Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program

Integrated Monitoring Report
Part C: Stressor/Source Identification Projects

Water Year 2014 through Water Year 2019

Submitted in compliance with Provision C.8.h.v of NPDES Permit No. CAS612008, Order No. R2-2015-049

March 31, 2020

LIST OF ACRONYMS

ACCWP	Alameda Countywide Clean Water Program
BASMAA	Bay Area Stormwater Management Agency Association
BMI	Benthic Macroinvertebrate
CCCWP	Contra Costa Clean Water Program
CEDEN	California Environmental Data Exchange Network
CSCI	California Stream Condition Index
CWA	Clean Water Act
FSURMP	Fairfield Suisun Urban Runoff Management Program
IBI	Index of Biotic Integrity
IMR	Integrated Monitoring Report
MRP	Municipal Regional Permit
MS4	Municipal separate storm sewer system
NPDES	National Pollution Discharge Elimination System
OES	Office of Emergency Services
OFEE	Oil Filled Electrical Equipment
PCBs	Polychlorinated Biphenyls
PG&E	Pacific Gas and Electric Company
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo County Water Pollution Prevention Program
SPoT	Stream Pollution Trends
SOP	Standard Operating Protocol
SSID	Stressor/Source Identification
SWAMP	Surface Water Ambient Monitoring Program
TMDL	Total Maximum Daily Load
UCMR	Urban Creeks Monitoring Report
USEPA	Environmental Protection Agency
WY	Water Year

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1.0 INTRODUCTION

This *Integrated Monitoring Report (IMR) Part C: Stressor/Source Identification Projects, Water Year*[1] *(WY) 2014 through WY 2019* was prepared by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program), on behalf of its 15 member agencies (13 cities/towns, the County of Santa Clara, and the Santa Clara Valley Water District), which are subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities referred to as the Municipal Regional Permit (MRP). The MRP was first adopted by the San Francisco Regional Water Quality Control Board (SFRWQCB or Regional Water Board) on October 14, 2009 as Order R2-2009-0074 (SFRWQCB 2009; referred to as MRP 1.0). On November 19, 2015, the Regional Water Board updated and reissued the MRP as Order R2-2015-0049 (SFRWQCB 2015; referred to as MRP 2.0).

This report fulfills the requirements of provision C.8.h.v of MRP 2.0 for comprehensively interpreting and reporting all Stressor/Source Identification (SSID) monitoring data collected since the previous IMR was submitted in 2014. As such, this report includes data collected during WY 2014 through WY 2019. The previous IMR included data collected during WY 2012 and WY 2013 (SCVURPPP 2014).

Monitoring data were collected in accordance with the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) Quality Assurance Project Plan (QAPP; BASMAA 2016a) and Standard Operating Procedures (SOPs; BASMAA 2016b). Where applicable, monitoring data were derived using methods comparable with those specified by the California Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Program Plan (QAPrP)[2].

The BASMAA QAPP and SOPs were revised twice, once in 2014 and again in 2016, to conform to MRP 2.0 and changes made to the SWAMP QAPrP. The changes made were minor.

Data presented in this report were submitted electronically to the Regional Water Board by SCVURPPP and may be obtained via the California Environmental Data Exchange Network (CEDEN).

1.1 SSID Requirements

Provision C.8 of the MRP requires that Permittees evaluate Creek Status and Pesticides and Toxicity monitoring data with respect to triggers defined in the MRP. Sites where triggers are exceeded may indicate potential impacts to Aquatic Life or other Beneficial Uses and are therefore considered as candidates for SSID projects. SSID projects are selected from the list of trigger exceedances based on criteria such as magnitude of threshold exceedance, parameter, and likelihood that stormwater management action(s) could address the exceedance. Pollutants of Concern (POC) monitoring results (provision C.8.f) may be considered as appropriate.

Both MRP 1.0 (2009) and MRP 2.0 (2015) allow Permittees to comply with the SSID requirements of Provision C.8 through a regional collaborative effort, their Stormwater Program,

[1] Most hydrologic monitoring occurs for a period defined as a Water Year, which begins on October 1 and ends on September 30 of the named year. For example, Water Year 2019 (WY 2019) began on October 1, 2018 and concluded on September 30, 2019.

[2] The current SWAMP QAPrP is available at: https://www.waterboards.ca.gov/water_issues/programs/swamp/qapp/swamp_QAPrP_2017_Final.pdf

and/or individually. In June 2010, Permittees notified the Water Board in writing of their agreement to participate in a regional monitoring collaborative to address requirements in provision C.8. The regional monitoring collaborative is referred to as the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC). In a November 2, 2010 letter to the Permittees, the Regional Water Board's Assistant Executive Officer (Dr. Thomas Mumley) acknowledged that all Permittees have opted to conduct monitoring required by the MRP through a regional monitoring collaborative, the BASMAA RMC. Participants in the BASMAA RMC are listed in Table 1.1.

Table 0.1. Regional Monitoring Coalition (RMC) participants.

Stormwater Programs	RMC Participants
Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)	Cities of Campbell, Cupertino, Los Altos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, Sunnyvale, Los Altos Hills, and Los Gatos; Santa Clara Valley Water District; and, Santa Clara County
Clean Water Program of Alameda County (ACCWP)	Cities of Alameda, Albany, Berkeley, Dublin, Emeryville, Fremont, Hayward, Livermore, Newark, Oakland, Piedmont, Pleasanton, San Leandro, and Union City; Alameda County; Alameda County Flood Control and Water Conservation District; and, Zone 7
Contra Costa Clean Water Program (CCCWP)	Cities of Antioch, Brentwood, Clayton, Concord, El Cerrito, Hercules, Lafayette, Martinez, Oakley, Orinda, Pinole, Pittsburg, Pleasant Hill, Richmond, San Pablo, San Ramon, Walnut Creek, Danville, and Moraga; Contra Costa County; and, Contra Costa County Flood Control and Water Conservation District
San Mateo County Wide Water Pollution Prevention Program (SMCWPPP)	Cities of Belmont, Brisbane, Burlingame, Daly City, East Palo Alto, Foster City, Half Moon Bay, Menlo Park, Millbrae, Pacifica, Redwood City, San Bruno, San Carlos, San Mateo, South San Francisco, Atherton, Colma, Hillsborough, Portola Valley, and Woodside; San Mateo County Flood Control District; and, San Mateo County
Fairfield-Suisun Urban Runoff Management Program (FSURMP)	Cities of Fairfield and Suisun City
Vallejo Permittees	City of Vallejo and Vallejo Sanitation and Flood Control District

The MRP requires that Permittees initiate a minimum number of SSID projects during the permit term. During MRP 1.0 (WY 2012 – WY 2015), as a regional collaborative, SCVURPPP and its RMC partners were required to collectively initiate a region-wide minimum of 10 SSID projects, with a minimum of two assessing toxicity. During MRP 2.0, SCVURPPP and its RMC partners were required to collectively initiate a region-wide minimum of eight SSID projects, with a minimum of one assessing toxicity. During both permit terms, the RMC partners agreed to a population-based distribution of the required number of SSID projects among the Programs, with most projects conducted by individual Programs addressing local needs and one MRP 2.0 project conducted regionally. Through these agreements, SCVURPPP initiated three Santa Clara Basin-specific projects during MRP 1.0, two during MRP 2.0, and participated in one regional project during MRP 2.0.

Provision C.8.e.ii of MRP 2.0 requires that all SSID project reports initiated during MRP 2.0 are presented in a unified, regional-level report. As such, the BASMAA RMC Regional SSID Report is included as Attachment 1.

SSID projects must identify and isolate potential sources and/or stressors associated with observed water quality impacts. They are intended to be oriented to taking action(s) to alleviate stressors and reduce sources of pollutants. Provision C.8.e.iii of MRP 2.0 describes a stepwise process for conducting SSID projects:

- Step 1: Develop a work plan for each SSID project that defines the problem to the extent known, describes the SSID project objectives, considers the problem within a watershed context, lists candidate causes of the problem, and establishes a schedule for investigating the cause(s) of the trigger. The MRP recommends study approaches for specific triggers. For example, toxicity studies should follow guidance for Toxicity Reduction Evaluations (TRE) or Toxicity Identification Evaluations (TIE), physical habitat and conventional parameter (e.g., dissolved oxygen, temperature) studies should generally follow Step 5 (Identify Probable Causes) of the Causal Analysis/Diagnosis Decision Information System (CADDIS), and pathogen indicator studies should generally follow the California Microbial Source Identification Manual (Griffith et al. 2013).

- Step 2: Conduct SSID investigation according to the schedule in the SSID work plan and report on the status of SSID investigations annually.

- Step 3: Conduct follow-up actions based on SSID investigation findings. These may include development of an implementation schedule for new or improved best management practices (BMPs). If a Permittee determines that municipal separate storm sewer system (MS4) discharges are not contributing to an exceedance of a water quality standard, the Permittee may end the SSID project upon written concurrence of the Executive Officer. If the SSID investigation is inconclusive, the Permittee may request that the Executive Officer consider the SSID project complete.[3]

2.0 SSID PROJECTS INITIATED BY SCVURPPP

This section summarizes the results of SSID projects initiated or completed by SCVURPPP during WY 2014 through WY 2019.

During MRP 1.0, the Program initiated three SSID projects. Two of the MRP 1.0 SSID projects were completed in WY 2013 with results included in the previous IMR (SCVURPPP 2014). These projects evaluated fish kills observed in Guadalupe River and reduced dissolved oxygen in Coyote Creek and are not described further in this report. The third MRP 1.0 SSID project addressed poor biological condition in Upper Penitencia Creek. The Upper Penitencia Creek project was initiated in WY 2013 and completed in WY 2016.

During MRP 2.0, the Program initiated two SSID projects addressing toxicity in Coyote Creek and low biological condition in Lower Silver Creek. The Program also participated in a regional project addressing releases and spills of PCBs from electrical utiity equipment (see Section 3.0).

[3] MRP 1.0 did not require that the Executive Officer concur in writing before an SSID project is determined to be completed.

2.1 Upper Penitencia Creek SSID Project

In WY 2013, SCVURPPP initiated the Upper Penitencia Creek SSID Project by developing a work plan to investigate low creek condition scores[4] and temperature trigger exceedances. Over the next two years, field work was unable to be conducted due to drought conditions that resulted in a lack of flow in the study reach during the bioassessment index period. In WY 2016, biological assessments and water and sediment quality monitoring were conducted at two locations in Upper Penitencia Creek following a relatively wet winter. The monitoring design followed the CADDIS framework developed by the USEPA (2010). Monitoring parameters were selected to evaluate a range of potential stressors to biological condition at the two locations. One site (the "test site") is potentially affected by discharges from the Robert Gross Percolation Ponds and the second site (the "comparator site") is located about one mile upstream the test site above the ponds outfall. The percolation ponds are owned and operated by Valley Water. A photograph of the outfall is shown in Figure 2.1.

Figure 2.1. Water release from Robert Gross Percolation Ponds on June 9, 2016. The channel directly upstream of the outfall is nearly dry.

Based on results of the WY 2016 monitoring, the reduced biological integrity observed in Upper Penitencia creek is believed to be associated with episodic streamflow in the segment where the reduced condition was observed. This segment has historically stopped flowing during the spring/summer season due to percolation of surface flow into the underlying groundwater basin. The impacts of this loss of flow are reflected in the aquatic biota that have adapted to abrupt, seasonal changes in flow and water quality conditions. The natural seasonal changes in habitat have further been magnified by anthropogenic activities associated with operation of the off-

[4] Creek condition was assessed using the California Stream Conditrion Index (CSCI) and the Southern California Index of Biological Integrity (SoCal IBI). Both indices translate benthic macroinvertebrate (BMI) data into an overall assessment of stream health.

stream percolation ponds. Therefore, the sources of stressors identified as causing poor biological condition in the study area cannot be mitigated through stormwater management. As a result, the Upper Penitencia Creek SSID Project was considered complete.

Project results were presented in a Final Upper Penitencia Creek SSID Report that was submitted to the Regional Water Board with the WY 2016 Urban Creeks Monitoring Report (UCMR; SCVURPPP 2017).

In effort to assist in future management of natural resources in Upper Penitencia Creek watershed, the Program identified additional follow-up actions, which are included in the report. These actions include:

- Conduct biological assessments at the SSID Project study sites in WY 2017 to evaluate potential variability in biological conditions during years with different hydrological conditions.
- Conduct a brief evaluation of current management practices associated with water quality and water flows in Upper Penitencia Creek and provide recommendations on how biological conditions may be improved in the water body.

Both actions were implemented in WY 2017.

The WY 2017 monitoring results showed biological conditions, based on California Stream Condition Index (CSCI) scores, at the case site were much higher in WY 2017 compared to WY 2016 (0.84 and 0.65, respectively). The increase in CSCI scores was likely associated with longer periods of wetted channel during the spring season of WY 2017 as a result of a very wet winter season in WY 2017 and resultant higher groundwater levels.

The management practices assessment evaluated three types of practices in Upper Penitencia Creek that may impact the Project reach, including: 1) water operations; 2) channel maintenance, and 3) sediment controls in upper watershed.

