Pollutants of concern (POC) loads monitoring data progress report, water year (WY) 2012

Prepared by

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1. Introduction

The San Francisco Regional Water Quality Control Board (Water Board) has determined that San Francisco Bay is impaired by mercury and PCBs due to threats to wildlife and human consumers of fish from the Bay. These contaminants persist in the environment and accumulate in aquatic food webs (SFRWRCB 2006; SFRWRCB, 2008). The Water Board has identified urban runoff from local watersheds as a pathway for pollutants of concern into the Bay, including mercury and PCBs. The Municipal Regional Stormwater Permit (MRP; SFRWRCB, 2009) contains several provisions requiring studies to measure local watershed loads of mercury and PCBs (provisions C.8.e), as well as other pollutants covered under C.13. (copper) and provision C.14. (e.g., legacy pesticides, PBDEs, and selenium).

Bay Area Stormwater Programs, represented by the Bay Area Stormwater Management Agencies Association (BASMAA), are collaborating with The San Francisco Bay Regional Monitoring Program (RMP) to develop an alternative strategy allowed by Provision C.8.e of the MRP, known as the Small Tributaries Loading Strategy (STLS) (SFEI, 2009). An early version of the STLS provided an initial outline of the general strategy and activities to address four key management questions (MQs) that are found in MRP provision C.8.e:

> MQ1. Which Bay tributaries (including stormwater conveyances) contribute most to Bay impairment from POCs;
>
> MQ2. What are the annual loads or concentrations of POCs from tributaries to the Bay;
>
> MQ3. What are the decadal-scale loading or concentration trends of POCs from small tributaries to the Bay; and,
>
> MQ4. What are the projected impacts of management actions (including control measures) on tributaries and where should these management actions be implemented to have the greatest beneficial impact.

Since then, a Multi-Year-Plan (MYP) (BASMAA, 2011) has been written and updated (BASMAA, 2012). The MYP provides a comprehensive description of activities that will be implemented over the next 5-10 years to provide information and comply with the MRP. The MYP provides rationale for the methods and locations of proposed activities to answer the four MQs listed above. Activities include modeling using the regional watershed spreadsheet model (RWSM) to estimate regional scale loads (Lent and McKee, 2011; Lent et al., 2012; Gilbreath et al., in preparation), and pollutant characterization and loads monitoring of local tributaries beginning Water Year (WY) 2011 (McKee et al., in review) and continuing (this report).

The purpose of this report is to describe data collected during WY 2012 in compliance with MRP provision C.8.e., following the standard report content described in provision C.8.g.vi. The study design (selected watersheds and sampling locations, analytes, sampling methodologies and frequencies) as outlined in the MYP was developed to assess concentrations and loads in watersheds that are considered to likely be important watersheds where PCB and mercury load reductions from urban runoff will be sought (MQ1):

- Lower Marsh Creek (Hg);
- San Leandro Creek (Hg);
- Guadalupe River (Hg and PCBs); and
- Sunnyvale East Channel (PCBs).

The loads monitoring will provide calibration data for the RWSM (MQ2), and is intended to provide baseline data to assess long term loading trends (MQ3) in relation to management actions (MQ4). This report is structured in a manner that allows annual updates after each subsequent winter season of data collection (likely WY 2013; 2014).

2. Watershed physiography, sampling locations, and methods

The San Francisco Bay estuary is surrounded by nine highly urbanized counties with a total population greater than seven million people (US Census Bureau, 2010). Although urban runoff from approximately 500 small tributaries flowing from the adjacent landscape represents only about 6% of the total freshwater input to the San Francisco Bay, this input has broadly been identified as a significant source of pollutants of concern (POCs) to the estuary (Davis et al., 2007; Oram et al., 2008; Davis et al., 2012; Gilbreath et al., 2012). Four watersheds were sampled in WY 2012 (Figure 1; Table 1) and two more sites will come online in WY 2013. The sites were distributed throughout the counties where loads monitoring are required by the MRP. The selected watersheds include urban and industrial land uses, watersheds where stormwater programs are planning enhanced management actions to reduce PCB and mercury discharges, and watersheds with historic mercury or PCB occurrences or related management concerns.

Composite and discrete samples were collected for multiple analytes from the water column over the rising, peak, and falling stages of the hydrograph. Composite samples represent average concentrations of storm runoff over the entire storm event and were collected using the ISCO autosampler at all of the sites except Guadalupe River, where the FISP D-95 depth integrating water quality sampler was used. Discrete samples were collected using the ISCO as a pump at all the sites besides Guadalupe; discrete mercury and methylmercury samples were collected with the D-95 at all sites, except at Lower Marsh Creek where samples were manually taken by dipping an opened bottle from the side of the channel (Table 1). Tubing for the ISCOs was installed using the clean hands technique, as was the 1 L Teflon bottle when used in the D-95. Samples for dissolved nutrients were filtered in the field within 15 minutes of sample collection while dissolved selenium/dissolved copper samples were filtered off site within 48 hours of collection.

Blind field duplicates were collected using the same methods and filled sequentially. Thus, field duplicates reflect environmental variability over a short period of time (minutes) as well as other issues of sample integrity such as inconsistencies in preservation, shipping, storage, and handling prior to

Figure 1. Water year 2012 sampling watersheds.

Table 1. Sampling locations in relation to County programs and sampling methods at each site.

County program	Watershed name	Watershed area (km^2)[1]	Sampling location			Operator	Discharge monitoring method		Turbidity	Water sampling for pollutant analysis		
			City	Latitude (WGS1984)	Longitude (WGS1984)		USGS	STLS creek stage/ velocity/ discharge rating		FISP US D95[6]	ISCO auto pump sampler[7]	Manual grab
Contra Costa	Marsh Creek	99	Brentwood	37.990723	-122.16265	ADH	Gauge Number: 11337600[2]	X	OBS-500[4]		X	X
Alameda	San Leandro Creek	8.9	San Leandro	37.726073	-122.16265	SFEI		X	OBS-500	X	X	
Santa Clara	Guadalupe River	236	San Jose	37.373543	-121.69612	SFEI	Gauge Number: 11169025[3]	X	DTS-12[5]	X		
Santa Clara	Sunnyvale East Channel	14.8	Sunnyvale	37.394487	-122.01047	SFEI		X	DTS-12*	X	X	

[1]Area downstream from reservoirs.
[2]USGS 11337600 MARSH C A BRENTWOOD CA
[3]USGS 11169025 GUADALUPE R ABV HWY 101 A SAN JOSE CA
[4]Campbell Scientific OBS-500 Turbidity Probe
[5]Forest Technology Systems DTS-12 Turbidity Sensor
[6]FISP US D-95 Depth integrating suspended hand line sampler
[7]Teledyne ISCO 6712 Full Size Portable Sampler
*OBS-500 malfunctioned during WY 2012 due to low flow water depth. A DTS-12 was installed during WY 2013.

analysis. Lab duplicates were collected for PCBs, PBDEs, and PAHs to test the precision of the analyses; the samples were collected side-by-side (simultaneously). Field blanks were collected using the same methodology as field sample collection. Field Blanks were collected with ISCO autosamplers by rinsing and purging the suction with high purity water (HPW) provided by a laboratory, then directly filling the appropriate analyte bottle with HPW using the autosampler.

3. Laboratory analysis and quality assurance

3.1. Sample preservation and laboratory analysis methods

All samples were labeled, placed on ice, transferred back to the respective site operator's headquarters, and refrigerated at 4 °C until transport to the laboratory for analysis. Laboratory methods were chosen to ensure the highest practical ratio between method detection limits, accuracy and precision, and costs (BASMAA, 2011; 2012) (Table 2). For details on sample I.D., date and time of collection, and media, please see Appendix 1.

3.2. Quality Assurance Methods

3.2.1. Sensitivity

The sensitivity review evaluated the percentage of field samples that were non-detects as a way to evaluate if the analytical methods employed were sensitive enough to detect expected environmental concentrations of the targeted parameters. In general, if more than 50 % of the samples were ND then the method may not be sensitive enough to detect ambient concentrations. However, review of historical data from the same project/matrix/region (or a similar one) helped to put this evaluation into perspective; in most cases the lab was already using a method that is as sensitive as is possible.

3.2.2. Blank Contamination

Blank contamination review was performed to quantify the amount of targeted analyte in a sample from external contamination in the lab or field. This metric was performed on a lab-batch basis. Lab blanks within a batch were averaged. When the average blank concentration was greater than the method detection limit (MDL), the field samples, within this batch, were qualified as blank contaminated. If the field sample result was less than 3 times the average blank concentration (including those reported as ND) those results were "censored" and not reported or used for any data analyses.

3.2.3. Precision

Rather than evaluation by lab batch, precision review was performed on a project or dataset level (e.g., a year or season's data) so that the review took into account variation across batches. Only results that were greater than 3 times the MDL were evaluated, as results near MDL were expected to be highly variable. The overarching goal was to review precision using sample results that were most similar in characteristics and concentrations to field sample results. Therefore the priority of sample types used in this review was as follows: lab-replicates from field samples, or field replicates (but only if the field replicates are fairly homogeneous - unlikely for wet-season runoff event samples unless collected simultaneously from a location). Replicates from CRMs, matrix spikes, or spiked blank samples were

Table 2. Laboratory analysis methods.

Analyte	Method	Field Filtration	Field Acidification	Laboratory
Carbaryl	EPA 632M	no	no	DFG WPCL
Fipronil	EPA 619M	no	no	DFG WPCL
Suspended Sediment Concentration	ASTM D3977	no	no	EBMUD
Total Phosphorus	EBMUD 488 Phosphorus	no	no	EBMUD
Nitrate	EPA 300.1	yes	no	EBMUD
Dissolved OrthoPhosphate	EPA 300.1	yes	no	EBMUD
PAHs	AXYS MLA-021 Rev 10	no	no	AXYS Analytical Services Ltd.
PBDEs	AXYS MLA-033 Rev 06	no	no	AXYS Analytical Services Ltd.
PCBs	AXYS MLA-010 Rev 11	no	no	AXYS Analytical Services Ltd.
Pyrethroids	AXYS MLA-046 Rev 04	no	no	AXYS Analytical Services Ltd.
Total Methylmercury	EPA 1630M	no	yes	Moss Landing Marine Laboratories
Total Mercury	EPA 1631EM	no	yes	Moss Landing Marine Laboratories
Copper	EPA 1638M	no	no	Brooks Rand Labs LLC
Selenium	EPA 1638M	no	no	Brooks Rand Labs LLC
Total Hardness[1]	EPA 1638M	no	no	Brooks Rand Labs LLC
Total Organic Carbon	SM 5310 C	no	yes (bottle pre-preserved)	Delta Environmental Lab LLC
Toxicity	See 2 below	no	yes	Pacific Eco-Risk Labs

[1] Hardness is a calculated property of water based on magnesium and calcium concentrations. The formula is: Hardness (mg/L) = (2.497 [Ca, mg/L] + 4.118 [Mg, mg/L])

[2] Toxicity testing includes: chronic algal growth test with *Selenastrum capricornutum* (EPA 821/R-02-013)chronic survival & reproduction test with *Ceriodaphnia dubia* (EPA 821/R-02-013), chronic survival and growth test with fathead minnows (EPA 821/R-02-013), and10-day survival test with *Hyalella Azteca* (EPA 600/R-99-064M)

reviewed next with preference to select the samples that most resembled the targeted ambient samples in matrix characteristics and concentrations. Results outside of the project management quality objective (MQO) but less than 2 times the MQO (e.g., ≤50% if the MQO RPD is ≤25%) were qualified, those outside of 2 times the MQO were censored.

3.2.4. Accuracy

Accuracy review was also performed on a project or dataset level (rather than a batch basis) so that the review takes into account variation across batches. Only results that were greater than 3 times the MDL were evaluated. Again, the preference was for samples most similar in characteristics and concentrations to field samples. Thus the priority of sample types used in this review was as follows:

Certified Reference Materials (CRMs), then Matrix Spikes (MS), then Blank Spikes. If CRMs and MS were both reported in the same concentration range, CRMs were preferred because of external validation/certification of expected concentrations, as well as better integration into the sample matrix (MS samples were often spiked just before extraction). If both MS and blank spike samples were reported for an analyte, the MS was preferred due to its more similar and complex matrix. Blank spikes were used only when preferred recovery sample types were not available (e.g., no CRMs, and insufficient or unsplittable material for creating an MS). Results outside the MQO were flagged, and those outside 2 times the MQO (e.g., >50% deviation from the target concentration, when the MQO is ≤25% deviation) were censored for poor recovery.

3.2.5. Comparison of dissolved and total phases

This review was only conducted on water samples that reported dissolved and particulate fractions. In most cases the dissolved fraction was less than the particulate or total fraction. Some allowance is granted for variation in individual measurements, e.g. with an MQO of RPD<25%, a dissolved sample result might easily be higher than a total result by that amount.

3.2.6. Average and range of field sample versus previous years

Comparing the average range of the field sample results to comparable data from previous years (either from the same program or other projects) provided confidence that the reported data do not contain egregious errors in calculation or reporting (errors in correction factors and/or reporting units). Comparing the average, standard deviation, minimum and maximum concentrations from the past several years of data aided in exploring data, for example if a higher average was driven largely by a single higher maximum concentration.

3.2.7. Fingerprinting summary

The fingerprinting review evaluated the ratios or relative concentrations of analytes within an analysis. For this review, we looked at the reported compounds to find out if there are unusual ratios for individual samples compared to expected patterns from historic datasets or within the given dataset.

4. Results

The following sections present results from the four monitored tributaries. In this section, a summary of data quality is initially presented. This is then followed by sub-sections specific for each monitoring location where we report on flow, SSC and turbidity, POC concentrations, and toxicity.

4.1. Project Quality Assurance Summary

Overall the data were acceptable with few data quality issues. The exceptions were PAH and pyrethroids. Below is a summary of quality assurance and data validation for the data set. QA tables can be found in Appendix 2.

The PCB data were acceptable. MDLs were sufficient for all of the PCBs, including lab-replicates. NDs were reported for only PCB 170 (2% NDs). There was some laboratory blank contamination but no field samples were censored. Precision and accuracy metrics were within MQOs.

Total mercury and total methylmercury results were generally acceptable. MDLs were sufficient and there was only one ND for methylmercury. Methylmercury was found in blanks for most batches, with most results qualified but not censored. Two of the 44 methylmercury results (4%) were censored. Precision and accuracy metrics were within MQOs.

The nutrient data were generally acceptable. Concentrations of most analytes were above their MDLs, with no NDs. There was no contamination in field or laboratory blank samples. Precision and accuracy metrics were within MQOs.

The carbaryl and fipronil data were acceptable. MDLs were mostly sufficient except for carbaryl where 26% of samples were non-detects. No blank contamination was found. Precision and accuracy metrics were within MQOs.

The PAH data set was acceptable with some minor QA issues. MDLs were sufficient, with >50% NDs only for Benz(a)anthracene. One half of the target analytes were found in laboratory blanks, but only 17 results had field sample concentrations less than 3x those in blanks and required censoring, Biphenyl and Fluorenes, C1 were around 40% censored. Precision was good with <35% RSD on lab or blank spike replicates for all analytes. Recovery was good, average <35% from target for all except *Tetramethylnaphthalene, 1,4,6,7-,* which was ~40% above target and represents the C4 Naphthalenes, which was flagged for marginal recovery.

The PBDE data were generally acceptable. MDLs were sufficient for most PBDEs, with >50% NDs for some minor congeners. Some of the congeners (BDE 28, 37, 47, 49, 85, 99, 100, 153, 183, 209) were found in blanks, but only BDE 37 had half the samples with <3x the blank level and were censored. Precision and accuracy metrics were within MQOs.

The pyrethroid data were acceptable with various QA issues summarized below. The majority of the pyrethroid samples, 77% (10 of 13), had extensive NDs (>50% NDs for some analytes). Bifenthrin, Delta/Tralomethrin, and total Permethrin were the only pyrethroids where the MDLs were sufficient (<50% NDs). Five lab blanks were reported with 73% (11 out of 15) of the pyrethroids having some blank contamination. Allethrin, total Cyfluthrin, total lambda Cyhalothrin, Delta/Tralomethrin, total Esfenvalerate/Fenvalerate, Fenpropathri, Phenothrin, Resmethrin, and Tetramethrin had 13.3% of results censored. Blank spike samples were used to evaluate accuracy, as no CRMS or matrix spikes were provided, with the average % Error generally below the target MQO of 35%. Only two pyrethroids required flagging, Phenothrin and Resmethrin, which were above 35%, but below 70% % error, and were flagged with a non-censoring qualifier. The field replicates on field samples, and replicates on blank spikes, were generally good with Bifenthrin, total Cypermethrin, Delta/Tralomethrin, total Permethrin, total lambda Cyhalothrin, Fenpropathrin, total Esfenvalerate/Fenvalerate, and total Cyfluthrin having average RSDs below the target MQO of 35%. Allethrin , Phenothrin, Prallethrin, Resmethrin, and Tetramethrin had blank spike average RSDs above 35%, but below 70%, and were, therefore, flagged with a non-censoring qualifier.

