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Central Coast Watershed Studies

CCoWS

Installation and Initial Analysis of Two Stream Gages on San Jose Creek, Monterey County, CA

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Executive Summary

The purpose of this report is to document the installation and first analyses of stream gages on two major San Jose Creek tributaries—Williams Canyon Creek and the upper watershed of the main stem of San Jose Creek (Upper San Jose Creek). Precipitation and streamflow summaries are presented for the 2011 water year (October 1, 2010 to September 30, 2011). In water year 2011 William Canyon Creek annual discharge was 1,128 x 10^3 m^3 and the Upper San Jose Creek annual discharge was 1,466 x 10^3 m^3. A smaller yield (m^3/km^2) would be expected from Upper San Jose Creek compared to Williams Canyon Creek because Williams Canyon Creek receives more precipitation on average. Upper San Jose Creek is a developed portion of the watershed so direct runoff may increase from the existence of impervious surfaces while baseflow may decrease from reduced infiltration and groundwater pumping. The annual yield from Upper San Jose Creek was 63% of the annual yield from Williams Canyon Creek in water year 2011. Upper San Jose Creek monthly yield in the high precipitation months was 75% of Williams Canyon Creek yield. Upper San Jose Creek monthly yield in the dry months was 36% percent of Williams Canyon Creek yield. In water year 2011 Upper San Jose Creek had a yield of 184 x 10^3 m^3/km^2, similar to other developed watersheds within the Santa Lucia Preserve. In water year 2011 Williams Canyon Creek had a yield of 295 x 10^3 m^3/km^2 and is an important source of summer baseflow.

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Introduction

Two common goals of rural watershed management are sufficient water quantity (perennial flow) and optimized water quality (sediment reduction). In particular, groundwater protection and sediment reduction are important in headwater tributaries where springs and seeps contribute base flow to the trunk stream and where steep topography can accelerate the production and transport of eroded sediment from disturbed lands. Management of water quality and availability is the key to sustainable water use, ecosystem function and protection of endangered riverine species.

San Jose Creek (Figure 1) is the northernmost stream within the Big Sur Coast biogeographic population group of the threatened south-central California coast Steelhead (Oncorhynchus mykiss (Hunt 2008). The watershed currently supports limited ranching, low-density development and a small run of Steelhead. Hunt (2008) found that overall habitat conditions for Steelhead in San Jose Creek are "Fair." Factors that negatively affect Steelhead habitat on the San Jose are groundwater and surface water diversions, sedimentation from the erosion of dirt roads and the existence of road crossings over the creek (Nelson et al. 2006; Hunt 2008). San Jose Creek's key role in Steelhead sustainability has fueled habitat assessment studies that will lead to habitat improvement (Nelson et al. 2006; Smith et al. 2003, Regional Water Management Group 2011).

To improve Steelhead habitat in the San Jose watershed Smith et al. (2003) recommended groundwater conservation, reduced sedimentation through road improvements or decommissioning, and selective stream channel barrier removal. In an effort to reduce sedimentation in Williams Canyon Creek, the Big Sur Land Trust completed a major road restoration project in 2011 (Chabre pers. comm.). Smith et al. (2003) also suggested future work to include an analysis of surface and groundwater budgets. The Monterey Peninsula Water Management District maintains a gage near the mouth of San Jose Creek, but there is also a need to understand the watershed yield by subwatershed in order to optimize conservation strategies (Regional Water Management Group 2011). This report documents the installation and first analyses of stream gages on two major San Jose Creek tributaries—Williams Canyon Creek and the upper watershed of the main stem of San Jose Creek (Upper San Jose Creek).

San Jose Watershed

San Jose Creek watershed is 36.7 km^2 (Figure 1). The creek flows generally northwest to the Pacific Ocean at Monastery Beach. San Jose Creek has several perennial tributaries including Williams Canyon Creek, Van Winkley Creek, Seneca Creek and North Fork San Jose Creek. The Monterey Peninsula Regional Park District, Big Sur Land Trust (BSLT), and the Santa Lucia

Preserve (SLP) are three organizations that own land within the San Jose Creek watershed (Regional Water Management Group 2011).

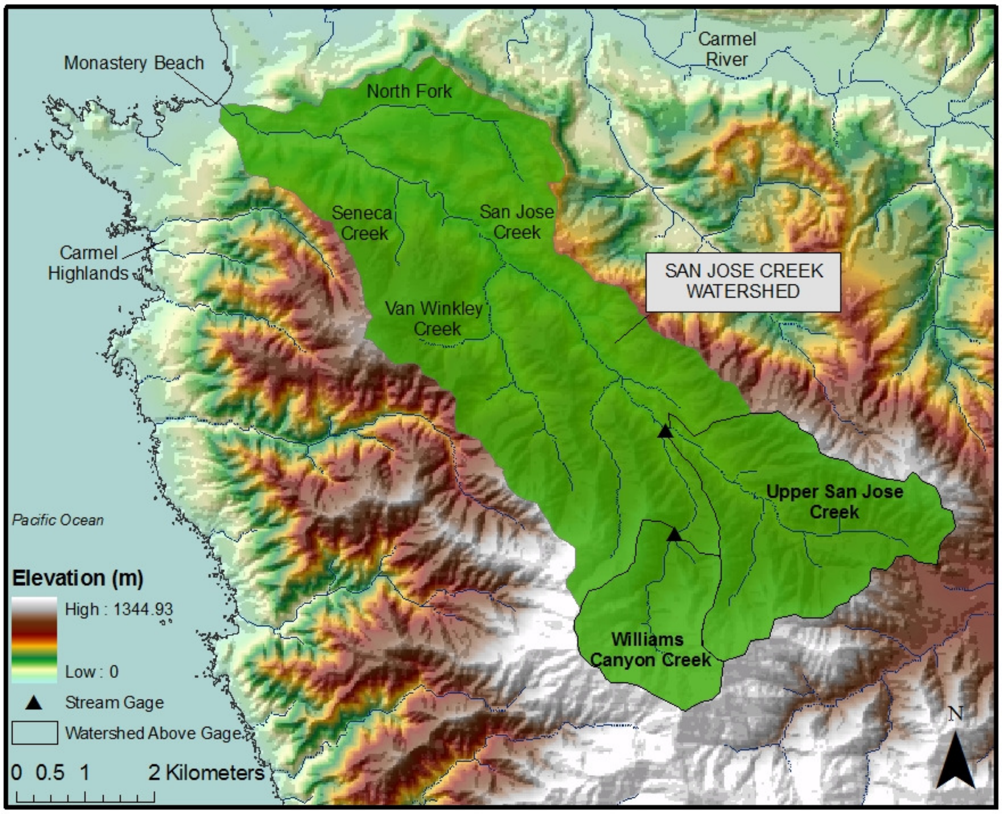

Figure 1. San Jose Creek Watershed. San Jose Creek flows to the Pacific Ocean at Monastery Beach. The area of San Jose Creek watershed is 36.7 km^2 and reaches 1,340 m in elevation. The two gages described in this report are on Williams Canyon Creek and Upper San Jose Creek.