Recommended management/monitoring actions were as follows:

- Evaluate management scenarios to release water from Robert Gross Percolation Ponds that would enhance aquatic life uses in Upper Penitencia Creek. Management scenarios may include changing the timing, duration and magnitude of water releases to potentially benefit downstream migration of juvenile steelhead.
- Consider removal of non-native plant species, such as ivy, and encourage natural recruitment of native riparian vegetation at the case site to improve aquatic conditions as part of actions taken by Valley Water's Safe Clean Water and Natural Flood Protection Program, Priority D[5]. Priority D focuses on Restoring Wildlife Habitat and Providing Open Space in Santa Clara County.
- Consider installation of large woody debris to increase habitat type diversity (e.g., scour pools) to increase the diversity of aquatic biota, leveraging Valley Water's Safe Clean

[5] https://www.valleywater.org/project-updates/safe-clean-water-and-natural-flood-protection-program/priority-d-restore-wildlife-habitat-and-provide-open-space

Water and Natural Flood Protection Program, Priority D opportunities when possible. Large woody debris placement should consider habitat benefit versus flood risk.

Monitoring results and management practices assessment are summarized in the Upper Penitencia Creek SSID Project Follow-up Monitoring and Management Assessment Report that was submitted with the Program's WY 2017 UCMR (SCVURPPP 2018a).

2.2 Coyote Creek Toxicity SSID Project

The Coyote Creek Toxicity SSID Project was triggered by the Water Board staff's recommended listing of Coyote Creek for sediment toxicity via the 2016 Integrated Report (303(d) List/305(b) Report for the San Francisco Bay Region. Sediment toxicity data collected by the Water Board in 2007 and 2008 at two sites in Coyote Creek were determined to exceed the 303(d) listing evaluation guidelines. The sediment toxicity tests included survival and growth of *Hyalella azteca*.

In WY 2017, SCVURPP developed the Coyote Creek Toxicity SSID Work Plan. The work plan identified SCVURPPP's approach to determine whether sediment toxicity is present in an urban reach of Coyote Creek and, if so, evaluating the stressors and sources that may be causing the toxicity. The following monitoring objectives were identified:

1. Identify the magnitude and extent of toxicity in a reach of the Coyote Creek mainstem where sediment toxicity was observed in 2008; and
2. Identify potential causes of sediment toxicity (if observed).
3. Evaluate existing data for trends in toxicity

The Coyote Toxicity SSID monitoring design includes an evaluation of sediment chemistry and toxicity testing during the dry season over a two-year period (Water Years 2018 and 2019). In July 2018, sediment samples were collected at 5 sites within an urban reach of Coyote Creek mainstem (between Montague Exp and Story Rd). In WY 2019, sediment sampling was conducted at 3 of the 5 sites evaluated in WY 2018. Acute (survival) toxicity testing was conducted using *Hyallela azteca* and *Chironomus dilutes* test organisms. *Hyallela azteca* is an amphipod crustacean known to be sensitive to pyrethroid pesticides. *Chironomum dilutus* is an invertebrate midge known to be sensitive to neonicotinoid pesticides. Sediment samples were also analyzed for metals and pesticides, including neonicotinoids, fipronil and pyrethroids.

Overall, toxicity to *Hyalella azteca* and *Chironomum dilutus* was very low during the 2018 and 2019 monitoring period. In 2018, only one of five sediment samples had observed toxicity. Site 205COY080 at Oakland Avenue had toxicity levels for *Hylella azteca* that were slightly higher than acceptable threshold (> 20% percent effect compared to control). A subsequent Toxicity Investigation Evaluation on the same sample resulted in no significant toxicity.

One of the three WY 2019 samples exhibited toxicity: site 205COY080 had toxic levels for *Chironomus dilutes* that were just above evaluation threshold (> 20% percent effect compared to control). However, these results were ambiguous due to an identified outlier for one of the test replicates. There was no significant toxicity when the outlier was excluded from the results. Due to low levels of toxicity, a TIE was not conducted on the 2019 sample.

Evaluation of sediment chemistry results at sites where toxicity was observed were inconclusive (i.e., pesticide and metal concentrations were not at levels known to cause toxic effects). The subsequent TIE conducted in 2018 did not result in toxicity and thus, treatments to evaluate potential causes of toxicity (i.e., metals or pyrethroids) were not effective.

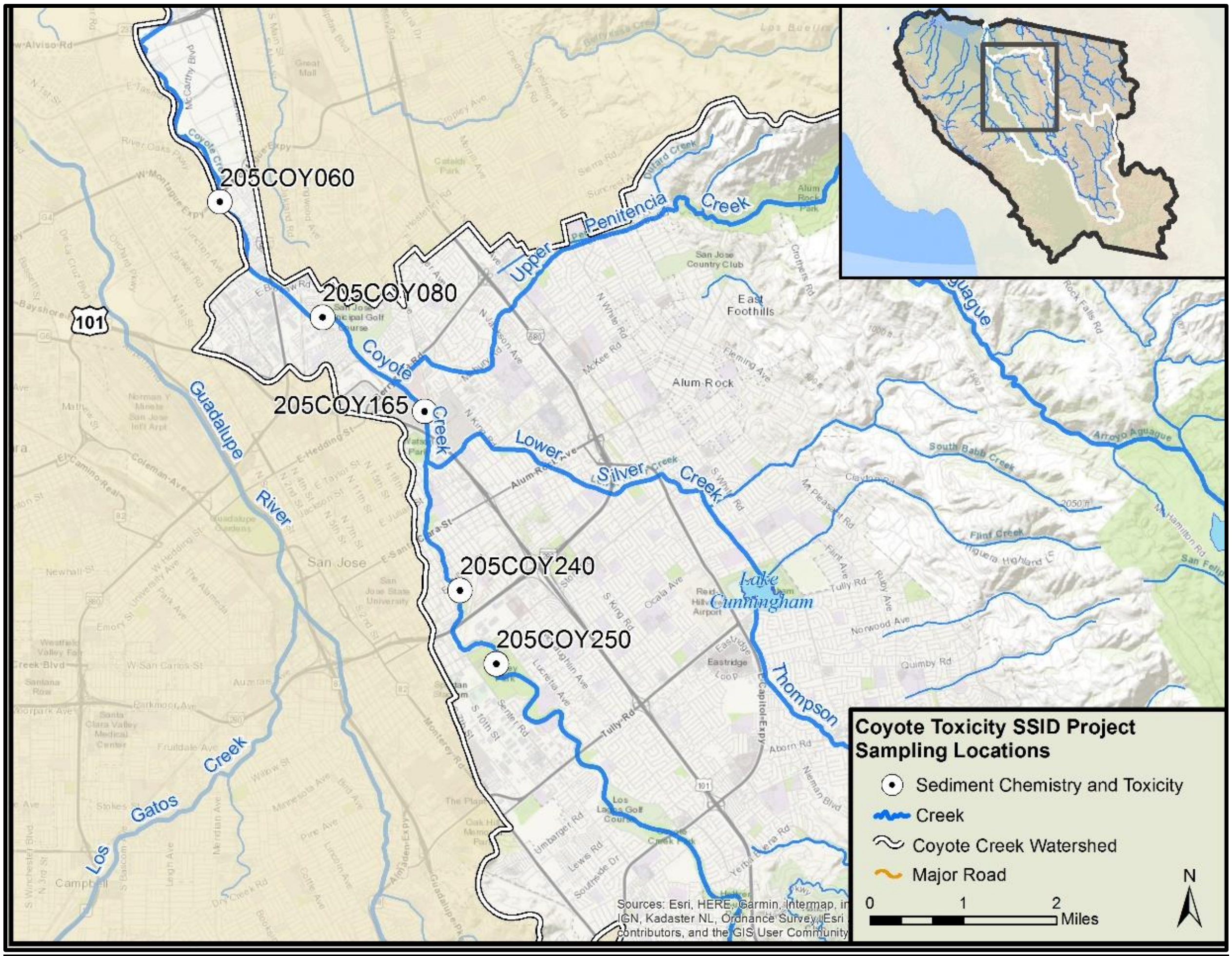

Figure 2.2. Sediment sampling locations for the Coyote Creek Toxicity SSID Project.

Long term toxicity data collected at site 205COY060 (Coyote Creek at Montague Exp) since 2008 by the SWAMP Stream Pollution Trends Monitoring Program (SPoT) were also evaluated as part of the SSID study. Over the past 12 years, there appears to be trend of decreasing *Hyalella azteca* toxicity in Coyote Creek. The decline in acute sediment toxicity at this Coyote site may reflect a decrease in pyrethroid concentrations in sediment over time since there also appears to be a general decrease in pyrethroid concentrations since 2012.

The results of this SSID Study and review of toxicity data collected over the past 14 years suggest that sediment toxicity is generally not present in Coyote Creek. Based on these results and analyses, the Coyote Creek Toxicity SSID Project is considered complete.

In Fiscal Year 2018-19, SCVURPPP conducted an evaluation of pesticide source control actions implemented by SCVURPPP and its Permittees. The results of the evaluation are described in the Pesticide Source Control Actions Effectiveness Evaluation Report (SCVURPPP 2019a) which was included in the Fiscal Year 2018-19 SCVURPPP Annual Report. As described in the Report, SCVURPPP will continue to implement the pesticide toxicity control measures described in provision C.9 of MRP 2.0.

Consistent with MRP procedures, the Program seeks approval of the completion of the Coyote Creek Sediment Toxicity SSID Study from the Water Board Executive Officer.

The Final Coyote Creek Toxicity SSID Project Report is included with this IMR as Attachment 2.

2.3 Lower Silver SSID Project

The Lower Silver SSID project was triggered by creek status/condition data suggesting that Lower Silver/Thompson Creek watershed has reduced biological integrity. Specifically, the California Stream Condition Index Scores (CSCI), based on benthic macroinvertebrate data previously collected at six bioassessment sites on Lower Silver and Thompson Creek, were below the MRP 2.0 trigger threshold for CSCI scores. In addition, water chemistry data collected during Creek Status Monitoring showed that nutrient concentrations in the water column were elevated during the spring season when biological conditions were assessed. Furthermore, algal biomass measurements at selected sites indicated the potential for eutrophication on Lower Silver/Thompson Creek. Excess nutrients may be problematic under certain conditions (e.g., sunlight exposure, high temperatures) that result in algal production. Increased algal biomass can result in poor water quality or changes in food availability, resulting in reduced biological conditions.

In WY 2019, SCVURPPP developed the Lower Silver SSID Work Plan (SCVURPPP 2019). The objective of the project is to focus on potential causes of reduced biological conditions in Lower Silver-Thompson Creek. Specifically, the study is designed to help answer the following questions:

1. What sources are contributing nutrients to the creek?
2. Are high nutrient concentrations contributing to the low biological quality in the creek?
3. Is eutrophication occurring, and if so what conditions are potential contributing factors?
4. What other conditions might contribute to the low biological quality in the creek?

The project was initiated during the WY 2019 dry season to evaluate the extent and magnitude of nutrient concentrations and the importance of nutrients in reducing bio-integrity in Lower Silver/Thompson Creek watershed. Three water sampling events were conducted at several sites between August and October 2019 to evaluate potential sources of nutrients. In addition, continuous water quality monitoring was conducted at locations that appeared to have high algal production to assess potential impacts of eutrophication on water quality.

Preliminary results suggest that nutrient concentrations in the creek are affected by flow velocity and MS4 discharges. Figure 2.3 shows creek sampling locations targeted on August 8, 2019. Follow-up monitoring in September 2019 targeted a subset of these sites and added several non-receiving water stations within the MS4. Figure 2.4 illustrates emergent vegetation and turbidity at Station LST07 on August 8, 2019.

The Lower Silver SSID project will extend to the spring and fall seasons of 2020 in an effort to gather additional information. In spring 2020, bioassessments will be conducted to evaluate biological conditions, physical habitat and water quality data. Creek walks will be conducted in fall 2020 to identify locations in the watershed that appear to have potential for eutrophic conditions. Measurements of nutrients, eutrophication indicators (e.g., chlorophyll a, ash free dry mass), and general water quality (pH, dissolved oxygen, specific conductance, temperature) will be conducted at these sites.

The Lower Silver SSID Work Plan is included with this Part C of the IMR as Attachment 3. Data collected in WY 2019 were submitted to the Regional Water Board pursuant to Provision C.8.h.ii of the MRP and may be obtained via CEDEN. Data were assessed for data quality attributes according to the BASMAA RMC QAPP (BASMAA 2016a). Results of the Quality Assurance/Quality Control (QA/QC) review suggest that the SSID data were of sufficient quality.

No data were rejected; however, some data were flagged in accordance with the QA/QC protocols.

It is anticipated that the final project report will be submitted to the Regional Water Board with the Program's WY 2020 UCMR by March 31, 2021.