Overall the other trace elements dataset was acceptable. All of the calcium, copper, magnesium, selenium and computed hardness results were above the detection limits with no NDs reported. No blank contamination was observed. Precision and accuracy metrics were within MQOs. The average dissolved/total ratio for hardness (0.74), calcium (0.83), copper (0.43), magnesium (0.79), and selenium (0.74) was less than 1. Three individual dissolved/total ratios (1 copper and 2 selenium) were >1, but the percent difference for each was <35%.

4.2. Marsh Creek

4.2.1. Marsh Creek flow

The US geological survey has maintained a flow record on Marsh Creek (gauge number 11337600) since October 1, 2000 (13 WYs). Peak annual flows for the previous 12 years have ranged between 168 cfs (1/22/2009) and 1770 cfs (1/2/2006). Annual runoff from Marsh Creek based on the previous 12 years of United States Geological Survey (USGS) records has ranged between 3.03 Mm^3 (WY 2009) and 26.8 Mm^3 (WY 2006). WY 2006 may be considered representative of very rare wet conditions (upper 10th percentile) and WY 2009 is perhaps representative of moderately rare dry conditions (lower 20th percentile) based on long-term records that began in WY 1953 at a nearby East Bay USGS gauging location (USGS gauge number 11182500, San Ramon Creek near San Ramon). A number of relatively minor storms occurred during WY 2012 (Figure 2). Flow peaked at 174 cfs on 1/21/2012 at 1:30 am and then again 51 ½ hours later at 143 cfs on 1/23/2012 at 5:00 am. Total runoff during WY 2012 based on preliminary USGS data was 1.83 Mm^3; discharge of this magnitude is likely exceeded most years in this watershed. Rainfall data corroborates this assertion; rainfall during WY 2012 was 69% of mean annual precipitation (MAP) based on a long-term record at Concord Wastewater treatment plant (NOAA gauge number 041967) for the period Climate Year (CY) 1992-2012.

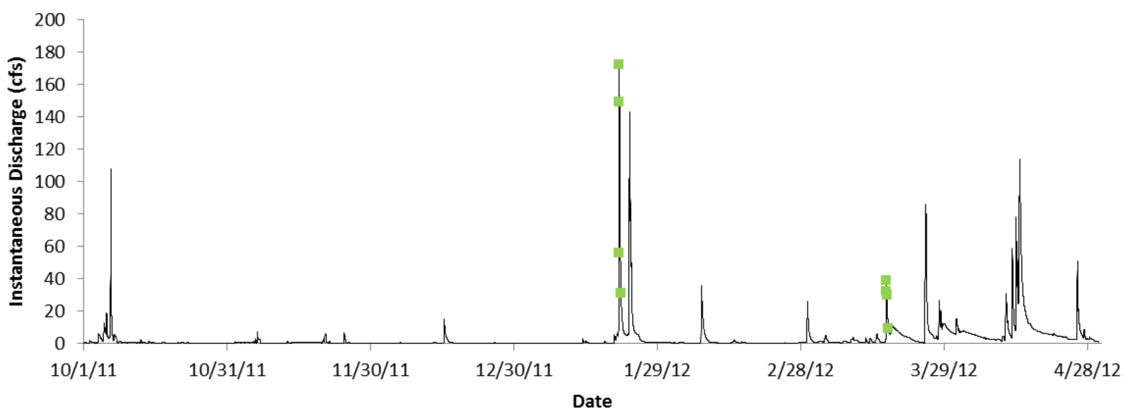


Figure 2. Flow characteristics in Marsh Creek during Water Year 2012 based on preliminary 15 minute data provided by the United States Geological Survey, gauge number 11337600) with sampling events plotted in green. Note, USGS normally publishes finalized data for the permanent record in the spring following the end of each Water Year.

4.2.2. Marsh Creek turbidity and suspended sediment concentration

Turbidity is a measure of the "cloudiness" in water caused by suspension of particles, most of which are less than 62.5 µm in size and, for most creeks in the Bay Area, virtually always less than 250 µm (USGS data). In natural flowing rivers and urban creeks or storm drains, turbidity usually correlates with the concentrations of suspended sediments and hydrophobic pollutants. Turbidity generally responded to rainfall events in a similar manner to runoff. Turbidity peaked at 532 NTU during a late season storm on 4/13/12 at 7 pm. Relative to flow magnitude, turbidity remained elevated during all storms and was the greatest during the last storm despite lower flow. These observations, and observations made previously during the RMP reconnaissance study (maximum 3211 NTU; McKee et al., in review), provide evidence that during larger storms and wetter years, the Marsh Creek watershed is capable of much greater sediment erosion and transport than occurred during WY 2012, resulting in greater turbidity and concentrations of suspended sediment. The OBS-500 instrument utilized at this sampling location with a range of 0-4000 NTU will likely be exceeded during medium or larger storms.

Suspended sediment concentration, since it was computed from the continuous turbidity data, follows the same patterns as turbidity in relation to discharge. SSC peaked at 1312 mg/L during the 4/13/12 late season storm at the same time as the turbidity peak. Relative to flow magnitude, SSC remained elevated during all storms and was the greatest during the last storm despite lower flow. The maximum SSC observed during the RMP reconnaissance study (McKee et al., in review) was 4139 mg/L, indicating that in wetter years, greater SSC can be expected.

4.2.3. Marsh Creek POC concentrations summary (summary statistics)

Summary statistics (Table 3) help compare Marsh Creek water quality to other Bay Area nonurban streams. The maximum PCB concentrations (4.32 ng/L) was similar to background concentrations normally found in relatively nonurban areas and maximum mercury concentrations (252 ng/L) were similar to concentrations found in mixed land use watersheds (Lent and McKee, 2011). Maximum and mean MeHg concentrations (0.407 ng/L; 0.219 ng/L (n=5)) were greater than the proposed implementation goal of 0.06 ng/l for methylmercury in ambient water for watershed tributary to the Central Delta (Wood et al., 2010: Table 4.1, page 40). Nutrient concentrations appear to be reasonably typical of other Bay Area watersheds (McKee and Krottje, 2005). As is typical in the Bay Area, phosphorus concentrations appear greater than elsewhere in the world under similar land use scenarios, an observation perhaps attributable to geological sources (McKee and Krottje, 2005). For pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients), concentrations exhibited the typical pattern of median < mean with the exception of organic carbon. Thus, the comparison of summary statistics to knowledge from other watersheds and our conceptual model of the statistical distribution of water quality data provided a first order check on quality assurance.

A similar style of first order quality assurance is also possible for analytes measured at a lower frequency. Pollutants sampled at a lesser frequency and appropriate for characterization only (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) were quite low and similar to concentrations found in watersheds with limited or no urban influences. Carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US

Table 3. Summary of laboratory measured pollutant concentrations in Marsh Creek during WY 2012.

Analyte Name	Unit	Samples taken (n)	Proportion detected (%)	Min	Max	Median	Mean	Standard Deviation	FWMC[1]	Mean Particle Ratio (mass/mass)[2]	Standard Deviation of Particle Ratios
SSC	mg/L	27	96	43	930	215	308	275	154	NA	NA
∑PCB	ng/L	7	100	0.354	4.32	1.27	1.95	1.61	1.15	6.87	2.05
Total Hg	ng/L	8	100	8.31	252	34.6	74.3	85.2	38.9	193	58.6
Total MeHg	ng/L	5	100	0.090	0.407	0.185	0.219	0.118	0.763[3]	1.19	0.248
TOC	mg/L	8	100	4.60	12.4	8.55	8.34	2.37	8.02	52.4	41.7
NO3	mg/L	8	100	0.47	1.10	0.64	0.68	0.20	0.741	NA	NA
Total P	mg/L	8	100	0.295	1.10	0.545	0.576	0.285	0.469	2.64	1.52
PO4	mg/L	8	100	0.022	0.120	0.056	0.065	0.030	0.439	NA	NA
Hardness	mg/L	2	100	200	203	202	202	2	NA	NA	NA
Total Cu	µg/L	2	100	0.650	0.784	0.717	0.717	0.095	NA	NA	NA
Dissolved Cu	µg/L	2	100	0.483	0.802	0.643	0.643	0.226	NA	NA	NA
Total Se	µg/L	2	100	13.8	27.5	20.7	20.7	9.69	NA	NA	NA
Dissolved Se	µg/L	2	100	4.99	5.62	5.31	5.31	0.45	NA	NA	NA
Carbaryl	ng/L	2	50	-	-	-	16	-	NA	NA	NA
Fipronil	ng/L	2	100	7	18	13	13	8	NA	NA	NA
∑PAH	ng/L	1	100	-	-	-	494	-	NA	NA	NA
∑PBDE	ng/L	1	100		-	-	20.0	-	NA	NA	NA
Delta/ Tralo-methrin	ng/L	2	100	0.954	6.00	3.48	3.48	3.57	NA	NA	NA
Fenpropathrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Esfenvalerate/ Fenvalerate	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Cypermethrin	ng/L	2	50	-	-	-	68.0	-	NA	NA	NA
Cyfluthrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Cyhalothrin lambda	ng/L	2	50	-	-	-	3.00	-	NA	NA	NA
Permethrin	ng/L	2	100	3.81	17.0	10.4	10.4	9.33	NA	NA	NA
Bifenthrin	ng/L	2	100	25.3	257	141	141	164	NA	NA	NA
Allethrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Prallethrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Phenothrin	ng/L	2	0		-	-	-	-	NA	NA	NA
Resmethrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA

[1] FWMC = flow weighted mean concentration. Calculation is total annual mass load divided by total annual discharge volume.
[2] ∑PCB, Total Hg, and Total MeHg unit is µg/kg, and TOC and Total P unit is g/kg. Note: mean particle ratios were computed based on the individual paired samples and not by regression as is shown in Table 7. PCB ratios were not blank corrected.
[3] The interpolation method may have over predicted concentrations during unsampled periods. Subsequent years sampling will provide improved interpretation of mean concentrations as well as resulting loads.

and California (fipronil: 70 – 1300 ng/L, Moran, 2007) (Carbaryl: DL - 700 ng/L, Ensiminger et al., 2012). Pyrethroid concentrations of Delta/ Tralo-methrin and Cyhalothrin lambda were similar to those observed in Zone 4 Line A, a small 100% urban tributary in Hayward, whereas concentrations of

Permethrin were about 5x lower and concentrations of Bifenthrin were about 10x higher; cypermethrin was not detected in Z4LA (Gilbreath et al., 2012). In summary, the statistics indicate pollutant concentrations typical of a Bay Area non-urban stream; we have no reason to suspect data quality issues.

4.2.4. Marsh Creek toxicity

Composite water samples were collected at the Marsh Creek station during two storm events in Water Year 2012. No significant reductions in the survival, reproduction and growth of three of four test species were observed during these storms. Significant reductions in the survival of the amphipod *Hyalella azteca* was observed during both storm events. Although limited use of this species has occurred for the evaluation of toxicity in water, it has consistently been used by scientists to assess the toxicity of sediments in receiving waters.

Results from sampling in Marsh Creek are similar to those from recent wet weather monitoring conducted in Southern California (Riverside County 2007, Weston Solutions 2006), the Imperial Valley (Phillips et al. 2007), the Central Valley (Weston and Lydy 2010a, b), and the Sacramento-San Joaquin Delta (Werner et al., 2010), where follow up toxicity identification evaluations indicated that pyrethroid pesticides were almost certainly the cause of the toxicity observed. Via studies of toxicity in California receiving waters (Amweg et al. 2005, Weston and Holmes 2005, Anderson et al. 2010), pyrethroid pesticides have also been identified as the likely current causes of sediment toxicity in urban creeks. The toxicity testing results from Water Year 2012 monitoring in Marsh Creek are not unexpected given that *H. azteca* is considerably more sensitive to pyrethroids than other species tested as part of the POC monitoring studies.

4.3. San Leandro Creek

4.3.1. San Leandro Creek flow

There is no historic flow record on San Leandro Creek. A preliminary rating curve was developed by the SFEI team based on discharge sampling during WY 2012 and augmented by the Manning's formula. This rating will be improved in future sampling years. Based on this preliminary rating curve, total runoff during WY 2012 for the period 11/7/11 to 4/30/12 was 4.13 Mm^3, although we suspect the rating is low.

A series of relatively minor storms occurred during WY 2012 (Figure 3). Flow peaked at 121 cfs on 1/20/12 22:45. San Lorenzo Creek to the south has been gauged by the USGS in the town of San Lorenzo (gauge number 11181040) from WY 1968-78 and again from WY 1988-present. Based on these records, annual peak flow has ranged between 300 cfs (1971) and 10300 cfs (1998). During WY 2012, flow peaked on San Lorenzo Creek at San Lorenzo at 1600 cfs on 1/20/2012 at 23:00; a flow that has been exceeded 65% of the years on record. Based on this evidence alone, we suggest flow in San Leandro Creek was much lower than average.

In addition to the flow response from rainfall, East Bay Municipal Utility District (EBMUD) made releases from Chabot Reservoir in the first half of the season indicated by the square and sustained nature of the hydrograph at the sampling location, and the corresponding reservoir release data obtained from EBMUD (presented on the secondary y-axis of Figure 3). Despite this augmentation, it seems likely that

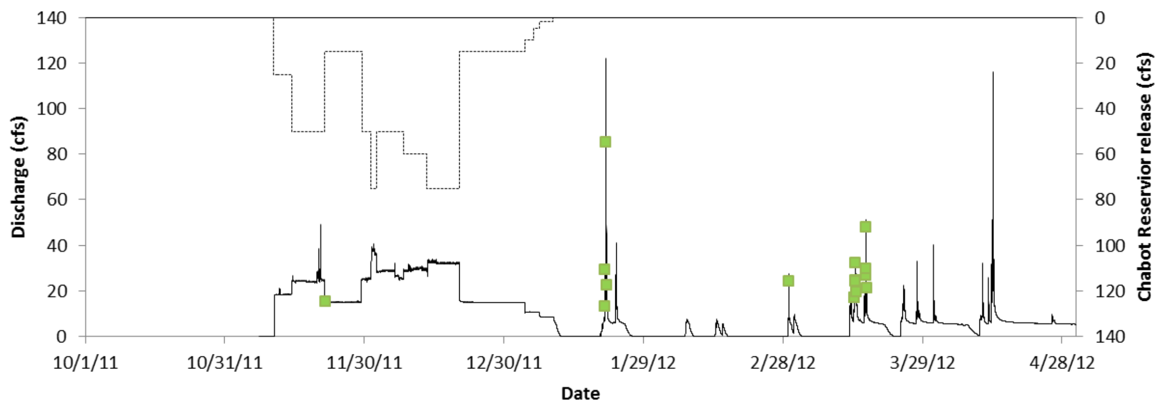


Figure 3. Preliminary flow characteristics (primary y axis) in San Leandro Creek at San Leandro Boulevard during Water Year 2012 with sampling events plotted in green. Note, flow information will be updated in the future with more velocity sampling and an improved rating curve.

annual flow in San Leandro Creek during WY 2012 was below average and would be exceeded in 60-70% of years. Rainfall data corroborates this assertion; rainfall during WY 2012 was 19.14 inches, or 75% of mean annual precipitation (MAP = 25.67 in) based on a long-term record at Upper San Leandro Filter (gauge number 049185) for the period 1971-2010 (Climate Year (CY)). CY 2012 ranked 18th driest in the available 57-year record (1949-present [Note 7-year data-gap during CY 1952-58]).

Flow data is based on preliminary 5 minute data generated by a rating relationship between stage and periodic discharge measurements made by the SFEI field team and augmented with computations using Manning's formula[1]. For comparison, the release from Chabot Reservoir is provided on the secondary y-axis. It is seen that the flow from Chabot reservoir exceeded the estimated flow from the rating relationship but at this time we have chosen not to manipulate the rating. The rating relationship for this location will be improved in subsequent years with additional field data and will result in updated flow and loads estimate for Water Year 2012 that will likely be greater.

4.3.2. San Leandro Creek turbidity and suspended sediment concentration

Turbidity generally responded to rainfall events in a similar manner to runoff. During the reservoir release period in the early part of the season, turbidity remained relatively low indicating very little sediment is within San Leandro Creek and available for transport at this magnitude and consistency of stream power. With each of the storms that occurred beginning 1/20/2012, maximum storm turbidity increased in magnitude. Turbidity peaked at 929 NTU during a late season storm on 4/13/12 at 5:15 am. These observations provide evidence that during larger storms and wetter years, the San Leandro Creek watershed is likely capable of much greater sediment erosion and transport resulting in greater turbidity and concentrations of suspended sediment. At this time, we have no evidence to suggest that the OBS-

[1] Manning's formula defines an empirical relationship between channel geometry, roughness, and hydraulic slope. (Chow, 1959).