San Jose Creek Precipitation

The region receives widely variable precipitation amounts within the boundaries of each watershed (Figure 2). The regional map of average annual precipitation indicates a strong elevation gradient (PRISM Climate Group 2010). For example, San Jose Creek watershed receives an annual average that ranges from 372 to 1,100 mm (14.7 to 43.3 inches), depending on elevation. A precipitation gage does not exist in the San Jose Creek watershed. The closest known precipitation gage is to the west of the watershed on the golf course within the SLP (Figure 2) (Appendix A). The SLP golf course gage received a total of 936 mm (36.83 inches) of precipitation in water year 2011 (Santa Lucia Preserve 2011). There is also a precipitation gage at the San Clemente Dam (Figure 2). The San Clemente Dam received 628 mm (24.73 inches) in water year 2011 (Monterey Peninsula Water Management District 2011). The isohyetal method was used to calculate the average precipitation at the gages. Upper San Jose Creek gage receives an annual average of 654 mm (25.75 inches) of precipitation and Williams Canyon Creek gage receives an annual average of 663 mm (26.10 inches) of precipitation. Williams Canyon Creek watershed reaches higher elevations than Upper San Jose Creek watershed and receives more average precipitation.

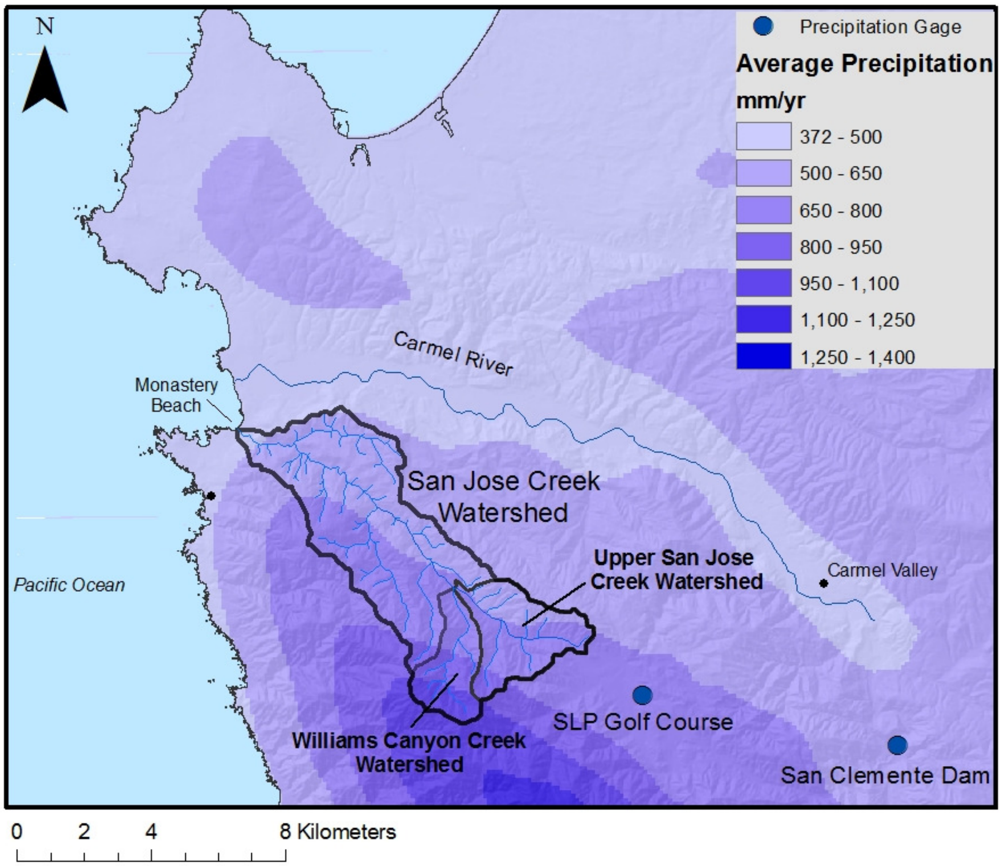

Figure 2. Average annual precipitation. San Jose Creek watershed average precipitation ranges from 372 mm to 1,100 mm (14.7 to 43.3 inches). Within San Jose watershed, Williams Canyon Creek watershed receives the highest average precipitation. The closest precipitation gages are at the SLP Golf Course and the San Clemente Dam. Data from PRISM Climate Group (2010).

Methods

Site Description

There were two gages installed within the San Jose watershed. One gage was installed on San Jose Creek on October 10, 2009 to gage the "Upper San Jose Creek" watershed yield. Another gage was installed on Williams Canyon Creek tributary on August 27, 2010. The watershed area above the Williams Canyon Creek gage is 3.8 km^2 and is within the BSLT Mitteldorf Preserve property. There was historical logging in the Williams Canyon Creek watershed (Smith et al. 2003). Dirt roads and a single lodge persist in the otherwise undeveloped watershed. The watershed area above the Upper San Jose Creek gage is 8.0 km^2 and is within the SLP. The Upper San Jose Creek watershed contains ten wells owned and operated by the SLP and one private well (Figure 3). There is a paved road and several private residences within the Upper San Jose Creek watershed. The development in the Upper San Jose Creek portion of the watershed may increase direct runoff from the existence of impervious surfaces. Impervious surfaces and the existence of wells in the Upper San Jose Creek watershed may also decrease baseflow from reduced infiltration or groundwater pumping.

