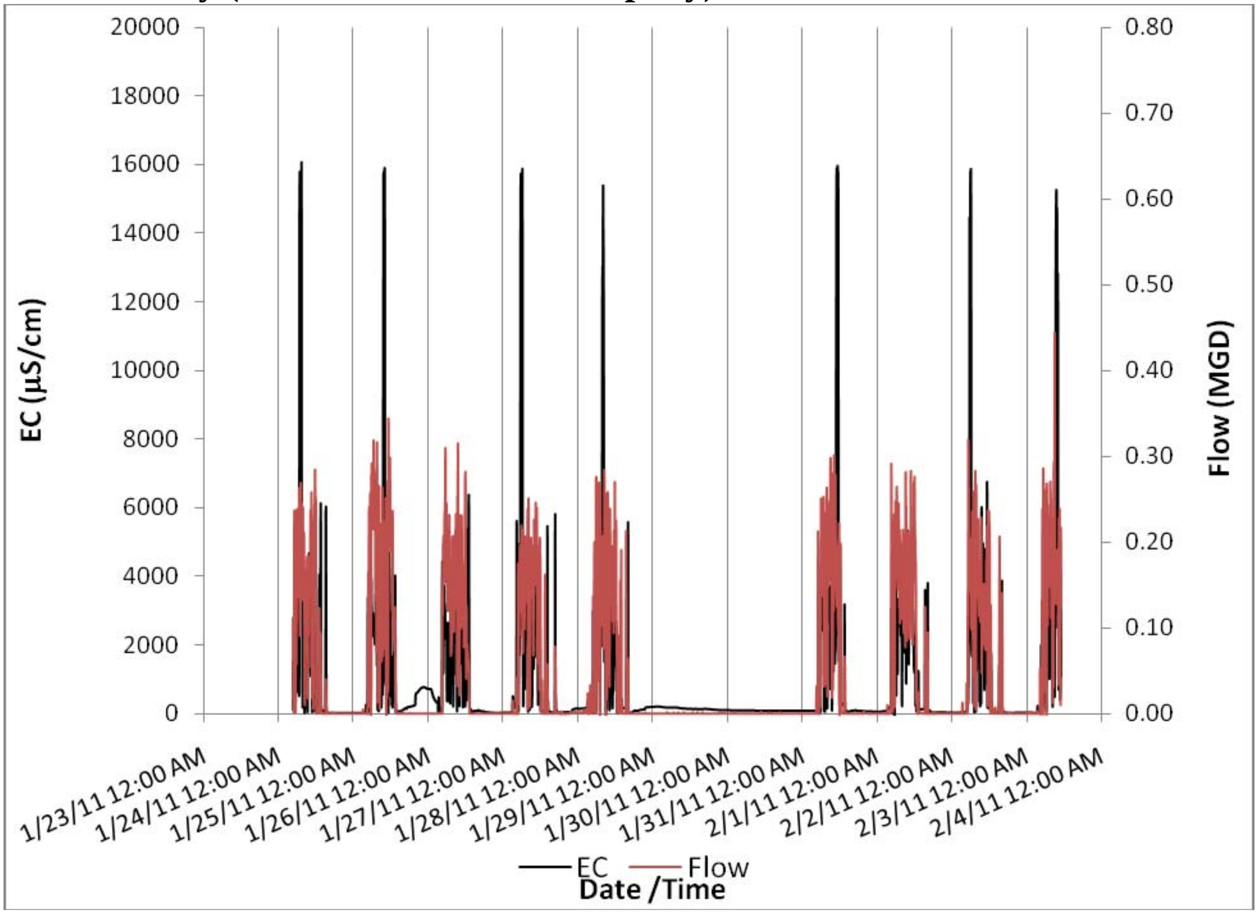
Notes:

1. Flow data were plotted as 15 minute averages to reduce the variability observed in the data set.
2. Data were limited as instrument failure appeared to have occurred between 1/8 and 1/11.