500 instrument utilized at this sampling location (with a range of 0-4000 NTU) will not be sufficient to handle most future storms.

Suspended sediment concentration, since it was computed from the continuous turbidity data, follows the same patterns as turbidity in relation to discharge. Suspended sediment concentration peaked at 1324 mg/L during the late season storm on 4/13/12 at 5:15 am. The maximum concentration observed during the RMP reconnaissance study (McKee et al., in review) was 965 mg/L but at this time we have not evaluated the relative storm magnitude between WY 2011 and WY 2012 to determine if the relative concentrations are logical.

4.3.3. San Leandro Creek POC concentrations summary (summary statistics)

Summary statistics of pollutant concentrations measured in San Leandro Creek in WY 2012 are presented in Table 4 to provide a basic understanding of general water quality and also to provide a first order judgment of quality assurance. For pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients), concentrations followed the typical pattern of median < mean with the exception of organic carbon. The range of PCB concentrations were typical of mixed urban land use watersheds (Lent and McKee, 2011). Maximum mercury concentrations (577 ng/L) were greater than observed in Zone 4 Line A in Hayward (Gilbreath et al., 2012) and of a similar magnitude to those observed in the San Pedro stormdrain draining an older urban residential area of San Jose (SFEI, unpublished). Nutrient concentrations were in the same range as measured in in Z4LA (Gilbreath et al., 2012), and as is typical in the Bay Area, phosphorus concentrations appear to be greater than reported elsewhere in the world under similar land use scenarios, an observation perhaps attributable to geological sources (McKee and Krottje, 2005). We find no reason to suspect data quality issues since the concentration ranges appear reasonable in relation to our conceptual models of water quality for these analytes.

Pollutants sampled at a lesser frequency and appropriate for water quality characterization only (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) were similar to concentrations observed in Z4LA (Gilbreath et al., 2012). Carbaryl and fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (Fipronil: 70 – 1300 ng/L, Moran, 2007) (Carbaryl: DL - 700 ng/L, Ensiminger et al., 2012). Pyrethroid concentrations of Delta/ Tralo-methrin, Cyhalothrin lambda, and Bifenthrin were similar to those observed in Z4LA whereas concentrations of Permethrin were about 10x lower (Gilbreath et al., 2012). In summary, mercury concentrations in San Leandro are on the high end of typical Bay Area urban watersheds, whereas concentrations of other POCs are either within the range of or below those measured in other typical Bay Area urban watersheds. The does not appear to be any data quality issues.

4.3.4. San Leandro Creek toxicity

Composite water samples were collected at the San Leandro Creek station during four storm events in Water Year 2012. The survival of the freshwater fish species Pimephales promelas was significantly reduced during one of the four events. Similar to the results for other POC monitoring stations, significant reductions in the survival of the amphipod Hyalella azteca were observed, in this case in three

Table 4. Summary of laboratory measured pollutant concentrations in San Leandro Creek during WY 2012.

Analyte Name	Unit	Samples taken (n)	Proportion detected (%)	Min	Max	Median	Mean	Standard Deviation	FWM[1]	Mean Particle Ratio (mass/ mass)[2]	Standard Deviation of Particle Ratios
SSC	mg/L	53	98	21.0	590	105	165	144	242	NA	NA
∑PCB	ng/L	16	100	2.91	29.4	10.5	12.3	8.74	3.76	96.1	51.3
Total Hg	ng/L	16	100	11.9	577	89.4	184	203	31.9	965	520
Total MeHg	ng/L	9	100	0.164	1.48	0.220	0.499	0.456	0.432	4.17	2.40
TOC	mg/L	16	100	4.50	12.7	8.05	7.98	2.27	8.20	112	108
NO3	mg/L	16	100	0.140	0.830	0.340	0.356	0.194	0.334	NA	NA
Total P	mg/L	16	100	0.200	0.760	0.355	0.393	0.176	0.250	3.26	2.43
PO4	mg/L	16	100	0.0570	0.160	0.0725	0.0866	0.0282	0.070	NA	NA
Hardness	mg/L	4	100	33.8	72.5	56.5	54.8	18.5	NA	NA	NA
Total Cu	µg/L	4	100	12.3	39.5	20.1	23.0	11.8	NA	NA	NA
Dissolved Cu	µg/L	4	100	6.04	10.00	8.34	8.18	1.99	NA	NA	NA
Total Se	µg/L	4	100	0.112	0.292	0.216	0.209	0.085	NA	NA	NA
Dissolved Se	µg/L	4	100	0.0680	0.195	0.131	0.131	0.057	NA	NA	NA
Carbaryl	ng/L	4	50	10	14	12	12	2.83	NA	NA	NA
Fipronil	ng/L	4	100	6	10	8	8	1.63	NA	NA	NA
∑PAH	ng/L	2	100	3230	5352	4291	4291	1501	NA	NA	NA
∑PBDE	ng/L	2	100	64.9	82.0	73.5	73.5	12.1	NA	NA	NA
Delta/ Tralo-methrin	ng/L	4	75	0.326	1.74	1.41	1.16	0.740	NA	NA	NA
Fenpropathrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Esfenvalerate/ Fenvalerate	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Cypermethrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Cyfluthrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Cyhalothrin lambda	ng/L	4	25	-	-	-	3.86	-	NA	NA	NA
Permethrin	ng/L	4	100	3.35	13.1	5.77	7.00	4.45	NA	NA	NA
Bifenthrin	ng/L	4	75	10.2	32.4	14.0	18.9	11.9	NA	NA	NA
Allethrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Prallethrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Phenothrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA
Resmethrin	ng/L	4	0	-	-	-	-	-	NA	NA	NA

[1] FWMC = flow weighted mean concentration. Calculation is total annual mass load divided by total annual discharge volume.
[2] ∑PCB, Total Hg, and Total MeHg unit is µg/kg, and TOC and Total P unit is g/kg. Note: mean particle ratios were computed based on the individual paired samples and not by regression as is shown in Table 7. PCB ratios were not blank corrected.

of the four storm events sampled. Although limited use of this species has occurred for the evaluation of toxicity in water, it has consistently been used by scientists to assess the toxicity of sediments in receiving waters. No significant reductions in the survival, reproduction and growth of the crustacean Ceriodaphnia dubia or the algae Selenastrum capricornutum were observed during these storms.

Results from sampling in San Leandro Creek are similar to those from recent wet weather monitoring conducted in Southern California (Riverside County 2007, Weston Solutions 2006), the Imperial Valley (Phillips et al. 2007), the Central Valley (Weston and Lydy 2010a, b), and the Sacramento- San Joaquin Delta (Werner et al., 2010), where follow up toxicity identification evaluations indicated that pyrethroid pesticides were almost certainly the cause of the toxicity to H. azteca. Via studies of toxicity in California receiving waters (Amweg et al. 2005, Weston and Holmes 2005, Anderson et al. 2010), pyrethroid pesticides have also been identified as the likely current causes of sediment toxicity in urban creeks. The toxicity testing results from Water Year 2012 monitoring in San Leandro Creek are not unexpected given that H. azteca is considerably more sensitive to pyrethroids than other species tested as part of the POC monitoring studies.

4.4. Guadalupe River

4.4.1. Guadalupe River flow

The US Geological Survey has maintained a flow record on lower Guadalupe River (gauge number 11169000; 11169025) since October 1, 1930 (82 WYs; note 1931 is missing). Peak annual flows for the period have ranged between 125 cfs (WY 1960) and 11000 cfs (WY 1995). Annual runoff from Guadalupe River has ranged between 0.422 (WY 1933) and 241 Mm^3 (WY 1983).

During WY 2012, a series of relatively minor storms[2] occurred (Figure 4). A storm that caused flow to escape the low flow channel and inundate the in-channel bars did not occur until January 21st 2012, very late in the season compared to what has generally occurred over the past years of sampling and analysis for this system (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006; McKee et al., 2010; Owens et al., 2011). The flow during this January storm was 1220 cfs; flows of this magnitude are common in most years. Flow peaked at 1290 cfs on 4/13/2012 at 7:15 am. Total runoff during WY 2012 based on preliminary USGS data was 25.8 Mm^3; discharge of this magnitude is about 62% mean annual runoff (MAR) based on 81 years of record and 46% MAR if we consider the period WY1971-2010 (perhaps more representative of current climatic conditions given climate change). Rainfall data corroborates this assertion; rainfall during WY 2012 was 7.05 inches, or 47% of mean annual precipitation (MAP = 14.89 in) based on a long-term record at San Jose (NOAA gauge number 047821) for the period 1971-2010 (CY). CY 2012 was the driest year in the past 42 years and the 7th driest for the record beginning CY 1875 (138 years). Flow data and resulting loads calculations for this site will be updated once USGS publishes the official record. The USGS normally publishes finalized data for the permanent record in the spring following the end of each Water Year.

[2] A storm is defined as resulting in flow that exceeds bankfull, which, at this location, is 200 cfs, and is separated by non-storm flow for a minimum of two days.

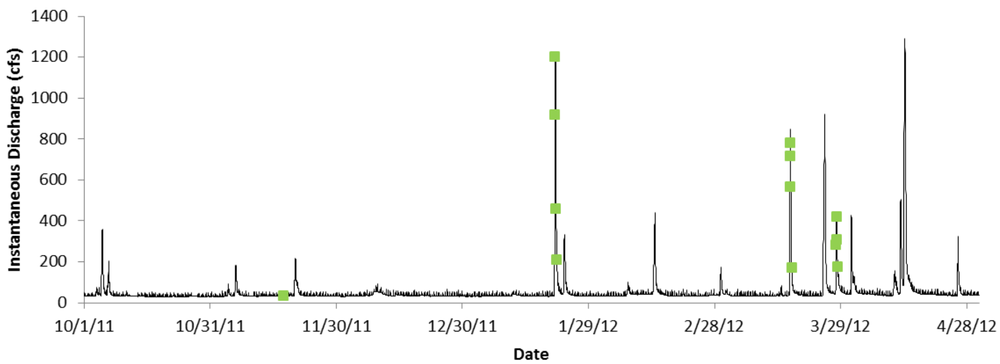


Figure 4. Preliminary flow characteristics in Guadalupe River during Water Year 2012 based on preliminary 15 minute data provided by the USGS (gauge number 11169025), with sampling events plotted in green. The fuzzy nature of the low flow data is caused by baseflow discharge fluctuations likely caused by pump station discharges near[3] the gauge.

4.4.2. Guadalupe River turbidity and suspended sediment concentration

Turbidity generally responded to rainfall events in a similar manner to runoff. Guadalupe River exhibited a pronounced first flush during a very minor early season storm when, relative to flow, turbidity was elevated and reached 260 FNU. In contrast, the storm that produced the greatest flow for the season that occurred on 4/13/2012 had lower peak turbidity (185 FNU). Peak turbidity for the season was 388 FNU during a storm on 1/21/12 at 3:15 am. Based on past years of record, turbidity can exceed 1000 FNU at the sampling location and the FTS DTS-12 turbidity probe is quite capable of sampling most if not all future sediment transport conditions for the site.

The USGS data record on SSC is not yet available. Therefore, preliminary estimates were computed by SFEI using the POC monitoring SSC data, the preliminary USGS turbidity record, and a linear regression model between instantaneous turbidity and SSC. Based on USGS sampling in Guadalupe River in past years, >90% of particles in this system are <62.5 µm in size (e.g. McKee et al., 2004). Because of these consistently fine particle sizes, turbidity correlates well with the concentrations of suspended sediments and hydrophobic pollutants (e.g. McKee et al., 2004). Suspended sediment concentration, since it was computed from the continuous turbidity data, follows the same patterns as turbidity in relation to discharge. It is estimated that SSC peaked at 844 mg/L during the January 21st storm event at 3:15 am. The maximum SSC observed during previous monitoring years was 1180 mg/L in 2002. Rainfall intensity was much greater during WY 2003 than any other year since leading to the hypothesis that concentrations of this magnitude will likely occur in the future during wetter years with greater and more intense rainfall (McKee et al., 2006).

[3] Pump station discharges actually occur downstream of the gauge; however, the gradient in this area is low enough that it affects upstream water levels on the hydrograph (pers comm., K. Abusaba, February 2013).

4.4.3. Guadalupe River POC concentrations summary (summary statistics)

A summary of concentrations is useful for providing comparisons to other systems and also for doing a first order quality assurance check. Concentrations measured in Guadalupe River during WY 2012 are summarized in Table 5. The range of PCB concentrations are typical of mixed urban land use watersheds (Lent and McKee, 2011) and maximum concentrations in this watershed were the 2nd highest measured of the four locations (Sunnyvale Channel >Guadalupe River >San Leandro Creek >Lower Marsh Creek). Maximum mercury concentrations (1000 ng/L) are greater than observed in Z4LA (Gilbreath et al., 2012) and the San Pedro stormdrain, which drains an older urban residential area of San Jose. This maximum concentration was higher than the average mercury concentration (690 ng/L) over the period of record at this location (2002-2010). Nutrient concentrations were in the same range as measured in in Z4LA (Gilbreath et al., 2012), and typical for the Bay Area, phosphorus concentrations appear greater than elsewhere in the world under similar land use scenarios, perhaps attributable to geological sources (McKee and Krottje, 2005). We have no reason to suspect any data quality issues.

In a similar manner, summary statistics and comparisons were developed for the lower sample frequency analytes. Copper, which was sampled at a lesser frequency for characterization only, was similar to concentrations previously observed ((McKee et al., 2004; McKee et al., 2005; McKee et al., 2006) and similar to those observed in Z4LA (Gilbreath et al., 2012). Selenium concentrations were generally 2-5 fold greater than the other three locations; elevated groundwater concentrations have been observed in Santa Clara County previously (Anderson, 1998). Carbaryl and fipronil were on the lower side of the range of peak concentrations reported in studies across the US and California (Fipronil: 70 – 1300 ng/L, Moran, 2007) (Carbaryl: DL - 700 ng/L, Ensiminger et al., 2012). Pyrethroid concentrations of Delta/ Tralo-methrin and Cyhalothrin lambda were similar to those observed in Z4LA whereas concentrations of Permethrin and Bifenthrin were lower (Gilbreath et al., 2012). No quality issues appear from the comparisons.

4.4.4. Guadalupe River toxicity

Composite water samples were collected at the Guadalupe River station during three storm events in WY 2012. Similar to the results for other POC monitoring stations, no significant reductions in the survival, reproduction and growth of three of four test species were observed during storms. Significant reductions in the survival of the amphipod Hyalella azteca was observed during two of the three storm events sampled. Although limited use of this species has occurred for the evaluation of toxicity in water, it has consistently been used by scientists to assess the toxicity of receiving water sediments.

Results from sampling in Guadalupe River are similar to those from recent wet weather monitoring conducted in Southern California (Riverside County 2007, Weston Solutions 2006), the Imperial Valley (Phillips et al. 2007), the Central Valley (Weston and Lydy 2010a, b), and the Sacramento- San Joaquin Delta (Werner et al., 2010), where follow up toxicity identification evaluations indicated that pyrethroid pesticides were likely the cause of toxicity. Via studies of toxicity in California receiving waters (Amweg et al. 2005, Weston and Holmes 2005, Anderson et al. 2010), pyrethroid pesticides have also been identified as the likely current causes of sediment toxicity in urban creeks. The toxicity testing results for WY 2012 in the Guadalupe River are not unexpected given that H. azteca is considerably more sensitive to pyrethroids than other species tested as part of the POC monitoring studies.

Table 5. Summary of laboratory measured pollutant concentrations in Guadalupe River.