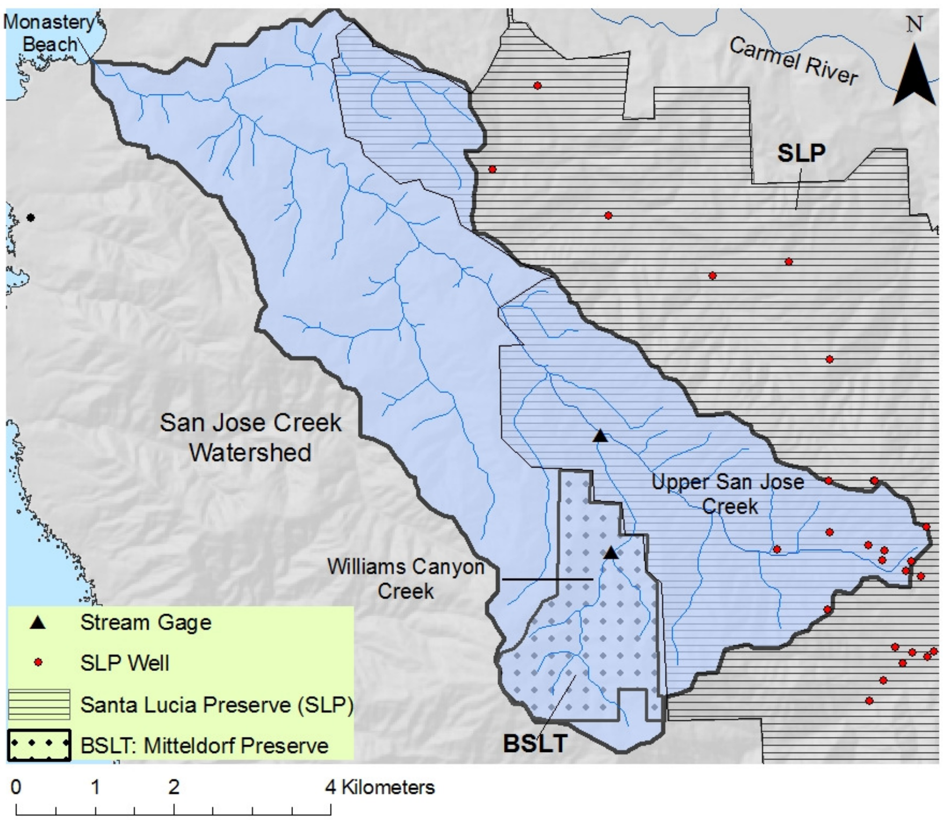

Figure 3. Upper San Jose Creek and Williams Canyon Creek watersheds. The watershed area above the Upper San Jose Creek gage is 8.0 km^2 and is within the Santa Lucia Preserve property. The watershed area above the Williams Canyon Creek gage is 3.8 km^2 and is within the BSLT Mitteldorf Preserve property. There are seven SLP wells within the San Jose Creek watershed and three SLP wells on the border of the watershed. There is also a private well not shown on the map that is within the Upper San Jose Creek portion of the watershed above the gage. (Well data from the SLP 2011).

Stream Gage Procedure

Staff plates were installed near each stream gage. The gages were rated for water discharge by repeat measurements of discharge, stage and pressure. Discharge measurements were completed with a Parshall Flume during low flow conditions and a SonTek Doppler FlowTracker when the flow was higher. A mathematical relationship (rating curve) was developed between pressure and discharge. The rating curve allows the pressure readings from the gage to be converted into streamflow estimates. After each discharge measurement, the gage data were downloaded and the water stage measured by the staff plate (ft) was recorded. In addition, water temperature (°C), dissolved oxygen (mg/L), specific conductivity (µS/cm @ 25 °C), pH and total dissolved solids (g/L) were recorded on each site visit to initiate long-term records of water quality (Appendix B and C).

Upper San Jose Creek Gage Description

A Telog WLS-31 Level Tracker pressure gage was installed on the Upper San Jose Creek on October 10, 2009. The gage is located on Santa Lucia Preserve Property. Permission from the Santa Lucia Conservancy is required to access the gage. The gage records pressure (PSI) with a date and time stamp. The gage was programmed to record an average measurement every 15 minutes. The pressure gage was housed in a perforated, one inch diameter, schedule 40 pipe. Filter cloth was placed around the pressure transducer to keep fine sediment from disrupting measurements. The pipe was secured to the creek bottom with a rebar stake. The gage data cable was run through one inch pipe to a nearby redwood tree where the data recorder was housed in an aluminum box above flood stage (Figure 4). A staff plate was installed on the left bank near the pressure transducer (Figure 5). The gage and surrounding reaches were surveyed on March 14th 2011 (Figures 6 and 7). A longitudinal profile survey was completed 40 meters upstream and downstream of the gage (Figure 8). The stream gradient of the gage stream reach is 2%. The gage pool control is formed by small embedded cobbles and sand (Figure 9). Although it is not the most stable gage pool control, the substrate is typical for the creek and the pool was the best choice for the area.

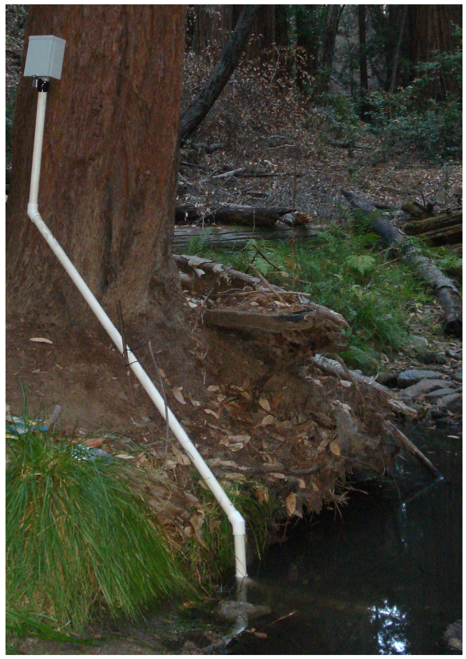

Figure 4. Upper San Jose Creek gage. The Telog pressure gage was housed in a one inch perforated pipe. The gage cable was run through one inch pipe to the redwood tree. The data recorder was housed in an aluminum box above flood stage.

Figure 5. Upper San Jose Creek Gage and staff plate on October 10, 2009. The pipe housing the gage was staked to the creek bottom. A staff plate was installed on the left bank.

Figure 6. Upper San Jose Creek Gage and staff plate on March 14, 2011. A survey cross section was completed over the gage pool and staff plate.