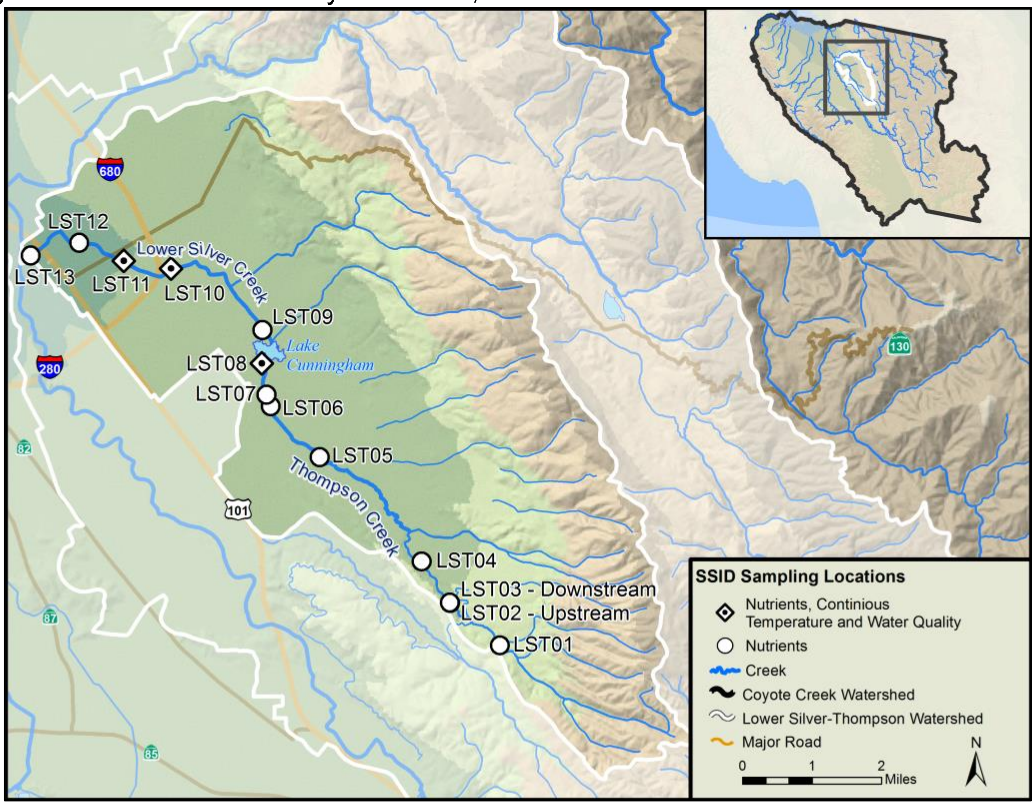

Figure 2.3. Sampling stations along Lower Silver/Thompson Creek, August 8, 2019.

Figure 2.4. Station LST07, August 8, 2019. See Figure 2.3 for location.

3.0 REGIONAL PCBS FROM ELECTRICAL UTILITY EQUIPMENT

In late-2018, BASMAA contracted with EOA, Inc. to develop a work plan for a regional SSID project addressing releases and spills of PCBs from electrical utility equipment. The Regional SSID Project - Electrical Utilities as a Potential PCBs Source to Stormwater in the San Francisco Bay Area – was triggered by fish tissue monitoring in the Bay that led to the Bay being designated as impaired on the Clean Water Act (CWA) Section 303(d) list and the adoption of a TMDL for PCBs in 2008. Subsequent PCBs monitoring by the BASMAA RMC partners and the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) suggests that diffuse sources of PCBs are present throughout the region. One potential source of PCBs to stormwater is releases and spills from electrical utility equipment.

PCBs were historically used in several types of electrical utility equipment, some of which still contain PCBs. Although much of the PCB-containing equipment has been removed from service, some remains in use, and releases and spills from the equipment may be occurring at levels approaching the TMDL waste load allocation. However, the information currently available is not adequate to fully quantify the scope and magnitude of electrical utility applications as a source of PCBs to stormwater. The information gap is partially due to state and federal regulatory levels for reporting and clean-up of PCBs spills that are higher than the PCB levels needed to comply with the PCBs TMDL requirements. Furthermore, stormwater Programs have neither the authority to compel electrical utilities to provide information about spills, equipment replacement programs, and clean-up protocols, nor the authority to require additional controls. Therefore, BASMAA identified a need to develop and implement a regional SSID work plan to further understand the magnitude and extent of this potential PCBs source, and identify controls (if necessary) that could be put into place to reduce the water quality impacts of this source.

The work plan was submitted with each countywide stormwater program's WY 2018 UCMR. It presents a framework for working with the Regional Water Board, which does have jurisdictional authority over electrical utility companies. The overall goal for the regional SSID project is to investigate electrical utility equipment as a source of PCBs to urban stormwater runoff and identify appropriate actions and control measures to reduce this source. Building on the information presented by SCVURPPP (2018b), this project is designed to achieve the following three objectives:

1. Gather information from Bay Area utilities to improve estimates of current PCBs loadings to municipal separate storm sewer systems (MS4s) from electrical utility equipment, and document current actions conducted by utilities to reduce or prevent release of PCBs from their equipment;
2. Identify opportunities to improve spill response, cleanup protocols, or other programs designed to reduce or prevent releases of PCBs from electrical utility equipment to MS4s;
3. Develop an appropriate mechanism for municipalities to ensure adequate clean-up, reporting and control measure implementation to reduce urban stormwater loadings of PCBs from electrical utility equipment.

The information gained during this project will also provide data that municipalities can use to provide better estimates of PCBs load reductions that can be achieved through implementation of a regional control measure program for electrical utilities.

3.1 Overview of the Regional SSID Work Plan

The work plan identified 4 project tasks: (1) conduct a desk top analysis; (2) propose a source control framework for electrical utility equipment to reduce ongoing PCBs loads to the Bay in stormwater runoff; (3) Develop data inputs to better estimate PCBs load reductions that can be achieved via new source controls; and (4) develop an SSID project report. Each of these tasks are described in more detail below. Progress made to date is provided in Section 3.2.

3.1.1 Task 1: Desktop Analysis

The desktop analysis is designed to gather and evaluate information on electrical utility equipment in the Bay Area to provide the foundation for development of a comprehensive regional control measure program to reduce PCBs loads from this source. The desktop analysis includes the following five sub-tasks:

- **Subtask 1.1 Request information from electrical utility companies.**
  This task will seek the assistance and support of the Regional Water Board to: obtain information from non-municipally owned utility companies that is not publicly available but is needed to better understand the extent and magnitude of PCBs releases from Oil Filled Electrical Equipment (OFEE); identify the most appropriate actions to prevent or reduce releases from this source; and develop and implement effective reporting and control measures. For this task, the Regional Water Board will be asked to assist BASMAA in compelling electrical utility companies (e.g., PG&E) to provide the necessary information. A preliminary list of information that will be requested includes the following:

    - Spill reporting and notification procedures (both region-wide and location-specific);
    - Spill records NOT reported to the California Governor's Office of Emergency Services (Cal OES);
    - SOPs and other documentation used by electrical utilities and their contractors to guide spill response and cleanup actions when releases from OFEE occur;
    - SOPs and documentation, including analytical methods for PCBs used by electrical utilities and their contractors to identify and clean up regular leaks from OFEE during regular maintenance activities;
    - Measurement data on concentrations of PCBs in OFEE;
    - Maintenance records that document when and where PCBs-containing OFEE are removed from the system and how often PCBs containing equipment is inspected for leaks or spills;
    - Documentation of past programs to voluntarily remove PCBs-containing oils or OFEE – including what equipment was removed, and the locations from which it was removed; and
    - Documentation of where PCBs-containing OFEE were located in the past, and where they are currently located across the Bay Area.

  Additional data gaps may also be identified and added to the data request based on discussions with Regional Water Board staff and/or preliminary information provided by utilities.

- **Subtask 1.2 Assess current electrical utility data.**
  This task will review, tabulate and analyze the information provided by electrical utilities as a result of the Regional Water Board's request for information, in order to document the following:

    - Measurement data on PCBs concentrations and/or mass in OFEE;
    - Locations of PCBs-containing OFEE;
    - Quantity of PCBs-containing OFEE removed from service annually;
    - Occurrences of spills or releases from OFEE;
    - Current PCBs spill and cleanup reporting requirements; and
    - Current PCBs cleanup protocols.

- **Subtask 1.3 Improve estimates of PCBs loadings.**
  This task will combine the information provided in Subtask 1.2 with all existing data in order to develop improved estimates of current PCBs loadings from electrical utility equipment to MS4s in the study area. The quality of these estimates will partly depend on the quality of the data received from the utilities.

- **Subtask 1.4 Refine PCBs reporting requirements**
  This task will review all current reporting and notification requirements to identify any improvements or clarifications that the Regional Water Board could require of electrical utilities to provide the type of data needed to better quantify the amount of PCBs released from OFEE spills, and to help ensure that adequate cleanup actions are being implemented.

- **Subtask 1.5 Evaluate PCBs cleanup protocols**
  This task will review all documented cleanup protocols that are currently used by electrical utilities in order to identify any changes or improvements that could be recommended to further reduce the discharge of PCBs to the MS4 when releases occur.

3.1.2 Task 2: Develop Source Control Framework

Based on the results of the desktop analysis, this task will propose an appropriate framework for managing and implementing control measures to reduce PCBs from electrical utility equipment. The framework should include prescribed methods and procedures for unplanned spills and releases from OFEE, as well as a plan for continued reduction of PCBs from in-use OFEE, and potentially further identification and cleanup of historic release sites. The framework will likely include the following elements:

- Summary of the outcomes of the desktop analysis results, including:
    - Summary of information provided by electrical utilities;
    - Improved estimates of current PCBs loadings from electrical utility equipment based on information received;
    - Documentation of current spill clean-up and reporting actions, and existing programs for proactive removal of PCBs-containing oils and equipment conducted by electrical utilities;
    - Recommended PCBs spill and cleanup reporting requirements that the Regional Water Board could require of electrical utilities;
    - Recommended improvements to PCBs spill cleanup protocol(s) that would reduce the discharge of PCBs to MS4s that the Regional Water Board could require of electrical utilities.

- Recommended approach to manage and control releases of PCBs from electrical utilities. The approach may include requirements the Regional Water Board could impose on electrical utilities in the Bay Area, such as new spill reporting and cleanup protocols.

3.1.3 Task 3: Develop methodologies to account for PCBs load reductions from new source control measures

BASMAA will further apply the results of the desktop analysis to develop data inputs to better account for the PCBs load reductions that can be achieved via the new clean-up and reporting protocols identified above in Task 2.

3.1.4 Task 4: Develop SSID Project Report

BASMAA will prepare a report describing the desktop analysis and outcomes. The report will summarize the information provided by electrical utilities and identify recommendations to modify or improve current control measures or management actions that will reduce PCBs released to MS4s. The Management Questions that will be addressed include:

1. What is the current magnitude and extent of PCBs stormwater loadings from electrical utility equipment and operations in the San Francisco Bay Area region?
2. Are there aspects of equipment or operational procedures that electrical utilities should be required to report to the Regional Water Board?
3. Are there additional spill and clean-up controls needed to reduce water quality impacts from the release of PCBs in electrical utility equipment?
4. Are there additional proactive activities needed to avoid releases of PCBs from electrical utility equipment?
5. What are the PCBs load reductions that can be achieved through implementation of a regional reporting and control measure program?

3.2 Current Status of the Regional SSID Project

Implementation of the regional SSID work plan began in WY 2019. The Work Plan focused on Pacific Gas and Electric Company (PG&E), the largest electrical utility operating in the MRP area, and the only utility that is not owned by a municipality. The work plan outlined a 2-step process to (1) conduct a desktop analysis using data from PG&E in order to better understand the extent and magnitude of PCBs releases from oil-filled electrical equipment (OFEE) and document current and past efforts to reduce PCBs in OFEE, and (2) propose a source control framework to potentially reduce ongoing PCBs loads to the Bay from electrical utility equipment. The project team developed a letter requesting assistance from the Regional Water Board and outlining the specific data that is needed from PG&E to complete this project. However, PG&E is currently in bankruptcy proceedings, and the outcomes of that process have not yet been determined.

Because of the current situation with PG&E, BASMAA developed a revised approach to the SSID project in early WY 2020 that focuses on municipally-owned electrical utilities in the MRP area. Although these municipally-owned electrical utilities represent a fraction of the electrical utility equipment and properties in the MRP area, BASMAA member agencies have a better opportunity to work with these utilities and gather the type of information needed to conduct the desktop analysis, albeit at a smaller scale. The revised approach will continue to implement the Regional SSID work plan but will focus exclusively on municipally-owned electrical utilities in the

Bay Area. The revised approach implements the SSID work plan objectives to develop an appropriate source control framework to inform the development of practices to potentially reduce the release of PCBs from electrical utility equipment; and to develop estimates of PCBs load reductions that could be achieved through implementation of revised management practices, such as improved clean-up and reporting procedures.

In November and December 2019, BASMAA held a series of meetings with representatives from municipally-owned electrical utilities and associated municipal staff in the MRP area to discuss the project and information needs. Based on input provided during these meetings, BASMAA developed an information request for municipally-owned electrical utilities that was similar to the request sent to the Regional Water Board for PG&E data.

BASMAA intends to continue this project during WY 2020. The new request for information will be submitted to each of the municipally-owned electrical utilities in the MRP area in the near future. The BASMAA project team will proceed with the desktop analysis upon receipt of data from these utility partners. It is anticipated that the final project report will be submitted to the Regional Water Board with the Program’s WY 2020 UCMR by March 31, 2021.

4.0 RECOMMENDATIONS

Overall, Permittees find that SSID monitoring provides valuable information to assist with identifying stressors and sources of water quality impacts. Although the SSID studies have found that the primary stressor sources are unrelated to municipal stormwater runoff and/or are inconclusive, they have resulted in a greater understanding of hydrology, water quality, and land use in the targeted watersheds, and the findings inform other aspects of management to improve the condition of local receiving waters. Continuation of SSID monitoring in the next permit should be considered, with the level-of-effort determined in a manner mindful of the overall costs of implementing Provision C.8 monitoring requirements and other provisions.

