



Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program



**Upper Penitencia Creek
Stressor/Source Identification Project**
Water Year 2016

March 31, 2017

Executive Summary

The purpose of this report is to summarize monitoring activities conducted during Water Year (WY) 2016 to meet requirements listed under Provision C.8.d.i of the San Francisco Bay Region Municipal Regional Stormwater NPDES Permit (“MRP 1.0”; Order No. R2-2009-0074). This MRP 1.0 provision requires Permittees to conduct monitoring projects to identify and isolate potential stressors and/or sources associated with observed potential water quality impacts.

The Upper Penitencia Creek SSID Project was triggered by Creek Status Monitoring data collected by the Program during WY 2013 and WY 2014. Bioassessment data collected at two monitoring stations in an urban segment of Upper Penitencia Creek had poor biological condition, based on the California Stream Condition Index (CSCI) score for benthic macroinvertebrate (BMI) data.

The Causal Analysis/Diagnosis Decision Information System (CADDIS) was applied to evaluate potential biological impacts observed in Upper Penitencia Creek. The study approach focused on evaluating the differences in biological, physical, chemical and toxicological indicators between a case site (114) located within the segment of interest and a comparator site (121) located directly upstream of the segment. Because the biological condition, as measured by CSCI scores, at the case site was consistently lower than the comparator site, the CADDIS process was focused on identifying indicators of biological condition stress that may indicate the cause of decreased CSCI scores.

Two sample events were conducted at sites 114 and 121 in WY 2016 to evaluate biological conditions and stressor levels during different flow conditions. Sampling event 1 was conducted on April 28 following a series of storms that resulted in perennial flow throughout the urban reach of Upper Penitencia Creek. Event 2 was conducted on June 9 when the source of flow at site 114 was primarily from percolation pond releases; no flow was observed in the upstream reach between the outfall from the ponds and a short distance downstream of Dorel Drive. Site 121 had perennial flow during both sampling events.

Biological conditions, based on CSCI scores, at the case site (114) were consistently lower than the comparator site (121). The BMIs collected at the case site were predominantly short-lived taxa and absence of organisms that require perennial flow. It appears that biological condition at the case site may be impacted by intermittent flow conditions. The case site (114) used in this study is located within a segment of Upper Penitencia Creek that historically dried up during the spring/summer season due to the percolation of surface flow into the underlying groundwater basin.

The stressor (physical, chemical and toxicological) data available for evaluation during the study do not show a clear linkage to the biological condition observed at the case site. In general, the physical habitat at the case and comparator sites were very similar and not likely the cause of reduced biological condition at the case site. Similarly, water and sediment chemistry at the two sites are very similar, with the exception of temperature and nutrient concentrations, which increased with the increase in water diverted from the percolation ponds into the stream channel during the summer months.

Based on the best available information, sources of stress on biological communities in the Upper Penitencia Creek segment of interest, whether natural (e.g., lack of stream flow) or anthropogenic (e.g., nutrients or temperature), are not associated with discharges from the

municipal separate storm sewer system (MS4). Rather, if reduced biological conditions in this segment are partially caused by anthropogenic inputs, they are likely associated with diversions from the percolation ponds to the channel, which are intended to sustain water flows for groundwater percolation to satisfy downstream well users/water rights.

Although municipal stormwater discharges do not appear to be the probable causes of reduced biological conditions in the Upper Penitencia Creek segment of interest, SCVURPPP recognizes the importance of freshwater habitat in this creek that currently supports freshwater organisms, including a viable steelhead community. SCVURPPP plans to complete a brief *Upper Penitencia Creek Watershed Management Practices Summary* by September 30, 2017 to assist in the continued management of this important natural resource. The management practices summary will include a compilation of watershed management activities that are currently in place or planned in the watershed, an evaluation of practices that could be implemented or enhanced to improve biological conditions in the creek, and recommendations of actions (monitoring or management) that would support the management of the freshwater habitat beneficial use in Upper Penitencia Creek.

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1.0 Introduction

The purpose of this report is to summarize monitoring activities conducted during Water Year (WY) 2016 to meet requirements listed under Provision C.8.d.i of the San Francisco Bay Region Municipal Regional Stormwater NPDES Permit (“MRP 1.0”; Order No. R2-2009-0074).¹ This MRP 1.0 provision requires Permittees to conduct monitoring projects to identify and isolate potential stressors and/or sources associated with observed potential water quality impacts. In FY 2013-14, the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) successfully completed two stressor/source identification projects (i.e., Guadalupe River and Coyote Creek) (SCVURPPP 2014). The Upper Penitencia Creek Stressor/Source Identification (SSID) Project, described in this report, is the third and final project to be completed consistent with MRP 1.0 requirements.

The Upper Penitencia Creek SSID Project was triggered by Creek Status Monitoring data collected by the Program during WY 2013 and WY 2014. Bioassessment data collected at two monitoring stations in an urban segment of Upper Penitencia Creek had poor biological condition, based on the California Stream Condition Index (CSCI) score for benthic macroinvertebrate (BMI) data.

In March 2015, the Program submitted a Work Plan (SCVURPPP 2015) to the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) that outlined the data collection efforts and analysis procedures that SCVURPPP would take to evaluate factors potentially impacting biological condition in the creek segment of interest. The Causal Analysis/Diagnosis Decision Information System (CADDIS) framework (USEPA 2010) was selected by SCVURPPP to identify and evaluate potential stressors and sources affecting biological condition. The Work Plan assessed existing available data, identified information gaps, and included a monitoring plan to investigate the linkage between probable stressors and biological condition.

The Program was unable to implement monitoring activities identified in the Work Plan in WY 2014 or WY 2015 due to an extended drought and dry channel conditions within the study area. A wetter winter season during WY 2016 provided suitable sampling conditions to conduct the monitoring activities for the SSID project. This report presents results and conclusions from monitoring conducted in WY 2016.

2.0 Background

2.1 Biological Condition Assessments

The Program has conducted biological condition assessments at multiple locations along Upper Penitencia Creek on several occasions since 2008. The Program conducted bioassessments using benthic macroinvertebrates at six sites in Upper Penitencia Creek in 2008 as part of its Annual Monitoring Program (SCVURPPP 2008). Sampling locations were selected in 2008 using a targeted design to conduct monitoring across a wide range of stream conditions in the watershed (Figure 1). The BMI results were interpreted using two existing tools: the Southern California Index of Biological Integrity (SoCal IBI) (Ode et al. 2005) and the California Stream Condition Index (CSCI) (Mazor et al. 2015). SoCal IBI and CSCI scores are listed in Table 1.

¹ The San Francisco Bay Regional Water Quality Control Board (Regional Water Board) issued MRP 1.0 to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (Regional Water Board 2009). In 2015, the Regional Water Board revised and reissued the MRP (Order No. R2-2015-2049). The 2015 permit is referred to as “MRP 2.0.”

During WYs 2012 and 2013, the Program conducted bioassessments at three locations in Upper Penitencia Creek to meet requirements for Creek Status Monitoring under the MRP. Sampling locations were selected using a probabilistic monitoring design (SCVURPPP 2014). Two of the sampling locations (sites 105 and 114), located between Interstate 680 and Piedmont Road, had CSCI scores of 0.59 and 0.64, respectively (Table 1). The CSCI scores for both sites are classified as “very likely altered” biological condition and are below the MRP 2.0 trigger (<0.795) for sites to be considered for potential SSID projects. The third monitoring location (site 140), located about 3 miles upstream of Piedmont Road in Alum Rock Park, received a CSCI score of 1.26.

Table 1. Location and date of bioassessments conducted by SCVURPPP in 2008 through 2013. Biological condition scores and condition categories using CSCI are also presented.

Site ID ²	Elevation (ft)	Sample Date	Monitoring Design	SoCal IBI		CSCI	
				Score	Condition	Score	Condition
90	74	4/30/2008	Targeted	7	Very Poor	0.52	Very Likely Altered
100	123	4/30/2008	Targeted	4	Very Poor	0.43	Very Likely Altered
105	145	5/24/2012	Probabilistic	21	Poor	0.59	Very Likely Altered
114	194	6/5/2013	Probabilistic	30	Poor	0.64	Likely Altered
115	206	5/1/2008	Targeted	29	Poor	0.66	Likely Altered
120	256	5/1/2008	Targeted	52	Fair	0.86	Likely Intact
130	431	5/2/2008	Targeted	54	Fair	0.93	Likely Intact
140	597	5/2/2008	Targeted	90	Very Good	1.23	Likely Intact
140	607	6/12/2013	Probabilistic	99	Very Good	1.26	Likely Intact

The biological condition scores decreased in an upstream to downstream direction (Table 1). A relatively large decrease in CSCI score was observed in 2008 between sites 120 and 115, with scores of 0.86 and 0.66, respectively. These sites are approximately 1 mile apart. Subsequent bioassessment monitoring in 2013 at site 114, had a similar CSCI score (0.64) as site 115. These sites are only 100 meters apart. The purpose of this SSID study is to understand why there was such a dramatic decrease in CSCI scores downstream of site 120.

² Site IDs are based on the last three numbers of the station codes used by SCVURPPP for identifying monitoring stations (e.g., 90 represents monitoring station 205COY090).

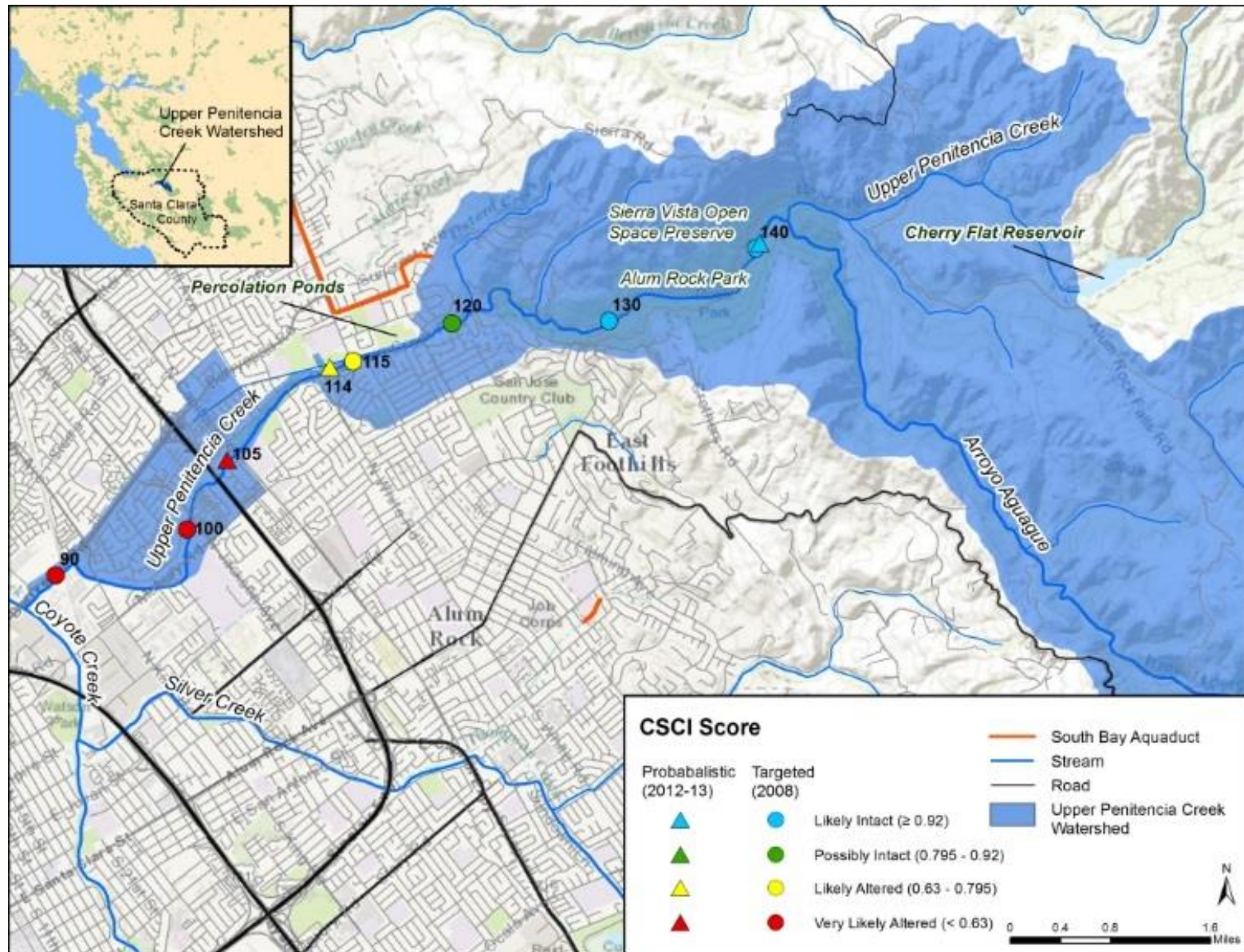


Figure 1. Nine bioassessment locations in Upper Penitencia Creek sampled between 2008 and 2013.