Analyte Name	Unit	Samples taken (n)	Proportion detected (%)	Min	Max	Median	Mean	Standard Deviation	FWM[1]	Mean Particle Ratio (mass/ mass)[2]	Standard Deviation of Particle Ratios
SSC	mg/L	40	100	9	730	106	203	205	59	NA	NA
∑PCB	ng/L	11	100	2.702	59.08	7.17	17.66	21.46	6.79	97.3	77.4
Total Hg	ng/L	13	100	0.14	1000	91.7	247.1	318.7	71.6	1111	428
Total MeHg	ng/L	9	100	0.086	1.150	0.386	0.478	0.356	0.522	6.20	3.74
TOC	mg/L	12	100	4.90	18.0	7.45	8.73	4.03	5.06	81.0	59.2
NO3	mg/L	12	100	0.56	1.90	0.82	0.92	0.38	1.020	NA	NA
Total P	mg/L	12	100	0.190	0.81	0.315	0.453	0.247	0.307	3.56	2.07
PO4	mg/L	12	100	0.060	0.160	0.101	0.101	0.032	0.075	NA	NA
Hardness	mg/L	3	100	133	157	140	143	12	NA	NA	NA
Total Cu	µg/L	3	100	10.7	26.3	24.7	20.6	8.582	NA	NA	NA
Dissolved Cu	µg/L	3	100	5.07	7.91	5.51	6.16	1.529	NA	NA	NA
Total Se	µg/L	3	100	1.2	1.6	1.2	1.3	0.26	NA	NA	NA
Dissolved Se	µg/L	3	100	0.77	1.32	1.04	1.04	0.27	NA	NA	NA
Carbaryl	ng/L	3	100	13	67	57	46	28.73	NA	NA	NA
Fipronil	ng/L	3	100	7	20	11	13	7	NA	NA	NA
∑PAH	ng/L	1	100	-	-	-	2186	-	NA	NA	NA
∑PBDE	ng/L	1	100	-	-	-	34.5	-	NA	NA	NA
Delta/ Tralo-methrin	ng/L	3	100	0.704	1.90	1.82	1.47	0.67	NA	NA	NA
Fenpropathrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA
Esfenvalerate/ Fenvalerate	ng/L	3	33	-	-	-	3.30	-	NA	NA	NA
Cypermethrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA
Cyfluthrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA
Cyhalothrin lambda	ng/L	3	33	-	-	-	1.20	-	NA	NA	NA
Permethrin	ng/L	3	100	16.80	20.5	19.5	18.9	1.91	NA	NA	NA
Bifenthrin	ng/L	3	67	6.2	13	10	10	5	NA	NA	NA
Allethrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA
Prallethrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA
Phenothrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA
Resmethrin	ng/L	3	0	-	-	-	-	-	NA	NA	NA

[1] FWMC = flow weighted mean concentration. Calculation is total annual mass load divided by total annual discharge volume.
[2] ∑PCB, Total Hg, and Total MeHg unit is µg/kg, and TOC and Total P unit is g/kg. Note: mean particle ratios were computed based on the individual paired samples and not by regression as is shown in Table 7. PCB ratios were not blank corrected.

4.5. Sunnyvale East Channel

4.5.1. Sunnyvale East Channel flow

Santa Clara Valley Water District (SCVWD) has maintained a flow gauge on Sunnyvale East Channel from WY 1983 to present. Unfortunately, the record is known to be poor quality (pers. comm., Ken Stumpf, SCVWD), which was apparent when the record was regressed against rainfall (R^2 = 0.58) (Lent et al., 2012). The gauge is presently scheduled for improvement by SCVWD. In the absence of a reliable agency record at this time, a preliminary rating curve was developed by the SFEI team based on discharge sampling during WY 2012 and Manning's formula. This rating will be improved in future sampling years with additional field data and will likely result in updated flow estimate for WY 2012.

A series of relatively minor storms occurred during WY 2012 (Figure 5). Flow peaked at 227 cfs overnight on 4/12/12- 4/13/12 at midnight. Total runoff during WY 2012 for the period 11/30/11 to 4/30/12 was 2.05 Mm^3 based on our preliminary rating curve. Given that SCVWD maintains the channel to support a peak discharge of 800 cfs, it seems likely that flows observed in Sunnyvale East Channel during WY 2012 were likely below average. Rainfall data corroborates this assertion; rainfall during WY 2012 was 8.82 inches, 58% of mean annual precipitation (MAP = 15.25 in) based on a long-term record at Palo Alto (NOAA gauge number 046646) for the period 1971-2010 (CY). CY 2012 ranked 6th driest in the available 59-year record (1954-present).

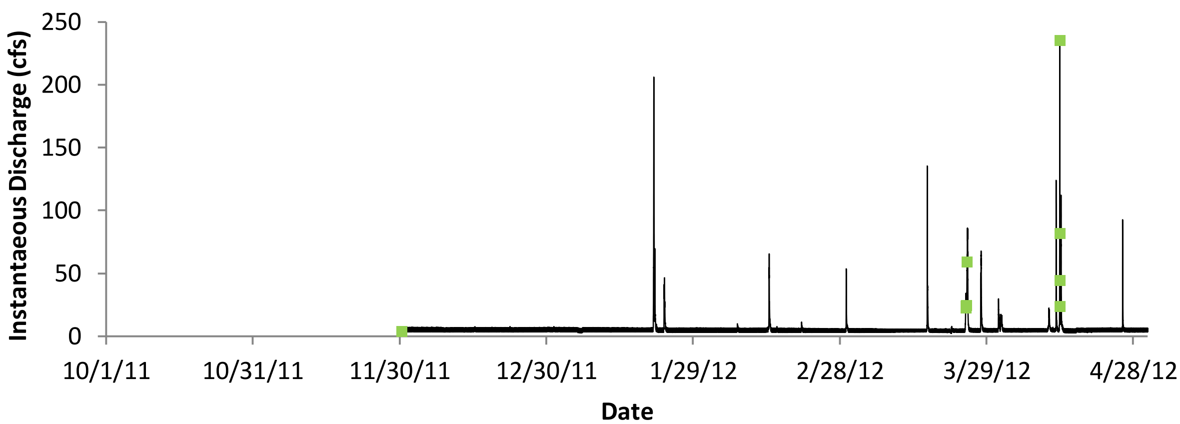


Figure 5. Preliminary flow characteristics in Sunnyvale East Channel at East Ahwanee Avenue during WY 2012 with sampling events marked in green. The flow record is based on preliminary 5 minute data generated by a rating relationship between stage and periodic discharge measurements augmented with Manning's formula computations. The rating relationship will be improved in subsequent years.

4.5.2. Sunnyvale East Channel turbidity and suspended sediment concentration

Turbidity for WY 2012 was rejected due to problems with the installation design and the OBS-500 instrument seeing the bottom of the channel. In WY 2013 it was replaced with an FTS DTS-12 turbidity probe (0-1,600 NTU range) which, based on WY 2012 SSC lab results, should be in range for all storms. Suspended sediment concentration could not be computed from the continuous turbidity data, and was alternatively computed during WY 2012 as a function of flow.

4.5.3. Sunnyvale East Channel POC concentrations summary (summary statistics)

A wide range of pollutants were measured in Sunnyvale East Channel during WY 2012 (Table 6). Concentrations for pollutants sampled at a sufficient frequency for loads analysis (suspended sediments, PCBs, mercury, organic carbon, and nutrients) exhibited the typical pattern of median < mean. The range of PCB concentrations were typical of mixed urban land use watersheds (Lent and McKee, 2011). Maximum mercury concentrations (64.1 ng/L) were less than observed in Z4LA (Gilbreath et al., 2012). Nutrient concentrations were also in the same range as measured in in Z4LA (Gilbreath et al., 2012) and like the other watersheds here reported, phosphorus concentrations are greater than elsewhere in the world under similar land use scenarios. Pollutants sampled at a lesser frequency appropriate for characterization only (copper, selenium, PAHs, carbaryl, fipronil, and PBDEs) were similar to concentrations observed in Z4LA (Gilbreath et al., 2012). Carbaryl and Fipronil (not measured previously by RMP studies) were on the lower side of the range of peak concentrations reported in studies across the US and California (Fipronil: 70 – 1300 ng/L, Moran, 2007) (Carbaryl: DL - 700 ng/L, Ensiminger et al., 2012). Pyrethroid concentrations of Bifenthrin were about 5x lower than observed in Z4LA and concentrations of Permethrin were about 10x lower (Gilbreath et al., 2012). No other pyrethroids were detected. Based on these first order comparisons, we see no quality issues with the data.

4.5.4. Sunnyvale East Channel toxicity

Composite water samples were collected in the Sunnyvale East Channel during two storm events in WY 2012. No significant reductions in the survival, reproduction and growth of three of four test species were observed during storms. Significant reductions in the survival of the amphipod Hyalella azteca was observed during both storm events[4]. Although limited use of this species has occurred for the evaluation of toxicity in water, it has consistently been used for assessments of receiving water sediment toxicity.

Results from sampling in the Sunnyvale East Channel are similar to those from recent wet weather monitoring conducted in Southern California (Riverside County 2007, Weston Solutions 2006), the Imperial Valley (Phillips et al. 2007), the Central Valley (Weston and Lydy 2010a, b), and the Sacramento-San Joaquin Delta (Werner et al., 2010), where follow up toxicity identification evaluations indicated that pyrethroid pesticides were almost certainly the cause of the toxicity observed. Via studies of toxicity in California receiving waters (Amweg et al. 2005, Weston and Holmes 2005, Anderson et al. 2010), pyrethroid pesticides have also been identified as the likely current causes of sediment toxicity in urban creeks. The toxicity testing results from WY 2012 monitoring in the Sunnyvale East Channel are not unexpected given that H. azteca is considerably more sensitive to pyrethroids than other species tested as part of the POC monitoring studies.

[4] In one of the two samples where significant toxicity was observed, a holding time violation occurred and therefore the results should be considered in the context of this exceedance of measurement quality objectives.

Table 6. Summary of laboratory measured pollutant concentrations in Sunnyvale East Channel.

Analyte Name	Unit	Samples taken (n)	Proportion detected (%)	Min	Max	Median	Mean	Standard Deviation	FWMC[1]	Mean Particle Ratio (mass/ mass)[2]	Standard Deviation of Particle Ratios
SSC	mg/L	28	96	6.30	370	50.0	84.6	101	22.3	NA	NA
∑PCB	ng/L	8	100	3.05	119	33.6	41.3	41.5	16.8	476	265
Total Hg	ng/L	9	89	6.30	64.1	21.7	27.7	21.7	12.1	427	118
Total MeHg	ng/L	5	100	0.045	0.558	0.267	0.300	0.205	0.143	3.66	2.03
TOC	mg/L	8	100	4.91	8.60	5.94	6.41	1.40	6.40	255	277
NO3	mg/L	8	100	0.200	0.560	0.280	0.309	0.119	0.307	NA	NA
Total P	mg/L	8	100	0.190	0.500	0.250	0.278	0.0975	0.214	7.96	7.10
PO4	mg/L	8	100	0.0670	0.110	0.0790	0.0849	0.0191	0.0847	NA	NA
Hardness	mg/L	2	100	51.4	61.2	56.3	56.3	6.93	NA	NA	NA
Total Cu	µg/L	2	100	10.8	19.0	14.9	14.9	5.80	NA	NA	NA
Dissolved Cu	µg/L	2	100	4.36	14.80	9.58	9.58	7.38	NA	NA	NA
Total Se	µg/L	2	100	0.327	0.494	0.411	0.411	0.118	NA	NA	NA
Dissolved Se	µg/L	2	100	0.308	0.325	0.317	0.317	0.0120	NA	NA	NA
Carbaryl	ng/L	2	100	11	21	16	16	7.07	NA	NA	NA
Fipronil	ng/L	2	100	6	12	9	9	4.24	NA	NA	NA
∑PAH	ng/L	1	100	-	-	-	1289	-	NA	NA	NA
∑PBDE	ng/L	1	100	-	-	-	4.77	-	NA	NA	NA
Delta/ Tralo-methrin	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Fenpropathrin	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Esfenvalerate/ Fenvalerate	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Cypermethrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Cyfluthrin	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Cyhalothrin lambda	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Permethrin	ng/L	2	100	5.70	20.9	13.3	13.3	10.8	NA	NA	NA
Bifenthrin	ng/L	2	50	-	-	-	8	-	NA	NA	NA
Allethrin	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Prallethrin	ng/L	2	0	-	-	-	-	-	NA	NA	NA
Phenothrin	ng/L	1	0	-	-	-	-	-	NA	NA	NA
Resmethrin	ng/L	1	0	-	-	-	-	-	NA	NA	NA

[1] FWMC = flow weighted mean concentration. Calculation is total annual mass load divided by total annual discharge volume.

[2] ∑PCB, Total Hg, and Total MeHg unit is µg/kg, and TOC and Total P unit is g/kg. Note: mean particle ratios were computed based on the individual paired samples and not by regression as is shown in Table 7. PCB ratios were not blank corrected.

5. Estimated Loads

Within the context of limited sampling during a very dry year water year, less storms were sampled than had been planned (2 of 4 storms in Marsh Creek and Sunnyvale East Channel, and 3 of 4 storms in Guadalupe River) in addition to limitations with the original sampling design (limited samples collected that represent base flow conditions), loads estimates are presented which will likely be updated when additional data are collected in subsequent years. The STLS plans to sample additional storms in subsequent monitoring years so that overall, on average 4 storms are sampled each year. Loads presented in this report will be updated in future years when improved flow data becomes available at each site and when a better understanding of discharge-turbidity-pollutant relationships is learned as more data is collected.

5.1. Marsh Creek preliminary loading estimates

The following loads computation methods were applied. During sampled stormflow conditions, linear interpolation using particle ratios was used to estimate total mercury, methylmercury, PCBs, and total phosphorus concentrations between sample concentrations that were measured by our laboratories, and linear interpolation using water concentrations was used to estimate nitrate and phosphate concentrations between sample concentrations that were measured by our laboratories. During unsampled storm flow, total mercury, methylmercury, TP, TOC, and PCB concentrations were computed using regression equations with SSC (Table 7). During base flow, total mercury and PCB concentrations were computed using regression equations with SSC, whereas the dry weather total methylmercury concentration from the lab's analysis was applied to the base flow conditions and the TOC concentration measured during the lowest flow was applied to all base flow conditions. No wet season loads estimates were reported for nitrate and phosphate because there was insufficient data at this time to speculate on defensible loads computation methods during non-sampled storm flow and base flow.

Table 7. Regression equations used for loads computations for Marsh Creek during water year 2012. Note that regression equations will be reformulated with each future wet season of storm sampling.

Analyte	Slope	Intercept	Correlation coefficient (r^2)	Notes
Total PCBs (ng/mg)[1]	0.0047	0.27	0.98	Great correlation despite small number of samples.
Total Mercury (ng/mg)	0.25	0.00	0.93	Forced through zero.
Total Methylmercury (ng/mg)	0.00074	0.055	0.96	Dry weather methylmercury sample not included.
Total Organic Carbon (mg/mg)	0.0049	6.8	0.45	
Total Phosphorus (mg/mg)	0.00089	0.29	0.91	

[1]PCB regressions were based on data that were not blank corrected.

Preliminary monthly loading estimates correlate fairly well with monthly discharge (Table 8). There are no data available for October and November because monitoring equipment was not installed until the end of November. Monthly discharge was greatest in April as were the highest monthly loads for each of

Table 8. Preliminary monthly loads (if data were sufficient) for Marsh Creek.

Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
Oct-11	33	0.105	-	-	-	-	-	-	-	-
Nov-11	26	0.038	-	-	-	-	-	-	-	-
Dec-11	6	0.025	0.435	173	0.110	0.00359	0.0129	-	-	8.45
Jan-12	51	0.318	64.2	3409	16.1	0.315	0.458	-	-	220
Feb-12	22	0.078	2.63	541	0.665	0.0170	0.0456	-	-	28.7
Mar-12	60	0.360	14.9	2536	3.60	0.0802	0.238	-	-	145
Apr-12	59	0.646	138	4788	35.0	0.674	0.884	-	-	267
Wet season total	198	1.43	220	11447	55.5	1.09	1.64 [1]	-	-	669

Rainfall in the lower watershed (Ironhouse Sanitary District, Oakley ISD39).

All loads were reported with a minimum of 3 significant figures to allow other to post manipulate the data. Loads are only accurate to 1-2 significant figures.

[1] The interpolation method may have over predicted concentrations during unsampled periods. Subsequent years sampling will provide improved interpretation of mean concentrations as well as resulting loads. Methyl mercury loads will most likely decrease with improved information.

the contaminants. The suspended sediment load in March appears to be low relative to rainfall and discharge; this may be due to the small magnitude of the storms during that month. At this time, all loads estimate should be considered preliminary. In addition (and, in this case, more importantly), data collected during WY 2013 will be used to improve our understanding of rainfall-runoff-pollutant transport processes and used to recalculate and finalize loads for WY 2012. Regardless of these improvements however, given the very dry flow conditions of WY 2012 (see discussion on flow above), preliminary loads presented here may be considered representative of very dry conditions.

5.2. San Leandro Creek preliminary loading estimates

The following methods were applied for calculating preliminary loading estimates. During sampled stormflow conditions, linear interpolation using particle ratios was used to estimate total mercury, methylmercury, PCBs, and total phosphorus concentrations between sample concentrations that were measured by our laboratories. Since TOC did not correlate with SSC or discharge, loads were not reported this year but data from subsequent sampling years may help to decide better how to interpolate data sufficiently to estimate monthly loads. During sampled stormflow conditions, linear interpolation using water concentrations was used to estimate nitrate and phosphate between sample concentrations that were measured by our laboratories. During nonsampled storm flows, concentrations were computed using regression equations between PCBs, total mercury and methylmercury, and SSC (Table 9). Of interest, there is evidence, that, relative to SSC, total mercury concentrations are lesser in flow derived from the urban areas and PCBs concentrations are greater; a pattern seen before for Guadalupe River (McKee et al., 2004; McKee et al., 2005). During base flows,

Table 9. Regression equations used for loads computations for San Leandro Creek during water year 2012. Note that regression equations will be reformulated with future wet season storm sampling.