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ATTACHMENTS

Attachment 1

BASMAA RMC Regional SSID Report

SSID Project ID	Date Updated	County/ Program	Creek/ Channel Name	Site Code(s) or Other Site ID	Project Title	Primary Indicator(s) Triggering Stressor/Source ID Project									Indicator Result Summary	Rationale for Proposing/Selecting Project	Current Status of SSID Project or Date Completed	EO Concurrence of project completion (per C.8.e.iii.(b))
						Bioassess	General WQ	Chlorine	Temp	Water Tox	Sed Tox	Sed Chem	Pathogen Indicators	Other				
AL-1	3/23/20	ACCWP	Palo Seco Creek		Exploring Unexpected CSCI Results and the Impacts of Restoration Activities	X									Sites where there is a substantial difference in CSCI score observed at a location relative to upstream or downstream sites, including sites on Palo Seco Creek upstream of the Sausal Creek restoration-related sites, that had substantial and unexpected differences in CSCI scores.	The project will provide additional data to aid consideration of unexpected and unexplained CSCI results from previous water year sampling on Palo Seco Creek, enable a more focused study of monitoring data collected over many years in a single watershed, and allow analysis of before and after data at sites upstream and downstream of previously completed restoration activities.	In WY 2019, nutrient sampling, bioassessment, and additional DO and temperature monitoring were conducted. The final SSID progress report is included in ACCWP's March 2020 IMR, recommending project completion.	
AL-2	1/22/20	ACCWP	Arroyo Las Positas		Arroyo Las Positas Stressor Source Identification Project	X									CSCI scores below the threshold were recorded on Arroyo Las Positas in WYs 2016 and 2017. In 2017, one site exceeded the Basin Plan threshold for chloride. The creek is also listed on the 303(d) list for eutrophication and has an approved TMDL for Diazinon.	The Water Board is conducting sampling in the watershed as part of their TMDL development efforts and an SSID project will supplement those efforts and generate a better overall picture of stressors impacting the waterbody.	In WY 2019, ACCWP conducted bioassessments, nutrient sampling, and continuous monitoring at multiple locations within the watershed over the course of spring and summer months. The first SSID progress report is included in ACCWP's March 2020 IMR.	
CC-1	1/27/20	CCCWP	Lower Marsh Creek		Marsh Creek Stressor Source Identification Study									X	10 fish kills have been documented in Marsh Creek between September 2005 and September 2019. Low dissolved oxygen was proved to be the cause in the most recent (9/17/19) event; circumstances indicate low DO was a likely cause in many if not all of the prior events.	This SSID study addresses the root causes of fish kills in Marsh Creek. Monitoring data collected by CCCWP and other parties are being used to investigate multiple potential causes, including low dissolved oxygen, warm temperatures, daily pH swings, fluctuating flows, physical stranding, and pesticide exposure. During year 2 a pilot test of water storage and night-time flow augmentation was conducted by the City of Brentwood Wastewater Treatment Plant (WWTP).	The CCCWP SSID work plan was submitted in 2018. The Year 2 Status Report is included in CCCWP's March 2020 IMR. The study successfully concluded in Year 2. The final report will recommend project completion. Flow augmentation appears to be a viable means of avoiding lethally low DO in portions of the creek downstream of the WWTP.	

SSID Project ID	Date Updated	County/ Program	Creek/ Channel Name	Site Code(s) or Other Site ID	Project Title	Primary Indicator(s) Triggering Stressor/Source ID Project									Indicator Result Summary	Rationale for Proposing/Selecting Project	Current Status of SSID Project or Date Completed	EO Concurrence of project completion (per C.8.e.iii.(b))
						Bioassess	General WQ	Chlorine	Temp	Water Tox	Sed Tox	Sed Chem	Pathogen Indicators	Other				
SC-1	3/24/20	SCVURPPP	Coyote Creek	NA	Coyote Creek Toxicity SSID Project						X				The SWRCB recently added Coyote Creek to the 303(d) list for toxicity.	This SSID study investigated the extent and magnitude of toxicity in an urban reach of Coyote Creek. Sediment samples (n=8) were collected during the dry season of 2018 and 2019. Samples were generally not toxic, with the exception of one sample that had low levels of toxicity (subsequent re-test of sample was not toxic). Sediment chemistry results were inconclusive (i.e., pesticide concentrations were not at levels suspected of causing toxicity). SSID Project results support similar findings from long term monitoring conducted by the SWAMP SPoT Program of reduced acute toxicity in Coyote Creek over the past 10 years.	The work plan was submitted with SCVURPPP's WY 2017 UCMR. A project report describing the results of the WY 2018 and WY 2019 monitoring and recommending project completion will be submitted with the WY 2019 IMR.	
SC-2	1/29/20	SCVURPPP	Lower Silver-Thompson Creek	NA	Lower Silver SSID Project	X								X	Low CSCI scores and high nutrient concentrations at a majority of bioassessment locations.	Evaluate potential causes of reduced biological conditions in Lower Silver-Thompson Creek. The SSID Project is investigating sources of nutrients and assessing the range and extent of eutrophic conditions (if present). The Project will evaluate association between stressor data (e.g., water chemistry, dissolved oxygen and physical habitat) and biological condition indicators (i.e., CSCI and ASCI scores)	The work plan was submitted with SCVURPPP's FY 18-19 Annual Report. It is anticipated to be a two-year project with the project report to be submitted with the WY 2020 UCMR.	
SM-1	3/24/20	SMCWPPP	Pillar Point / Deer Creek / Denniston Creek	NA	Pillar Point Harbor Bacteria SSID Project								X		FIB samples from 2008 and 2011-2012 exceeded WQOs.	A grant-funded Pillar Point Harbor MST study conducted by the RCD and UC Davis in 2008, 2011-2012 pointed to urban runoff as a primary contributor to bacteria at Capistrano Beach and Pillar Point Harbor. The study, however, did not identify the specific urban locations or types of bacteria. This SSID project investigated bacteria contributions from the urban areas within the watershed. In WY 2018, Pathogen indicator and MST monitoring was conducted at 14 freshwater sites during 2 wet and 2 dry events. Very few samples contained “controllable” source markers (i.e., human and dog). Additional field studies	The work plan was submitted with SMCWPPP’s WY 2017 UCMR. A project report describing the results of the WY 2018 and WY 2019 investigations was submitted on October 28, 2019. RWQCB staff requested minor report changes prior to Executive Officer concurrence regarding project completion. A TMDL addressing bacteria in Pillar Point	

SSID Project ID	Date Updated	County/ Program	Creek/ Channel Name	Site Code(s) or Other Site ID	Project Title	Primary Indicator(s) Triggering Stressor/Source ID Project									Indicator Result Summary	Rationale for Proposing/Selecting Project	Current Status of SSID Project or Date Completed	EO Concurrence of project completion (per C.8.e.iii.(b))
						Bioassess	General WQ	Chlorine	Temp	Water Tox	Sed Tox	Sed Chem	Pathogen Indicators	Other				
																were conducted in WY 2019 to understand hydrology and specific source areas.	Harbor is currently under development.	
FSV-1	1/16/20	City of Vallejo in assoc. with FSURMP	Rindler Creek	207R03504	Rindler Creek Bacteria and Nitrogen Study								X		E. coli result of 2800 MPN/100mL in Sept. 2017.	A source identification study is warranted in Rindler Creek due to the elevated FIB result, other (non-RMC) monitoring indicating elevated ammonia levels, and the presence of a suspected pollutant source upstream of the data collection point. Rindler Creek is a highly urbanized and modified creek that originates in open space northeast of the City of Vallejo. Monitoring is conducted just downstream of the creek crossing under Columbus Parkway; upstream of this site there is City-owned land that is grazed by cattle roughly from December-June.	Additional monitoring in the spring and summer of 2019 revealed consistently high levels of E coli and enterococci when cattle are present. A Work Plan is in development and will be submitted with the IMR in March 2020.	
RMC-1	3/24/20	RMC/ Regional	NA (entire RMC area)	NA	Regional SSID Project: Electrical Utilities as a Potential PCBs Source to Stormwater in the San Francisco Bay Area									X	Fish tissue monitoring in San Francisco Bay led to the Bay being designated as impaired on the CWA 303(d) list and the adoption of a TMDL for PCBs in 2008. POC monitoring suggests diffuse PCBs sources throughout region.	PCBs were historically used in electrical utility equipment, some of which still contain PCBs. Although much of the equipment has been removed from services, ongoing releases and spills may be occurring at levels approaching the TMDL waste load allocation. This regional SSID project is investigating opportunities for BASMAA RMC partners to work with RWQCB staff to: 1) improve knowledge about the extent and magnitude of PCB releases and spills, 2) improve the flow of information from utility companies, and 3) compel cooperation from utility companies to implement improved control measures.	The work plan was submitted with each Program's WY 2018 UCMR and implementation began in WY 2019. The work plan outlined a process for BASMAA RMC partners to work with RWQCB staff to better understand PCB releases from electrical utility equipment owned by PG&E and to propose a source control framework. Ongoing bankruptcy proceedings at PG&E stalled the process. Therefore, BASMAA is now reaching out to municipally-owned utilities. The SSID project is anticipated to be completed in June 2020.	

Attachment 2

Final Coyote Creek Toxicity SSID Project Report

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program

Coyote Creek Toxicity
Stressor Source Identification Project

Final Report - Water Years 2018 - 2019

March 31, 2020

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EXECUTIVE SUMMARY

The Coyote Creek Toxicity SSID Project was triggered by the Water Board staff's recommended listing of Coyote Creek for sediment toxicity via the 2016 Integrated Report (303(d) List/305(b) Report for the San Francisco Bay Region. Sediment toxicity data collected by the Water Board in 2007 and 2008 at two sites in Coyote Creek were determined to exceed the 303(d) listing evaluation guidelines. The sediment toxicity tests included survival and growth of *Hyalella azteca*.

In WY 2017, SCVURPP developed the Coyote Creek Toxicity SSID Work Plan. The work plan identified SCVURPPP's approach to determine whether sediment toxicity is present in an urban reach of Coyote Creek and, if so, evaluating the stressors and sources that may be causing the toxicity. The following monitoring objectives were identified:

1. Identify the magnitude and extent of toxicity in a reach of the Coyote Creek mainstem where sediment toxicity was observed in 2008; and
2. Identify potential causes of sediment toxicity (if observed).
3. Evaluate existing data for trends in toxicity

The Coyote Toxicity SSID monitoring design includes an evaluation of sediment chemistry and toxicity testing during the dry season over a two-year period (Water Years 2018 and 2019). In July 2018, sediment samples were collected at 5 sites within an urban reach of Coyote Creek mainstem (between Montague Exp and Story Rd). In WY 2019, sediment sampling was conducted at 3 of the 5 sites evaluated in WY 2018. Acute (survival) toxicity testing was conducted using *Hyallela azteca* and *Chironomus dilutes* test organisms. *Hyallela azteca* is an amphipod crustacean known to be sensitive to pyrethroid pesticides. *Chironomum dilutus* is an invertebrate midge known to be sensitive to neonicotinoid pesticides. Sediment samples were also analyzed for metals and pesticides, including neonicotinoids, fipronil and pyrethroids.

Overall, toxicity to *Hyalella azteca* and *Chironomum dilutus* was very low during the 2018 and 2019 monitoring period. In 2018, only one of five sediment samples had observed toxicity. Site 205COY080 at Oakland Avenue had toxicity levels for *Hylella azteca* that were slightly higher than acceptable threshold (> 20% percent effect compared to control). A subsequent Toxicity Investigation Evaluation on the same sample resulted in no significant toxicity.

One of the three WY 2019 samples exhibited toxicity: site 205COY080 had toxic levels for *Chironomum dilutes* that were just above evaluation threshold (> 20% percent effect compared to control). However, these results were ambiguous due to an identified outlier for one of the test replicants. There was no significant toxicity when the outlier was excluded from the results. Due to low levels of toxicity, a TIE was not conducted on the 2019 sample.

Evaluation of sediment chemistry results at sites where toxicity was observed were inconclusive (i.e., pesticide and metal concentrations were not at levels known to cause toxic effects). The subsequent TIE conducted in 2018 did not result in toxicity and thus, treatments to evaluate potential causes of toxicity (i.e., metals or pyrethroids) were not effective.

Long term toxicity data collected at site 205COY060 (Coyote Creek at Montague Exp) since 2008 by the SWAMP Stream Pollution Trends Monitoring Program (SPoT) were also evaluated as part of the SSID study. Over the past 12 years, there appears to be trend of decreasing *Hyalella azteca* toxicity in Coyote Creek. The decline in acute sediment toxicity at this Coyote site may reflect a decrease in pyrethroid concentrations in sediment over time since there also appears to be a general decrease in pyrethroid concentrations since 2012.

The results of this SSID Study and review of toxicity data collected over the past 14 years suggest that sediment toxicity is generally not present in Coyote Creek. Based on these results and analyses, the Coyote Creek Toxicity SSID Project is considered complete.