2.2 Causal Assessment Approach

The Causal Analysis/Diagnosis Decision Information System (CADDIS) was applied to evaluate potential biological impacts observed in Upper Penitencia Creek. CADDIS was developed by the US EPA as an online guidance application for users to conduct causal assessments (US EPA 2010). The online tool provides a logical, step-by-step framework for Stressor Identification (SI) for biologically impacted aquatic ecosystems. CADDIS identifies a five-step process for conducting a causal assessment:

- Step 1: Define the Case
- Step 2: List Candidate Causes
- Step 3: Evaluate Data from the Case
- Step 4: Evaluate Data from Elsewhere (e.g., comparator site)
- Step 5: Identify Probable Causes

The five-step process is illustrated in Figure 2.

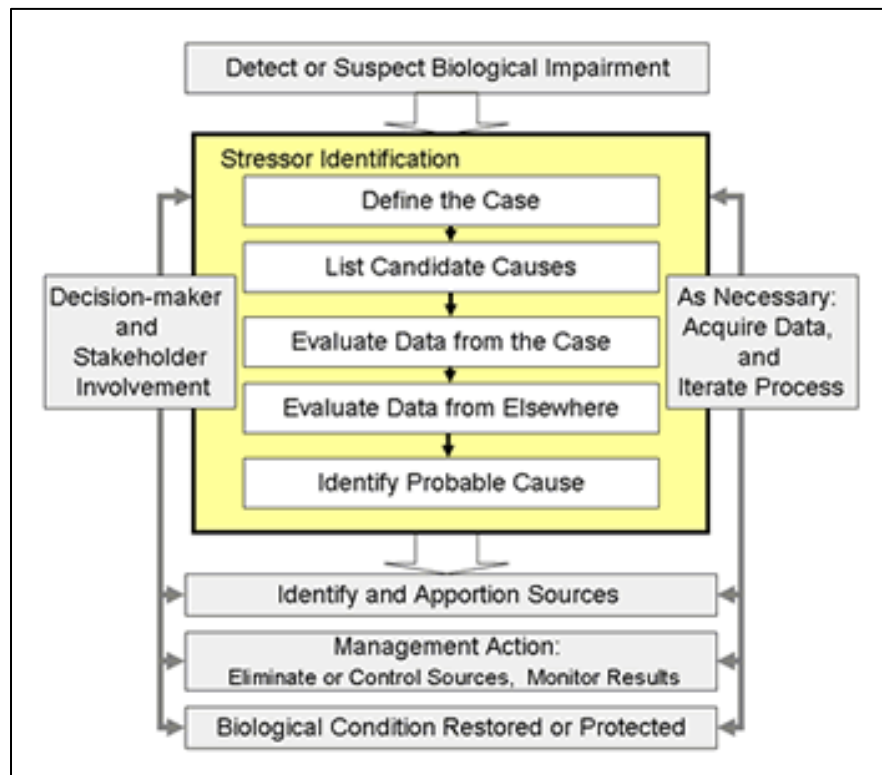


Figure 2. Causal assessment process defined in CADDIS (US EPA 2010).

The first step (Step 1) of the Stressor Identification process is to define the subject of the analysis (i.e., the case), by determining the geographic area of the investigation and the effects to be analyzed. The case definition sets the stage for the rest of the causal analysis in terms of the information that will be assembled, the causes to be evaluated, and how conclusions will be presented.

The next step (Step 2) is to develop a comprehensive list of candidate causes, or stressors, to be evaluated for potential impacts to biological conditions observed at the case site. Identification of the stressors further refines the scope of the causal analysis, and provides a framework for assembling available data and determining what data are needed for the causal analysis.

In Step 3, existing data are analyzed to compare measures of the biological response (e.g., BMI taxonomic richness) with direct measures of proximate stressors (e.g., toxicant concentrations or percent embeddedness values), or intermediate measures that link sources, stressors, and biological effects. Data are analyzed with two goals in mind:

- To develop consistent and credible evidence that allows one to confidently eliminate very improbable stressors, or to use symptoms to refute or diagnose a stressor, and
- To begin building the body of evidence for those candidate stressors that cannot be eliminated or diagnosed, which will be used in Step 5 to identify the most probable stressor.

In Step 4, the candidate stressors that remain are evaluated further by bringing in data from studies conducted outside of the case. The evidence developed from this exercise completes the body of evidence used to identify the most probable stressors of the observed biological effects. *The key distinction between data from elsewhere and data from the case is location: data from elsewhere are assumed to be independent of what is observed at the case sites.*

The last step (Step 5) in the stressor identification process is to distinguish the most probable stressor(s). Each candidate stressor must be compared to every other candidate stressor to evaluate which stressor led to the specific observed effects. The rationale for identifying one stressor relative to the others needs to be clear, reasonable, and convincing if management action is to be motivated and effectively directed.

Steps 1-4 of the CADDIS process for the Upper Penitencia Creek SSID Project were summarized in the Work Plan (SCVURPPP 2015). The majority of the data available were suitable to evaluate most of the candidate stressors that directly impacted the case site. Thus, there was limited application of *Step 4 (Evaluate Data from Elsewhere)*. In some cases, however, existing data did not consistently provide both spatial and temporal co-occurrence to evaluate all stressors. As a result, additional monitoring activities were identified in the Work Plan to address the data gaps. The results of these monitoring activities and the application of *Step 5 (Identify Probable Cause)* are presented in this report.

2.3 Study Area

The Upper Penitencia Creek subwatershed drains approximately 24 square miles area within the larger Coyote Creek watershed in Santa Clara County (Figure 1). The creek flows approximately eleven miles from its headwaters in the Diablo Range to its confluence with Coyote Creek approximately 10 miles upstream of the San Francisco Bay. The upper reach of the creek flows into Cherry Flat Reservoir, a small reservoir (500 acre-feet) that was constructed in 1932 for water supply. The creek continues to flow through Alum Rock Park (ARP), managed by the City of San Jose, where it exits the foothills onto the valley floor. The creek continues west for approximately four miles through an urbanized section of eastern Santa Clara Valley.

Historical flow conditions in the upper reaches of the creek are typically perennial with the majority of flow derived from springs and tributary inputs from Arroyo Aguague (Stillwater Sciences 2006). In the lower reaches of the valley floor, the creek was historically intermittent, with the majority of dry season flow permeating into the alluvial fan deposits of the valley floor and recharging the groundwater aquifer. Transition from perennial to intermittent flow regime is supported by historical observations of the change in the riparian vegetation from a mixed riparian forest in the foothill region to a more sycamore-dominated riparian canopy in the valley floor (Beller et al 2012).

A number of hydromodifications in the Upper Penitencia Creek subwatershed have altered the dry season hydrology of the creek.

- Periodic flow augmentation downstream of the Cherry Flat Reservoir dam is believed to have increased the extent and duration of the wetted channel in Alum Rock Park (SCVURPPP 2003).
- There is a diversion structure located upstream of Noble Ave that diverts water to off-channel percolation ponds for groundwater percolation (Figure 3). Diversions from the Upper Penitencia Creek typically occur during spring season when surface flows are still present. The Robert Gross Percolation Ponds are owned and operated by the Santa Clara Valley Water District (SCVWD or District).
- When creek flows begin to decrease during the declining hydrograph of spring season, additional water from the South Bay Aqueduct is diverted directly into the percolation ponds, which are located just upstream of Piedmont Ave. Water imports to percolation ponds may continue through the summer season.
- A portion of the water from the percolation pond is typically released back into the main channel of Upper Penitencia Creek during the dry season for groundwater percolation to satisfy downstream well users/water rights (Figure 3). There are two locations that water is released back into the channel³: 1) Gross Pond 1 via turnout near Toyon Ave; and Gross Pond 3 via overflow structure, just upstream of Piedmont Rd.
- Typically, the augmented water extends downstream to Jackson Road, where the water is then diverted to another off-channel percolation pond at Mabury Road. In 2016, the water did not extend to the diversion at Mabury, presumably due to high percolation rates caused by low elevation of the groundwater basin.

³ In 2016, a preliminary estimate of 1890 acre feet was released from Robert Gross Percolation Ponds into Upper Penitencia Creek between May 12 – July 22 and September 1 – October 6 (Carole Foster, SCVWD, personal communication). Over 90% of water released came from the Pond 1 turnout.

- There are 8 storm drain outfalls along reach of Upper Penitencia Creek between White Road and Dorel Drive. These outfalls drain approximately 375 acres of area that is comprised of predominantly single family homes. A majority of the urban area along the north side of Upper Penitencia Creek, between Piedmont and Noble Ave, drains north into the Berryessa Creek watershed. Upstream of Dorel Drive there are 43 storm drain outfalls within Alum Rock Park that drain approximately 585 acres of the park area that is used for parking, picnicking, hiking etc.

Percolation pond operations described above were drastically changed during WY 2014 and WY 2015 due to extended period of drought. During this time, no water was imported from the State Water Project to the percolation ponds. As a result, the reach of Upper Penitencia Creek below Dorel Drive remained dry during the dry season. Following the return of imported water to percolation ponds in 2016, the extent of the wetted channel below the ponds appeared to be limited, presumably due to low elevation of the groundwater table following the drought.

There are two stream gages in Upper Penitencia Creek that are within the study area, one at Piedmont Road and one at Dorel Drive (gaging low flow only). The drainage area upstream of the lower gage (Piedmont Road) is primarily comprised of open space, urban park and residential land uses.

Throughout much of Alum Rock Park, Upper Penitencia Creek provides cool temperatures and physical habitat conditions that support rearing and spawning lifestages for *Oncorhynchus mykiss* (steelhead). This reach also supports a predominately native fish community of Pacific lamprey, hitch, California roach, stickleback, Sacramento pikeminnow, Sacramento sucker and sculpin species. Lower reaches may support native warm water fishes when flow is available, but more importantly, are important for upstream and downstream passage for migratory fishes. Insufficient flow in the lower urban reaches was identified as an important factor limiting the juvenile steelhead populations. (Stillwater Sciences 2006)



Figure 3. Study reach for the Upper Penitencia Creek showing monitoring locations used for SSID Project during WY 2016.

3.0 Methods

3.1 Sampling Design

The Upper Penitencia SSID project focused on a causal analysis of stressors that may impact the biological condition at site 114, herein referred to as the case site. Biological indicator and potential stressor data were collected at site 114, as well as site 121, located about one mile upstream near Dorel Drive (Figure 3). Site 121, herein referred to as the comparator site, is located near the upper boundary of urban/residential area and just downstream of Alum Rock Park. Site 121 is perennial year-round, but the channel typically dries up a short distance downstream of Dorel Drive. Site 114 is typically non-perennial, although may have stream flow during portions of the dry season due to releases from the off-channel percolation ponds. The SCVWD operates stream gages near each of the bioassessment locations - Piedmont Road (site 114) and Dorel Drive (site 121).

Bioassessments were also conducted at two additional stations in Upper Penitencia Creek as part of Creek Status Monitoring activities during WY 2016. Site 117 (RMC Site 205R01731), located immediately upstream of the percolation pond outfall and just downstream of Dorel Drive, is approximately half-way between sites 114 and 121 (Figure 3). Site 135 (RMC site 205R02853) is located farther upstream, in Alum Rock Park. Both of the Creek Status Monitoring sites were sampled on May 5, 2016.

Two sample events were conducted at sites 114 and 121 in WY 2016 to evaluate biological conditions and stressor levels during different flow conditions. Sampling event 1 was conducted on April 28 following a series of storms that resulted in perennial flow throughout the urban reach of Upper Penitencia Creek. Event 2 was conducted on June 9 when the source of flow at site 114 was primarily from percolation pond releases; no flow was observed in the upstream reach between the outfall from the ponds and a short distance downstream of Dorel Drive (Figure 4). Site 121 had perennial flow during both sampling events.

A summary of parameters, sampling locations and frequencies for 2016 monitoring is shown in Table 2. Sampling locations are illustrated in Figure 3. Sampling methods are described in the next section.