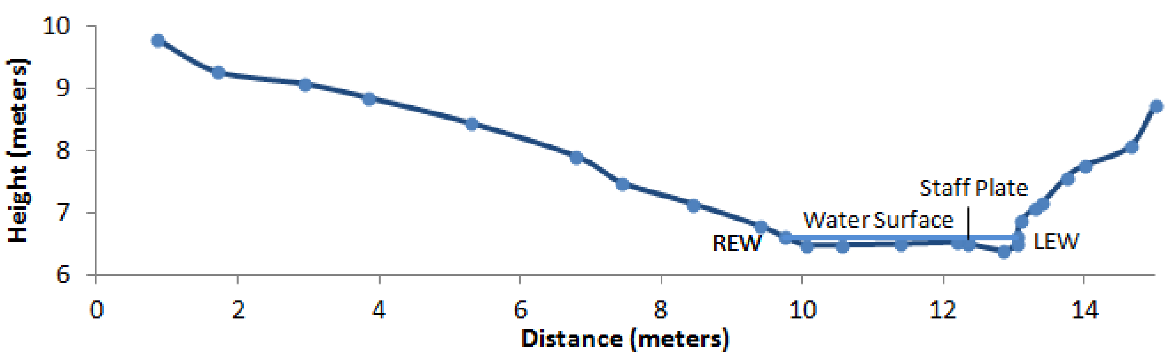

Figure 7. Cross section of Upper San Jose Creek over staff plate and gage pool on March 14, 2011.

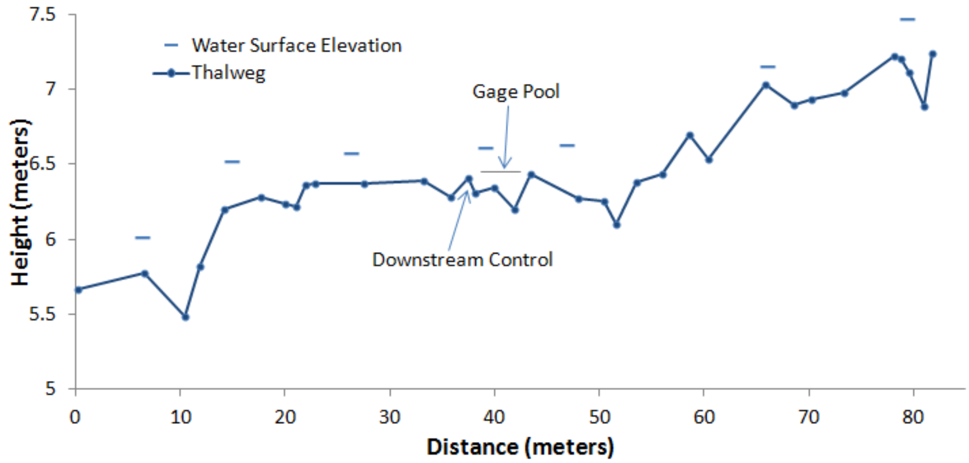

Figure 8. Longitudinal profile survey of Upper San Jose Creek gage and 40 meters upstream and downstream of gage. The vertical scale is exaggerated for illustrative purposes. The slope of the surveyed water surface is 2%.

Figure 9. Upper San Jose Creek gage pool control. The substrate consists of small embedded cobbles and sand.

Williams Canyon Creek Gage Description

An In Situ Level Troll 500 pressure gage was installed on Williams Canyon Creek on August 27, 2010. Paddock (2011) describes the Williams Canyon Creek gage installation. The gage is located on the BSLT Mitteldorf Preserve Property. Permission from the Santa Lucia Conservancy and the BSLT is required to access the gage. The gage was programmed to record temperature (C), depth (mm) and average pressure measurements (PSI) every 15 minutes. The gage area was not recently surveyed.

Results

Upper San Jose Creek

The gage was installed on October 10, 2009. The results presented in this report are modeled from a rating curve developed by water year 2011 discharge measurements and pressure readings (October 2010-September 2011). The relationship between the gage and the staff plate has remained stable since October of 2009 (Figure 10). The high R^2 value and the one-to-one relationship between staff plate (ft) and gage (psi) both indicated the gage readings were stable and indicative of changes in the water surface elevation. The gage reach and surrounding cross sections were surveyed on March 14, 2011. There was aggradation in the channel since the installation of the gage. The sediment level on the staff plate on October 10, 2009 was 0.2 feet. The sediment level on the staff plate on March 14, 2011 was 0.97 ft. There was 0.77 ft of aggradation recorded by the sediment level on the staff plate.

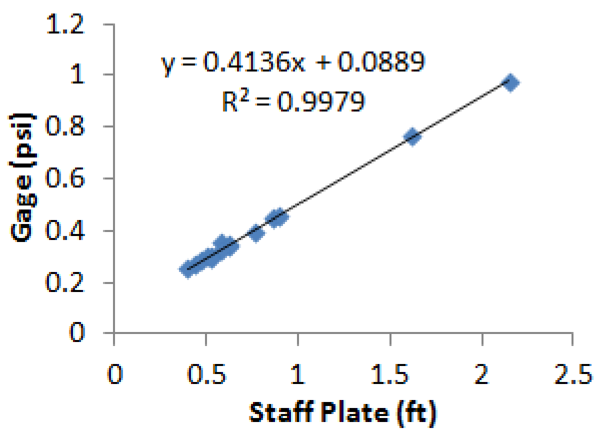

Figure 10. Staff Plate water surface elevation (ft) and gage reading (ft) from the Upper San Jose gage. The high R^2 value of 0.9979 indicated a stable relationship between staff plate readings and gage readings.

The point of zero flow of the gage pool was surveyed as 0.56 (ft) on the staff plate on March 14, 2011. The high discharges in the end of March 2011 lowered the elevation of the point of zero flow.

Upper San Jose Creek Rating Curve

On Upper San Jose Creek a rating curve was developed from ten discharge measurements taken between November 2010 and October 2011 (Figure 11). A pressure-discharge relationship was modeled by a second order polynomial equation developed by regression. A hydrologic model in HEC-RAS confirmed that a second order polynomial equation most accurately described streamflow in the surveyed portion of the channel. The HEC-RAS hydrologic model indicated that a power function for small volume discharges was also an appropriate model (USACE 2009). A power function was used to describe the relationship of discharge (cms) to gage (psi) values below a pressure of 0.325 psi.