In Fiscal Year 2018-19, SCVURPPP conducted an evaluation of pesticide source control actions implemented by SCVURPPP and its Permittees. The results of the evaluation are described in the Pesticide Source Control Actions Effectiveness Evaluation Report (SCVURPPP 2019a) which was included in the Fiscal Year 2018-19 SCVURPPP Annual Report. As described in the Report, SCVURPPP will continue to implement the pesticide toxicity control measures described in provision C.9 of MRP 2.0.

Consistent with MRP procedures, the Program seeks approval of the completion of the Coyote Creek Sediment Toxicity SSID Study from the Water Board Executive Officer.

1.0 INTRODUCTION

This report presents the results of the Coyote Creek Sediment Toxicity Stressor/Source Identification Project (Coyote Creek Toxicity SSID) which was initiated in 2018 to address requirements listed under Provision C.8.e of the San Francisco Bay Region National Pollutant Discharge Elimination System (NPDES) stormwater Municipal Regional Permit (MRP) (Order R2-2015-0049). The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) is working with Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) members to collectively initiate eight Stressor/Source Identification (SSID) projects during the five-year term of the MRP (i.e., 2016 – 2020). This project satisfies the requirement that a minimum of one SSID project must address toxicity.

The Coyote Creek Toxicity SSID project is one of two SSID projects that SCVURPPP is conducting during the MRP term. Per MRP Provision C.8.e.ii, SSID projects are designed to identify and address potential sources and/or stressors associated with observed or potential impacts to aquatic life or other Beneficial Uses. SSID projects are intended to be oriented toward taking action(s) to alleviate stressors and reduce sources of pollutants.

The Program initiated the Coyote Creek Toxicity SSID Project in response to the recommended listing of Coyote Creek for toxicity in sediment in the 2016 Integrated Report (303(d) List/305(b) Report) for the San Francisco Bay Region (Integrated Report). The revised Integrated Report (dated April 2017) was approved by the San Francisco Bay Regional Water Quality Control Board (Regional Water Board) on April 12, 2017. The Regional Water Board identified Coyote Creek for toxicity as a Category 5 listing group; which is defined as listing "when at least one beneficial use is not supported and a TMDL is needed." The listing recommendation was submitted to the State Water Resources Control Board (State Water Board) and compiled into a statewide 303(d) list subject to the approval of the State Water Board and the USEPA.

This introduction (Section 1.0) provides a summary of the Coyote Creek Toxicity SSID Project Work Plan (Work Plan) (SCVURPPP 2018). Section 2.0 of this report describes methods used in the investigation. Section 3.0 presents results of the SSID project field investigations. Section 4.0 discusses the results. Section 5.0 summarizes the results and recommends management actions. References are listed in Section 6.0.

1.1 Work Plan Summary

In 2018, the Program developed the Coyote Creek Sediment Toxicity SSID Project Work Plan, which was submitted to the Water Board as an attachment to the Water Year (WY) 2017 Urban Creeks Monitoring Report on March 31, 2018. The Work Plan provides information describing the steps and process used to define the SSID Project, per Provision C.8.e.iii of the MRP. These steps include defining the problem, identifying probable causes, describing study objectives, and establishing the study design and schedule. A summary of the steps are provided below.

Problem Definition

This Coyote Creek Toxicity SSID Project was triggered by the recommended listing of Coyote Creek for toxicity in sediment in the 2016 Integrated Report (303(d) List/305(b) Report) for the San Francisco Bay Region. Sediment toxicity data collected by the Water Board in 2007 and 2008 at two sites in Coyote Creek were determined to exceed the 303(d) listing evaluation guidelines. The sediment toxicity tests included survival and growth of *Hyalella azteca*. Toxicity was defined as a statistically significant effect in the sample exposure compared to the control using EPA-recommended hypothesis testing.

In 2007 and 2008, the SCVURPPP also conducted sediment chemistry and toxicity sampling in Coyote Creek as part of the Sediment Quality Triad Pilot Study (SCVURPPP 2008). Sediment data at two of the sampling locations exhibited significant acute toxicity for *Hyalella azteca* (less than 80% survival compared to control) for at least three of the four sampling events conducted over the two-year study period. Sediment samples were also analyzed for total recoverable metals and a suite of pyrethroid pesticides. The co-occurrence of pyrethroid concentrations above LC50s[1] and sediment toxicity in samples collected during the spring 2008 sampling event suggests that pyrethroids may have caused (or contributed to) the toxicity at those sites.

<u>Candidate Causes</u>

The toxicity data used for the 303(d) listing was collected over ten years ago. At that time, pyrethroid pesticides were identified as the predominant group of chemicals deployed for insect control in urban areas in California, and likely one of the primary cause of toxicity in urban water bodies in the state. Ruby (2013) compiled and summarized pyrethroid and fipronil pesticide data from monitoring conducted in urban areas of California , as well as related toxicity testing results, covering the ten year period from 2003-2012. Ruby (2013) concluded that pyrethroids were linked to toxicity to the amphipod *Hyalella azteca* in water and sediment samples from urban creeks in all of California's major urban areas. Bifenthrin was the most frequently detected pyrethroid (64% of water samples, 69% of sediment samples) and the greatest contributor to toxic potency in both water and sediment samples collected from urban creeks (Ruby 2013). Average concentrations for seven pyrethroids that were summarized in the study were substantially greater than the published LC50 values.

Ruby (2013) also showed that fipronil, a common pyrethroid replacement pesticide, was frequently detected in water and sediment samples. The maximum reported concentrations of fipronil and its degradates in sediment samples were generally well above published toxicity (LC50) values.

<u>Study Objectives</u>

The Coyote Toxicity SSID Project focuses on evaluating whether sediment toxicity is present in an urban reach of Coyote Creek and, if so, evaluating the stressors and sources that may be causing the toxicity. The study is designed to:

1. Identify the magnitude and extent of toxicity in a reach of the Coyote Creek mainstem where sediment toxicity was observed in 2008; and
2. Identify potential causes of sediment toxicity (if observed).
3. Evaluate existing data for trends in toxicity

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

Depending on results of the investigation, management actions to control toxicity in Coyote Creek will be identified in the project report.

Study Design and Schedule

The Program used an adaptive monitoring approach to investigate potential sources and causes of sediment toxicity in Coyote Creek. The approach is consistent with Section C.8.e.iii.(1)(f) of the MRP, which states:

> "*Conduct a site specific study (or non-site specific if the problem is wide-spread) in a stepwise process to identify and isolate the cause(s) of the trigger stressor/source…..for toxicity studies where there is no chemical pollutant associated with the creek status monitoring sample exhibiting toxicity, a TIE should be conducted. Where chemical data indicate a pollutant, such as fipronil or a pyrethroid, is present at adverse effects levels in the sample location, it is not necessary to conduct a TIE, and the SSID project would be considered complete*."

The Coyote Toxicity SSID monitoring design includes an evaluation of sediment chemistry and toxicity testing during the dry season over a two-year period (Water Years 2018 and 2019). Toxicity testing was conducted using *Hyallela azteca* and *Chironomus dilutes* for acute toxicity (survival). Sediment chemistry was analyzed for metals and pesticides, including fipronil and pyrethroids. The Program evaluated sediment chemistry results for adverse effects using the analytical methods described in Section 2.4 below. The monitoring design included the following steps:

- If toxicity tests exhibit **significant toxicity** and percent effect is greater than 20% reduction in survival (compared to the Lab Control) **AND** sediment chemistry results indicate the presence of pyrethroid or fipronil **pesticide at adverse effects levels** (i.e., greater than LC50 threshold), then it will be determined that the cause of the toxicity is pesticides and the **SSID project will be considered complete**.

- If toxicity tests exhibit **significant toxicity**, **BUT the sediment chemistry results are inconclusive**, the Program will implement a **Toxicity Identification Evaluation** (TIE) consistent with guidance provided in the EPA sediment TIE manual (EPA/600/R-08/080). The TIE will consist of a series of treatments designed to identify the type of chemicals that may be causing toxicity. The Program will implement a TIE that includes three targeted tests: 1) Baseline sample (i.e., re-test of sample); 2) Activated Carbon (i.e., general organic contaminants); and 3) Cationic Resin (metals). The TIE will confirm toxicity is present (or not), and the type of contaminant (i.e., metal and/or organic) that may be causing the toxicity. TIEs are more effective when there is sufficient toxicity in the sample.

All toxicity testing, sediment chemistry results and TIE results from monitoring conducted during WY 2018 were used to inform follow-up monitoring during WY 2019. The monitoring approach described above was also followed during WY 2019.

1.2 Trend Monitoring in Coyote Creek

The Stream Pollution Trends Program (SPoT) is a core component of the California Surface Water Ambient Monitoring Program (SWAMP) that conducts statewide monitoring to provide information on the health of California waterways with respect to sediment toxicity and contamination (Phillips et al. 2016). SPoT data are used by the State and Regional Water Boards to assess the levels to which aquatic life beneficial uses are supported in California streams and rivers.

The SPoT Program has annually conducted monitoring of sediment chemistry and toxicity testing at site 205COY060 (Coyote Creek at Montague Expressway; Figure 2) since 2008. The toxicity of sediments is evaluated by exposing the amphipod, *Hyalella azteca,* to the collected sediments in a standard ten-day survival test (EPA method 600-R-99/064). Both chronic (growth) and acute (survival) toxicity tests are conducted.

Between 2008 and 2010, the SPoT Program collected one sediment sample during the dry season for toxicity testing and chemical analyses. Between 2011 and 2013, SPoT increased sampling frequency to two or three events each year, typically during the month of July and again during September/October. Between 2011 and 2016, SPoT conducted sediment toxicity tests using two different temperature treatments. Toxicity tests were conducted at the standard temperature defined in the EPA protocol (23°C) and at a lower temperature (15°C), which may be more representative of creek conditions and often results in higher toxicity to *Hyalella azteca*. In 2015, SPoT initiated use of a new test organism (i.e., *Chironomus dilutus*) to assess potential toxic effects associated with fipronil.

A summary of acute and chronic toxicity test results conducted for sediment samples collected by the SPoT Program at site 205COY060 during the dry season between 2008 and 2018 is shown in Table 1. These data do not include additional samples taken by SPoT to investigate impacts on Toxicity related to variable seasons and temperature used for laboratory testing.

- Acute toxicity. Since 2010, none of the nine sediment samples met the two criteria of being significantly toxic AND having a percent effect greater than 20% reduction in *Hyalella azteca* survival compared to the Lab Control.
- Chronic toxicity. Over the same sampling period, 2010 - 2018, two of the nine sediment samples collected (22%) were significantly toxic AND the percent effect was greater than 20% reduction in *Hyalella azteca* growth compared to the lab control.

Between 2015 and 2018, no chronic or acute toxicity was observed for *Chironomus dilutes*.

There appears to be trend of increasing amphipod (*Hyalella azteca*) survival in toxicity tests at site 205COY060. The decline in acute toxicity at the Coyote site may reflect a decrease in pyrethroid concentrations in sediment over time. Excluding one sample with a very high concentration in 2012[2], there appears to be a general decrease in pyrethroid concentrations between 2011 and 2017 (Figure 1).

[2] Pyrethroid concentration in sediment sample collected on 7/5/2012 had a concentration of cyfluthrin of 539 ng/g dw.

Table 1. Sediment toxicity testing results for *Hyalella azteca* conducted between 2008 and 2018 by the SPoT Program at Coyote Creek site 205COY060.

Year	Date	Significant Toxicity and > 20% Effect Threshold (*Hyalella azteca*)	
		Chronic (Growth)	Acute (Survival)
2008	6/17/2008	X	
2009	6/16/2009	X	X
2010	6/30/2010		
2011	7/21/11		
2012	7/5/2012		
2013	7/2/2013		
2014	6/25/2014		
2015	7/1/2015	X	
2016	7/19/2016	X	
2017	6/27/2017		
2018	6/27/2018		

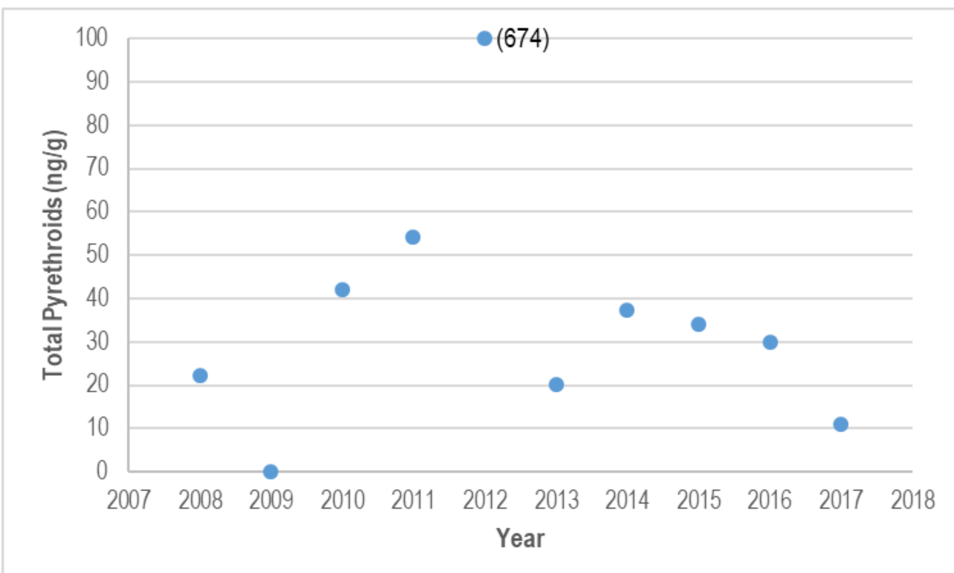

Figure 1. Total pyrethroid concentrations in sediment samples collected by the SPoT Program at Coyote Creek site 205COY060 between 2007 and 2017.