Figure 4. Upper photo: Water release from Robert Gross Percolation Ponds on June 9, 2016. The channel directly upstream the outfall is nearly dry. Lower photo: Site 114, approx. 0.5 mile downstream of outfall. (Site 117, where bioassessment was conducted on May 5, 2016, is located in the dry reach above the outfall.)

Table 2. Parameter type and data collection period at five stations in the Upper Penitencia Creek that were monitored during 2016 for the SSID project.

Sampling Site ID	Location	Latitude	Longitude	Bioassessment (BMI, algae), Physical Habitat	Nutrients, Chlorine, General WQ	Water Temp	Water Quality	Sediment Chemistry & Toxicity
114	Piedmont Ave	37.39007	-121.84361	4/28/16	4/28/16	3/24/16-8/20/16	4/11/16-4/28/16	5/5/16
				6/9/16	6/9/16		6/16/16-6/23/16	
117	Nobel Ave	37.39264	-121.83477	5/5/16	5/5/16	--	4/11/16-4/28/16	--
							6/16/16-6/23/16	
121	Dorel Drive	37.39530	-121.82668	4/28/16	4/28/16	3/24/16-8/20/16	4/11/16-4/28/16	5/5/16
				6/9/16	6/9/16		6/16/16-6/23/16	
130	Quail Hollow	37.39362	-121.81783	--	--	4/5/16-8/20/16	9/7/16-9/20/16	--
135	Log Cabin	37.39658	-121.80390	5/5/16	5/5/16	6/5/16-8/20/16	9/7/16-9/20/16	--

Data types associated with potential stressors of biological condition that were evaluated in the Work Plan (SCVURPPP 2015) are shown in Table 3. The expected biological response to each stressor is also indicated in the table. Each of the data types was collected at the case and comparator sites for the SSID project (sites 114 and 121). In addition, some of the data types were collected at the bioassessment (sites 117 and 135) or targeted temperature monitoring (site 130) sites for the Creek Status Monitoring activities for WY 2016.

Table 3. Potential stressors and associated data type collected to evaluate biological condition response.

Potential Stressor	Data Type	Biological Condition Response
Flow alteration, dry channel conditions	Stream discharge	BMI community change (e.g., taxa with short life cycles)
Increase in water temperature	Water Temperature	Reduced cold water biota (e.g., EPT ¹ taxa)
Decrease in dissolved oxygen, high/low pH, elevated conductivity	Water Quality	Reduced oxygen dependent taxa (e.g., EPT taxa)
Increase sands + fine substrate, increase algal cover	Physical Habitat	BMI community change (e.g., increased sediment tolerant organisms)
Increase of total nitrogen, total phosphorus, ammonia	Nutrients	Toxic response; response to low Dissolved Oxygen related to eutrophication
Chronic and/or acute toxicity; toxic Pesticides and Toxicity	Pesticide concentrations and toxicity	Low BMI andr algae diversity, abundance

¹ EPT: Ephemeroptera, Trichoptera, Plecoptera- biological metric that indicates group of taxa that prefer good habitat and water quality conditions

3.2 Field Sampling

Stream Flow and Precipitation

Real-time stream flow data⁴ recorded at two gaging stations in Upper Penitencia Creek, both operated by the SCVWD, were downloaded from the SCVWD website⁵. Hourly stream discharge (cfs) data were obtained for the period between October 2015 and September 2016. The stream gage at Dorel Drive (alert ID 1548), located at the eastern edge of the Santa Clara Valley near the Alum Rock Park boundary, drains approximately 21.5 square miles. The stream gage at Piedmont Ave (alert ID 1489), located just downstream of the percolation ponds, drains approximately 22.6 square miles. The flow at the Piedmont Ave gage includes releases from the percolation ponds in addition to natural stream flow.

Precipitation data recorded at a station in San Jose, operated by National Oceanic and Atmospheric Administration (NOAA), were downloaded from NOAA website⁶. The daily record of precipitation was obtained for the period between October 2015 and September 2016. The precipitation gaging station (San Jose 5.8 NNE) is located approximately 0.5 mile south of the study reach on Upper Penitencia Creek.

Biological Indicators

Benthic macroinvertebrates and algae were collected using protocols described by Ode et al. (2016). Each bioassessment sampling site consisted of an approximately 150-meter stream reach that was divided into 11 equidistant transects placed perpendicular to the direction of flow. Benthic macroinvertebrate (BMI) and algae samples were collected at 11 evenly spaced transects using the Reachwide Benthos (RWB) method. Physical habitat data were collected within the sample reach using methods for the California Surface Water Ambient Monitoring Program (SWAMP) "Full" level of effort. The presence of micro- and macroalgae was assessed during the pebble counts.

Biological samples were sent to laboratories for analysis. The laboratory analytical methods used for BMIs followed Woodward et al. (2012), using Level 1 Standard Taxonomic Level of Effort, with the additional effort of identifying chironomids (midges) to subfamily/tribe instead of family (Chironomidae). Soft algae and diatom samples were analyzed following SWAMP protocols (Stancheva et al. 2015). The taxonomic resolution for all data was compared and revised when necessary to match the SWAMP master taxonomic list.

Water Chemistry

Immediately prior to biological and physical habitat data collection, water samples were collected for nutrients and conventional analytes using the Standard Grab Sample Collection Method as described in SOP FS-2 (BASMAA 2016b). Water samples were also collected and analyzed for free and total chlorine using a Pocket Colorimeter™ II and DPD Powder Pillows according to SOP FS-3 (BASMAA 2016b). In addition, general water quality parameters (dissolved oxygen, pH, specific conductivity and temperature) were measured at or near the centroid of the stream flow using pre-calibrated multi-parameter probes. Benthic algae composite samples were filtered to obtain ash free dry mass and chlorophyll a samples using procedures described by Ode et al. (2016). Water samples and filters were sent to a laboratory for analysis.

⁴ These data have not been through a quality review check; final data review was not completed in time for this report.

⁵ <http://alert.valleywater.org/>

⁶ <https://www.ncdc.noaa.gov/cdo-web/datasets/GHCND/stations/GHCND:US1CASC0027/detail>.

Continuous Water Temperature

Digital temperature loggers (Onset HOBO Water Temp Pro V2) were programmed to record data at 60-minute intervals and were deployed at both SSID bioassessment locations for approximately six months (April – September). At site 114, the device was removed in August due to dry channel conditions. Temperature devices were also deployed at six⁷ other stations in Upper Penitencia Creek for the Creek Status Monitoring project for six months, with the exception of site COY135 where the device was lost and data was only collected over a four-month timer period. Procedures used for calibrating, deploying, programming and downloading data are described in RMC SOP FS-5 (BASMAA 2016b).

Continuous Water Quality

Water quality monitoring equipment recording dissolved oxygen, temperature, conductivity, and pH at 15-minute intervals (YSI 6600 data sondes) were deployed at five⁸ monitoring sites for three 2-week periods in April, June and September 2017. In September, sondes were deployed for two-week period at site COY121 and two new sites (COY130 and COY135) in Alum Rock Park. Sondes could not be deployed in September at COY114 or COY117 due to dry channel conditions. Procedures used for calibrating, deploying, programming and downloading data are described in RMC SOP FS-4 (BASMAA 2016b).

Sediment Chemistry and Toxicity

Sediment samples were collected at the case and comparator sites (sites 114 and 121) and tested for sediment toxicity and pyrethroid pesticides. Sediment samples were collected from the top 2 cm at each sub-site beginning at the downstream-most location and continuing upstream. Samples were placed in a compositing container, thoroughly homogenized, and then aliquoted into separate jars for chemical or toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016b). Sample jars were sent to respective laboratories for analyses. Sediment toxicity testing was performed on two species, *Hyalella azteca* and *Chironomus dilutus* using acute endpoints (i.e., survival).

3.3 Data Analyses

Benthic Macroinvertebrates

Two existing tools were used to interpret the benthic macroinvertebrate data: the Southern California Index of Biological Integrity (SoCal IBI) (Ode et al. 2005) and the California Stream Condition Index (CSCI). The SoCal IBI was initially used to evaluate the BMI data collected in 2008 and 2013, was therefore used to interpret the data collected in 2016. The California Stream Condition Index (CSCI), developed by the State Water Resources Control Board (State Board), is an index used to score the condition of BMI communities in perennial wadeable rivers and streams in California. The CSCI is calculated using a combination of biological and environmental data following methods described in Rehn et al. (2015). It combines two types of indices: 1) taxonomic completeness, as measured by the ratio of observed-to-expected taxa (O/E); and 2) ecological structure and function, measured as a predictive multi-metric index (pMMI) that is based on reference conditions. The CSCI score is computed as the average of

⁷ Water temperature device was also deployed at site 117, however the first device was not recovered and the channel dried up soon after a second device was deployed. Thus, data from that site are not presented in this report.

⁸ The first two sampling events were conducted at same three sites. The two lower elevation sites had no flowing water during September sampling event. As a result, sondes were deployed at two new sites further upstream.

the sum of O/E and pMMI. Detailed information related to methods for calculating CSCI are in the Creek Status Monitoring Report (SCVURPPP 2017)

Benthic Algae

The State Water Resources Control Board and Southern California Coastal Water Research Project (SCCWRP) are currently developing and testing a statewide index using benthic algae data as a measure of biological condition for streams in California. The statewide algae IBI is expected to be completed in 2017. The statewide algae index will build upon studies by Fetscher et al. (2014) that developed and tested algal indices of biological integrity (IBIs) for streams in Southern California (SoCal Algae IBI). The SoCal Algae IBIs were developed from data comprised of either single-assemblage metrics (i.e., either diatoms or soft algae) or combinations of metrics presenting both assemblages (i.e., “hybrid” IBI).

Algae data collected in Upper Penitencia Creek were evaluated using the existing SWAMP Algae Reporting Module, (Algae RM) which was developed in 2012 using the SoCal Algae IBI as the basis for metric and IBI calculations (Marco Sigala, SWAMP, personal communication). A soft algae-diatom hybrid index (H20) was used as an interpretive tool for algae data collected for the SSID project. Detailed information related to methods for calculating H20 are in the Creek Status Monitoring Report (SCVURPPP 2017)

Biological Condition Thresholds

SoCal IBI scoring thresholds were used to interpret BMI data: Very Good (80-100), Good (60-79), Fair (40-49), Poor (20-39) and Very Poor (0-19). Existing thresholds for biological indicators defined in Mazor (2015) were used to evaluate the bioassessment data collected for the SSID Project (Table 4). The thresholds for each index were based on the distribution of scores for data collected at reference calibration sites in California (CSCI) or in Southern California (algae). Four condition categories are defined by these thresholds: “likely intact” (greater than 30th percentile of reference site scores); “possibly intact” (between the 10th and the 30th percentiles); “likely altered” (between the 1st and 10th percentiles; and “very likely altered” (less than the 1st percentile). A CSCI score below 0.795 is referenced in MRP 2.0 as a threshold below which indicates a potentially degraded biological community, and thus should be considered for a SSID Project.

Table 4. Condition categories used to evaluate CSCI and Algae IBI scores.

Index	Likely Intact (>30 th)	Possibly Intact (10 th – 30 th)	Likely Altered (1 st – 10 th)	Very Likely Altered (< 1 st)
CSCI - Benthic Macroinvertebrates	≥ 0.92	0.79 – 0.92	0.63 – 0.79	< 0.63
H20 Index – Benthic Algae	≥ 70	63 - 70	54 - 63	< 54

4.0 Results

4.1 Stream Flow

For over two years (WY 2014 and WY 2015) an extended drought in California resulted in extremely low flow conditions in the Santa Clara Valley. Stream flow was further reduced at some locations, including Upper Penitencia Creek, with cessation of water imports from the State Water Project (i.e., South Bay Aqueduct). Due to absence of water imports, there were no

water releases from the percolation ponds in Upper Penitencia Creek in 2014 or 2015. The lack of water during bioassessment index period (April 15 – June 30) resulted in a delay for the Upper Penitencia Creek SSID Project. Summary statistics of water discharge between beginning of April and end of June for the past five years is shown in Table 5.

Table 5. Summary statistics of stream flow discharge recorded at SCVWD gaging station at Piedmont Avenue during April 1 – June 30 for the past five years (2012 – 2016).