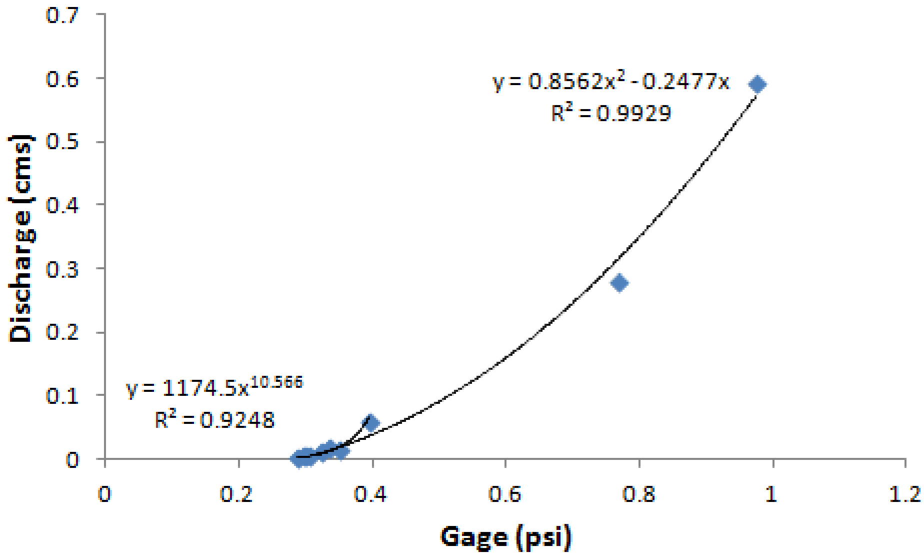

Figure 11. Pressure-Discharge relationship at the Upper San Jose gage. The 10 discharge measurements were plotted against the corresponding gage readings to develop a rating-curve. A second order polynomial was used to describe the relationship between gage (psi) and stream discharge (cms). A power function was used to describe the relationship of discharge (cms) to gage (psi) values below 0.325 psi.

Upper San Jose Creek Discharge

The rating curve was used to convert the 15 minute pressure readings to streamflow estimates for water year 2011 (Figure 12). Monthly and annual surface flow discharges were calculated from streamflow estimates (Table 1). The rating curve is valid up to 0.59 cms. In water year 2011 Upper San Jose Creek had a total discharge of 1,466 x 10^3 m^3. The peak monthly discharge was in February (572 x 10^3 m^3). Average monthly summer baseflow (July-September) was 17 x 10^3 m^3.

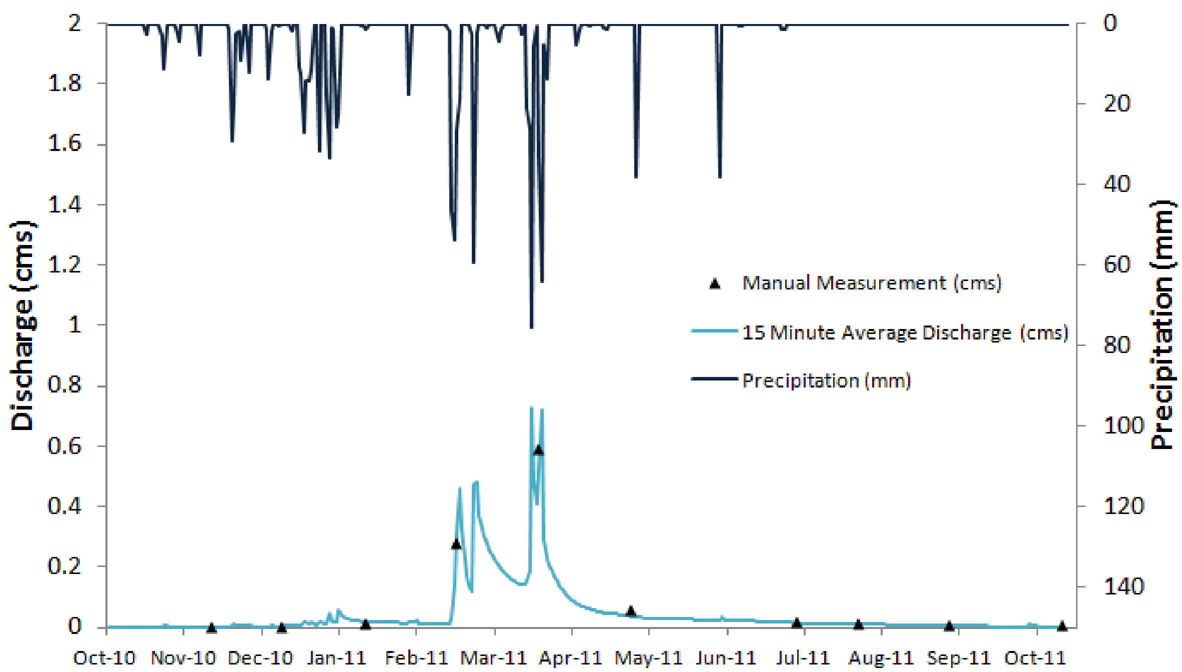

Figure 12. Hydrograph of San Jose Creek in water year 2011. At the SLP golf course precipitation gage there was a total of 936 mm (36.83 inches) of precipitation in water year 2011. The rating curve is valid up to 0.59 cms.

Table 1. Monthly discharge and water year totals for Upper San Jose Creek in water year 2011.

Month	$m^3 \times 10^3$	$ft^3 \times 10^3$	acre feet
October	6	226	5
November	10	354	8
December	56	1,968	45
January	40	1,425	33
February	572	20,201	464
March	527	18,595	427
April	95	3,369	77
May	67	2,355	54
June	42	1,488	34
July	28	976	22
August	13	471	11
September	9	331	8
Water Year 2011 Total	**1,466**	**51,758**	**1,188**

Williams Canyon Creek Temperature Record

The Williams Canyon Creek gage was programmed to record temperature (C), depth (mm) and average pressure measurements (PSI) every 15 minutes. The 15 minute record was averaged to find the daily mean temperature (Figure 13). The average daily temperature on Williams Canyon Creek in water year 2011 was 11.6 °C. The lowest water temperature was 8.26 °C on February 6, 2011 and the highest water temperature was 14.7 °C on October 14, 2010.