2.0 METHODS

2.1 Site Selection

The Work Plan identified five sediment sampling locations within the reach of the Coyote Creek mainstem that extends from Montague Expressway upstream to Kelley Park (south of Story Road). Three of these stations previously exhibited toxicity in 2007-2008, including two stations (205COY060 and 205COY240) used to determine the recommended 303(d) listing, and one station (205COY080) sampled by the Program as part of the Sediment Quality Triad Pilot Study in 2008. Two new stations within the study reach were added for the SSID Project. Sediment samples were collected at all five stations on July 17, 2018 and three of the five stations on July 22, 2019. Sampling location information is provided in Table 2 and illustrated in Figure 2.

Table 2. Sampling locations in WY 2018 and WY 2019 for sediment chemistry and toxicity testing in Coyote Creek mainstem as part of the Coyote Toxicity SSID Project.

Station ID	Sampling Location	Latitude	Longitude	Previous Sample Location Significant Toxicity	Sample Date	
					7/17/2018	7/22/2019
205COY060	Montague Exp	37.39540	121.91485	x	x	
205COY080	Oakland Ave	37.37778	121.89455	x	x	x
205COY165	Maybury	37.36341	121.87445		x	x
205COY240	Williams Park	37.33575	121.86707	x	x	
205COY250	Kelley Park	37.32444	-121.85983		x	x

2.2 Field Sampling

Sediment chemistry data were collected in accordance with SWAMP comparable methods and procedures described in the BASMAA Quality Assurance Project Plan (QAPP; BASMAA 2016a) and RMC Standard Operating Procedures (SOPs; BASMAA 2016b).

In accordance with the RMC SOP FS-6 (Collection of Bedded Sediment Samples for Chemical Analysis and Toxicity; BASMAA 2016b), field staff first survey the sampling location to identify appropriate fine-sediment depositional areas. Sediment samples are then collected from the top 2 cm at each sub-site beginning at the downstream-most location and continuing upstream. Field staff walk in an upstream direction, carefully avoiding to disturb the sediment at collection sub-sites. Sediment samples are placed in a compositing container, thoroughly homogenized, and then aliquoted into separate jars for chemical or toxicological analysis using standard clean sampling techniques.

Samples are submitted to respective laboratories under RMC SOP FS-9 Chain of Custody procedures and field data sheets are reviewed per SOP FS-13 Quality Assurance/Quality Control (QA/QC) Data Review procedures (BASMAA 2016b).

2.3 Laboratory Analyses

Sediment samples collected for the SSID Project were sent to Pacific EcoRisk for toxicity testing and to CalTest Laboratories for pesticide and metal analyses. Acute toxicity testing in sediment was conducted using two species: *Hyella azteca* (survival) and *Chironomus dilutus* (survival). Sediment chemistry analytes include pyrethroids, fipronil, metals, Total Organic Carbon (TOC), and sediment grain size. Analytic methods and reporting limits are shown in Table 3.

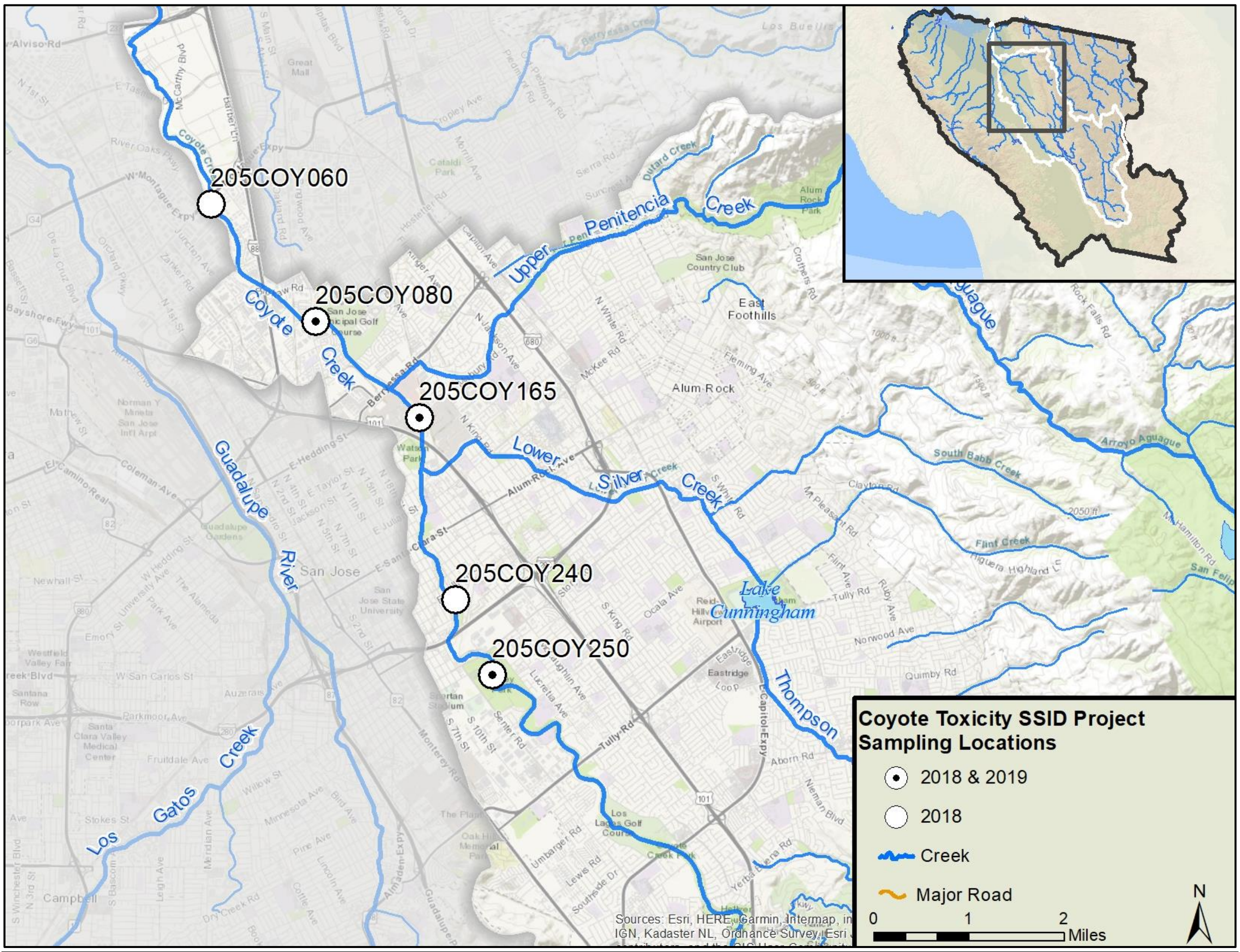

Figure 2. Sediment sampling locations for the Coyote Creek Toxicity SSID Project.

2.4 Data Evaluation

2.4.1 Sediment Toxicity

Data evaluation involves first determining whether the samples are toxic to the test organisms relative to the laboratory control treatment via statistical comparison using the Test of Significant Toxicity (TST) statistical approach. Samples are considered toxic when the TST analyses fail and the Percent Effect is greater than 20% (i.e., mortality) compared to the control sample. Both the TST result and the Percent Effect are determined by the laboratory.

2.3.2 Sediment Chemistry

The sediment sample results for metals are compared to Probable Effects Concentrations (PECs) and Threshold Effects Concentrations (TECs) as defined by MacDonald et al. (2000). PEC and TEC quotients are calculated as the ratio of the measured concentration to the respective PEC and TEC values from MacDonald et al. (2000). The TECs for bedded sediments are very conservative values that do not consider site specific background conditions, and are therefore should not be the only factor in identifying water quality concerns in receiving waters in the Santa Clara Valley. For example, all sites in Santa Clara County are likely to have at least one TEC quotient equal to or greater than 1.0 due to high levels of natural-occurring chromium and nickel in geologic formations (i.e., serpentinite) and soils.

Table 3. Analytical constituents, methods and reporting limits used for sediment samples collected for the Coyote Toxicity SSID Project.

Analyte	Analytical Method	Reporting Limit	Contracting Lab
***TOTAL RECOVERABLE METALS* (µg/kg)**			
Arsenic	EPA 6020	500	***Caltest***
Cadmium		40	
Chromium		100	
Copper		200	
Lead		100	
Nickel		100	
Zinc		1000	
Total Organic Carbon* (%)	EPA 9060	0.1	
Sediment Grain Analysis* (%)	ASTM D422M/PSEP	1	
Percent Solids	EPA 160.3	NA	
Pyrethroid Pesticides, including fipronil (ug/kg)	SW846 8270 Mod (GCMS-NCI-SIM)	0.33	
TOXICITY TESTING			
10-Day *Hyalella azteca* acute	EPA-600-R-99-064 2nd Edition	NA	***Pacific EcoRisk***
10-day *Chrironomus dilutus* acute	EPA-600-R-99-064 2nd Edition	NA	

** Analysis done by subcontracting lab*

Toxicity unit (TU) equivalents for individual pyrethroid and fipronil results were calculated using available literature values for pyrethroids and fipronil in sediment LC50 values. Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized concentrations. Therefore, the pesticide concentrations as reported by the lab were divided by the measured TOC concentration at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each constituent. Concentrations equal to one-half of the respective laboratory method detection limits were substituted for non-detect data so that these statistics could be computed, potentially resulting in artificially elevated results.

2.5 Statement of Data Quality

Data QA/QC for the Coyote Creek Sediment Toxicity SSID Project was performed in accordance with procedures established in the BASMAA RMC QAPP (BASMAA 2016a) and BASMAA RMC SOPs (BASMAA 2016b), including SOP FS-13 (Standard Operating Proecdures for QA/QC Data Review). The BASMAA RMC SOPs and QAPP are based on the SOP and QAPP developed by SWAMP. Data collected during the SSID Project were compared to qualitative and quantitative Data Quality Objectives (DQOs) and Measurement Quality Objectives (MQOs) defined in the BASMAA RMC QAPP that determine whether collected data are of adequate quality for their intended use. Overall, it was found that data collected for the SSID Project met established QA/QC objectives. While some data were flagged based on MQO exceedances, none of the data were rejected.

3.0 RESULTS

3.1 Toxicity Testing

In 2018, one of the five sediment samples collected from Coyote Creek had significant toxicity to either of the test organisms. Site 205COY080 at Oakland Avenue failed the TST test for *Hyalella Azteca* and had a percent effect slightly greater than 20% compared to the lab control (Table 4). Evaluation of sediment chemistry results from site 205COY080 were inconclusive (i.e., pyrethroid and metal concentrations were not at levels that are known to cause toxic effects). Following the study design, the Program subsequently conducted a Toxicity Investigation Evaluation (TIE) using stored sediment from the original sample. No significant toxicity was observed for the re-test. As a result, a determination for the cause of toxicity in the initial test could not be made and the Program decided to re-sample in 2019.

In 2019, none of the three sediment samples had significant toxicity to *Hyalella azteca* (Table 4). However, the toxicity test for sediment collected at site 205COY080 was somewhat ambiguous due to a mathematical outlier (one of the eight replicant tests) that resulted in a failed TST test and a percent effect greater than 20% for *Chironomus dilutes*. There was no apparent cause for low survival in the replicate (e.g., low dissolved oxygen or foreign species present). Consistent with guidance in the EPA's freshwater sediment manual, if no explanation for the outlier can be determined, then both results (inclusion and exclusion of outlier) should be reported. The results including the outlier was a failed TST test with percent effect of 23.4%. The results excluding the outlier was a passed TST test with percent effect of 14.3%. A follow-up TIE could not be conducted because the percent effect of the results, including the outlier, was too low (23.4%) to confidently perform a TIE.

Table 4. Summary of SCVURPPP dry weather toxicity results for WYs 2018 and 2019.

Site	% Survival		% Effect	TST Value	TIE conducted (TST "Fail" and ≥ 20% Effect)
	Lab Control	Organism Test			
2018					
Hyalella azteca					
205COY060	93.8	91.3	2.7	Pass	No
205COY080	93.8	67.5	**28**	**Fail**	**Yes**
205COY165	93.8	96.2	-2.7	Pass	No
205COY240	93.8	90	4	Pass	No
205COY250	93.8	85	9.3	Pass	No
Chironomus dilutus					
205COY060	73.7	82.5	-11.9	Pass	No
205COY080	73.7	80	-8.5	Pass	No
205COY165	73.7	91.3	-23.7	Pass	No
205COY240	73.7	90	-22.0	Pass	No
205COY250	73.7	76.3	-3.4	Pass	No
2019					
Hyalella azteca					
205COY080	96.2	93.8	2.6	Pass	No
205COY165	96.2	90	6.5	Pass	No
205COY250	96.2	96.3	0	Pass	No
Chironomus dilutus					
205COY080	80	61.2	14.3/23.4	Pass/Fail[1]	No
205COY165	80	67.5	15.6	Pass	No
205COY250	80	72.5	9.4	Pass	No

[1] One of the 8 replicants was identified as an outlier. The TST analysis resulted in “pass” when outlier was excluded.