Flow Discharge (cfs)	2012	2013	2014	2015	2016
Minimum	2.5	3.8	0	0	0.0
Maximum	98.1	12.9	0	0	12.6
Median	4.3	4.5	0	0	5.2
Average	5.7	4.6	0	0	5.6

Stream flow discharge data (cfs) recorded at the two gages (Dorel and Piedmont) in Upper Penitencia Creek and precipitation data recorded near the study area during WY 2016 are plotted in Figure 5. Precipitation data is also plotted for the same time period. Winter peak flows measured at the Piedmont gage occurred in mid-December (346 cfs) and mid-January (487 cfs). (Note: Stream gage at Dorel is only accurate for low flow conditions). A period of dry weather in February was followed by a series of storms in March that resulted in flow conditions at both case and comparator sites.

Stream flow at the Dorel and Piedmont stream gages during the spring and summer seasons and bioassessment timing are detailed in Figure 6. The increase in stream flow at the Piedmont stream gage during this timeframe is associated with percolation pond releases. Flow levels at the Piedmont gage increased up to a maximum of 12 cfs between May and July, while flow at Dorel gage was relatively consistent at less than 1 cfs. The June 9 sampling event occurred during these flow conditions (Figure 5). Once the pond releases were stopped on July 20, the channel at Piedmont became dry again. Percolation pond discharges were re-initiated on September 1 and continued through the end of the study.

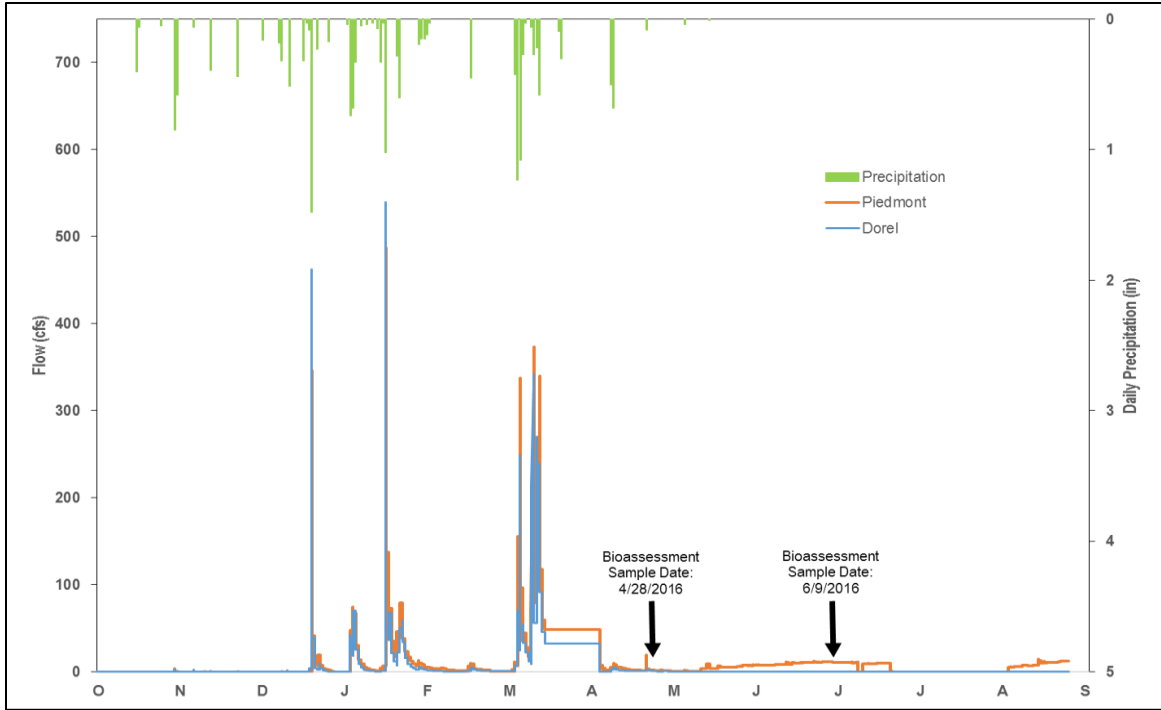


Figure 5. Stream flow discharge recorded at SCVWD Alert Gage at Dorel and Piedmont during WY 2016. Precipitation records, recorded at NOAA rain gage, are also presented.

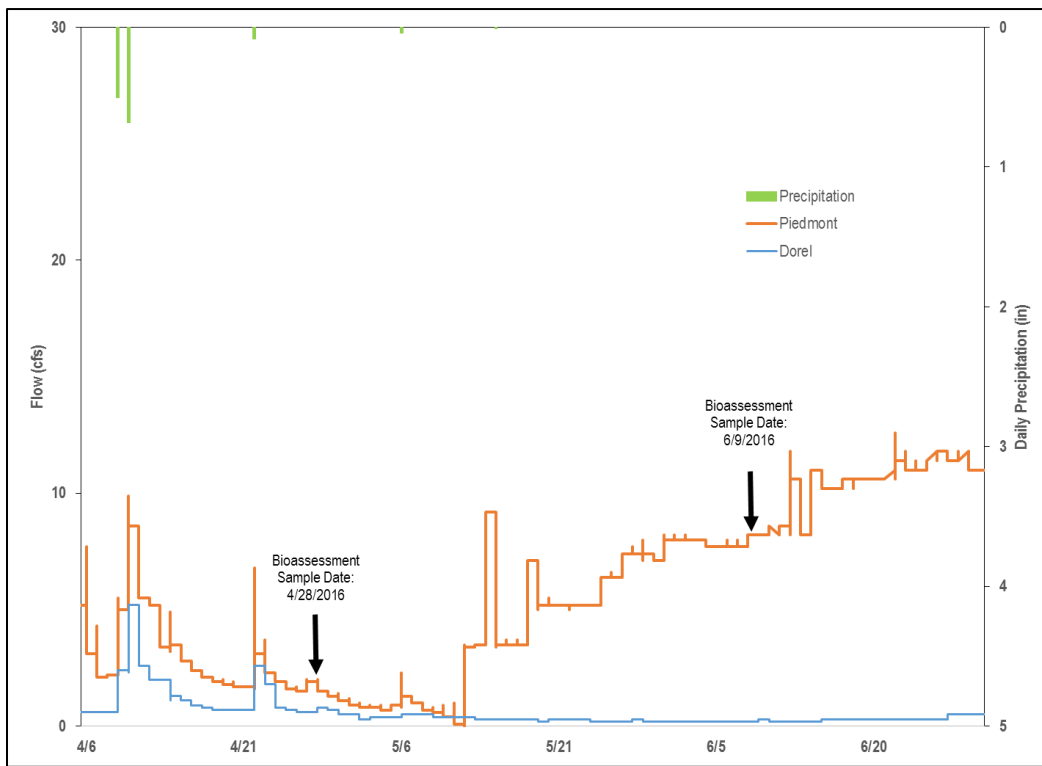


Figure 6. Stream flow discharge recorded at SCVWD Alert Gage at Dorel and Piedmont between April 15 and September 27, 2016.

4.2 Biological Condition

Biological condition scores, based on indices for benthic macroinvertebrate (CSCI and SoCal IBI) and algae (SoCal Algae H2O IBI) data, for the four sites in Upper Penitencia Creek where bioassessments were conducted during WY 2016 are shown in Table 6. Site elevation and flow status for each site are also shown. Biological condition scores are shown for both sampling events (April 28 and June 9, 2016) conducted at the case site (114) and comparator site (121) for SSID Project and assessments conducted at the two probabilistic sites (117 and 135) for the Creek Status Monitoring Project are shown.

Table 6. Biological condition, based on CSCI and SoCal IBI scores for benthic macroinvertebrates and SoCal Algae H2O IBI scores for algae data, for four bioassessment sites in Upper Penitencia Creek in 2016.

Station Code	Project	Sampling Date	Elevation (ft)	Flow Status	Benthic Macroinvertebrates			Benthic Algae
					CSCI Score	CSCI Condition	SoCal IBI Score	Hybrid "H2O" IBI Score
114	SSID	4/28/2016	209	NP	0.65	Likely Altered	26	11
		6/9/2016	209	NP	0.66	Likely Altered	29	19
117	Creek Status	5/5/2016	239	NP	0.63	Likely Altered	36	20
121	SSID	4/28/2016	270	P	0.78	Possibly Intact	39	20
		6/9/2016	270	P	0.97	Likely Intact	59	32
135	Creek Status	5/5/2016	521	P	0.79	Possibly Intact	53	38

Benthic Macroinvertebrates

CSCI scores were similar for both sampling events at site 114 and at site 117, ranging 0.63 to 0.65. The highest CSCI score (0.97) occurred at site 121 during the June sampling event⁹. The CSCI scores were always higher at the site 121 compared to site 114, however the difference in score was greater for June event compared to the April event. The CSCI scores were relatively similar at sites 121 and 132 during the April/May sampling event, 0.78 and 0.79, respectively. The SoCal IBI scores show similar pattern to the CSCI, with scores higher at site 121 compared to site 114 during both sampling events.

Individual metric scores for the BMI data collected during six sampling events are shown in Table 7. Biological metric scores associated with richness, composition, tolerance and functional feeding group measures were calculated for each sampling event. The metric scores results indicate the following characteristics for the case and comparator sites:

- Fluctuating habitat conditions at case site (114) – The BMI assemblages at the case site for both sampling events were predominantly taxa with short life cycles (i.e., Chironomids and black flies comprised over 90% of the taxa). These metrics suggest that biological condition may be impacted by changes in habitat, magnitude of flow and/or water quality.
- Habitat/water quality conditions improved over time at comparator site (121). The BMI assemblage transitioned from short-lived taxa during April sampling event to long-lived, and more diverse taxa during the June event. Biological condition at site 121 appears to have increased following onset of summer base flow conditions.

⁹ CSCI scores at reference sites are typically at or above 1.0

- Non-perennial flow status at case site; absence of both larval and adult life stages of Coleoptera taxa (beetles).
- Perennial flow status at comparator site; presence of long-lived, predator and intolerant taxa.

Benthic Algae

The Algae H20 IBI scores were generally very low across all sites and sampling events (Table 6). The H20 scores ranged from 11 to 38 (highest possible score is 100). All of the sampling events had algae IBI scores that fell into the “very likely altered” condition category (Mazor et al. 2015). Algae IBI scores were higher for the June sampling event compared to the April sampling event for both case (114) and comparator (121) sites.

Individual metric scores used to generate the H20 IBI score for algae data are shown in Table 8. The metric scores were relatively similar between sites 114 and 121, with the exception of the following:

- Evidence of more stressors at site 114 (both events); greater proportion of taxa tolerant of fine sediment and dissolved salts (halobiontic).
- Response to nutrients at site 114 (June event); greater proportion of diatom taxa that utilize organic bound nitrogen (heterotrophic). These taxa may have been dispersed into the case sites from percolation ponds.

Table 7. Biological metric scores for BMI data collected at four sites on Upper Penitencia Creek during WY 2016. Sampling station number for SSID sites are in bold.

Biological Metrics	April/May 2016				June 2016	
	114	117	121	135	114	121
Richness:						
Taxonomic	19	16	27	27	26	40
EPT	6	7	12	14	8	14
Ephemeroptera	3	4	4	4	2	6
Plecoptera	0	1	3	3	0	1
Trichoptera	3	2	5	7	6	7
Coleoptera	0	1	1	1	0	3
Predator	5	3	9	10	10	13
Diptera	7	7	7	8	8	12
Composition:						
EPT Index (%)	2.8	7.1	5.8	6.2	10	32
Sensitive EPT Index (%)	0.5	0.5	2.6	2.1	0.9	5.1
Shannon Diversity	1.3	1.66	1.6	1.37	1.8	2.8
Dominant Taxon (%)	54	33	39	62	54	18
Non-insect Taxa (%)	26	6.3	22	15	35	23
Tolerance:						
Tolerance Value	5.4	5.7	5.5	5.6	5.9	5.7
Intolerant Organisms (%)	0.3	0.5	2.3	1.8	0.9	5.4
Intolerant Taxa (%)	5.3	19	22	19	7.7	18
Tolerant Organisms (%)	0.6	0.5	1.6	0.2	10	14
Tolerant Taxa (%)	11	13	22	4	31	23
Functional Feeding Groups:						
Collector-Gatherers (%)	68	83	55	30	28	52
Collector-Filterers (%)	29	16	40	63	56	19
Collectors (%)	98	99	95	92	85	71
Scrapers (%)	0.3	0.2	1.4	3.1	8.5	2.5
Predators (%)	1.6	1.3	3.4	3.8	6.5	19
Shredders (%)	0.3	0.0	0.5	0.5	0.0	1.3
Other (%)	0.0	0.0	0.0	0.2	0.3	6.4
Taxa characteristics:						
Chironomids + blackflies (%)	93	92	91	90	76	46
Sensitive Taxa (TV < 3)	1	3	6	5	2	7
Estimated Abundance	20,000	29,000	7,000	19,000	12,000	10,000
Biological Condition Score:						
SoCal IBI Score (0-100)	26	36	39	53	29	59
CSCI Score (1 – 1.0)	0.65	0.63	0.78	0.79	0.66	0.97

Table 8. Scores for biological metrics used to calculate H2O IBI for sites in Upper Penitencia Creek sampled during WY 2016. SSID station numbers are in bold.