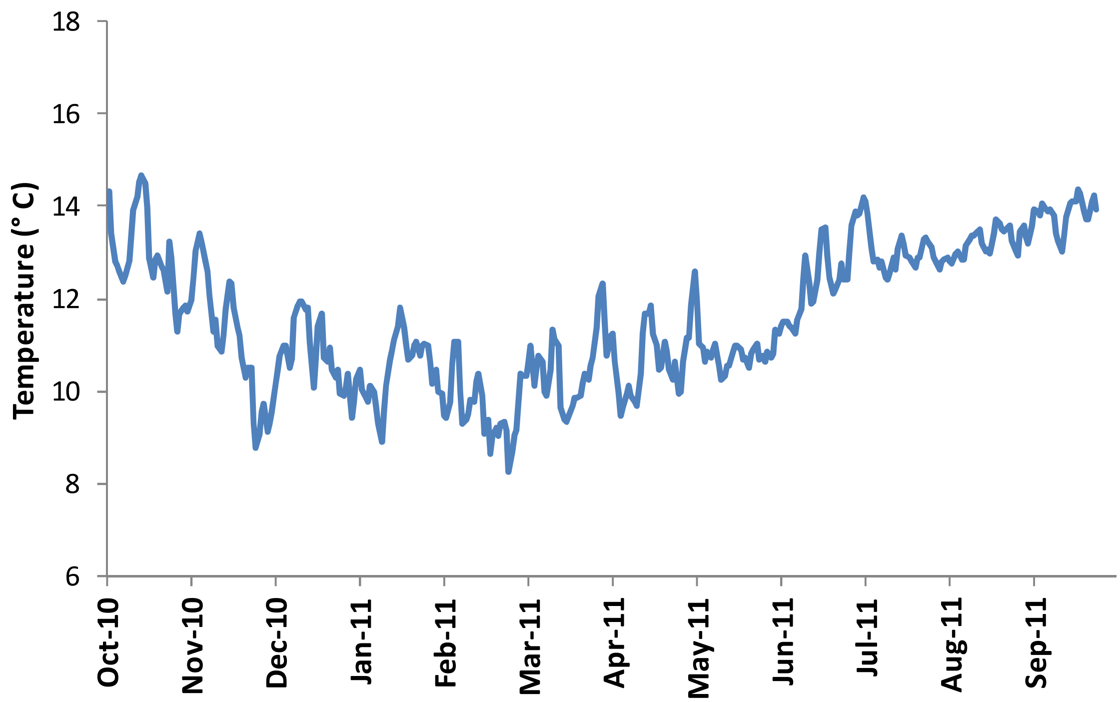

Figure 13. Average daily water temperature (°C) of Williams Canyon Creek in water year 2011. The average daily temperature on Williams Canyon Creek in water year 2011 was 11.6 °C. The lowest water temperature was 8.26 °C on February 6, 2011 and the highest water temperature was 14.7 °C on October 14, 2010.

Williams Canyon Creek Rating Curve

On Williams Canyon Creek a rating curve was initially created in March 2011 from six stream measurements taken between September 2010 and March 2011 (Paddock 2011). The relationship between the staff plate (ft) and gage (PSI) remained stable since the gage was installed in August of 2010. The rating curve was further developed by the inclusion of an additional six stream measurements from March 2011 to October 2011, including a high flow measurement of 0.2 cms. A pressure-discharge relationship was described by a second order polynomial equation developed by regression. A power function was used to describe the relationship of discharge (cms) to stage (psi) values below 0.430 psi (Figure 14).

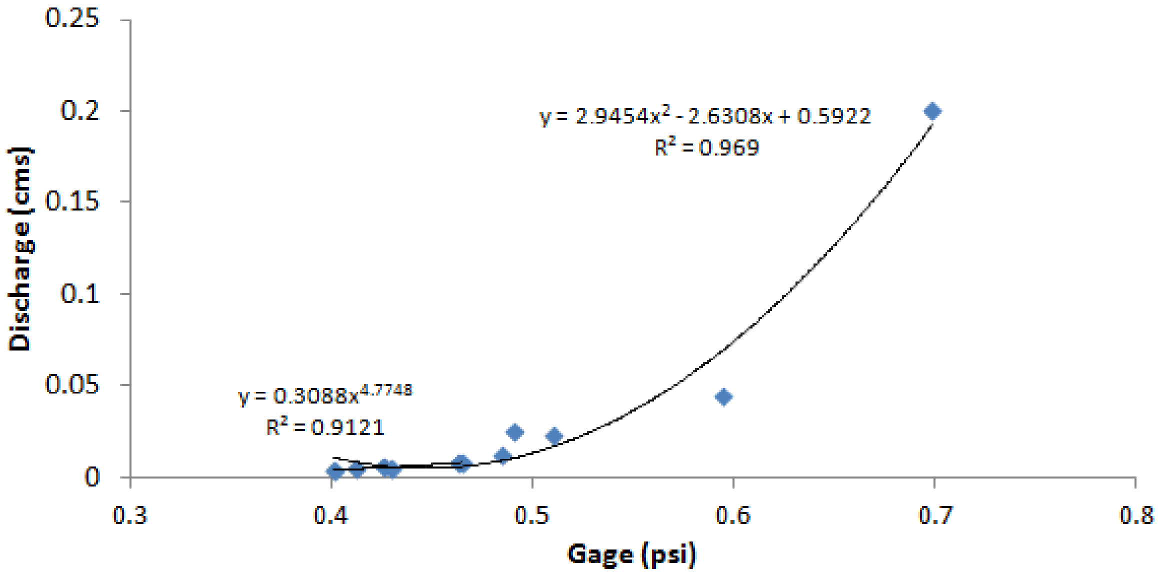

Figure 14. Pressure-Discharge relationship at the Williams Canyon Creek gage. Twelve discharge measurements were plotted against the corresponding gage readings to develop a rating-curve. A second order polynomial was used to describe the relationship between gage (psi) and stream discharge (cms). A power function was used to describe the relationship of discharge (cms) to gage (psi) values below 0.430 psi.

Williams Canyon Creek Discharge

The rating curve was used to convert the 15 minute pressure readings to streamflow estimates for water year 2011 (Figure 15). The peak discharge of the high flow event in April 2011 is poorly known because the rating does not include a measurement at that flow magnitude. The rating curve is valid up to 0.2 cms. Monthly and annual surface flow discharges were calculated from streamflow estimates (Table 2). In water year 2011 Williams Canyon Creek had a total discharge of 1,128 x 10^3 m^3. The peak monthly discharge was in March (359 x 10^3 m^3). Average monthly summer baseflow (July-September) was 22 x 10^3 m^3.