Analyte	Origin of runoff	Slope	Intercept	Correlation coefficient (r^2)	Notes
Total PCBs (ng/mg)[1, 2]	Mainly urban	0.21	0.76	0.86	A combination of rainfall records and professional judgment was used to separate the samples. These interpretations will be revisited when WY 2013 data become available. Non-urban PCB regression forced through zero.
Total PCBs (ng/mg)[2]	Mainly non-urban	0.048	0	0.88	
Total Mercury (ng/mg)[2]	Mainly urban	0.50	5.0	0.97	
Total Mercury (ng/mg)[2]	Mainly non-urban	1.45	1.58	0.84	
Total Methylmercury (ng/mg)	-	0.0024	0.083	0.98	
Total Organic Carbon (mg/mg)	-	-	-	-	Scattershot – additional data might illuminate pattern.
Total Phosphorus (mg/mg)	-	0.0011	0.22		

[1]PCB regressions were based on data that were not blank corrected.
[2]Note the opposite patters of the regressions for PCBs and total mercury relative to SSC based on the origin of water.

PCB concentrations were assumed to be 2.91 ng/L (the lowest measured during the study year). The choice of base flow PCB concentration had a large impact on the total wet season load due to reservoir release; this weakness may not be as important during a wetter year but if reservoir releases are normal, sampling design may need to be modified in future years. The dry weather total methylmercury concentration from the lab's analysis was applied to the early season base flow conditions.

Preliminary monthly loading estimates correlate fairly well with monthly discharge except when reservoir releases were occurring (November and December) (Table 10). During November and December, flow conditions were elevated but suspended turbidity and sediment concentrations were low. Monthly discharge was greatest in April as were the highest monthly loads for suspended sediment and most pollutants. At this time, all loads estimates should be considered preliminary. Flow data will be improved as the rating curve is improved. In addition (and, in this case, as importantly), pollutant data collected during WY 2013 will be used to improve our understanding of rainfall-runoff-pollutant transport processes and used to recalculate and finalize loads for WY 2012. Further discussion is needed on the choice of pollutant concentrations to apply during reservoir release periods. Regardless, given the very dry conditions, loads during WY 2012 may be considered representative of very dry conditions.

5.3. Guadalupe River preliminary loading estimates

Within the context of limited sampling during the very dry year (three out of the four planned storms) in addition to limitations with the sampling design (limited samples collected that represent base flow conditions), the following methods were applied. Suspended sediment concentration was estimated from the turbidity record using a power relation (SSC = 0.80*turbidity$^{1.17}$). Once the official USGS flow and SSC record is published, the loads will be recalculated for suspended sediments and other dependent analytes. During sampled stormflow conditions, linear interpolation using particle ratios was used to estimate total mercury, methylmercury, PCBs, and total phosphorus concentrations between

Table 10. Preliminary monthly loads for *San Leandro Creek*.

Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
Oct-11	64	-	-	-	-	-	-	-	-	-
Nov-11	37	0.986	3.21	-	2.87	6.22	0.416	326	67.7	225
Dec-11	0	1.87	12.8	-	5.44	21.4	0.788	617	129	434
Jan-12	73	0.384	12.6	-	2.13	15.5	0.167	139	27.8	98.9
Feb-12	22	0.0545	1.56	-	0.164	2.29	0.0226	18.4	3.84	14.0
Mar-12	151	0.350	24.1	-	1.61	31.4	0.135	117	25.5	105
Apr-12	85	0.481	41.3	-	3.33	54.8	0.253	164	35.8	154
Wet season total	369	4.13	95.6	-	15.5	132	1.78	1380	289	1031

Rainfall data for the lower watershed is from the Estudillo-Huff Fire Stn, gauge 02G0007, except in October, in which the data is from the WRCC San Leandro Fltr station, gauge number 049185

All loads were reported with a minimum of 3 significant figures (s.f.) to allow other to post manipulate data. Loads are only accurate to 1-2 s.f.

sample concentrations that were measured by our laboratories. During sampled stormflow conditions, linear interpolation using water concentrations was used to estimate nitrate and phosphate between sample concentrations that were measured by our laboratories. During other storm flows and during base flow, concentrations were estimated using regression equations between total mercury and methylmercury, PCBs, and total phosphorus and SSC (Table 11). As found during other dry years (McKee et al., 2006), a separation of the data for PCBs and total mercury to form to regression relations based on origin of flow was not possible with WY 2012 data. During base flow, NO3 and PO4 concentrations were estimated using regression equations with flow. The dry weather total methylmercury concentration from the lab's analysis was applied to the early season base flow.

Table 11. Regression equations used for loads computations for Guadalupe River during water year 2012. Note that regression equations will be reformulated upon future wet season storm sampling.

Analyte	Slope	Intercept	Correlation coefficient (r2)	Notes
Total PCBs (ng/mg)[1]	0.070	2.81	0.65	This is lower slope than previously reported.
Total Mercury (ng/mg)	1.24	0	0.90	Forced through zero.
Total Methylmercury (ng/mg)	0.0047	0.26	0.42	
Total Organic Carbon (mg/cfs)	0.0109	3.16	0.82	Better correlation with discharge than with SSC.
Total Phosphorus (mg/mg)	0.0090	0.25	0.72	

[1]PCB regressions were based on data that were not blank corrected.

Preliminary monthly loading estimates correlate fairly well with monthly discharge except for January when the first flush caused elevated SSC relative to flow (Table 12). Monthly discharge was greatest in April as were loads of most pollutants (exceptions being suspended sediment and total mercury).

Table 12. Preliminary monthly loads for Guadalupe River.

Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
Oct-11	19	2.91	140	11232	18.0	173	1.41	3053	191	857
Nov-11	15	2.88	70.3	10761	13.0	87.0	1.08	3038	187	789
Dec-11	1	2.73	19.4	9751	9.05	24.0	0.801	2893	174	705
Jan-12	18	3.85	458	23817	37.2	575	3.15	4015	326	1408
Feb-12	14	3.15	170	12697	20.7	210	1.62	3295	211	945
Mar-12	50	5.06	330	28509	39.8	378	2.54	4919	403	1609
Apr-12	44	5.23	325	33784	37.5	402	2.89	5123	444	1609
Wet season total	161	25.8	1511	130551	175	1849	13.5	26336	1937	7923

Rainfall for the lower watershed (City of San Jose, SCVWD gauge number RF-131).
All loads were reported with a minimum of 3 significant figures to allow other to post manipulate the data. Loads are only accurate to 1-2 significant figures.

Compared to previous sampling years (McKee et al., 2004; McKee et al., 2005; McKee et al., 2006; McKee et al., 2010; Owens et al., 2011), loads of total mercury and PCBs were 3-4x lower. At this time, all loads estimates should be considered preliminary. Once available, USGS official records for flow, turbidity, and SSC can be substituted for the preliminary data presented here. In addition (and, in this case, as importantly for nutrients), pollutant data collected during WY 2013 will be used to improve our understanding of rainfall-runoff-pollutant transport processes and used to recalculate and finalize loads for WY 2012. Regardless of these improvements, overall, given the very dry flow conditions, loads during WY 2012 may be considered representative of very dry conditions.

5.4. Sunnyvale East Channel preliminary loading estimates

Within the context of limited sampling during the very dry year (two out of the four planned storms) in addition to limitations with the sampling design (limited samples collected that represent base flow conditions), the following methods were applied. Given that the turbidity record appears spurious and unreliable due to optical interference from bottom substrate (note problem now rectified), suspended sediment concentration was estimated from the discharge record using a linear relation (SSC (mg/L) = 1.496*discharge (cfs). During sampled stormflow conditions, linear interpolation using particle ratios was used to estimate total mercury, methylmercury, PCBs, and total phosphorus concentrations between sample concentrations that were measured by our laboratories. During sampled stormflow conditions, linear interpolation using water concentrations was used to estimate nitrate and phosphate between sample concentrations that were measured by our laboratories. During unsampled storm flow and base flow, concentrations were estimated using regression equations between total mercury and methylmercury, PCBs, and total phosphorus and SSC (Table 13). During base flow, POC, NO3 and PO4 concentrations were assumed to be the concentrations measured during the lowest flow conditions we observed during storms. The dry weather total methylmercury concentration from the lab's analysis was applied to the early season base flow.

Table 13. Regression equations used for loads computations for Sunnyvale East Channel during water year 2012. Note that regression equations will be reformulated upon future wet season storm sampling.

Analyte	Slope	Intercept	Correlation coefficient (r2)	Notes
Total PCBs (ng/mg)[1]	0.34	9.3	0.72	Great correlation despite small number of samples.
Total Mercury (ng/mg)	0.21	7.4	0.8	
Total Methylmercury (ng/mg)	0.0017	0.10	0.92	
Total Organic Carbon		-	-	Scattershot – additional data might illuminate pattern.
Total Phosphorus (mg/mg)	0.00090	0.19	0.93	Great correlation despite small number of samples.

[1]PCB regressions were based on data that were not blank corrected.

Preliminary monthly loading estimates correlate fairly well with monthly discharge (Table 14). Monthly discharge was greatest in January and April as were loads of most water quality constituents. At this time, all loads estimate should be considered preliminary. Sampling during WY 2013 should provide data on velocity during storms. In addition, pollutant data collected during WY 2013 will be used to improve our understanding of rainfall-runoff-pollutant transport processes and be used to recalculate and finalize loads for WY 2012. Regardless of these improvements, overall, given the very dry flow conditions, loads during WY 2012 may be considered representative of very dry conditions.

Table 14. Preliminary monthly loads for Sunnyvale East Channel.

Month	Rainfall (mm)	Discharge (Mm^3)	SS (t)	TOC (kg)	PCBs (g)	HgT (g)	MeHgT (g)	NO3 (kg)	PO4 (kg)	Total P (kg)
Oct-11	21	-	-	-	-	-	-	-	-	-
Nov-11		-	-	-	-	-	-	-	-	-
Dec-11	2	0.377	2.94	-	4.49	3.42	0.0443	116	32.0	75.8
Jan-12	37	0.442	14.3	-	8.93	6.27	0.0704	136	37.5	98.7
Feb-12	22	0.353	3.76	-	4.55	3.41	0.0432	109	29.9	71.9
Mar-12	69	0.441	10.6	-	7.38	5.38	0.0641	137	37.7	94.9
Apr-12	39	0.436	14.3	-	9.19	6.43	0.0709	134	36.8	97.9
Wet season total	169	2.05	45.9	-	34.6	24.9	0.293	632	174	439

Rainfall data collected at Sunnyvale Hamilton WTP.
All loads were reported with a minimum of 3 significant figures to allow other to post manipulate the data. Loads are only accurate to 1-2 significant figures.

5.5. Comparison of regression slopes and normalized loads estimates between watersheds

The comparison of loading estimates between watersheds is confounded by variations in drainage area, climate, and the suitability of the sampling design and the number of available samples collected so far.

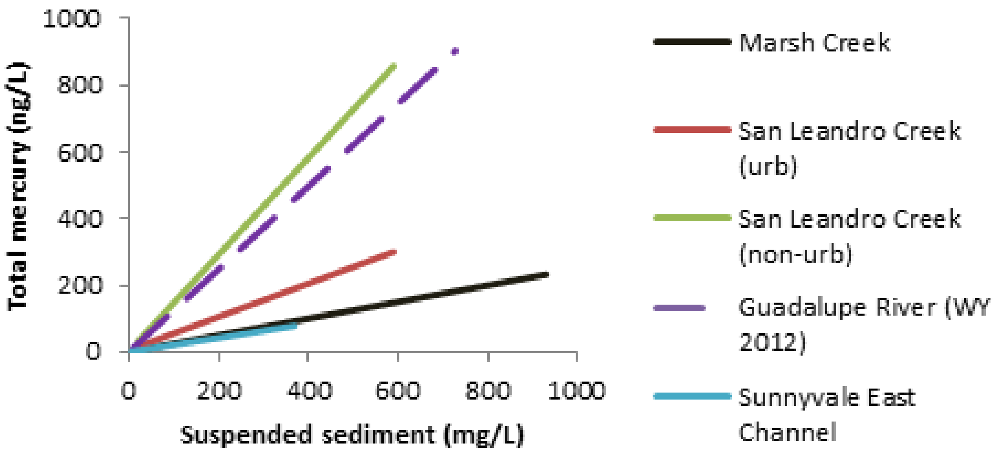
These caveats accepted, a preliminary comparison based on data collected during water year 2012 was provided here. We anticipate that these comparisons will change as additional data are collected in subsequent water years, and, should data be sufficient eventually, the best comparisons will be made with climatically averaged data.

One method of comparing watersheds is facilitated by comparing regression slopes based on the relationship between suspended sediment concentration and the target analyte (Figure 6). This method is valid for pollutants that are dominantly transported in a particulate form (total Mercury and the sum of PCBs are examples) and when there is relatively little variation in the particle ratios between water years. Based on particle ratios, runoff from San Leandro Creek that was derived mainly from the upper watershed and run-off from the Guadalupe River watershed exhibit the greatest particle ratios for total mercury (Figure 6). Given confidence intervals (not shown) and the relatively low numbers of samples collected during a relatively dry year, the relative nature of these two regression equations may change in the future as more samples are collected. Similarly, Marsh Creek and Sunnyvale East channel appear to have relatively low particle ratios for total mercury. In contrast, for the sum of PCBs, Sunnyvale East channel exhibits the highest particle ratios among these four watersheds, with urban sourced run-off from San Leandro Creek and Guadalupe River ranked second and third. Marsh Creek exhibits very low particle ratios for PCBs. Even with improved sample numbers, Marsh Creek will likely retain a low ranking for PCB pollution. At this time, given the very small number of samples, we have chosen not to report particle ratios for other analytes. These can be computed in the future once additional samples are available.

An alternative method for ranking watersheds in a relative sense is to compare area normalized loads (Table 15). This method is much more highly subject to climatic variation then the particle ratio method for ranking and is ideally done on climatically averaged loads. Despite quite large differences in unit run-off between the watersheds during water year 2012, in a general sense, the relative rankings for mercury and PCBs still follow the same trends using this method. However, we would anticipate changes of greater magnitude in the relative nature of the normalized loads with improved data in subsequent years. In particular, the relative rankings for suspended sediment loads normalized by unit area could change substantially with the addition of data from a water year that is closer to the climatic normal for each watershed. The same would be said for total phosphorus unit loads.

6. Conclusions and lessons learned

Overall, sampling during WY 2012 was reasonably successful. Given the dry conditions, only two of four storms planned for sampling were monitored on Lower Marsh Creek and Sunnyvale East Channel, and three of four were sampled on the Guadalupe River. Also given that Water Year 2012 was the first year of data collection under the STLS Multi-Year Plan (Plan), the results presented should be viewed as preliminary. Once implementation of the plan is completed, we intend to have a full set of representative data for both loads computations and characterization. The main objective this year was to complete a preliminary review of the data and develop the first versions of the loads computation techniques for each analyte and each watershed to support recommendations for improvement. A



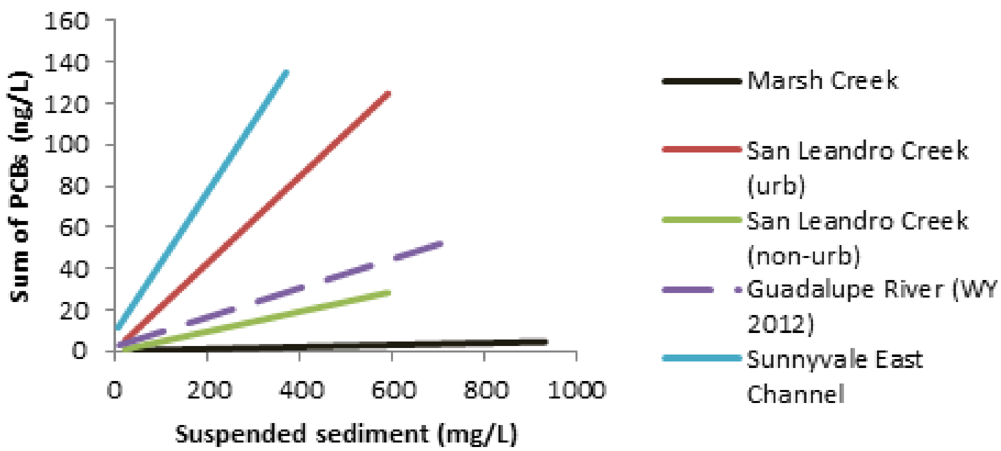


Figure 6. Comparison of regression slopes between watersheds based on data collected during water year 2012. Note these will likely change once additional data is collected in subsequent water years.