Biological Metrics	April/May 2016				June 2016	
	114	117	121	135	114	121
Proportion halobiontic Score	0	1	3	5	1	3
Proportion high copper indicators Score	0	1	0	1	0	0
Proportion high DOC ¹ indicators Score	0	4	0	6	0	0
Proportion low TN ² indicators Score	2	3	2	2	3	2
Proportion low TP ³ indicators Score	0	0	0	0	0	0
Proportion Nitrogen heterotrophs Score	0	0	1	5	1	6
Proportion requiring >50% DO ⁴ saturation Score	7	6	7	6	8	8
Proportion sediment tolerant (highly motile) Score	0	1	3	5	2	7
Total H2O Score	11	20	20	38	19	32

¹ DOC: Dissolved Organic Carbon

² TN: Total Nitrogen

³ Total Phosphorus

⁴ DO: Dissolved Oxygen

4.3 Physical Habitat

The physical habitat assessment collected during each bioassessment sampling event are shown in Table 9. The amount of fine substrate and percentage of canopy cover were similar across sites. The percent riffle habitat was highly correlated with flow rates; higher at site 114 during June event and higher at site 121 at April event. The percent macroalgae cover was much higher during the June sampling event at both sites.

Table 9. Selected physical habitat variables collected at 4 bioassessment sites in Upper Penitencia Creek, Santa Clara County during WY2016.

Station Code	Sampling Date	% Micro Algae Cover	% Macro Algae Cover	% Canopy Cover	% Sands+ Fines	% Riffle Habitat
114	4/28/2016	0	4.8	74.7	23.8	28
	6/9/2016	1.0	47.6	83.7	27.6	58
117	5/5/2016	1.9	19.1	70.2	16.2	NR
121	4/28/2016	5.7	22.9	79.6	24.8	61
	6/9/2016	1.9	59.1	81.0	25.7	36
135	5/5/2016	7.6	10.5	85.8	27.6	NR

4.4 Water Temperature

Plots showing temperature data collected at the four monitoring sites in Upper Penitencia Creek in WY 2016 are presented in Figure 7. The temperature plot for site 114 indicates period of higher temperatures and reduced diurnal variability between June and the end of the deployment in July (when percolation pond releases were stopped). Temperatures during this period appear to show influence of warmer water from the percolation ponds coupled with reduced (or absent) surface flow from the upstream channel reach.

The maximum weekly average temperatures (MWAT) were calculated for non-overlapping, 7-day periods for all sites. The MWAT values calculated from temperatures recorded at the four lowest elevation sites in Upper Penitencia Creek (sites 114, 121, 130, and 135) are plotted in Figure 8. The case site (114) had MWAT values that were 2 to 6 °C higher than other sites during months of June - July.

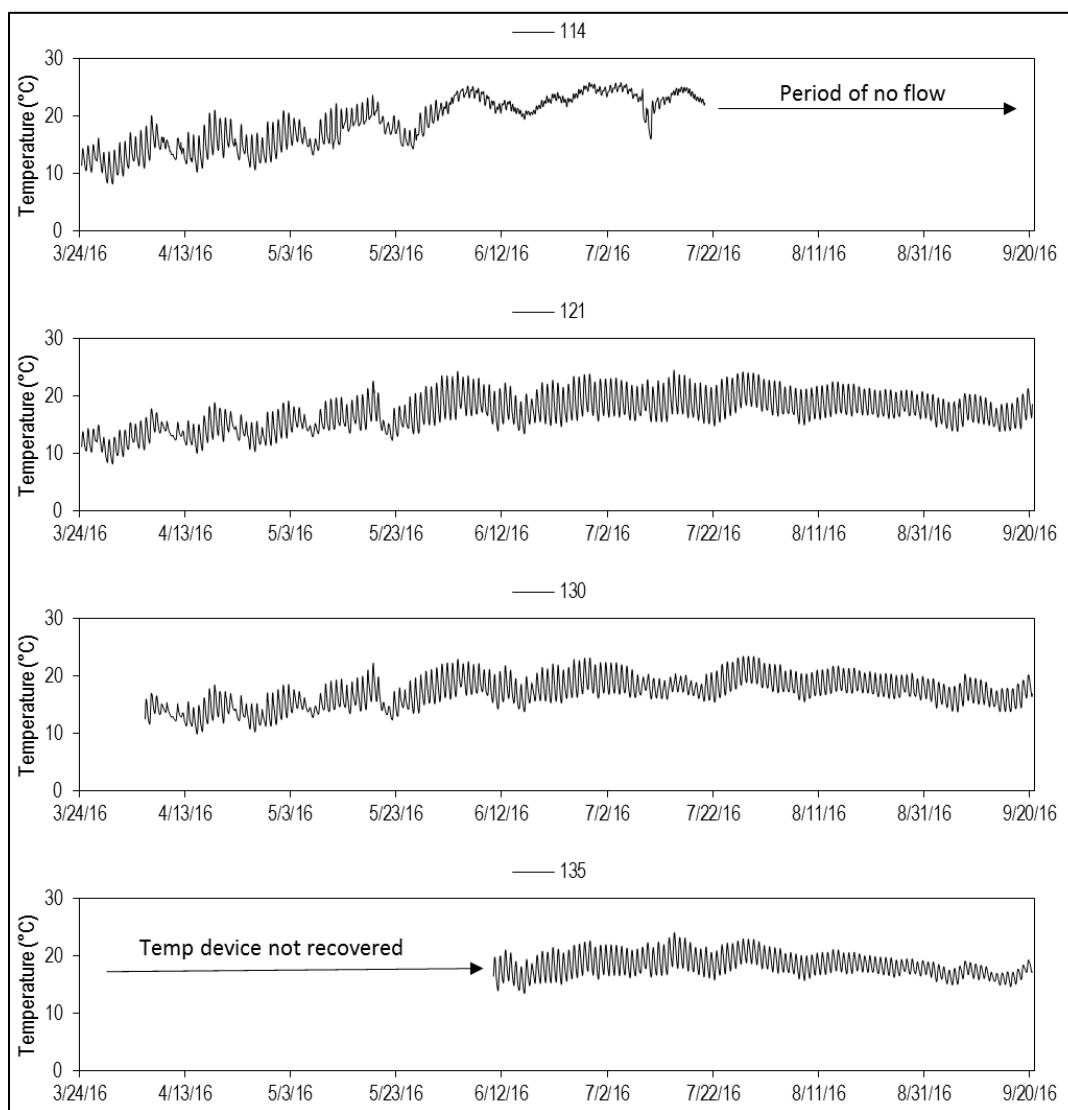


Figure 7. Plot of hourly temperature data collected at four monitoring sites in Upper Penitencia Creek during WY 2016.

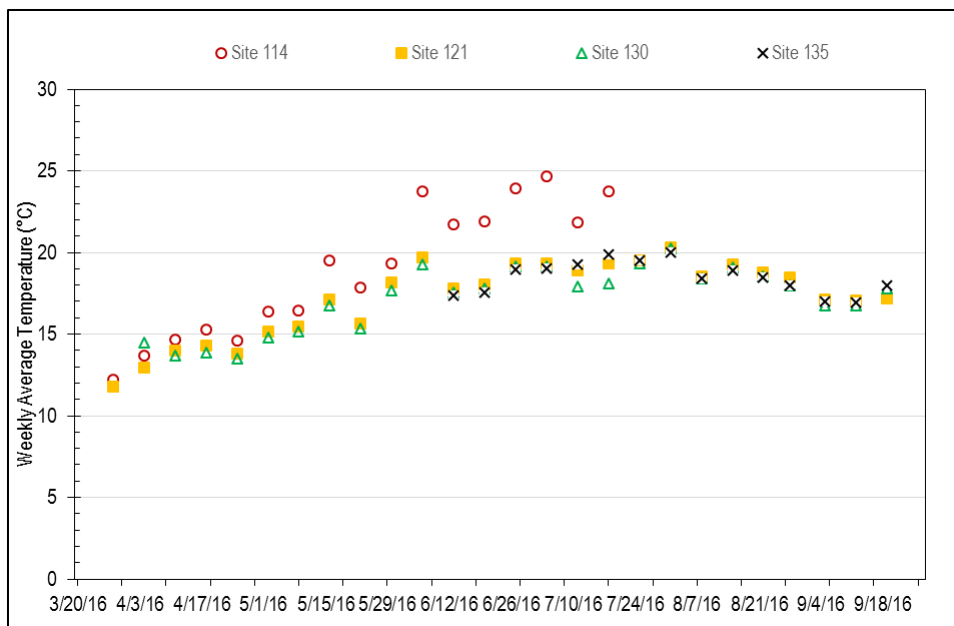


Figure 8. MWAT values for temperature data collected at four monitoring locations in Upper Penitencia Creek during WY 2016.

4.5 General Water Quality

Summary statistics for general water quality measurements collected at the five sites in Upper Penitencia Creek during three sampling events occurring in April, June and September 2016 are listed in Table 10. Continuous water quality monitoring during Event 1 and Event 2 occurred directly before and after, respectively, the two bioassessment sampling events conducted at sites 114 and 121. Summary of the results for each of the water quality parameters are provided below:

- **Temperature:** Median temperature measured during Event 1 was about 1°C warmer at site 114 compared to site 121. During Event 2, median temperature was 4°C warmer at site 114 compared to site 121. The higher temperatures coincide with period of discharges from the percolation ponds.
- **Dissolved Oxygen:** Median DO measured at sites 114 and 121 ranged from 8.8 to 10.4 mg/L for both sampling events. There was very little difference between sites.
- **pH:** Median pH measured at sites 114 and 121 ranged from 8.0 to 8.5 for both events. The maximum values of pH ranged from 8.5 to 9.0, with the highest value measured at site 121 during Event 1.
- **Specific Conductance:** The median specific conductance measured during Event 1 was 722 uS/cm for both sites. The specific conductance measured during Event 2 was much lower at site 114 (305 uS/cm) compared to site 121 (1025 uS/cm). The lower conductivity measurement for Event 2 is likely influenced from imported water originating from percolation ponds.

Table 10. Descriptive statistics for continuous water temperature, dissolved oxygen, pH, and specific conductance measured at five sites in Upper Penitencia Creek, Santa Clara County during WY2016. Data were collected every 15 minutes over a two two-week time periods during April (Event 1), June (Event 2) and September (Event 3).

Sample Month		Event 1 (April 14-28)			Event 2 (June 10-23)		Event 3 (Sept 7-20)		
Station Code		114	117	121	114	121	121	130	135
Temperature (°C)	Min	10.3	9.9	9.9	19.2	13.3	20.4	13.6	13.8
	Median	14.5	14.0	13.6	21.6	17.5	22.1	16.5	16.8
	Mean	14.7	14.2	13.8	21.6	17.8	22.1	16.5	16.9
	Max	21.1	20.3	18.8	24.2	22.8	23.8	19.8	20.6
Dissolved Oxygen (mg/L)	Min	8.0	8.9	9.0	8.0	7.2	7.8	6.8	7.8
	Median	9.9	10.4	10.4	8.8	8.8	8.4	8.9	9.3
	Mean	10.0	10.5	10.4	8.9	9.0	8.5	8.9	9.5
	Max	12.1	12.1	11.8	9.9	11.3	9.6	10.5	11.1
pH	Min	7.9	8.4	8.2	7.7	8.2	7.8	8.0	8.2
	Median	8.1	8.5	8.5	8.0	8.3	8.1	8.2	8.3
	Mean	8.2	8.6	8.5	8.0	8.4	8.2	8.2	8.4
	Max	8.8	9.1	9.0	8.5	8.7	8.9	8.4	8.6
Specific Conductivity (uS/cm)	Min	240	65	507	286	977	427	1185	1196
	Median	722	630	721	305	1025	475	1245	1246
	Mean	705	626	699	305	1023	481	1238	1240
	Max	800	813	800	333	1072	547	1289	1275
<i>Total number of data points (N)</i>		1632	1621	1623	1262	1260	1252	1252	1253

4.6 Water Chemistry

Concentrations of nutrients and conventional analytes measured in water samples collected at the four bioassessment sites in Upper Penitencia Creek during WY 2016 are shown in Table 11.