Observation and Commentary:

- Average Water Supply TDS is 397 mg/l and Hardness is 288 mg/l CaCO3.
- Water supply hardness is at a level where water softener use would be expected. On demand softeners would also regenerate more often than water softeners in the import surface water area where hardness is significantly lower.
- The median TDS of 322.0 mg/l was below the average source water TDS. The median value is assumed to be representative of the source water and consumptive use TDS addition. This could be a result of the non-ideal flow conditions or an indication of a meter calibration issues. Source water in this area may also not be groundwater. Additional study is needed to further understanding is the data collected was valid.
- Salinity spikes occurred on a regular basis at 8:20 pm. This indicates the presence of water softener that is regenerating on a daily basis at the same time. One other salinity spike occurred on 1/11/11, which is also thought to be a water softener regeneration cycle.
- The diurnal flow pattern was highly variable and erratic. It was unclear if low flows inhibited the collection of good data.
- A “Flow Weighted Average” TDS of 369.8 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- Therefore, the difference between the “Flow Weighted Average” and the Median TDS of 47.8 mg/l is thought to be a reasonable estimate of the overall water softener contribution.

C7 –Laundry (Commercial Linen Company) SJWC Groundwater



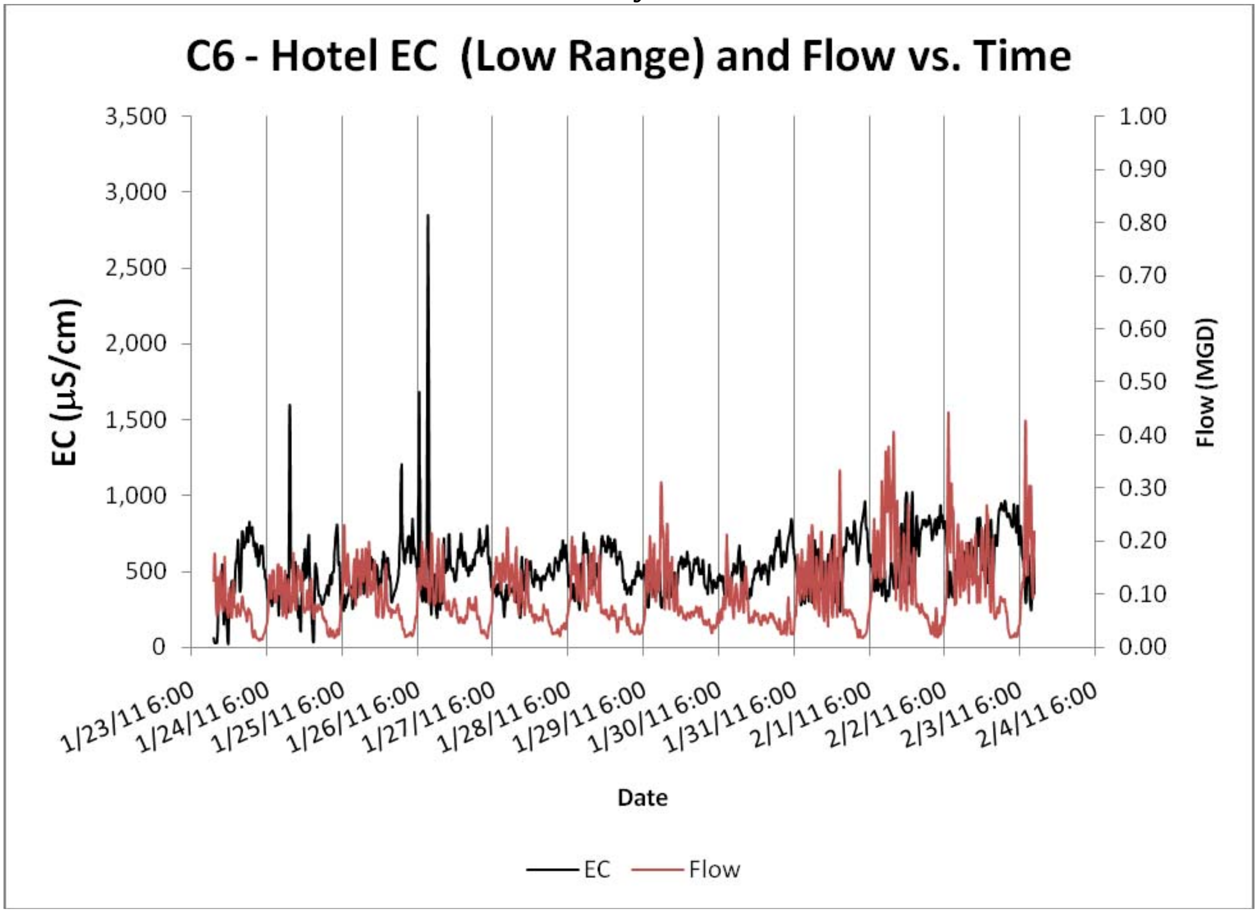
Notes:

1. No flow observed on weekend (1/29 and 1/30)

<u>Observation and Commentary:</u>

- Average Water Supply TDS is 397 mg/l and Hardness is 288 mg/l CaCO3.
- Water supply hardness is at a level where water softener use would be expected.
- The median TDS of 1,507.8 mg/l is 1,110.8 mg/l average source water TDS. This salinity is expected as laundries are expected to have high salinity discharges.
- High salinity spikes generally observed daily at different times. These spikes reached conductivity levels around 16,000 µS/cm. These spikes are thought to be an indication of water softener regeneration cycles. These EC spikes had the highest values seen with the exception of the industrial laundry site.
- The diurnal flow pattern exhibited large swings during operational hours. Flow was approximately zero during non-operation.
- A “Flow Weighted Average” TDS (for 1/25/11) of 1,866.3 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- The difference between the “Flow Weighted Average” and the Median TDS was 358.5 mg/l. In evaluation of other uses, this value was assumed to be the water softener contribution. However, given the nature of this high salinity discharge, it was unclear if this value was due to water softener discharge or typical use.

Alt C6 –Hotel Santa Clara Hetch Hetchy



Observation and Commentary:

- Average Water Supply TDS is 92 mg/l and Hardness is 55 mg/l CaCO3.
- Water supply hardness is at a level where water softener use would not be expected.
- The median TDS of 304.4 mg/l is an increase of 212.4 mg/l over the source water TDS. This median value is assumed to be representative of the source water and consumptive use TDS addition. The increase in TDS of 212.4 is relatively close to the 200 mg/l increase associated with "Residential" use, which seems reasonable.
- A few high salinity spikes were observed on 1/24 and 1/26. As water softener use is not necessary in this area it is unclear if these were due to water softener regeneration or some other operation such as laundry.
- Generally, higher conductivity was observed during low flow periods and vice versa.
- The diurnal flow pattern exhibited large swings during typical work/daylight hours. The flow pattern appeared to follow a repeatable trend on a daily basis as would be expected.
- A "Flow Weighted Average" TDS of 298 mg/l was estimated for the data set. The flow weighted average accounts for all TDS contributions from source water, typical residential use, and water softener discharge.
- The "Flow Weighted Average" was less than the "Median TDS." Therefore, if the high salinity spike in the graph was related to a water softener regeneration it had little to no impact on the overall "Flow Weighted Average" relative to the "Median TDS value."
- Hotel flows and loads may vary seasonally and with high occupancy rates. Discussion with hotel operations would provide additional insight into the use of water softeners.

Appendix C – Industrial Sites with Two Sample Events

Average TDS for Industries Sampled in 2011

Industrial User Name	Sample Date	TDS Sample Value (mg/l)	Average Value (mg/l)	Difference (mg/l)
Industrial launderers	01/28/2011	1770	1800	60
	01/14/2011	1830		
Special industry machinery	01/31/2011	454	569	230
	01/11/2011	684		
Paperboard mills	01/12/2011	2390	2425	70
	01/19/2011	2460		
Canned fruits and vegetables	01/12/2011	3460	5460	4000
	01/19/2011	7460		
Distilled and blended liquors	01/10/2011	687	3079	4783
	01/18/2011	5470		
Water supply	01/13/2011	7430	7875	890
	01/26/2011	8320		
Brewery	01/14/2011	3320	3870	1100
	01/28/2011	4420		
Paperboard mills	01/19/2011	3450	3820	740
	01/12/2011	4190		
Computer storage devices	01/13/2011	676	832	311
	01/26/2011	987		
Wines, brandy, and brandy spirits	01/19/2011	1340	1440	200
	01/12/2011	1540		
Semiconductors and related devices	01/12/2011	847	1139	583
	01/27/2011	1430		
Semiconductors and related devices	01/24/2011	635	635	0
	01/10/2011	635		
Sausages and other prepared meats	01/28/2011	51400	58600	14400
	01/14/2011	65800		
Semiconductors and related devices	01/27/2011	231	482.5	503
	01/12/2011	734		
Printed circuit boards	01/27/2011	1360	1685	650
	01/12/2011	2010		
Magnetic and optical recording media	01/31/2011	334	226	216
	01/18/2011	118		