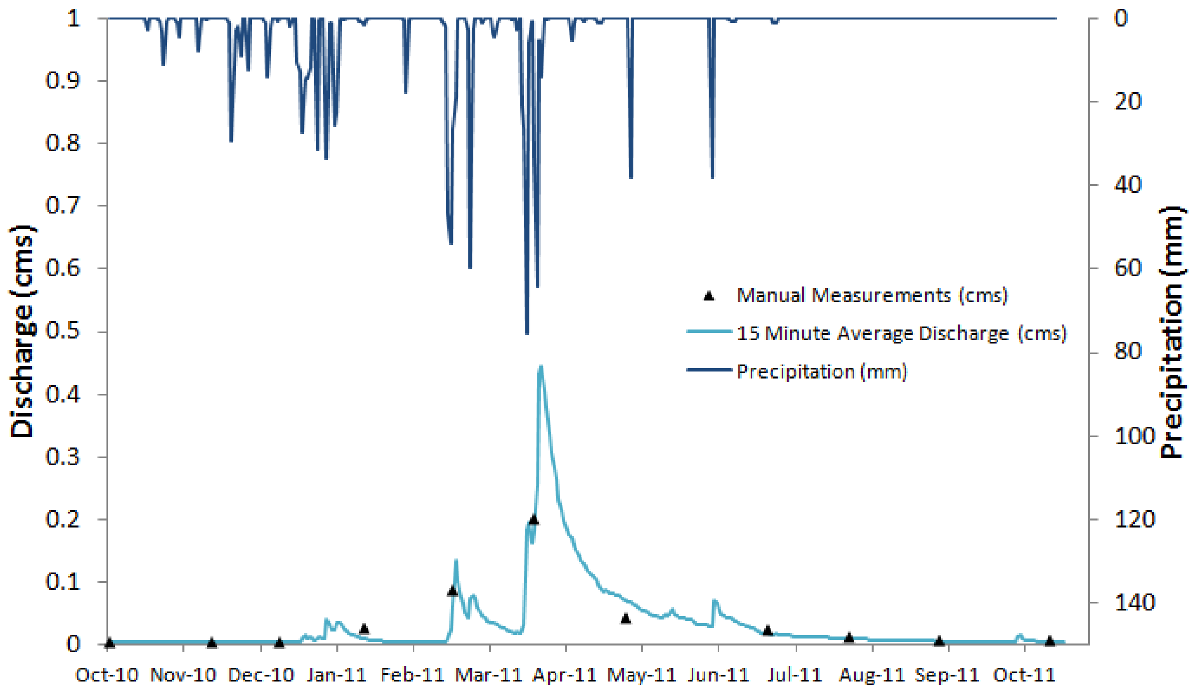

Figure 15. Hydrograph of Williams Canyon Creek in water year 2011. At the SLP golf course precipitation gage there was a total of 936 mm (36.83 inches) of precipitation in water year 2011. The rating curve is valid up to 0.2 cms.

Table 2. Monthly discharge and water year totals for Williams Canyon Creek in water year 2011.

Month	$m^3 \times 10^3$	$ft^3 \times 10^3$	acre feet
October	11	379	9
November	12	424	10
December	26	923	21
January	33	1,170	27
February	81	2,871	66
March	359	12,670	291
April	328	11,567	266
May	127	4,476	103
June	85	2,995	69
July	33	1,170	27
August	20	707	16
September	14	495	11
Water Year 2011 Total	**1,128**	**39,846**	**915**

Upper San Jose Creek and Williams Canyon Creek Monthly and Annual Yields

A smaller yield would be expected from Upper San Jose Creek compared to Williams Canyon Creek because Williams Canyon Creek watershed receives more precipitation on average. Upper San Jose Creek has several wells, a paved road and several residences so direct runoff may increase from the existence of impervious surfaces. Impervious surfaces and the existence of wells in the Upper San Jose Creek watershed may also decrease baseflow from reduced infiltration and groundwater pumping. As expected, the yield from Upper San Jose Creek was less than Williams Canyon Creek. The annual yield from Upper San Jose Creek in water year 2011 was 63% of the annual yield from Williams Canyon Creek in water year 2011 (Table 3). The total monthly yields of three high precipitation months (February, March and April) and three dry months (July, August and September) were compared. Upper San Jose Creek yield in the high precipitation months was 75% of Williams Canyon Creek yield. Upper San Jose Creek yield in the dry months was 36% percent of Williams Canyon Creek yield. The yield comparison provides evidence that the developed Upper San Jose Creek watershed has increased direct runoff and decreased baseflow when compared to Williams Canyon Creek watershed.

Table 3. Monthly and annual yield $m^3 \times 10^3/km^2$ for Williams Canyon Creek watershed and Upper San Jose Creek in water year 2011.

WY 2011 Month	Williams Yield $m^3 \times 10^3/km^2$	Upper San Jose Yield $m^3 \times 10^3/km^2$
October	3	1
November	3	1
December	7	7
January	9	5
February	21	72
March	94	66
April	86	12
May	33	8
June	22	5
July	9	4
August	5	2
September	4	1
Water Year 2011 Yield	**295**	**184**

Regional Comparison

Three other developed watersheds within the Santa Lucia Preserve are gaged and monitored: San Clemente Creek, Potrero Creek and Las Garzas Creek. The annual yields of San Clemente Creek and Potrero Creek in water year 2011 were compared to the yields of Upper San Jose and Williams Canyon Creek (Table 4). The San Clemente Creek yield was 184 x 10^3 m^3/km^2 and the

Potrero Creek yield was 143 x 10^3 m^3/km^2 (Stoner et al. 2012). Upper San Jose Creek, another watershed within the Santa Lucia Preserve has a similar yield of 184 x 10^3 m^3/km^2.

Pine Creek yield is referenced for a regional undeveloped watershed comparison. Pine Creek is an undeveloped watershed in Carmel Valley. Pine Creek discharge data are not available for water year 2011. To compare Pine Creek to Williams Canyon Creek, a similar precipitation year must be used for comparison. In water year 2011, the San Clemente Dam received 628 mm (24.73 inches) of precipitation and there was above average precipitation in preceding water year (698 mm, 27.46 inches). Water year 1996 received similar precipitation when compared to water year 2011. There were 569 mm (22.4 inches) of precipitation recorded in water year 1996 with above average antecedent precipitation in water year 1995 (922 mm, 36.29 inches). Pine Creek discharge data from 1996 was used for an undeveloped subwatershed comparison to Williams Canyon Creek discharge data in 2011 (Table 5). Williams Canyon Creek annual yield in water year 2011 was 295 x 10^3 m^3/km^2 and Pine Creek annual yield in water year 1996 was 395 x 10^3 m^3/km^2. Future research could include the comparison of the two undeveloped watersheds in the same water year for a better insight into their relationship.