Table 11. Nutrient and conventional constituent concentrations in water samples collected at four sites in Upper Penitencia Creek during WY 2016.

Parameter	Units	Water Quality Objective ¹	114		117	121		135
			4/28/16	6/9/16	5/5/16	4/28/16	6/9/16	5/5/16
Ammonia as N	mg/L	NA	0.025	0.11	0.03	0.043	0.043	0.17
Unionized Ammonia (as N)	mg/L	0.025	NR	0.01	0.001	0.002	0.003	0.004
Chloride	mg/L	250	43	42	41	42	78	120
AFDM	g/m ²	NA	52.4	47.9	55.2	60.9	29.3	247.7
Chlorophyll a	mg/m ²	NA	23.4	31.7	2	31.2	110.4	74.3
Nitrate as N	mg/L	0.42	0.13	0.3	0.19	0.24	0.04	0.3
Nitrite as N	mg/L	NA	0.008	0.008	0.004	0.011	0.001	0.035
Total Kjeldahl	mg/L	NA	0.57	1.1	1.1	0.48	0.88	0.97
Total Nitrogen	mg/L	NA	0.71	1.41	1.29	0.73	0.92	1.31
Ortho-Phosphate as P	mg/L	NA	0.02	0.14	0.02	0.02	0.01	0.03
Phosphorus as P	mg/L	NA	0.03	0.28	0.03	0.03	0.09	0.04
Total Phosphorus	mg/L	NA	0.057	0.42	0.046	0.055	0.095	0.072
Silica as SiO ₂	mg/L	NA	12	10	15	12	9.4	15

¹ Nitrate and chloride water quality objectives only apply to waters with MUN designated Beneficial Uses (BU) SFRWQCB (2013). MUN is not a designated BU for Upper Penitencia Creek.

The highest concentrations for nitrate (0.3 mg/L), total nitrogen (1.41 mg/L), total phosphorus (0.42 mg/L) and unionized ammonia (0.01) occurred at the case site 114 during the June event. The concentrations for the same analytes at site 121 during the June event were much lower, suggesting that augmented water from the percolation ponds are likely a source of additional nutrients to site 114. In contrast, similar nutrient levels occurred at sites 114 and 121 during the April sampling event and sites 117 and 135 during the May sampling event.

There are no established nutrient thresholds for Santa Clara County that are associated with biological condition. An evaluation of CSCI scores in relation to nutrient concentrations was conducted for 112 bioassessment sites sampled between 2012 and 2016 for Creek Status Monitoring. The results indicated that all sites with “likely intact” and “possibly intact” and the majority of sites with “likely altered” CSCI scores had total nitrogen concentrations that were ≤ 1.5 mg/L. All of the samples collected at sites 114 and 121 were below this threshold.

4.7 Sediment Chemistry and Toxicity

To evaluate sediment chemistry impacts to biological condition, sediment samples were analyzed for pyrethroid pesticide concentrations. Toxicity unit (TU) equivalents were computed for individual pyrethroid and fipronil results, based on available literature values for pyrethroids in sediment LC50 values.^{10,11} (Table 12). Because organic carbon mitigates the toxicity of pyrethroids and fipronil in sediments, the LC50 values were derived on the basis of TOC-normalized pyrethroid concentrations. Similarly, the constituent concentrations as reported by the lab were divided by the measured TOC concentration at each site, and the TOC-normalized concentrations were used to compute TU equivalents. None of the pesticide constituents had TU equivalents that exceeded 1.0 for either site.

Table 12. Calculated pyrethroid toxic unit (TU) equivalents for sediment samples collected at two sites in Upper Penitencia Creek in 2016.

Pyrethroid	Units	LC50	Sampling Location	
			114	121
Bifenthrin	µg/g dw	0.52	0.19	0.14 a
Cyfluthrin	µg/g dw	1.08	0.03 b	0.07 a
Cypermethrin	µg/g dw	0.38	0.08 b	0.19 a
Deltamethrin	µg/g dw	0.79	0.02 a	0.11 a
Esfenvalerate	µg/g dw	1.54	0.01 a	0.06 a
Lambda-Cyhalothrin	µg/g dw	0.45	0.04 b	0.16 a
Permethrin	µg/g dw	10.83	0.00 b	0.01 a
Other MRP Pesticides of Concern				
Carbaryl	µg/g dw	NA ^c	NA c	NA c
Fipronil	µg/g dw	0.41	0.03 a	0.17 a

^a Concentration was below the method detection limit (MDL). TU equivalents calculated using 1/2 MDL.

^b TU equivalents calculated from concentration below the reporting limit (DNQ-flagged).

^c Currently there is no available LC50 value for Carbaryl, however the observed concentration was below the detection limit.

A summary of toxicity testing results for two stations on Upper Penitencia Creek during WY 2016 is presented in Table 13. The toxicity of sediment samples to the test organisms are relative to the laboratory control treatment via statistical comparison using the Test of Significant Toxicity (TST) statistical approach. For samples with toxicity (i.e., those that “failed” the TST), the Percent Effect is evaluated. The Percent Effect compares sample endpoints (survival, reproduction, growth) to the laboratory control endpoints. Both the TST result and the Percent Effect are determined by the analytical laboratory.

¹⁰ The LC50 is the concentration of a given chemical that is lethal on average to 50% of test organisms.

¹¹ No LC50 is published for carbaryl.

Table 13. Summary of SCVURPPP toxicity results for sediment samples collected at two sites in Upper Penitencia Creek in 2016.

Site ID	Organism	Test Type	Unit	Results		TST Result	% Effect
				Lab Control	Organism Test		
114	<i>Chironomus dilutus</i>	Survival	%	86.3	93.8	Pass	-8.7%
	<i>Hyalella azteca</i>	Survival	%	100	97.5	Pass	2.5%
121	<i>Chironomus dilutus</i>	Survival	%	86.3	96.3	Pass	-11.6%
	<i>Hyalella azteca</i>	Survival	%	100	100	Pass	0%

5.0 Discussion

Using the CADDIS process outlined in section 3.0, existing information and new data collected as part of this project was analyzed to distinguish the most probable stressor(s) causing decreased biological condition in a segment of Upper Penitencia Creek roughly defined by the outfall of the Robert Gross Percolation Ponds to the stream crossing of Piedmont Avenue. The study approach focused on evaluating the differences in biological, physical, chemical and toxicological indicators between a case site (114) located within the segment of interest and a comparator site (121) located directly upstream of the segment. Because the biological condition, as measured by CSCI scores, at the case site was consistently lower than the comparator site, the CADDIS process was focused on identifying indicators of biological condition stress that may indicate the cause of decreased CSCI scores. A comparison of indicator values observed at the case and comparator sites during April and June 2016 is provided as Table 14.

5.1 Spatial and Temporal Differences in Macroinvertebrate and Algal Communities

The combined bioassessment results from 2008, 2013 and 2016 at sites within urban reach of Upper Penitencia Creek show a distinct biological gradient, with CSCI scores decreasing from upstream to downstream direction (Figure 9). The change between “intact” and “altered” biological condition categories (as defined by MRP trigger of 0.795) is located at approximately the 250-foot elevation mark, just downstream of the Dorel Drive bridge and the SCVWD stream gage. This location is approximately the downstream extent of perennial flow in Upper Penitencia Creek and the upstream extent of the Santa Clara Valley groundwater basin.

Benthic macroinvertebrate communities and CSCI scores varied between April 2016 and June 2016 at the comparator site (121). CSCI scores ranged from 0.78 in April to 0.97 in June. In April, the macroinvertebrate community was dominated by short-lived taxa, indicating a recent change in the extent of wetted channel that was likely related to spring pulse flows (i.e., newly wetted stream margins are first colonized by taxa with short life cycles). Following a period of consistent baseflows, a more diverse benthic macroinvertebrate community including the presence of long-lived taxa (e.g., water beetles) was observed in samples collected in June.

In contrast, CSCI scores calculated for the three bioassessments conducted in 2013 (n=1) and 2016 (n=2) at the case site (114) were relatively consistent, ranging from 0.64 to 0.66) and the

biological community was dominated by short-lived taxa. Benthic macroinvertebrate taxa that typically indicate the presence of perennial flows were noticeably absent from the communities observed at the case site. Although CSCI scores remained stable at the case site, variations in water quality conditions were observed between April and June 2016. Percolation pond discharges directly upstream of the case site resulted in higher flow rates and warmer temperatures during the June 2016 bioassessment event. It is likely that very few or no BMIs would historically be present at the case site during the bioassessment index period without imported water getting released from the percolation ponds.

Table 14. Summary of the biological indicator and physical and chemical stressor data collected at the case site (114) and the comparator site (121) during the April and June 2016 events.

Indicator or Potential Stressor	April 2016			June 2016		
	114	121	% Difference ^a	114	121	% Difference ^a
Biological Indicators						
<i>Benthic Macroinvertebrates</i>						
CSCI Score	0.65	0.75	-13%	0.66	0.97	-32%
CSCI Condition Category	Likely Altered	Possibly Intact	One Category	Likely Altered	Likely Intact	Two Categories
<i>Benthic Algae</i>						
H2O Score	11	20	-45%	19	32	-41%
H2O Condition Category	Very Likely Altered	Very Likely Altered	None	Very Likely Altered	Very Likely Altered	None
Potential Stressors						
Stream Discharge (cfs)	2.3	0.9	156%	7.7	0.2	3750%
Release from Percolation Ponds	No	No	-	Yes	No	-
Flow Regime	NP	P	-	NP	P	-
Continuous WQ (mean values) ^b						
Temperature (C)	14.7	13.8	7%	21.6	17.8	21%
DO (mg/L)	10	10.4	-4%	8.9	9	-1%
pH	8.2	8.5	-4%	8	8.4	-5%
Specific conductivity (uS/cm)	705	699	1%	305	1023	-70%
% sand and fines	23.8	24.8	-4%	27.6	25.7	7%
% riffle habitat	28	61	-54%	58	36	61%
% Macroalgae cover	4.8	22.9	-79%	47.6	59.1	-19%
Ammonia as N (mg/L)	0.025	0.043	-42%	0.11	0.043	156%
Total nitrogen (mg/L)	0.71	0.73	-3%	1.41	0.92	53%
Total phosphorus (mg/L)	0.057	0.055	4%	0.42	0.1	320%
Chlorophyll a (mg/m2)	23.4	31.2	-25%	31.7	110.4	-71%
Ash Free Dry Mass (AFDM)	52.4	60.9	-14%	47.9	29.3	64%

^a % Difference = ((value at case site-value at comparator site)/value at comparator site*100%).

^b Represents data collected for period of two weeks prior (Event 1) and following (Event 2) bioassessment sample event.

Values over 10% are indicated in bold.

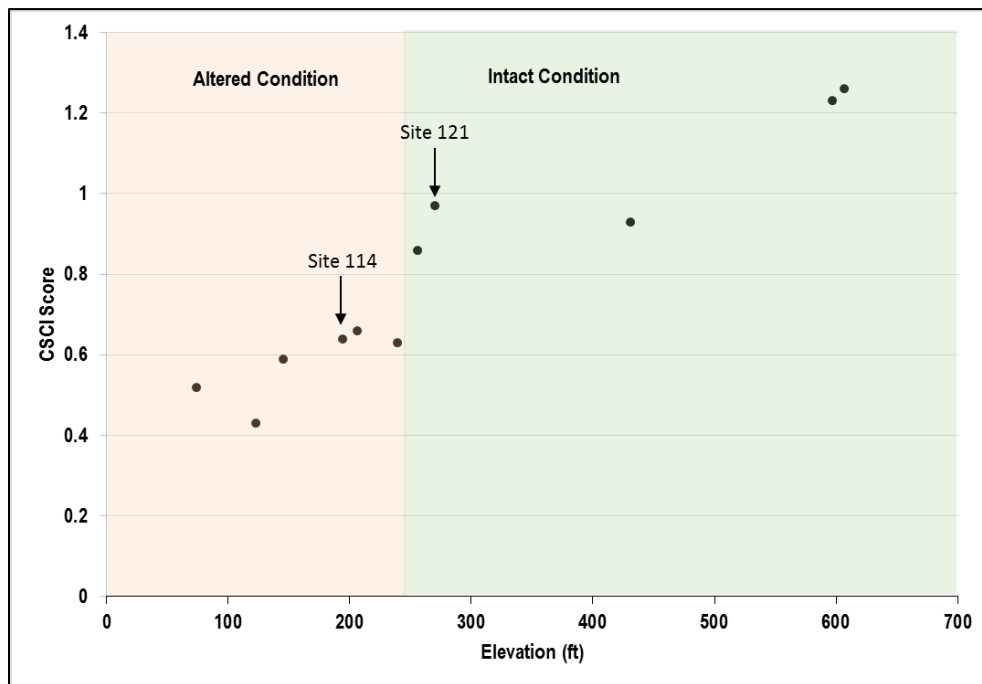


Figure 9. CSCI scores at bioassessment sites sampled in Upper Penitencia Creek between 2008 and 2016 across the elevation gradient.