Table 15. Area normalized loads for water year 2012 based on free flowing areas downstream from reservoirs (see Table 1 for areas used in the computations). Note, direct comparison is confounded by the dry year and differing unit runoff. With additional years of sampling, climatically-averaged area-normalized loads may be generated.

	Unit runoff (m)	SS (t/km^2)	TOC (mg/m^2)	PCBs (µg/m^2)	HgT (µg/m^2)	MeHgT (µg/m^2)	NO3 (mg/m^2)	PO4 (mg/m^2)	Total P (mg/m^2)
Marsh Creek	0.014	2.2	116	0.56	0.011	0.017	-	-	6.8
San Leandro Creek	0.46	11	-	1.7	15	0.20	155	33	116
Guadalupe River	0.11	6.4	553	0.74	7.8	0.057	112	8.2	34
Sunnyvale East Channel	0.14	3.1	888	2.3	1.7	0.020	43	12	30

preliminary synthesis of the data using two techniques (regression slopes and normalized loads) also provided a further quality check on the preliminary results. We anticipate the general trends between watersheds won't change substantially with additional sampling in subsequent years, however, we do anticipate changes will occur to most of the regression equations and loads estimates. Based on this first year effort, recommended improvements in the sampling design to increase the quality of data collected via composite sampling include:

- A change from flow-based to time-based sampling in order to collect date more representative of *in-situ* organism exposure to pollutants (toxicity sample),
- A change from borosilicate glass containers for selenium/copper to polyethylene to align better with analytical protocols, and
- A reduced number of aliquots per storm from 24 to 16 in order to increase the accuracy of the autosamplers in relation to the measured aliquot volume.

Additionally, the turbidity instrument was changed at Sunnyvale Channel due to the poor data quality during WY2012. At this time, comparison of loads between sites is not too instructive given loads are not finalized but more importantly because WY 2012 was so dry. Variations between sites for such dry years might be overwhelmed by climatic conditions rather than variations in sources. Therefore, our further preliminary recommendations are:

- Once a second year of data is collected for each site, comparisons between concentrations and loads or more importantly exports (mass per unit area) should be recalculated,
- Generally for all sites, two additional grab samples collected during base flow early and late in the season and analyzed for, at a minimum, SSC, Hg, PCBs, would improve loads estimates. This would ideally be implemented in WY 2013 or as soon as budgets allow, and
- Specifically for San Leandro Creek, at least one sample taken during reservoir release and analyzed for, at a minimum, SSC, Hg, PCBs, would improve loads estimates. This would ideally be implemented WY 2013 or as soon as budgets allow.

7. References

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Appendix 1. Sample ID, sample date, station name, and analyte name

As called for in provision C.8.g.vi. of the MRP.

Sample ID	Sample Date	Station Name	Analyte Name
ST-SunCh-200	11/30/2011	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-200	11/30/2011	East Sunnyvale Channel	Mercury, Methyl
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Survival
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Total Cell Count
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Calcium
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Magnesium
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Carbaryl
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Copper
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Fipronil
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	PYRETHROIDS
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Selenium
ST-SunCh-210	3/24/2012	East Sunnyvale Channel	Total Hardness (calc)
ST-SunCh-211	3/24/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-211	3/24/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-211	3/24/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-211	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-211	3/24/2012	East Sunnyvale Channel	PCB
ST-SunCh-212	3/24/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-212	3/24/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-212	3/24/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-212	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-212	3/24/2012	East Sunnyvale Channel	PAHs
ST-SunCh-212	3/24/2012	East Sunnyvale Channel	PCB
ST-SunCh-213	3/24/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-213	3/24/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-213	3/24/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-213	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-213	3/24/2012	East Sunnyvale Channel	PBDPE
ST-SunCh-213	3/24/2012	East Sunnyvale Channel	PCB
ST-SunCh-214	3/25/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-214	3/25/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-214	3/25/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-214	3/25/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-214	3/25/2012	East Sunnyvale Channel	PCB
ST-SunCh-215	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-215	3/24/2012	East Sunnyvale Channel	Mercury
ST-SunCh-216	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration

Sample ID	Sample Date	Station Name	Analyte Name
ST-SunCh-216	3/24/2012	East Sunnyvale Channel	Mercury
ST-SunCh-217	3/24/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-217	3/24/2012	East Sunnyvale Channel	Mercury
ST-SunCh-218	3/25/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-218	3/25/2012	East Sunnyvale Channel	Mercury
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Survival
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Total Cell Count
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Calcium
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Carbaryl
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Copper
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Fipronil
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Magnesium
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	PYRETHROIDS
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Selenium
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-220	4/12/2012	East Sunnyvale Channel	Total Hardness (calc)
ST-SunCh-221	4/12/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-221	4/13/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-221	4/13/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-221	4/13/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-221	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-221	4/13/2012	East Sunnyvale Channel	PCB
ST-SunCh-222	4/13/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-222	4/13/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-222	4/13/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-222	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-222	4/13/2012	East Sunnyvale Channel	PCB
ST-SunCh-223	4/13/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-223	4/13/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-223	4/13/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-223	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-223	4/13/2012	East Sunnyvale Channel	PCB
ST-SunCh-224	4/13/2012	East Sunnyvale Channel	Nitrate as N
ST-SunCh-224	4/13/2012	East Sunnyvale Channel	OrthoPhosphate as P
ST-SunCh-224	4/13/2012	East Sunnyvale Channel	Phosphorus as P
ST-SunCh-224	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-224	4/13/2012	East Sunnyvale Channel	PCB
ST-SunCh-225	4/12/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-225	4/12/2012	East Sunnyvale Channel	Mercury
ST-SunCh-225	4/12/2012	East Sunnyvale Channel	Mercury, Methyl

Sample ID	Sample Date	Station Name	Analyte Name
ST-SunCh-226	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-226	4/13/2012	East Sunnyvale Channel	Mercury
ST-SunCh-226	4/13/2012	East Sunnyvale Channel	Mercury, Methyl
ST-SunCh-227	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-227	4/13/2012	East Sunnyvale Channel	Mercury
ST-SunCh-227	4/13/2012	East Sunnyvale Channel	Mercury, Methyl
ST-SunCh-228	4/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
ST-SunCh-228	4/13/2012	East Sunnyvale Channel	Mercury
ST-SunCh-228	4/13/2012	East Sunnyvale Channel	Mercury, Methyl
ST-SunCh-250	6/13/2012	East Sunnyvale Channel	Mercury, Methyl
ST-SunCh-250	6/13/2012	East Sunnyvale Channel	Suspended Sediment Concentration
GR-900	11/17/2011	Guadalupe River	Mercury, Methyl
GR-900	11/17/2011	Guadalupe River	Suspended Sediment Concentration
GR-910	1/21/2012	Guadalupe River	Survival
GR-910	1/21/2012	Guadalupe River	Total Cell Count
GR-910	1/21/2012	Guadalupe River	Calcium
GR-910	1/21/2012	Guadalupe River	Carbaryl
GR-910	1/21/2012	Guadalupe River	Copper
GR-910	1/21/2012	Guadalupe River	Fipronil
GR-910	1/21/2012	Guadalupe River	Magnesium
GR-910	1/21/2012	Guadalupe River	PYRETHROIDS
GR-910	1/21/2012	Guadalupe River	Selenium
GR-910	1/21/2012	Guadalupe River	Suspended Sediment Concentration
GR-910	1/21/2012	Guadalupe River	Total Hardness (calc)
GR-911	1/21/2012	Guadalupe River	Mercury
GR-911	1/21/2012	Guadalupe River	Nitrate as N
GR-911	1/21/2012	Guadalupe River	OrthoPhosphate as P
GR-911	1/21/2012	Guadalupe River	PCB
GR-911	1/21/2012	Guadalupe River	Phosphorus as P
GR-911	1/21/2012	Guadalupe River	Suspended Sediment Concentration
GR-912	1/21/2012	Guadalupe River	Mercury
GR-912	1/21/2012	Guadalupe River	Nitrate as N
GR-912	1/21/2012	Guadalupe River	OrthoPhosphate as P
GR-912	1/21/2012	Guadalupe River	PAHs
GR-912	1/21/2012	Guadalupe River	PCB
GR-912	1/21/2012	Guadalupe River	Phosphorus as P
GR-912	1/21/2012	Guadalupe River	Suspended Sediment Concentration
GR-913	1/21/2012	Guadalupe River	Mercury
GR-913	1/21/2012	Guadalupe River	Nitrate as N
GR-913	1/21/2012	Guadalupe River	OrthoPhosphate as P

Sample ID	Sample Date	Station Name	Analyte Name
GR-913	1/21/2012	Guadalupe River	PBDPE
GR-913	1/21/2012	Guadalupe River	PCB
GR-913	1/21/2012	Guadalupe River	Phosphorus as P
GR-913	1/21/2012	Guadalupe River	Suspended Sediment Concentration
GR-914	1/21/2012	Guadalupe River	Mercury
GR-914	1/21/2012	Guadalupe River	Nitrate as N
GR-914	1/21/2012	Guadalupe River	OrthoPhosphate as P
GR-914	1/21/2012	Guadalupe River	PCB
GR-914	1/21/2012	Guadalupe River	Phosphorus as P
GR-914	1/21/2012	Guadalupe River	Suspended Sediment Concentration
GR-920	3/16/2012	Guadalupe River	Survival
GR-920	3/16/2012	Guadalupe River	Total Cell Count
GR-920	3/16/2012	Guadalupe River	Calcium
GR-920	3/16/2012	Guadalupe River	Carbaryl
GR-920	3/16/2012	Guadalupe River	Copper
GR-920	3/16/2012	Guadalupe River	Fipronil
GR-920	3/16/2012	Guadalupe River	Magnesium
GR-920	3/16/2012	Guadalupe River	PYRETHROIDS
GR-920	3/16/2012	Guadalupe River	Selenium
GR-920	3/16/2012	Guadalupe River	Suspended Sediment Concentration
GR-920	3/16/2012	Guadalupe River	Total Hardness (calc)
GR-921	3/16/2012	Guadalupe River	Mercury
GR-921	3/16/2012	Guadalupe River	Mercury, Methyl
GR-921	3/16/2012	Guadalupe River	Nitrate as N
GR-921	3/16/2012	Guadalupe River	OrthoPhosphate as P
GR-921	3/16/2012	Guadalupe River	PCB
GR-921	3/16/2012	Guadalupe River	Phosphorus as P
GR-921	3/16/2012	Guadalupe River	Suspended Sediment Concentration
GR-922	3/17/2012	Guadalupe River	Mercury
GR-922	3/17/2012	Guadalupe River	Mercury, Methyl
GR-922	3/17/2012	Guadalupe River	Nitrate as N
GR-922	3/17/2012	Guadalupe River	OrthoPhosphate as P
GR-922	3/17/2012	Guadalupe River	Phosphorus as P
GR-922	3/17/2012	Guadalupe River	Suspended Sediment Concentration
GR-923	3/17/2012	Guadalupe River	Mercury
GR-923	3/17/2012	Guadalupe River	Mercury, Methyl
GR-923	3/17/2012	Guadalupe River	Nitrate as N
GR-923	3/17/2012	Guadalupe River	OrthoPhosphate as P
GR-923	3/17/2012	Guadalupe River	PCB
GR-923	3/17/2012	Guadalupe River	Phosphorus as P

Sample ID	Sample Date	Station Name	Analyte Name
GR-923	3/17/2012	Guadalupe River	Suspended Sediment Concentration
GR-924	3/17/2012	Guadalupe River	Mercury
GR-924	3/17/2012	Guadalupe River	Mercury, Methyl
GR-924	3/17/2012	Guadalupe River	Nitrate as N
GR-924	3/17/2012	Guadalupe River	OrthoPhosphate as P
GR-924	3/17/2012	Guadalupe River	PCB
GR-924	3/17/2012	Guadalupe River	Phosphorus as P
GR-924	3/17/2012	Guadalupe River	Suspended Sediment Concentration
GR-930	3/27/2012	Guadalupe River	Total Cell Count
GR-930	3/27/2012	Guadalupe River	Survival
GR-930	3/27/2012	Guadalupe River	Calcium
GR-930	3/27/2012	Guadalupe River	Carbaryl
GR-930	3/27/2012	Guadalupe River	Copper
GR-930	3/27/2012	Guadalupe River	Fipronil
GR-930	3/27/2012	Guadalupe River	Magnesium
GR-930	3/27/2012	Guadalupe River	PYRETHROIDS
GR-930	3/27/2012	Guadalupe River	Selenium
GR-930	3/27/2012	Guadalupe River	Suspended Sediment Concentration
GR-930	3/27/2012	Guadalupe River	Total Hardness (calc)
GR-931	3/27/2012	Guadalupe River	Mercury
GR-931	3/27/2012	Guadalupe River	Mercury, Methyl
GR-931	3/27/2012	Guadalupe River	Nitrate as N
GR-931	3/27/2012	Guadalupe River	OrthoPhosphate as P
GR-931	3/27/2012	Guadalupe River	PCB
GR-931	3/27/2012	Guadalupe River	Phosphorus as P
GR-931	3/27/2012	Guadalupe River	Suspended Sediment Concentration
GR-932	3/28/2012	Guadalupe River	Mercury
GR-932	3/28/2012	Guadalupe River	Mercury, Methyl
GR-932	3/28/2012	Guadalupe River	Nitrate as N
GR-932	3/28/2012	Guadalupe River	OrthoPhosphate as P
GR-932	3/28/2012	Guadalupe River	PCB
GR-932	3/28/2012	Guadalupe River	Phosphorus as P
GR-932	3/28/2012	Guadalupe River	Suspended Sediment Concentration
GR-933	3/28/2012	Guadalupe River	Mercury
GR-933	3/28/2012	Guadalupe River	Mercury, Methyl
GR-933	3/28/2012	Guadalupe River	Nitrate as N
GR-933	3/28/2012	Guadalupe River	OrthoPhosphate as P
GR-933	3/28/2012	Guadalupe River	PCB
GR-933	3/28/2012	Guadalupe River	Phosphorus as P
GR-933	3/28/2012	Guadalupe River	Suspended Sediment Concentration

Sample ID	Sample Date	Station Name	Analyte Name
GR-934	3/28/2012	Guadalupe River	Mercury
GR-934	3/28/2012	Guadalupe River	Mercury, Methyl
GR-934	3/28/2012	Guadalupe River	Nitrate as N
GR-934	3/28/2012	Guadalupe River	OrthoPhosphate as P
GR-934	3/28/2012	Guadalupe River	PCB
GR-934	3/28/2012	Guadalupe River	Phosphorus as P
GR-934	3/28/2012	Guadalupe River	Suspended Sediment Concentration
GR-950	6/13/2012	Guadalupe River	Mercury, Methyl
GR-950	6/13/2012	Guadalupe River	Suspended Sediment Concentration
ST-LMarCr-210	1/20/2012	Lower Marsh Creek	Survival
ST-LMarCr-210	1/20/2012	Lower Marsh Creek	Total Cell Count
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Calcium
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Carbaryl
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Copper
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Fipronil
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Magnesium
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	PYRETHROIDS
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Selenium
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-210	1/21/2012	Lower Marsh Creek	Total Hardness (calc)
ST-LMarCr-210-Dup	1/21/2012	Lower Marsh Creek	PYRETHROIDS
ST-LMarCr-210-Dup	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-211	1/20/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-211	1/20/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-211	1/20/2012	Lower Marsh Creek	PCB
ST-LMarCr-211	1/20/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-211	1/20/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-212	1/21/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-212	1/21/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-212	1/21/2012	Lower Marsh Creek	PCB
ST-LMarCr-212	1/21/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-212	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-213	1/21/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-213	1/21/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-213	1/21/2012	Lower Marsh Creek	PCB
ST-LMarCr-213	1/21/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-213	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-214	1/21/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-214	1/21/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-214	1/21/2012	Lower Marsh Creek	PCB

Sample ID	Sample Date	Station Name	Analyte Name
ST-LMarCr-214	1/21/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-214	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-215	1/20/2012	Lower Marsh Creek	Mercury
ST-LMarCr-215	1/20/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-216	1/21/2012	Lower Marsh Creek	Mercury
ST-LMarCr-216	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-217	1/21/2012	Lower Marsh Creek	Mercury
ST-LMarCr-217	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-218	1/21/2012	Lower Marsh Creek	Mercury
ST-LMarCr-218	1/21/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-220	3/16/2012	Lower Marsh Creek	Survival
ST-LMarCr-220	3/16/2012	Lower Marsh Creek	Total Cell Count
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Calcium
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Carbaryl
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Copper
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Fipronil
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Magnesium
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	PYRETHROIDS
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Selenium
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-220	3/17/2012	Lower Marsh Creek	Total Hardness (calc)
ST-LMarCr-220-Dup	3/17/2012	Lower Marsh Creek	Carbaryl
ST-LMarCr-220-Dup	3/17/2012	Lower Marsh Creek	Fipronil
ST-LMarCr-221	3/16/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-221	3/16/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-221	3/16/2012	Lower Marsh Creek	PBDPE
ST-LMarCr-221	3/16/2012	Lower Marsh Creek	PCB
ST-LMarCr-221	3/16/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-221	3/16/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-221-Dup	3/16/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-222	3/16/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-222	3/16/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-222	3/16/2012	Lower Marsh Creek	PAHs
ST-LMarCr-222	3/16/2012	Lower Marsh Creek	PCB
ST-LMarCr-222	3/16/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-222	3/16/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-223	3/17/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-223	3/17/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-223	3/17/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-223	3/17/2012	Lower Marsh Creek	Suspended Sediment Concentration