3.2 Sediment Chemistry

Table 5 lists concentrations and TEC quotients for metal constituents in sediment samples collected at Coyote sites in 2018 and 2019. Table 6 lists concentrations and PEC quotients for metal constituents in sediment samples collected at Coyote sites in 2018 and 2019.

The PEC quotient was greater than 1.0 for nickel at all the sampling locations for both years. The TEC quotient was also greater than 1.0 for nickel at all sites and for chromium in 5 of 8 samples. Both metals are typically present in watersheds that have hillsides underlain by serpentinite formations. TEC quotients greater than 1.0 were also calculated for zinc and copper at three sites. Sites 205COY240 and 205COY250 had the highest number of metals that exceeded the TEC quotient of 1.0, five and four respectively.

Tables 7 and 8 list the concentrations of pesticides measured in sediment samples collected in 2018 and 2019, respectively, and calculated TOC-normalized TU equivalents for the pesticides for which there are published LC50 values (Amweg et al. 2005, Maul et al. 2008, and Maund et al. 2002). Most of the pesticides measured were below method detection limits (MDLs) and are listed as “<MDL” in the tables. Others are J-flagged, meaning that the measured concentration was above the MDL but below the reporting limit.

No TU equivalents for individual pyrethroids exceeded 1.0. Bifenthrin and cypermethrin had the highest TU equivalent values of 0.53 and 0.6, respectively, for all sampling events. Bifenthrin was generally the highest TU equivalent across sites, with median value of 0.33 (range 0.3 to 0.63). Bifenthrin is considered to be the leading cause of pyrethroid-related toxicity in urban areas (Ruby 2013) and is the most-commonly detected insecticide monitored by the Department Pesticide Regulation Surface of Watershed Protection Program (Ensminger 2017).

The sum of pyrethroid TU equivalents are shown in Tables 7 and 8. Values over 1.0 are shown in bold. The highest sum TU equivalent value (1.6) occurred at site 205COY080 during the 2019 sampling event. Sum TU equivalent values were above 1.0 at sites 205COY165 and 205COY250 during the 2018 sampling event. Toxicity was not significant at any of the locations where sum TU equivalent values were over 1.0.

Concentrations of fipronil and its degradates were below MDLs for all sampling events, with the exception of site 205COY240 in 2018, which had detectable concentrations, but TU equivalents below 1.0.

Grain size analyses for all sediment samples collected in WY 2018 and WY 2019 are provided in Tables 9 and 10, respectively. Percent fines (clay and silt) ranged from 18% to 50% for all five sites sampled in 2018 and 26% to 41% for the three sites sampled in 2019.

Table 5. Threshold Effect Concentration (TEC) quotients for WY 2018 sediment chemistry constituents. Bolded and shaded values indicate TEC quotient ≥ 1.0.

Year	Metals	TEC	205COY060		205COY080		205COY165		205COY240		205COY250	
			Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient
2018	Arsenic	9.79	5.4	0.55	8.2	0.84	3.7	0.38	5.5	0.56	4.1	0.42
	Cadmium	0.99	0.27	0.27	0.24	0.24	0.3	0.30	0.5	0.51	0.25	0.25
	Chromium	43.4	41	0.94	46	**1.1**	36	0.83	70	**1.6**	61	**1.4**
	Copper	31.6	30	0.95	28	0.89	25	0.79	56	**1.8**	35	**1.1**
	Lead	35.8	15	0.42	14	0.39	22	0.61	51	**1.4**	34	0.95
	Nickel	22.7	60	**2.6**	69	**3.0**	55	**2.4**	120	**5.3**	92	**4.1**
	Zinc	121	110	0.91	96	0.79	110	0.91	320	**2.6**	180	**1.5**
2019	Arsenic	9.79	-	-	4.8	0.49	4.1	0.42	-	-	4.7	0.48
	Cadmium	0.99	-	-	0.35	0.35	0.31	0.31	-	-	0.21	0.21
	Chromium	43.4	-	-	45	**1.0**	41	0.94	-	-	67	**1.5**
	Copper	31.6	-	-	26.4	0.84	22.5	0.71	-	-	31.7	**1.0**
	Lead	35.8	-	-	25	0.70	23	0.64	-	-	35	0.98
	Nickel	22.7	-	-	68	**3.0**	61	**2.7**	-	-	100	**4.4**
	Zinc	121	-	-	130	**1.07**	110	0.91	-	-	150	**1.2**

Table 6. Probable Effect Concentration (PEC) quotients for metals in sediment collected in WY 2018 and WY 2019. Bolded and shaded values indicate PEC quotient ≥ 1.0.

Year	Metals	PEC	205COY060		205COY080		205COY165		205COY240		205COY250	
			Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient	Conc (mg/kg) DW	Quotient
2018	Arsenic	33.0	5.4	0.16	8.2	0.25	3.7	0.11	5.5	0.17	4.1	0.12
	Cadmium	4.98	0.27	0.05	0.24	0.05	0.3	0.06	0.5	0.10	0.25	0.05
	Chromium	111	41	0.37	46	0.41	36	0.32	70	0.63	61	0.55
	Copper	149	30	0.20	28	0.19	25	0.17	56	0.38	35	0.23
	Lead	128	15	0.12	14	0.11	22	0.17	51	0.40	34	0.27
	Nickel	48.6	60	**1.2**	69	**1.4**	55	**1.1**	120	**2.5**	92	**1.9**
	Zinc	459	110	0.24	96	0.21	110	0.24	320	0.70	180	0.39
2019	Arsenic	33.0	-	-	4.8	0.15	4.1	0.12	-	-	4.7	0.14
	Cadmium	4.98	-	-	0.35	0.07	0.31	0.06	-	-	0.21	0.04
	Chromium	111	-	-	45	0.41	41	0.37	-	-	67	0.60
	Copper	149	-	-	26.4	0.18	22.5	0.15	-	-	31.7	0.21
	Lead	128	-	-	25	0.20	23	0.18	-	-	35	0.27
	Nickel	48.6	-	-	68	**1.4**	61	**1.3**	-	-	100	**2.1**
	Zinc	459	-	-	130	0.28	110	0.24	-	-	150	0.33

Table 7. Pesticide concentrations and calculated toxic unit (TU) equivalents, WY 2018. Toxic Unit equivalents were not calculated (NC) for pesticide concentrations that were below Method Detection Limits (MDL)s.

Analyte	LC50 [d]	205COY060			205COY080			205COY165			205COY240			205COY250		
		Conc	TOC Normal	TU Equiv.	Conc	TOC Normal	TU Equiv.	Conc	TOC Normal	TU Equiv.	Conc	TOC Normal	TU Equiv.	Conc	TOC Normal	TU Equiv.
Total Organic Carbon (%)	--	1.5	--	--	1.2	--	--	1.3	--	--	4.7	--	--	2.1	--	**--**
Pyrethroid (µg/g dw)																
Bifenthrin	0.52	0.0024	0.16	0.31	0.0019	0.16	0.30	0.0036	0.28	0.53	0.0078	0.17	0.32	0.0036	0.17	0.33
Cyfluthrin	1.08	0.00085	0.057	0.05	0.00064 [a]	0.053	0.05	0.0019	0.15	0.14	0.0072	0.15	0.14	0.0026	0.12	0.11
Cypermethrin	0.38	< MDL	0.017	NC	< MDL	0.022	NC	0.00094	0.072	0.19	0.0041	0.087	0.23	0.0048	0.23	0.60
Deltamethrin	0.79	< MDL	0.021	NC	< MDL	0.026	NC	0.0012	0.092	0.12	0.00033	0.0069	0.01	0.00032	0.015	0.02
Esfenvalerate	1.54	< MDL	0.022	NC	< MDL	0.028	NC	0.00034	0.026	0.02	0.00035	0.0074	0.005	0.00034	0.016	0.01
Lambda-Cyhalothrin	0.45	< MDL	0.010	NC	< MDL	0.013	NC	0.00031	0.024	0.05	0.0013	0.028	0.06	0.00016	0.007	0.02
Permethrin	10.8	0.00120	0.08	0.01	0.0014	0.117	0.01	0.0027	0.21	0.02	0.0072	0.15	0.01	0.0055	0.26	0.02
Total				0.5			0.5			**1.1**			0.8			**1.1**
Other Pesticides of Concern (ng/g dw)																
Fipronil	306	< MDL	17.3	NC	< MDL	21.7	NC	< MDL	20.0	NC	0.27	5.7	0.019	< MDL	12.4	NC
Fipronil Desulfinyl	NA [b]	< MDL	17.3	NC	< MDL	21.7	NC	< MDL	20.0	NC	0.27	5.7	NA	< MDL	12.4	NC
Fipronil Sulfide	435	< MDL	17.3	NC	< MDL	21.7	NC	< MDL	20.0	NC	3.5	74.5	0.17	< MDL	12.4	NC
Fipronil Sulfone	158	< MDL	17.3	NC	< MDL	21.7	NC	< MDL	20.0	NC	3.1	66.0	0.42	< MDL	12.4	NC

a. TU equivalents calculated from concentration below the reporting limit (J-flagged).
b. No available LC50 value for Fipronil Desulfinyl
c. Sources: Amweg et al. 2005. Maul et al. 2008, and Maund et al. 2002

Table 8. Pesticide concentrations and calculated toxic unit (TU) equivalents, WY 2019. Toxic Unit equivalents were not calculated (NC) for pesticide concentrations that were below Method Detection Limits (MDL)s.

Analyte	LC50	205COY080			205COY165			205COY250		
		Conc	TOC Normal	TU Equiv.	Conc	TOC Normal	TU Equiv.	Conc	TOC Normal	TU Equiv.
Total Organic Carbon (%)		0.86			1.3			2.1		
Pyrethroid (µg/g dw)										
Bifenthrin	0.52	0.0028	0.33	0.63	0.0024 [a]	0.18	0.36	0.0048	0.23	0.44
Cyfluthrin	1.08	0.0011[a]	0.128	0.12	< MDL	0.04	0.04	0.0021	0.10	0.09
Cypermethrin	0.38	0.0011[a]	0.128	0.34	< MDL	0.038	0.10	0.0019	0.09	0.24
Deltamethrin/Tralomethrin	0.79	0.0026	0.302	0.38	0.0015 [a]	0.115	0.15	0.0013	0.062	0.08
Esfenvalerate/Fenvalerate	1.54	< MDL	0.00034	NC	< MDL	0.050	NC	< MDL	0.016	NC
Lambda-Cyhalothrin	0.45	< MDL	0.018	NC	< MDL	0.024	NC	< MDL	0.007	NC
Permethrin	10.83	0.0033	0.384	0.04	0.0028	0.22	0.02	0.0030	0.14	0.01
Total				**1.6**			0.8			0.9
Other Pesticides of Concern (ng/g dw)										
Fipronil	306	< MDL	29.7	NC	< MDL	38.5	NC	< MDL	12.4	NC
Fipronil Desulfinyl	NA[b]	< MDL	29.7	NC	< MDL	38.5	NC	< MDL	12.4	NC
Fipronil Sulfide	435	< MDL	29.7	NC	< MDL	38.5	NC	< MDL	12.4	NC
Fipronil Sulfone	158	< MDL	29.7	NC	< MDL	38.5	NC	< MDL	12.4	NC

a. TU equivalents calculated from concentration below the reporting limit (J-flagged).
b. No available LC50 value for Fipronil Desulfinyl
c. Sources: Amweg et al. 2005. Maul et al. 2008, and Maund et al. 2002

Table 9. Summary of grain size for the five sampling locations in Coyote Creek during WY 2018.

Grain Size (%)		205COY060	205COY080	205COY165	205COY240	205COY250
Clay	<0.0039 mm	11.2%	14.7%	9.3%	14.0%	6.6%
Silt	0.0039 to <0.0625 mm	22.7%	13.4%	16.6%	36.2%	11.6%
Sand	V. Fine 0.0625 to <0.125 mm	5.8%	2.9%	16.4%	19.3%	8.3%
	Fine 0.125 to <0.25 mm	7.8%	9.3%	37.3%	18.3%	31.3%
	Medium 0.25 to <0.5 mm	7.5%	20.8%	16.2%	8.5%	33.8%
	Coarse 0.5 to <1.0 mm	6.8%	20.7%	3.4%	2.6%	5.5%
	V. Coarse 1.0 to <2.0 mm	38.3%	18.3%	1.2%	1.1%	3.0%
Granule	2.0 to <4.0 mm	16.7%	10.9%	1.0%	0.8%	3.6%
Pebble	Small 4 to <8 mm	26.6%	22%	ND	ND	6.5%
	Medium 8 to <16 mm	38.1%	ND	ND	ND	ND
	Large 16 to <32 mm	ND	ND	ND	ND	ND
	V. Large 32 to <64 mm	ND	ND	ND	ND	ND

Note: Sum of grain size values for both sites is greater than 100% due to the laboratory analytical methods used.

Table 10. Summary of grain size for the three sampling locations in Coyote Creek during WY 2019.