5.2 Differences in Physical Habitat Indicators between Sites

Physical habitat conditions at a site can significantly affect the biological condition measured via CSCI or H2O indices. Based on the results of the physical habitat assessments conducted during each bioassessment event at the comparator and case sites, the overall condition of the habitat at each site is similar. The amount of fine substrate, percentage of canopy cover, and other variables observed at both sites were nearly identical during both the April and June events.

One indicator of the physical condition of the stream segments that differed between the two sites was the percent riffle habitat present. This indicator measures the extent of riffle habitat present to support benthic macroinvertebrate communities and it is highly correlated with the stream flow at the site. Stream flow was greater at the comparator site during the April event and greater at the case site during the June event, presumably due to water inputs from the percolation ponds during the summer, which creates a greater extent of wetted stream channel at the case site than likely occurs during natural conditions.

5.3 Differences in Chemical and Toxicological Indicators between Sites

Water and sediment chemistry and toxicity can also affect the biological condition observed in stream segments. Based on the analysis of available data, water and sediment chemistry and toxicity do not appear to be the likely causes of reduced biological condition at the case site. With the exception of water temperature and possibly nutrients, differences in water and sediment chemistry between case and comparator sites were not observed during the study.

Temperature and nutrient increases were observed during the June event, and are assumed to be associated with percolation pond releases. Although nutrient concentrations increased, concentrations are within the average range observed in Santa Clara Valley streams. Average weekly maximum water temperatures during the summer are bordering levels of concern (i.e., 24 °C). Sediment toxicity was not observed at either site and therefore is not considered to be a stressor of interest.

6.0 Conclusions and Next Steps

A summary of the analysis conducted on the available physical, chemical and toxicological data from both the case and comparator sites is presented in Table 15. Summary conclusions drawn using the CADDIS process outlined in section 3.0 are also presented in Table 15 and below:

- Biological Condition Affected by Natural Stream Drying - The case site (114) used in this study is located within a segment of Upper Penitencia Creek that historically dried up during the spring/summer season due to the percolation of surface flow into the underlying groundwater basin (Beller et al 2012). Biological conditions, based on CSCI scores, at the case site are consistently lower than the comparator site (121) at least partially due to the lack of perennial flow in this segment. This conclusion is supported by the abundance of short-live taxa at the case site and lack of organisms that prefer perennial flow.
- Water Inputs from Percolation Ponds Improve Flows and Affect Water Quality - The stressor (physical, chemical and toxicological) data available for evaluation during the study do not show a clear linkage to the biological condition observed at the case site. With exception of the extent of riffle habitat, the physical habitat at the case and comparator sites is very similar and not likely the cause of reduced biological condition at the case site. Similarly, water and sediment chemistry at the two sites are very similar, with the exception of temperature and nutrient concentrations, which increased with the increase in water diverted from the percolation ponds into the stream channel during the summer months.
- Municipal Stormwater Unlikely Source of Stressors - Based on the best available information, sources of stress on biological communities in the Upper Penitencia Creek segment of interest, whether natural (e.g., lack of stream flow) or anthropogenic (e.g., nutrients or temperature), are not associated with discharges from the municipal separate storm sewer system (MS4). Rather, if reduced biological conditions in this segment are partially caused by anthropogenic inputs, they are likely associated with diversions from the percolation ponds to the channel, which are intended to sustain water flows for groundwater percolation to satisfy downstream well users/water rights.

Although municipal stormwater discharges do not appear to be the probable causes of reduced biological conditions in the Upper Penitencia Creek segment of interest, SCVURPPP recognizes the importance of freshwater habitat in this creek that currently supports freshwater organisms, including a viable steelhead community. SCVURPPP plans to complete a brief *Upper Penitencia Creek Watershed Management Practices Summary* by September 30, 2017 to assist in the continued management of this important natural resource. The management practices summary will include a compilation of watershed management activities that are currently in place or planned in the watershed, an evaluation of practices that could be implemented or enhanced to improve biological conditions in the creek, and recommendations of actions (monitoring or management) that would support the management of the freshwater habitat

beneficial use in Upper Penitencia Creek. The management practices summary will be included in the Program's FY 16-17 Annual Report, which will be submitted to the Regional Water Board in September 2017.

Table 15. Summary results and conclusions of the Upper Penitencia Creek SSID project.

Potential Cause of Reduced Biological Condition	Summary Results of Data Analysis	Likelihood that Stressor is Cause of Reduce Biological Condition	Likely Source of Stressor
Stream Flow	Natural non-perennial flow due to natural percolation of water into streambed reduces the CSCI score at the case site.	Probable Cause	NA (Naturally Occurring)
	Although increases in stream flow during summer months due to diversions into the channel from percolation ponds may exacerbate unstable habitat conditions for benthic macroinvertebrate communities, resulting in lower CSCI scores.	Possibly (Partial) Cause	Water Inputs from Percolation Ponds
Water Temperature	Water temperatures during the summer months greater (2 to 4 °C) than temperatures directly upstream and nearing weekly maximum thresholds (24 °C).	Possibly (Partial) Cause	Water Inputs from Percolation Ponds
General Water Quality	General water quality conditions in good ranges and similar between case and comparator sites.	Unlikely	NA
Physical Habitat	No significant differences in habitat quality between case and comparator sites.	Unlikely	NA
Nutrients	Higher nutrient concentrations observed during at the case site during summer.	Unlikely but Possible (Partial) Cause	Water Inputs from Percolation Ponds
Pesticides/Toxicity	Pesticide concentrations not observed at adverse concentrations. No differences in pesticide concentrations observed between the sites. No toxicity observed.	Unlikely	NA

7.0 References

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Appendix A

Quality Assurance/Quality Control Report

INTRODUCTION

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) conducted a Stressor/Source Identification (SSID) Project in Upper Penitencia Creek during Water Year (WY) 2016 to comply with Provision C.8.e (Stressor/Source Identification (SSID) Projects) of the National Pollutant Discharge Elimination Program (NPDES) Municipal Regional Permit for the San Francisco Bay Area (i.e., MRP). Data collected during monitoring conducted for Creek Status Monitoring (CSM; MRP Provision C.8.d) and Pollutants of Concern Monitoring (POC; MRP Provision C.8.f) were used for this project in addition to supplemental data collected solely for this project. Monitoring for this SSID project (hereinafter Project) was performed according to the Upper Penitencia Creek SSID Project Final Work Plan (SCVURPPP 2015).

In WY 2016, SCVURPPP implemented a comprehensive data quality assurance and quality control (QA/QC) program for all three projects. Data QA/QC for data collected was performed according to procedures detailed in the Quality Assurance Project Plan (QAPP) developed by the BASMAA RMC (BASMAA 2016a) and BASMAA RMC Standard Operating Procedures (SOP; BASMAA 2016b), SOP FS-13 (Standard Operating Procedures for QA/QC Data Review). The BASMAA RMC SOP and QAPP are based on the SOP and QAPP developed by the Surface Water Ambient Monitoring Program (SWAMP; SCCWRP 2008).

Data were assessed for seven data quality attributes, which include (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Contamination, (6) Accuracy, and (7) Precision. These seven attributes are compared to Data Quality Objectives (DQOs), which were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data – representativeness and comparability are qualitative while completeness, sensitivity, precision, accuracy, and contamination are quantitative assessments and are data type dependent. Specific DQOs are based on Measurement Quality Objectives (MQOs) for each data type and analyte. Detailed methodology for evaluating the data quality attributes is included in the SCVURPPP Creek Status Monitoring QA/QC report for WY 2016.

DATA TYPES

This QA/QC report only addresses data quality for those parameters conducted solely for this project, including biological, chemical, and toxicological analysis. Data QA/QC for parameters collected for the other projects is included in the QA/QC for their respective report. See Table 1 for the monitored parameters, sites, dates and to which project each corresponds.

Table 1. Distribution of sites, dates, and parameters monitored for the Upper Penitencia Creek Stressor/Source Identification Project in WY 2016 and projects/QA reports associated with those parameters. Project codes include Stressor Source Identification Project (SSID), Pollutants of Concern (POC) and Creek Status Monitoring (CSM).

Site	Dates	Parameters Monitored					
		Bioassessment ¹ , Physical Habitat, Field Measurements	Ammonia, Phosphorus, Nitrogen ²	Chloride, Silica	Sediment Toxicity & Chemistry	Continuous Water Temperature ³	Continuous Water Quality
205COY114	3/28/16-8/20/16					CSM	
	4/11/16-4/28/16						CSM
	4/28/16	SSID	POC	SSID			
	6/9/16	SSID	POC	SSID	SSID		
	6/10/16-6/23/16						CSM
	9/7/16-9/20/16						
205COY121	3/28/16-8/20/16					CSM	
	4/11/16-4/28/16						CSM
	4/28/16	SSID	POC	SSID			
	6/9/16	SSID	POC	SSID	SSID		
	6/10/16-6/23/16						CSM
	9/7/16-9/20/16						SSID
205COY117	3/28/16-8/20/16					CSM	
	6/10/16-6/23/16						CSM
205COY130	9/7/16-9/20/16						SSID
205COY135	9/7/16-9/20/16						SSID

¹ Includes benthic macroinvertebrates (BMI) and algae taxonomy plus chlorophyll a and ash free dry mass analysis.

² Phosphorus includes orthophosphate and phosphorus as P. Nitrogen includes nitrate, nitrite, and total Kjeldahl nitrogen.

³ Includes temperature, pH, specific conductivity, and dissolved oxygen.

PROJECT REPRESENTATIVENESS

The Project Work Plan staff and field crew members are trained in SWAMP and RMC protocols, and receive significant supervision from the local monitoring coordinator and QA officer. As a result, each field crew member is knowledgeable of, and performs data collection according to the protocols in the RMC QAPP and SOP, ensuring that all samples and field measurements are representative of conditions in Santa Clara Valley urban creeks.

PROJECT COMPARABILITY

Data for this SSID project, creek status monitoring and POC monitoring were collected by the same field crew and monitoring for all three projects was conducted in accordance with the RMC QAPP. As a result, any data collected for this SSID project is considered comparable to both monitoring projects and with other RMC monitoring. Additionally, electronic data deliverables (EDDs) for all three projects are

submitted to the San Francisco Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by SWAMP, to ensure data comparability with the California Surface Water Ambient Monitoring Program (SWAMP). Data entry follows SWAMP documentation specific to each data type, including the exclusion of qualitative values that do not appear on SWAMP's look up lists¹². Completed templates are reviewed using SWAMP's online data checker¹³, further ensuring SWAMP-comparability.

BIOASSESSMENTS AND PHYSICAL HABITAT ASSESSMENTS

Supplemental bioassessments conducted for the SSID Project were included in the same batch as bioassessments conducted for creek status monitoring, for a total of 24 sites. The RMC QAPP requires field duplicates be collected at 2 sites (10% of total sites) and benthic macroinvertebrates (BMI) at two sites be submitted to a second taxonomic laboratory for quality control. These QA samples and their results were collected and analyzed during creek status monitoring and apply to this project as well. Refer to the creek status monitoring QA/QC report for more information.

COMPLETENESS

The Project Work Plan identified three sites/reaches in Upper Penitencia Creek for bioassessments and physical habitat assessments. However, the reach for the middle site, 205COY117, overlapped with the reach of a probabilistic site selected for creek status monitoring and it was determined that the probabilistic site would be representative of that middle reach and could replace 205COY117. Consequently, only two of the three planned sites were monitored for the Project, but they were both assessed twice as planned by the Work Plan. During all four assessments, SCVURPPP completed bioassessments and physical habitat assessments for all 11 transects at each site.