Sample ID	Sample Date	Station Name	Analyte Name
ST-LMarCr-224	3/17/2012	Lower Marsh Creek	Nitrate as N
ST-LMarCr-224	3/17/2012	Lower Marsh Creek	OrthoPhosphate as P
ST-LMarCr-224	3/17/2012	Lower Marsh Creek	PCB
ST-LMarCr-224	3/17/2012	Lower Marsh Creek	Phosphorus as P
ST-LMarCr-224	3/17/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-225	3/16/2012	Lower Marsh Creek	Mercury
ST-LMarCr-225	3/16/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-225	3/16/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-226	3/16/2012	Lower Marsh Creek	Mercury
ST-LMarCr-226	3/16/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-226	3/16/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-227	3/17/2012	Lower Marsh Creek	Mercury
ST-LMarCr-227	3/17/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-227	3/17/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-228	3/17/2012	Lower Marsh Creek	Mercury
ST-LMarCr-228	3/17/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-228	3/17/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-228-Dup	3/17/2012	Lower Marsh Creek	Mercury
ST-LMarCr-228-Dup	3/17/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-240	6/20/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-240	6/20/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-LMarCr-240-Dup	6/20/2012	Lower Marsh Creek	Mercury, Methyl
ST-LMarCr-240-Dup	6/20/2012	Lower Marsh Creek	Suspended Sediment Concentration
ST-SLeaCr-200	11/21/2011	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-200	11/21/2011	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-211	1/20/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-211	1/20/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-211	1/20/2012	San Leandro Creek	PCB
ST-SLeaCr-211	1/20/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-211	1/20/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-212	1/20/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-212	1/20/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-212	1/20/2012	San Leandro Creek	PAHs
ST-SLeaCr-212	1/20/2012	San Leandro Creek	PCB
ST-SLeaCr-212	1/20/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-212	1/20/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-213	1/20/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-213	1/20/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-213	1/20/2012	San Leandro Creek	PBDPE
ST-SLeaCr-213	1/20/2012	San Leandro Creek	PCB

Sample ID	Sample Date	Station Name	Analyte Name
ST-SLeaCr-213	1/20/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-213	1/20/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-214	1/21/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-214	1/21/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-214	1/21/2012	San Leandro Creek	PCB
ST-SLeaCr-214	1/21/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-214	1/21/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-215	1/20/2012	San Leandro Creek	Mercury
ST-SLeaCr-215	1/20/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-216	1/20/2012	San Leandro Creek	Mercury
ST-SLeaCr-216	1/20/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-217	1/21/2012	San Leandro Creek	Mercury
ST-SLeaCr-217	1/21/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-218	1/21/2012	San Leandro Creek	Mercury
ST-SLeaCr-218	1/21/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Calcium
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Magnesium
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Survival
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Total Cell Count
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Carbaryl
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Copper
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Fipronil
ST-SLeaCr-220	2/29/2012	San Leandro Creek	PYRETHROIDS
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Selenium
ST-SLeaCr-220	2/29/2012	San Leandro Creek	Total Hardness (calc)
ST-SLeaCr-221	2/29/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-221	2/29/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-221	2/29/2012	San Leandro Creek	PCB
ST-SLeaCr-221	2/29/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-221	2/29/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-222	2/29/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-222	2/29/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-222	2/29/2012	San Leandro Creek	PCB
ST-SLeaCr-222	2/29/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-222	2/29/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Calcium
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Magnesium
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Survival

Sample ID	Sample Date	Station Name	Analyte Name
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Total Cell Count
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Carbaryl
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Copper
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Fipronil
ST-SLeaCr-230	3/14/2012	San Leandro Creek	PYRETHROIDS
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Selenium
ST-SLeaCr-230	3/14/2012	San Leandro Creek	Total Hardness (calc)
ST-SLeaCr-231	3/14/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-231	3/14/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-231	3/14/2012	San Leandro Creek	PCB
ST-SLeaCr-231	3/14/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-231	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-232	3/14/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-232	3/14/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-232	3/14/2012	San Leandro Creek	PCB
ST-SLeaCr-232	3/14/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-232	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-233	3/14/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-233	3/14/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-233	3/14/2012	San Leandro Creek	PCB
ST-SLeaCr-233	3/14/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-233	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-234	3/14/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-234	3/14/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-234	3/14/2012	San Leandro Creek	PCB
ST-SLeaCr-234	3/14/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-234	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-235	3/14/2012	San Leandro Creek	Mercury
ST-SLeaCr-235	3/14/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-235	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-236	3/14/2012	San Leandro Creek	Mercury
ST-SLeaCr-236	3/14/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-236	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-237	3/14/2012	San Leandro Creek	Mercury
ST-SLeaCr-237	3/14/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-237	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-237-Dup	3/14/2012	San Leandro Creek	Mercury
ST-SLeaCr-237-Dup	3/14/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-237-Dup	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-238	3/14/2012	San Leandro Creek	Mercury

Sample ID	Sample Date	Station Name	Analyte Name
ST-SLeaCr-238	3/14/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-238	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-241	3/14/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-241	3/14/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-241	3/14/2012	San Leandro Creek	PCB
ST-SLeaCr-241	3/14/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-241	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-242	3/14/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-242	3/14/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-242	3/14/2012	San Leandro Creek	PCB
ST-SLeaCr-242	3/14/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-242	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-245	3/14/2012	San Leandro Creek	Mercury
ST-SLeaCr-245	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-246	3/14/2012	San Leandro Creek	Mercury
ST-SLeaCr-246	3/14/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Calcium
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Magnesium
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Survival
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Total Cell Count
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Carbaryl
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Copper
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Fipronil
ST-SLeaCr-250	3/16/2012	San Leandro Creek	PYRETHROIDS
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Selenium
ST-SLeaCr-250	3/16/2012	San Leandro Creek	Total Hardness (calc)
ST-SLeaCr-251	3/16/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-251	3/16/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-251	3/16/2012	San Leandro Creek	PAHs
ST-SLeaCr-251	3/16/2012	San Leandro Creek	PBDPE
ST-SLeaCr-251	3/16/2012	San Leandro Creek	PCB
ST-SLeaCr-251	3/16/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-251	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-252	3/16/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-252	3/16/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-252	3/16/2012	San Leandro Creek	PCB
ST-SLeaCr-252	3/16/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-252	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-253	3/16/2012	San Leandro Creek	Nitrate as N

Sample ID	Sample Date	Station Name	Analyte Name
ST-SLeaCr-253	3/16/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-253	3/16/2012	San Leandro Creek	PCB
ST-SLeaCr-253	3/16/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-253	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-254	3/16/2012	San Leandro Creek	Nitrate as N
ST-SLeaCr-254	3/16/2012	San Leandro Creek	OrthoPhosphate as P
ST-SLeaCr-254	3/16/2012	San Leandro Creek	PCB
ST-SLeaCr-254	3/16/2012	San Leandro Creek	Phosphorus as P
ST-SLeaCr-254	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-255	3/16/2012	San Leandro Creek	Mercury
ST-SLeaCr-255	3/16/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-255	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-256	3/16/2012	San Leandro Creek	Mercury
ST-SLeaCr-256	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-257	3/16/2012	San Leandro Creek	Mercury
ST-SLeaCr-257	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-258	3/16/2012	San Leandro Creek	Mercury
ST-SLeaCr-258	3/16/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-258	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-259	3/16/2012	San Leandro Creek	Mercury
ST-SLeaCr-259	3/16/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-259	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-260	3/16/2012	San Leandro Creek	Mercury
ST-SLeaCr-260	3/16/2012	San Leandro Creek	Mercury, Methyl
ST-SLeaCr-260	3/16/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Calcium
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Magnesium
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Suspended Sediment Concentration
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Survival
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Total Cell Count
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Carbaryl
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Copper
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Fipronil
ST-SLeaCr-270	4/12/2012	San Leandro Creek	PYRETHROIDS
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Selenium
ST-SLeaCr-270	4/12/2012	San Leandro Creek	Total Hardness (calc)

Appendix 2. Quality Assurance information

Table A1: Summary of QA data at all sites. This table includes the top eight PAHs found commonly at all sites , the PBDE congeners that account for 75% of the sum of all PBDE congeners, the top nine PCB congeners found at all sites, and the pyrethroids that were detected at any site.

Analyte	Unit	Average Lab Blank	Detection Limit (MDL) (range; mean)	Average Reporting Limit (RL)	RSD of Lab Duplicates (% range; % mean)	RSD of Field Duplicates (% range; % mean)	Percent Recovery of CRM (% range; % mean)	Percent Recovery of Matrix Spike (% range; % mean)
Carbaryl	ug/L	0	0.01-0.01; 0.01	0.02	75.7-75.7; 75.7	83.5-83.5; 83.5	NA	67.4-120.3; 94.8
Fipronil	ug/L	0	0.002-0.005; 0.002	0.012	NA	0-17.7; 9.5	NA	51.5-127.3; 80.9
NH_4	mg/L	0.002	0.01-0.02; 0.015	NA	0-9.9; 1.9	0-9.9; 2.4	NA	78.8-111.9; 93.9
NO_3	mg/L	0	0.002-0.002; 0.002	0.005	0-0; 0	0-0; 0	NA	90-104; 98.3
NO_2	mg/L	0	0.001-0.001; 0.001	0.005	0-0.7; 0.3	0-2.2; 0.4	NA	97.6-107.6; 99.6
TKN	mg/L	0	0.4-0.4; 0.4	NA	0-47.9; 13.7	0-36.4; 15.6	NA	89.5-100.8; 95.6
PO_4	mg/L	0	0.004-0.004; 0.004	NA	0-1.6; 0.9	0-3.2; 0.9	NA	88.3-100.3; 91.5
Total P	mg/L	0	0.02-0.1; 0.049	NA	0-2.4; 0.8	0-14.2; 4.1	NA	86-100; 94.3
SSC	mg/L	0	0.23-6.8; 3.32	NA	NA	0-50.6; 14.9	89.1-114.5; 101.4	NA
Benz(a)anthracenes / Chrysenes, C1-	pg/L	123.225	147-1120; 603.1	NA	4.1-6.8; 5.4	3.8-6.9; 5.6	NA	NA
Benz(a)anthracenes / Chrysenes, C2-	pg/L	170.75	188-1980; 873.3	NA	8.7-16.4; 12.6	7.5-16.4; 9.5	NA	NA
Fluoranthene	pg/L	110	99.8-1410; 661.28	NA	1.3-16; 8.6	16-29.3; 21.4	NA	NA
Fluoranthene/ Pyrenes, C1-	pg/L	467.25	381-3050; 1322	NA	2.9-4.4; 3.6	2.9-20.5; 13	NA	NA
Fluorenes, C3-	pg/L	2076	198-29400; 3373	NA	0.1-5.4; 2.8	0.1-8.6; 6.5	NA	NA
Naphthalenes, C4-	pg/L	4145.25	146-3300; 1305.7	NA	5.9-11; 8.5	5.9-78.8; 36.1	NA	NA
Phenanthrene/ Anthracene, C4-	pg/L	2030.25	534-27100; 6996.9	NA	0-6.4; 3.2	3.5-12.8; 7.8	NA	NA
Pyrene	pg/L	74.65	441-5960; 1251.6	NA	1-14.4; 7.7	13.4-31.8; 21	NA	NA
PBDE 047	pg/L	18.133	0.368-0.407; 0.38	NA	1.2-18.2; 9.7	1.2-13.8; 7	NA	NA
PBDE 099	pg/L	19.067	0.472-5.6; 2.54	NA	3.9-9.9; 6.9	3.9-8.2; 7	NA	NA
PBDE 209	pg/L	110.333	40.9-80.2; 60.68	NA	2.2-19.4; 10.8	2.1-45.2; 16.9	NA	NA
PCB 087	pg/L	0.862	0.184-3.19; 0.68	NA	4.3-31.2; 13.3	4.3-31.2; 12.3	NA	NA
PCB 095	pg/L	0.757	0.184-4.12; 0.8	NA	3.9-38; 15.4	3.9-38; 17.1	NA	NA
PCB 110	pg/L	1.228	0.184-2.85; 0.586	NA	3.1-25.6; 11.7	3.1-25.6; 11.1	NA	NA
PCB 138	pg/L	0.809	0.245-10.9; 1.436	NA	3-25.4; 13.1	3-25.4; 13.2	NA	NA
PCB 149	pg/L	0.366	0.257-13.1; 1.637	NA	2-31.1; 12	2-25.8; 13.4	NA	NA
PCB 151	pg/L	0.062	0.184-2.71; 0.394	NA	0.3-29.2; 9.8	0.3-39.8; 16.6	NA	NA
PCB 153	pg/L	0.587	0.215-9.83; 1.292	NA	1.2-24.4; 11.2	1.2-23.9; 13.2	NA	NA
PCB 174	pg/L	0	0.202-3.89; 0.694	NA	0.3-36.3; 8.8	0.3-37; 13.6	NA	NA
PCB 180	pg/L	0.281	0.184-2.9; 0.473	NA	0.4-29.5; 7.8	0.4-23.7; 9.4	NA	NA
Bifenthrin	pg/L	274	1500-5520; 2830	NA	NA	4.8-35; 16.1	NA	NA

Analyte	Unit	Average Lab Blank	Detection Limit (MDL) (range; mean)	Average Reporting Limit (RL)	RSD of Lab Duplicates (% range; % mean)	RSD of Field Duplicates (% range; % mean)	Percent Recovery of CRM (% range; % mean)	Percent Recovery of Matrix Spike (% range; % mean)
Cypermethrin	pg/L	0	968-5290; 2694.533	NA	NA	27.6-27.6; 27.6	NA	NA
Delta/ Tralomethrin	pg/L	930	185-862; 353.6	NA	NA	23-32.4; 27.7	NA	NA
Total Cu	ug/L	0	0.042-0.421; 0.204	0.51	0.2-2.7; 0.9	0.2-2.7; 0.9	100.7-106.2; 102.5	90.5-105.4; 99.1
Dissolved Cu	Dissolve d	NA	0.042-0.421; 0.204	0.59	NA	0.126	1.007-1.062; 1.025	0.905-1.054; 0.991
Total Hg	ug/L	0	0.0002	0.0002	2-7.7; 4.9	2-31.1; 10	91.9-106.8; 100.1	93-119.9; 107.5
Total MeHg	ng/L	0.015	0.01-0.02; 0.011	0.011	1-5.9; 3.3	0.7-37.5; 9	NA	59-100; 81.4
Totel Se	ug/L	0.008	0.024-0.024; 0.024	0.072	0.3-27; 5.8	0.3-33.1; 10.5	92.6-103.8; 99.7	80.8-121.2; 99.1
Dissolved Se	Dissolve d	NA	0.024-0.024; 0.024	0.072	0.062	0-0.062; 0.021	0.926-1.038; 0.997	0.808-1.212; 0.991
TOC	ug/L	0	35-35; 35	402.222	NA	0-0; 0	NA	90.4-92.8; 91.6

Table A2: Field blank data from San Leandro Creek (the only site that collected field blanks). Note there is no PCB or PBDE field blank data available due to laboratory error with this sample.