Table 4. Water year 2011 subwatershed yield (m^3 x $10^3/km^2$)

Subwatershed Name	Gaged Area (km^2)	2011 Annual Yield (m^3x $10^3/km^2$)
Upper San Jose Creek	8.0	184
Williams Canyon Creek	3.8	295
San Clemente Creek	13.2	184
Potrero Creek	13.5	143

Table 5. Water year 1996 subwatershed yield (m^3 x $10^3/km^2$) (Data from James (2004)).

Subwatershed Name	Gaged Area (km^2)	1996 Annual Yield (m^3 x $10^3/km^2$)
Hitchcock Creek	13	188
Robinson Canyon	13	55
Potrero Creek	13	46
Pine Creek	21	395
Lower Las Garzas	34	175
Black Rock/San Clemente Creek	41	287
Cachagua Creek	119	40

Summary

Monitoring the streamflow contribution of the Upper San Jose Creek watershed and perennial tributaries such as Williams Canyon Creek is important because headwater tributaries contribute base flow to the trunk stream. Water quantity and quality management is the key to sustainable human water use, ecosystem function, and the protection of endangered riverine species. This report documents the installation and first analyses of stream gages on two major San Jose Creek tributaries—Williams Canyon Creek and the upper watershed of the main stem of San Jose Creek (Upper San Jose Creek).

In water year 2011 William Canyon Creek annual discharge was 1,128 x 10^3 m^3 and the Upper San Jose Creek annual discharge was 1,466 x 10^3 m^3. A smaller yield (m^3/km^2) would be expected from Upper San Jose Creek compared to Williams Canyon Creek because Williams Canyon Creek receives more precipitation on average. Upper San Jose Creek has several wells, a paved road and several residences so direct runoff may increase from the existence of impervious surfaces. Impervious surfaces and the existence of wells in the Upper San Jose Creek watershed may also decrease baseflow from reduced infiltration and groundwater pumping. As expected, the yield from Upper San Jose Creek was less than Williams Canyon Creek. The annual yield from Upper San Jose Creek in water year 2011 was 63% of the annual yield from Williams Canyon Creek in water year 2011. Upper San Jose Creek yield in the high precipitation months was 75% of Williams Canyon Creek yield. Upper San Jose Creek yield in the dry months was 36% percent of Williams Canyon Creek yield. The yield comparison provides evidence that the developed Upper San Jose Creek watershed has increased direct runoff and decreased baseflow when compared to Williams Canyon Creek watershed.

Upper San Jose Creek has a comparable annual yield to a closely located developed watershed, San Clemente Creek watershed. In water year 2011 Upper San Jose Creek and San Clemente Creek have similar annual yields of 184 x 10^3 m^3/km^2. Williams Canyon Creek had a smaller annual yield when compared to another undeveloped watershed, Pine Creek, but it is difficult to make strong conclusions when the comparison is based on different water years. The discharge from the Williams Canyon Creek tributary is an important source of streamflow to the main stem of the San Jose Creek, especially to maintain summer baseflow for steelhead habitat.

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Appendix A

Daily precipitation record and monthly totals, water year 2011

Santa Lucia Preserve Golf Course, Monterey County, California

Values are inches

Day	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1				1.01								
2				0.90		0.04						
3				0.01					1.50*			
4			0.05									
5			0.55	0.01								
6			0.08			0.13						
7		0.31				0.18	0.20					
8						0.05	0.05					
9			0.02									
10		0.01							0.01			
11				0.02				1.50*	0.03			
12				0.02			0.03		0.02			
13				0.06								
14			0.08	0.01	0.02	0.01						
15					0.07							
16					1.84	0.11						
17	0.10		0.42		2.11		0.01					
18			0.50		1.04	0.82	0.04					
19		0.05	1.07		0.74	1.04	0.05					
20		1.15	0.56		0.01	2.97						
21		0.79	0.56			0.22						
22	0.03	0.11	0.46			0.03						
23	0.12	0.08				1.31						
24	0.44	0.36	0.01		0.11	2.52						
25	0.02		1.24		2.34	0.20						
26			0.01		0.09	0.55						
27		0.48										
28			0.71			0.01			0.05			
29	0.04		1.31	0.01					0.05			
30	0.17		0.04	0.69								
31			0.05	0.01								
Total	0.92	3.34	7.72	2.75	8.37	10.19	0.38	1.50	1.66	0.00	0.00	0.00

Annual Total **36.83**

* Weather station down for repairs. Estimate.

Note: Rainfall recorded on day of measuring.

Appendix B

Water Quality Record from Upper San Jose Creek for water year 2011

Upper San Jose Creek	pH	Water Temperature (°C)	Specific Conductivity (µS/cm @25)	Total Dissolved Solids (g/L)
11/12/2010	8.49	10.52	297	0.193
12/10/2010	7.68	12.1	262	0.17
1/13/2011	8.56	8.82	269	0.175
2/18/2011	8.14	9.31	184	0.12
3/23/2011	8.45	10.11	169	0.11
4/29/2011	8.58	11.35	227	0.148
7/4/2011	9.52	15.16	266	0.173
7/29/2011	10.04	16.95	271	0.176
9/3/2011	7.17	15.7	277	0.18
10/18/2011	7.69	13.24	291	0.189

Appendix C

Water Quality Record from Williams Canyon Creek for water year 2011

Williams Cyn Creek	pH	Water Temperature (°C)	Specific Conductivity (µS/cm @25)	Total Dissolved Solids (g/L)
9/4/2010	8.42	15.6	193	0.128
10/2/2010	8.48	14.5	194	0.126
11/12/2010	8.46	10.28	201	0.131
12/10/2010	7.61	12.13	201	0.131
1/13/2011	8.88	9.93	179	0.116
2/18/2011	7.21	8.66	163	0.106
3/23/2011	8.68	10.48	136	0.089
4/29/2011	8.51	9.95	179	0.116
6/26/2011	8.95	13.94	177	0.115
7/29/2011	9.46	14.6	190	0.123
9/3/2011	6.67	15.22	183	0.119
10/18/2011	13.7	8.56	235	0.153