SENSITIVITY

Taxonomic Results

The benthic macroinvertebrate taxonomic identification met sensitivity objectives; the taxonomy laboratory that organisms were identified to SAFIT STE Level I.

Analytical Results

Due to high concentrations requiring large dilutions, the reporting limits for ash free dry mass analysis (8 mg/L) and the chlorophyll a (50 mg/L) were much higher than the RMC QAPP target reporting limits (2 mg/L and 5 mg/L, respectively). As concentrations were several orders of magnitude higher than either reporting limit, results were not affected by the higher reporting limit.

Note that the target reporting limits in the RMC QAPP are set by the SWAMP, but there are currently no appropriate SWAMP targets for either ash free dry mass and chlorophyll a. Limits in the RMC QAPP are meant to reflect current laboratory capabilities. At lower analyte concentrations where a dilution would not be necessary, the analytical reporting limits would have met the target reporting limits.

ACCURACY

Two BMI samples collected during creek status monitoring were submitted to a separate QC taxonomic laboratory. Refer to the creek status monitoring QA/QC report for accuracy results.

PRECISION

Duplicate algae and BMI samples were collected at two sites during creek status monitoring in WY 2016. Refer to the creek status monitoring QA/QC report for precision results.

¹² Look up lists available online at http://swamp.waterboards.ca.gov/swamp_checker/LookUpLists.php.

¹³ Checker available online at http://swamp.waterboards.ca.gov/swamp_checker/SWAMPUpload.php

CONTAMINATION

All field collection equipment was decontaminated between sites in accordance with the RMC SOP FS-8 and CDFW protocols. As a result, it is assumed that samples were free of biological contamination.

FIELD MEASUREMENTS

Field measurements of temperature, dissolved oxygen, pH, specific conductivity, and chlorine residual were collected concurrently with bioassessments and water chemistry samples. Chlorine residual was measured using a HACH Pocket Colorimeter™ II, which uses the DPD method. All other parameters were measured with a YSI Professional Plus multi-parameter instrument. All data collection was performed according to RMC SOP FS-3 (Performing Manual Field Measurements).

COMPLETENESS

Temperature, dissolved oxygen, pH, specific conductivity, total chlorine residual, and free chlorine residual were collected at three of the four bioassessment sites. Only pH was collected at 205COY114 during the April event. The error was not noticed until after the field crew had left the site, but staff were alerted to the error prior to any future assessments. Changes in internal field crew protocols were implemented to prevent future oversights in subsequent field seasons. Field crew will now send a photo of the field measurements to the local QA officer prior to leaving the site to allow for resampling if the QA officer deems it necessary.

SENSITIVITY

Free and total chlorine residual are measured using a HACH Pocket Colorimeter™ II, which uses the DPD method. For this method, the estimated detection limit for the low range measurements (0.02-2.00 mg/L) is 0.02 mg/L. There is, however, no established method reporting limit. Based on industry standards and best professional judgment, the method reporting limit is assumed to be 0.1 mg/L, which is much lower than the 0.5 mg/L target reporting limit listed in the RMC QAPP for free and total chlorine residual.

There are also no method reporting limits for temperature, dissolved oxygen, pH, and conductivity measurements, but the actual measurements are much higher than target reporting limits in the RMC QAPP, so it is assumed that target reporting limits are met for all field measurements.

ACCURACY

Data collection for the Project was intermixed with creek status monitoring and was conducted Monday through Thursday. The multi-parameter instrument was calibrated at least 12 hours prior to the first sample on Monday, with the dissolved oxygen probe calibrated every morning to ensure accurate measurements. Calibration solutions are certified standards, whose expiration dates were noted prior to use. The chlorine kit is factory-calibrated and does not need to be calibrated.

PRECISION

Precision could not be measured as no duplicate field measurements were required or collected.

WATER CHEMISTRY

Four water chemistry samples were collected by SCVURPPP staff concurrently with the four bioassessment samples, and analyzed by Caltest Analytical Laboratory (Caltest). Caltest analyzed samples within their respective holding times and performed all internal QA/QC requirements as specified in the QAPP and reported their findings to the RMC. Key water chemistry Measurement Quality Objectives (MQOs) are listed in RMC QAPP Table 26-2.

Ammonia, phosphorus, orthophosphate, nitrate, nitrite, and total Kjeldahl nitrogen samples were collected to comply with POC monitoring requirements, but results were also used for the SSID project. QA results for those analytes is included in the POC QA/QC report. Supplemental water chemistry samples collected for the SSID Project include silica and chloride. All water chemistry samples collected for the three projects (creek status, POC, and SSID) were included in the same batch, and all QA samples collected apply to all three project, including one field duplicate (5% of 24 total sites) that was collected during creek status monitoring.

COMPLETENESS

The Project Work Plan originally planned for the collection of water chemistry/nutrient samples at sites 205COY114 and 205COY121 once during the summer for a total of two planned samples. However, SCVURPPP collected water chemistry samples at the two sites twice, for a total of four samples instead. Samples were analyzed for all requested analytes, and 100% of results were reported. Water chemistry data were flagged when necessary, but none were rejected.

SENSITIVITY

The reporting limits for analytical results were compared to the target reporting limits in Appendix E (RMC Target Method Reporting Limits) of the RMC QAPP. Laboratory reporting limits for silica met the target reporting limits, while reporting limits for chloride exceeded the target reporting limit. Concentrations were much higher than reporting limits, and the elevated reporting limits do not decrease confidence in the measurements. Target and actual reporting limits are shown in Table 3. Results with reporting limits that exceeded the target reporting limit were flagged.

Table 3. Target and actual reporting limits for chloride and silica samples collected for stressor/source identification in Upper Penitencia Creek in WY 2016.

Analyte	Target RL mg/L	Actual RL mg/L
Chloride	0.25	1-20
Silica	1	1

ACCURACY

Caltest evaluated and reported the percent recovery (PR) of laboratory control samples (LCS; in lieu of reference materials) and matrix spikes (MS), which were recalculated and compared to the applicable MQOs set by Appendix A (Measurement Quality Objectives for RMC Analytes) of the RMC QAPP MQOs. Recoveries on all laboratory control samples (LCS), matrix spikes (MS), and matrix spike duplicates (MSD) were within the MQO target range of 80-120% recovery.

PRECISION

Precision is nominally assessed as the degree to which replicate measurements agree, nominally determined by calculation of the relative percent difference (RPD) between duplicate measurements. Caltest routinely analyzes matrix spike duplicate samples for target analytes. The relative percent differences (RPD) for all chloride and silica matrix spike duplicate pairs were well below the MQO target of < 25%.

One water chemistry field duplicate sample (5% of 24 samples) was collected during creek status monitoring. Precision of the duplicates is included in the creek status monitoring QA/QC report

CONTAMINATION

For chemical data, contamination is assessed as the presence of analytical constituents in blank samples. Neither of the target analytes were detected in any of the laboratory blanks.

CONTINUOUS WATER QUALITY

Continuous water quality measurements were recorded to supplement the two events conducted for creek status monitoring. Supplemental measurements were collected at one site 205COY121 in September 2016. Temperature, pH, dissolved oxygen, and specific conductivity were recorded once every 15 minutes over two-week deployments using a multi-parameter water quality sonde (YSI 6600-V2).

COMPLETENESS

Sondes were to be deployed at the same sites as creek status monitoring, but the two downstream sites were dry in September. Only the most upstream site, 205COY121, had enough flow for measurements to be collected. Consequently, two new upstream sites were added for September monitoring.

SENSITIVITY

There are no method reporting limits for temperature, dissolved oxygen, pH, and conductivity measurements, but the actual measurements are much higher than target reporting limits in the RMC QAPP, so it is assumed that target reporting limits are met for all field measurements.

ACCURACY

Accuracy for continuous water quality monitoring sondes was assured via continuing calibration verification for each instrument before and after each two-week deployment. Instrument drift was calculated by comparing the instrument's measurements in standard solutions taken before and after deployment. The drift was compared to measurement quality objectives for drift listed on the SWAMP calibration form, included as an attachment to the RMC SOP FS-3.

A summary of the drift measurements is shown in Table 5. All drift measurements met measurement quality objectives.

Table 5. Drift measurements for continuous water quality monitoring events in Upper Penitencia Creek in WY 2016

Parameter	Measurement Quality Objectives	205COY121	205COY130	205COY135
Dissolved Oxygen (mg/l)	± 0.5 mg/L or 10%	0.24	0.1	0.13
pH 7.0	± 0.2	-0.03	0.11	0
pH 10.0	± 0.2	0.13	-0.05	0.02
Specific Conductance (uS/cm)	± 10%	0.3%	0.1%	0.2%

PRECISION

There is no protocol listed in the RMC QAPP for measuring the precision of continuous water quality measurements.

SEDIMENT CHEMISTRY

Sediment chemistry samples were collected by SCVURPPP staff concurrently with dry season toxicity samples on May 5, 2016 and analyzed for pesticides (pyrethroids, carbaryl, and fipronil) by Caltest. All samples were analyzed their holding time. Caltest conducted all QA/QC requirements as specified in the RMC QAPP and reported their findings to the RMC. Key sediment chemistry MQOs are listed in RMC QAPP Tables 26-9 through 26-11.

COMPLETENESS

Both planned/required samples were collected and analyzed for all requested analytes, and all results were reported.

SENSITIVITY

Laboratory reporting limits exceeded RMC QAPP target reporting limits for all analytes, except for one carbaryl sample. A comparison of target and actual reporting limits for those parameters is shown in Table 6. This discrepancy affected four analytes collected at 205COY114 that were detected but not quantified, whose concentrations were between the method detection limit and the reporting limit.

Table 6. Comparison of target and actual reporting limits for sediment analytes where reporting limits exceeded target limits. Sediment samples were collected in Santa Clara County creeks in WY 2016.

Analyte	Target RL mg/kg	Actual RL mg/kg
Bifenthrin	0.33	0.51
Cyfluthrin	0.33	0.51
Lambda-Cyhalothrin	0.33	0.51
Cypermethrin	0.33	0.51
Deltamethrin/Tralomethrin	0.33	0.51
Esfenvalerate/Fenvalerate	0.33	0.51
Permethrin	0.03	0.51
Carbaryl	30	30-41
Fipronil	0.33	0.51

ACCURACY

All laboratory control samples and matrix spike samples met the percent recovery MQO for pyrethroids in sediment (50-150%) listed in the RMC QAPP. None of the sediment chemistry data was flagged or rejected.

PRECISION

All the matrix spike duplicates met the RPD MQO for pyrethroids listed in the RMC QAPP (<35%). In addition, a sediment sample field duplicate was collected during creek status monitoring. See the creek status monitoring QA/QC report for precision results.

CONTAMINATION

None of the other target analytes were detected in any of the blanks.

TOXICITY TESTING

Sediment toxicity samples were collected by SCVRUPPP staff concurrently with sediment chemistry samples at the two supplemental bioassessment sites on May 5, 2016. All toxicity tests were performed by Pacific EcoRisk. The water samples were analyzed for toxicity to four organisms (*Selenastrum capricornutum*, *Ceriodaphnia dubia*, *Pimephales promelas*, and *Hyalella azteca*) and the sediment samples were analyzed for toxicity to *Hyalella azteca* and *Chironomus dilutus*.

COMPLETENESS

Both planned sediment toxicity samples were collected in Upper Penitencia Creek in WY 2016. Pacific EcoRisk tested required organisms for toxicity, and 100% of results were reported.

SENSITIVITY AND ACCURACY

Internal laboratory procedures that align with the RMC QAPP, including water and sediment quality testing and reference toxicant testing, were performed and submitted to SCVRUPPP. The laboratory data QC checks found that all conditions and responses were acceptable. A copy of the laboratory QC report is available upon request.

PRECISION

One field duplicate was collected during creek status monitoring. See the creek status monitoring QA/QC report for precision results.

CONTAMINATION

There are no QA/QC procedures for contamination of toxicity samples, but staff followed applicable RMC SOPs to limit possible contamination of samples.

CONCLUSIONS

All planned data were collected with the exception of field measurements at 205COY114 in April. No issues with precision, accuracy, or contamination were encountered, but sensitivity exceedances (reporting limits) were noted in for ash free dry mass, chlorophyll a, silica and chloride in water, and pesticides in sediment. No data were rejected.

REFERENCES

- Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2016a. Creek Status Monitoring Program Quality Assurance Project Plan, Final Draft Version 3. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 128 pp.
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