AnalyteName	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
Carbaryl	ug/L	0.01	0.02	ND	ND	ND
Fipronil	ug/L	0.002	0.01	ND	ND	ND
Fipronil Desulfinyl	ug/L	0.001	0.005	ND	ND	ND
Fipronil Sulfide	ug/L	0.001	0.005	ND	ND	ND
Fipronil Sulfone	ug/L	0.002	0.01	ND	ND	ND
NH_4	mg/L	0.01	NA	0.01	0.01	0.01
NO_3	mg/L	0.002	0.005	ND	ND	ND
NO_2	mg/L	0.00071	0.005	ND	ND	ND
TKN	mg/L	0.4	NA	ND	ND	ND
PO_4	mg/L	0.0035	NA	ND	ND	ND
Total P	mg/L	0.01	NA	0.018	0.018	0.018
Acenaphthene	pg/L	130	NA	ND	ND	ND
Acenaphthylene	pg/L	118	NA	ND	ND	ND
Anthracene	pg/L	309	NA	ND	ND	ND
Benz(a)anthracene	pg/L	38.8	NA	ND	ND	ND
Benz(a)anthracenes/Chrysenes, C1-	pg/L	34.6	NA	69.5	69.5	69.5
Benz(a)anthracenes/Chrysenes, C2-	pg/L	62.3	NA	393	393	393
Benz(a)anthracenes/Chrysenes, C3-	pg/L	66	NA	389	389	389
Benz(a)anthracenes/Chrysenes, C4-	pg/L	73.3	NA	1030	1030	1030
Benzo(a)pyrene	pg/L	190	NA	ND	ND	ND

AnalyteName	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
Benzo(b)fluoranthene	pg/L	54.1	NA	ND	ND	ND
Benzo(e)pyrene	pg/L	171	NA	ND	ND	ND
Benzo(g,h,i)perylene	pg/L	185	NA	ND	ND	ND
Benzo(k)fluoranthene	pg/L	110	NA	ND	ND	ND
Biphenyl	pg/L	149	NA	552	552	552
Chrysene	pg/L	31.6	NA	86.5	86.5	86.5
Dibenz(a,h)anthracene	pg/L	113	NA	ND	ND	ND
Dibenzothiophene	pg/L	57.2	NA	ND	ND	ND
Dibenzothiophenes, C1-	pg/L	64.3	NA	ND	ND	ND
Dibenzothiophenes, C2-	pg/L	86.2	NA	278	278	278
Dibenzothiophenes, C3-	pg/L	43.1	NA	576	576	576
Dimethylnaphthalene, 2,6-	pg/L	296	NA	ND	ND	ND
Fluoranthene	pg/L	34.6	NA	238	238	238
Fluoranthene/Pyrenes, C1-	pg/L	79.1	NA	82.8	82.8	82.8
Fluorene	pg/L	102	NA	ND	ND	ND
Fluorenes, C1-	pg/L	219	NA	2350	2350	2350
Fluorenes, C2-	pg/L	199	NA	2730	2730	2730
Fluorenes, C3-	pg/L	160	NA	4130	4130	4130
Indeno(1,2,3-c,d)pyrene	pg/L	43.1	NA	ND	ND	ND
Methylnaphthalene, 1-	pg/L	821	NA	ND	ND	ND
Methylnaphthalene, 2-	pg/L	853	NA	ND	ND	ND
Methylphenanthrene, 1-	pg/L	80.4	NA	89.5	89.5	89.5
Naphthalene	pg/L	166	NA	2330	2330	2330
Naphthalenes, C1-	pg/L	152	NA	ND	ND	ND
Naphthalenes, C2-	pg/L	819	NA	1710	1710	1710
Naphthalenes, C3-	pg/L	419	NA	3940	3940	3940
Naphthalenes, C4-	pg/L	460	NA	ND	ND	ND
Perylene	pg/L	221	NA	ND	ND	ND
Phenanthrene	pg/L	60.2	NA	469	469	469
Phenanthrene/Anthracene, C1-	pg/L	80.4	NA	335	335	335
Phenanthrene/Anthracene, C2-	pg/L	71.9	NA	423	423	423
Phenanthrene/Anthracene, C3-	pg/L	91.8	NA	872	872	872
Phenanthrene/Anthracene, C4-	pg/L	187	NA	1100	1100	1100
Pyrene	pg/L	31.4	NA	179	179	179
Trimethylnaphthalene, 2,3,5-	pg/L	134	NA	189	189	189
Allethrin	pg/L	2790	NA	ND	ND	ND
Bifenthrin	pg/L	949	NA	ND	ND	ND
Cyfluthrin, total	pg/L	7020	NA	ND	ND	ND
Cyhalothrin, lambda, total	pg/L	748	NA	ND	ND	ND
Cypermethrin, total	pg/L	997	NA	ND	ND	ND

AnalyteName	Unit	Average MDL	RL	Minimum Field Blank	Maximum Field Blank	Average Field Blank
Delta/Tralomethrin	pg/L	539	NA	ND	ND	ND
Esfenvalerate/Fenvalerate, total	pg/L	845	NA	ND	ND	ND
Fenpropathrin	pg/L	1770	NA	ND	ND	ND
Permethrin, total	pg/L	287	NA	ND	ND	ND
Phenothrin	pg/L	525	NA	ND	ND	ND
Prallethrin	pg/L	7020	NA	ND	ND	ND
Resmethrin	pg/L	653	NA	ND	ND	ND
Tetramethrin	pg/L	1300	NA	ND	ND	ND
Calcium	ug/L	6.32	31.6	ND	ND	ND
Dissolved Cu	ug/L	0.042	0.105	0.681	0.681	0.681
Total Cu	ug/L	0.042	0.105	1.13	1.13	1.13
Magnesium	ug/L	0.63	3.16	0.68	0.68	0.68
Total Hg	ug/L	0.0002	0.0002	ND	ND	ND
Total MeHg	ng/L	0.01	0.01	0.021	0.021	0.021
Dissolved Se	ug/L	0.024	0.072	ND	ND	ND
Total Se	ug/L	0.024	0.072	ND	ND	ND
Total Hardness (calc)	mg/L	0.02	0.09	ND	ND	ND

Table A3: Average RSD of field and lab duplicates at each site.

Analyte	San Leandro		Sunnyvale Channel		Lower Marsh Creek		Guadalupe River	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Carbaryl							83.5%	75.7%
Fipronil	17.7%				0.0%		10.9%	
Fipronil Desulfinyl	10.9%		0.0%		20.2%			
Fipronil Sulfide	0.0%							
Fipronil Sulfone	0.0%							
NH_4	3.1%	0.0%	1.8%	1.5%	4.0%	4.9%	0.0%	0.0%
NO_3	0.0%	0.0%	0.0%	0.0%	0.0%		0.0%	0.0%
NO_2	1.5%	0.7%	0.0%	0.0%	0.0%		0.0%	0.0%
TKN	10.2%	3.4%			24.2%	23.9%	13.7%	
PO_4	0.4%	0.8%	0.9%	0.9%	0.6%		1.5%	1.1%
Total P	7.1%	0.0%	0.0%	0.0%	2.4%	2.4%	0.0%	0.0%
SSC	11.5%		7.2%		34.2%		8.6%	
Acenaphthene	22.9%						0.4%	0.4%
Acenaphthylene	16.7%						18.1%	18.1%
Anthracene	9.3%		24.6%	9.4%			23.4%	23.4%
Benz(a)anthracene	29.8%							
Benz(a)anthracenes/ Chrysenes, C1-	3.8%		6.9%	4.1%			6.8%	6.8%
Benz(a)anthracenes/ Chrysenes, C2-	8.1%		7.5%	8.7%			16.4%	16.4%
Benz(a)anthracenes/ Chrysenes, C3-	36.4%		6.3%	6.9%			8.9%	8.9%
Benz(a)anthracenes/ Chrysenes, C4-	3.2%		25.2%	20.6%			7.0%	7.0%
Benzo(a)pyrene	20.4%		19.5%	7.0%			6.5%	6.5%
Benzo(b)fluoranthene	10.5%		10.2%	2.7%			5.2%	5.2%
Benzo(e)pyrene	14.8%		7.0%	4.4%			5.9%	5.9%
Benzo(g,h,i)perylene	21.6%		8.8%	0.0%			5.3%	5.3%
Benzo(k)fluoranthene	36.4%		20.6%	1.8%			2.8%	2.8%
Chrysene	12.7%		11.6%	1.3%			7.5%	7.5%
Dibenz(a,h)anthracene	39.9%		31.9%	9.9%				
Dibenzothiophene			8.5%	2.1%			13.0%	13.0%
Dibenzothiophenes, C1-	2.2%		6.3%	1.7%			2.9%	2.9%
Dibenzothiophenes, C2-	6.7%		3.8%	0.7%			2.9%	2.9%
Dibenzothiophenes, C3-	5.3%		7.3%	2.1%			0.8%	0.8%
Dimethylnaphthalene, 2,6-	33.7%		4.7%	1.6%			13.8%	13.8%
Fluoranthene	29.3%		16.3%	1.3%			16.0%	16.0%
Fluoranthene/Pyrenes, C1-	20.5%		10.5%	4.4%			2.9%	2.9%
Fluorene	11.8%						9.1%	9.1%

Analyte	San Leandro		Sunnyvale Channel		Lower Marsh Creek		Guadalupe River	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
Fluorenes, C2-	21.8%		7.3%	8.9%			1.2%	1.2%
Fluorenes, C3-	7.7%		8.6%	5.4%			0.1%	0.1%
Indeno(1,2,3-c,d)pyrene	24.4%		14.5%	0.4%			5.3%	5.3%
Methylnaphthalene, 2-	14.0%		3.3%	1.1%			6.3%	6.3%
Methylphenanthrene, 1-	21.6%		12.7%	13.6%			10.7%	10.7%
Naphthalene	15.3%		7.6%	1.5%			3.8%	3.8%
Naphthalenes, C1-	23.6%						5.7%	5.7%
Naphthalenes, C3-	33.5%		1.3%	1.9%			11.2%	11.2%
Perylene	21.3%		20.8%	4.2%			8.6%	8.6%
Phenanthrene	2.9%		33.9%	6.1%			26.5%	26.5%
Phenanthrene/ Anthracene, C1-	46.8%		12.0%	2.1%			0.2%	0.2%
Phenanthrene/ Anthracene, C2-	21.1%		6.0%	8.4%			8.1%	8.1%
Pyrene	31.8%		13.4%	1.0%			14.4%	14.4%
Trimethylnaphthalene, 2,3,5-	22.1%		3.6%	0.3%			9.0%	9.0%
PBDE 007								11.2%
PBDE 008	8.3%	4.7%						
PBDE 010								
PBDE 011								
PBDE 012								11.7%
PBDE 013								
PBDE 015	11.7%	9.5%					3.2%	4.3%
PBDE 017	4.7%	12.7%	7.6%					
PBDE 025								
PBDE 028	3.9%	7.0%	0.9%				15.6%	20.7%
PBDE 030								
PBDE 032								
PBDE 033								
PBDE 035								
PBDE 047	3.2%	1.2%	5.9%				13.8%	18.2%
PBDE 049	3.3%	0.7%	1.7%				10.2%	8.6%
PBDE 051	5.7%	5.7%						
PBDE 066	2.6%	0.5%	1.0%				13.8%	14.1%
PBDE 071	1.9%	1.9%						
PBDE 075	0.7%	0.7%	9.8%					
PBDE 077	15.8%	15.8%						
PBDE 079	16.4%	16.4%						
PBDE 085	8.0%	5.2%	5.7%				4.6%	5.7%
PBDE 099	6.8%	3.9%	6.2%				8.1%	9.9%

Analyte	San Leandro		Sunnyvale Channel		Lower Marsh Creek		Guadalupe River	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PBDE 100	4.3%	0.3%	6.5%				9.2%	11.7%
PBDE 105								
PBDE 116								
PBDE 119	6.8%	6.3%						21.0%
PBDE 120								
PBDE 126								
PBDE 128								
PBDE 140							12.1%	12.5%
PBDE 153	8.6%	6.6%	5.5%				6.2%	7.1%
PBDE 155	8.1%	12.5%					6.4%	7.8%
PBDE 166								
PBDE 181								
PBDE 183	21.3%	1.5%					27.4%	32.6%
PBDE 190								
PBDE 197	42.2%	12.3%	15.8%					
PBDE 203	41.6%	17.6%						3.3%
PBDE 204								
PBDE 205								
PBDE 206	9.0%	23.9%	8.8%				6.1%	7.6%
PBDE 207	12.8%	25.5%	5.8%				2.0%	2.1%
PBDE 208	17.6%	23.7%	13.0%				3.5%	4.1%
PBDE 209	36.6%	19.4%	2.2%				2.1%	2.2%
PCB 008	7.0%	7.0%	12.1%	12.1%			4.7%	0.3%
PCB 018	5.3%	5.3%	13.2%	13.2%			6.2%	0.7%
PCB 020								
PCB 021								
PCB 028	16.1%	16.1%	7.2%	7.2%			5.1%	1.2%
PCB 030								
PCB 031	11.8%	11.8%	6.7%	6.7%			6.1%	0.7%
PCB 033	5.9%	5.9%	9.3%	9.3%			5.6%	0.4%
PCB 044	12.2%	12.2%	7.7%	7.7%			10.0%	13.3%
PCB 047								
PCB 049	11.3%	11.3%	5.4%	5.4%			9.6%	13.6%
PCB 052	17.2%	17.2%	5.6%	5.6%			10.2%	14.4%
PCB 056	4.1%	4.1%	29.4%				9.3%	12.0%
PCB 060	3.1%	3.1%	31.6%				10.8%	13.6%
PCB 061								
PCB 065								
PCB 066	8.4%	8.4%	11.7%	11.7%			11.1%	15.0%

Analyte	San Leandro		Sunnyvale Channel		Lower Marsh Creek		Guadalupe River	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PCB 069								
PCB 070	14.6%	14.6%	10.1%	10.1%			11.3%	15.5%
PCB 074								
PCB 076								
PCB 083								
PCB 086								
PCB 087	13.6%	13.6%	8.2%	8.2%			12.6%	17.6%
PCB 090								
PCB 093								
PCB 095	17.1%	17.1%	6.7%	6.7%			22.3%	18.8%
PCB 097								
PCB 098								
PCB 099	14.5%	14.5%	5.3%	5.3%			13.3%	18.7%
PCB 100								
PCB 101	11.6%	11.6%	4.2%	4.2%			25.4%	18.6%
PCB 102								
PCB 105	9.6%	9.6%	12.4%	12.4%			14.1%	19.2%
PCB 108								
PCB 110	12.0%	12.0%	4.1%	4.1%			13.2%	18.2%
PCB 113								
PCB 115								
PCB 118	10.6%	10.6%	6.3%	6.3%			14.7%	20.8%
PCB 119								
PCB 125								
PCB 128	8.3%	8.3%	0.0%	0.0%			19.3%	26.9%
PCB 129								
PCB 132	10.2%	10.2%	0.2%	0.2%			22.8%	25.8%
PCB 135								
PCB 138	12.4%	12.4%	3.0%	3.0%			19.6%	25.2%
PCB 141	12.0%	12.0%	2.0%	2.0%			25.3%	22.9%
PCB 147								
PCB 149	8.9%	8.9%	2.0%	2.0%			25.8%	31.1%
PCB 151	6.1%	6.1%	1.5%	1.5%			39.8%	29.2%
PCB 153	10.1%	10.1%	1.2%	1.2%			23.9%	24.4%
PCB 154								
PCB 156	10.9%	10.9%	0.8%	0.8%			17.7%	25.1%
PCB 157								
PCB 158	11.9%	11.9%	2.7%	2.7%			18.4%	24.8%
PCB 160								

Analyte	San Leandro		Sunnyvale Channel		Lower Marsh Creek		Guadalupe River	
	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD	Avg Field RSD	Avg Lab RSD
PCB 163								
PCB 166								
PCB 168								
PCB 170	4.9%	4.9%	0.6%	0.6%			20.1%	24.7%
PCB 174	2.1%	2.1%	1.2%	1.2%			37.0%	36.3%
PCB 177	3.1%	3.1%	2.9%	2.9%			30.1%	
PCB 180	1.9%	1.9%	3.5%	3.5%			23.7%	29.5%
PCB 183	3.8%	3.8%	3.7%	3.7%			33.1%	31.6%
PCB 185								
PCB 187	2.9%	2.9%	3.4%	3.4%			37.9%	34.9%
PCB 193								
PCB 194	3.6%	3.6%	6.0%	6.0%			27.3%	38.7%
PCB 195	1.5%	1.5%	4.1%	4.1%			24.2%	26.9%
PCB 201	2.4%	2.4%	1.7%	1.7%			28.8%	
PCB 203	6.4%	6.4%	6.8%	6.8%			30.7%	44.1%
Allethrin								
Bifenthrin	35.0%				8.5%		4.8%	
Cyfluthrin, total								
Cyhalothrin, lambda, total								
Cypermethrin, total					27.6%			
Delta/Tralomethrin					32.4%		23.0%	
Esfenvalerate/ Fenvalerate, total								
Fenpropathrin								
Permethrin, total	12.9%		2.4%		10.6%		2.1%	
Phenothrin								
Prallethrin								
Resmethrin								
Calcium	0.5%	0.4%			0.5%	0.5%	1.0%	1.0%
Total Cu	1.1%	1.1%	0.2%	0.2%	0.8%	0.8%		
Dissolved Cu	12.6%							
Magnesium	0.8%	0.6%	0.3%	0.3%	0.5%	0.5%	1.3%	1.3%
Total Hg	21.4%	2.1%			2.4%		6.6%	
Total MeHg	20.8%	4.1%	3.1%		5.5%		3.7%	2.6%
Dissolved Se	2.1%	6.2%						
Total Se	17.4%	10.1%			1.5%	1.5%	1.4%	1.4%
Total Hardness (calc)	0.4%							
TOC	0.0%							