Grain Size		205COY080	205COY165	205COY250
Clay	<0.0039 mm	20.4%	9.8%	7.9%
Silt	0.0039 to <0.0625 mm	20.5%	21.9%	17.6%
Sand	V. Fine 0.0625 to <0.125 mm	3.5%	11.6%	10.2%
	Fine 0.125 to <0.25 mm	10.7%	24.6%	18.5%
	Medium 0.25 to <0.5 mm	19.4%	22.0%	29.7%
	Coarse 0.5 to <1.0 mm	15.1%	6.7%	9.4%
	V. Coarse 1.0 to <2.0 mm	10.3%	3.4%	6.8%
Granule	2.0 to <4.0 mm	8.4%	1.2%	7.0%
Pebble	Small 4 to <8 mm	21.0%	ND	11.8%
	Medium 8 to <16 mm	29.0%	ND	ND
	Large 16 to <32 mm	ND	ND	21.9%
	V. Large 32 to <64 mm	ND	ND	ND

Note: Sum of grain size values for both sites is greater than 100% due to the laboratory analytical methods used.

4.0 DISCUSSION

The monitoring results from Coyote Creek Toxicity SSID Project are discussed below in the context of each monitoring objective identified in the Work Plan.

What is the magnitude and extent of toxicity at SSID monitoring sites?

Overall, acute toxicity to *Hyalella azteca* and *Chironomum dilutus* organisms was very low during the 2018 and 2019 monitoring period. In 2018, only one of five sediment samples had toxicity. A subsequent TIE on the same sample resulted in no observation of acute toxicity.

Three of the five sites sampled in 2018 were resampled in 2019. Only one of the three samples exhibited acute toxicity. However, the results are ambiguous due to an identified outlier for one of the test replicants. There was no significant toxicity when the outlier was excluded from the results. Due to low levels of toxicity, a TIE was not conducted on the 2019 sample.

What are the potential causes of toxicity?

Hyalella azteca and *Chironomus dilutus* are typically the only organisms used to evaluate toxicity in sediments from freshwater creeks. *Hyalella azteca* is highly sensitive to pyrethroid pesticides. *Chironomus dilutus* (a midge) is sensitive to fipronil, its degradates, and neonicotinoids (i.e., imidacloprid).

Evaluation of 2018 sediment chemistry results from site 205COY080 (where toxicity was observed) were inconclusive (i.e., pyrethroid or metal concentrations were not at levels that are known to cause toxic effects). The subsequent TIE conducted in 2018 did not result in toxicity and thus, treatments to evaluate potential causes of toxicity (i.e., metals or pyrethroids) were not effective.

Sediment chemistry results from 2019 at site 205COY080 did indicate pyrethroid concentrations were at levels that may cause toxicity (TU for sum of pyrethroids > 1.0). However, acute toxicity did not occur with *Hyalella azteca*, which is the test organism most sensitive to pyrethroids. Although there may have been toxic effects to *Chironomum dilutes* (when outlier replicant test was included in results), fipronil concentrations were all below method detection limits. Overall, toxicity results were too inconclusive to identify potential contaminants that may be causing toxicity.

Is toxicity declining in Coyote Creek?

Evaluation of sediment toxicity data collected during the dry season at site 205COY060 in Coyote Creek by the SPoT Program between 2008 and 2018 (summarized in Section 1.2 of this report) indicates that acute toxicity has declined over the 11 year time period. Sediment data collected over a wider range of seasons and across multiple sites within the Coyote Creek mainstem (not including sampling locations in tributaries to Coyote Creek) between 2006 and 2019 shows similar results (Table 11). These data were generated by the following programs:

- SCVURPPP has been collecting sediment chemistry data and conducting toxicity testing in Coyote Creek since 2006. Between 2006 and 2008, SCVURPPP collected sediment data at several sites in Coyote Creek as part of the Sediment Quality Triad Pilot Study (SCVURPPP 2008). In 2012 and 2013, SCVURPPP conducted sediment sampling at three locations in Coyote Creek to satisfy MRP Provision C.8 monitoring requirements (SCVURPPP 2014).

- SWAMP's SPoT program has conducted monitoring at site 205COY060 every year since 2008. SWAMP also conducted monitoring in 2007 at two locations in Coyote Creek as part of the Statewide Urban Pyrethroid Study.

Table 11. Sediment data collected in Coyote Creek mainstem by SCVURPP and SWAMP between 2006 and 2019. These data include samples collected by SPoT over variable seasonal time periods.

Year	SCVURPPP Monitoring Program			Surface Water Ambient Monitoring Program (SWAMP)		Total # Samples
	Pre-MRP Monitoring	RMC Monitoring (MRP)	SSID Project	Urban Pyrethroid Status Monitoring	Stream Pollution Trends (SPoT) Program[1]	
2006	6	-	-	-	-	6
2007	10	-	-	2	-	12
2008	4	-	-	-	1	5
2009	-	-	-	-	1	1
2010	-	-	-	-	1	1
2011	-	-	-	-	6	6
2012	-	1	-	-	9	10
2013	-	2	-	-	4	6
2014	-	-	-	-	1	1
2015	-	-	-	-	1	1
2016	-	-	-	-	1	1
2017	-	-	-	-	1	1
2018	-	-	5	-	1	6
2019	-	-	3	-	1	4

[1] Includes toxicity testing results for variable season and temperature treatments.

Figure 3 illustrates the number of samples collected in Coyote Creek mainstem over the span of 14 years (Table 11) that had acute toxicity[3] for the test organism *Hyalella azteca.* Between 2010 and 2019, only 4 of 36 (11%) samples were toxic. More recently, only 1 of 13 (8%) samples collected between 2014 to 2019 had observed acute sediment toxicity. Based on these data, it appears that toxicity for *Hyalella azteca* in Coyote Creek may have declined over the past 10 years.

The SPoT Program also conducted chronic (growth) toxicity tests using the *Hyalella azteca* test organism. Chronic toxicity was relatively infrequent over the 14 year monitoring period. Figure 4 shows the number of sediment samples collected in Coyote Creek (Table 11) that exhibited chronic (growth) toxicity[4]. Between 2010 and 2019, only 2 of 28 (7%) samples exhibited chronic toxicity to *Hyalella azteca*.

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[3] Does not include SWAMP results of toxicity tests conducted using the temperature treatment (15 C).
[4] Chronic toxicity tests were not conducted for the SSID project.

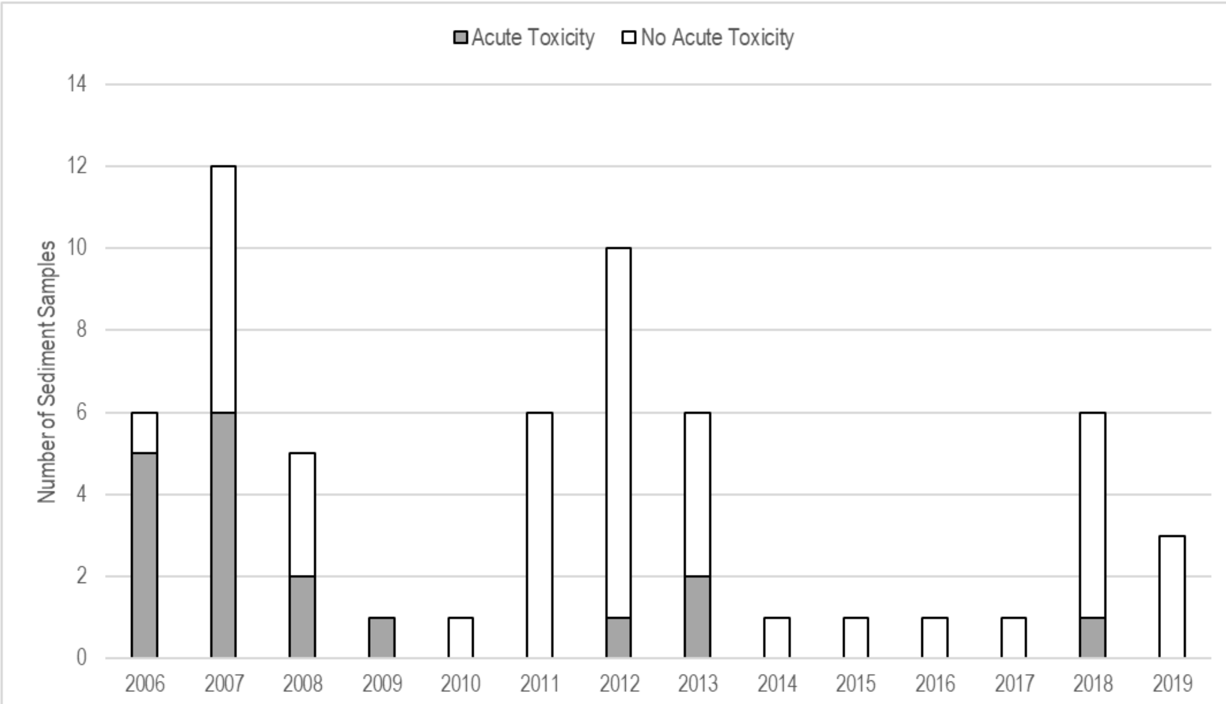

Figure 3. Number of sediment samples collected in Coyote Creek with acute toxicity to *Hyalella azteca*.

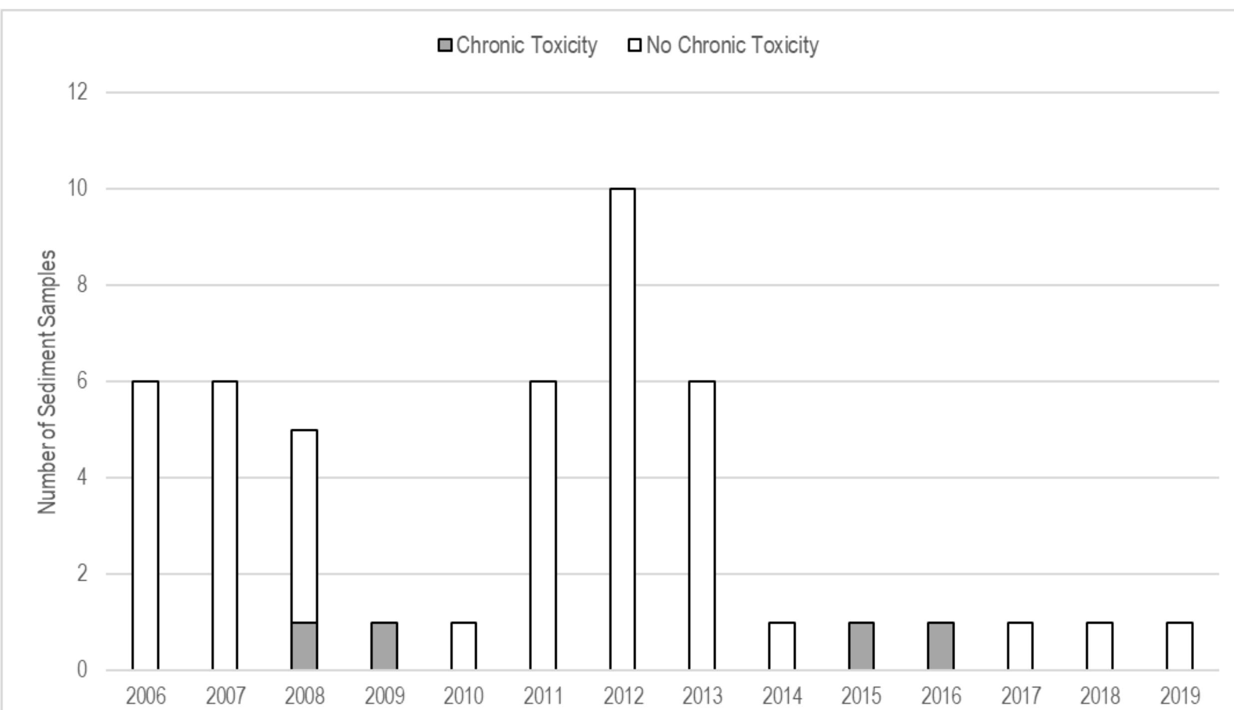

Figure 4. Number of sediment samples collected in Coyote Creek with chronic toxicity to *Hyalella azteca*.

A decline in overall toxicity to *Hyalella azteca* may be associated with reduction in pyrethroid pesticide concentrations in bedded stream sediments. Overall, there appears to be a decline in pyrethroid concentrations in samples collected by SPoT at site 205COY060 since 2012 (Figure 1 in Section 1.2). Pyrethroid concentrations also appear to be declining for sediment samples collected over the wider range of sites shown in Table 11. Figure 5 shows the concentrations for two pyrethroids, bifenthrin and cypermethrin, in samples collected between 2007 and 2019. Concentrations in samples collected at site 205COY060 at Montague Expressway are called out to show trends at a single sampling location over time. Both pesticides had concentrations that were consistently below the LC50 threshold for all samples collected in Coyote Creek after 2013.

A reduction in pyrethroid concentrations observed in Coyote Creek may reflect an overall reduction in the amount of pyrethroid used in the landscape (SCVURPPP 2019). However, sediment chemistry results for sediment samples collected in Coyote Creek since 2013 indicate minimal changes in fipronil concentrations over time. Fipronil degradates (sulfite and sulfone) concentrations in sediment samples between 2013 and 2018 are shown in Figure 6. Furthermore, acute toxicity tests over the monitoring period showed no significant mortality for *Chironomum* dilutes, an organism sensitive to fipronil.

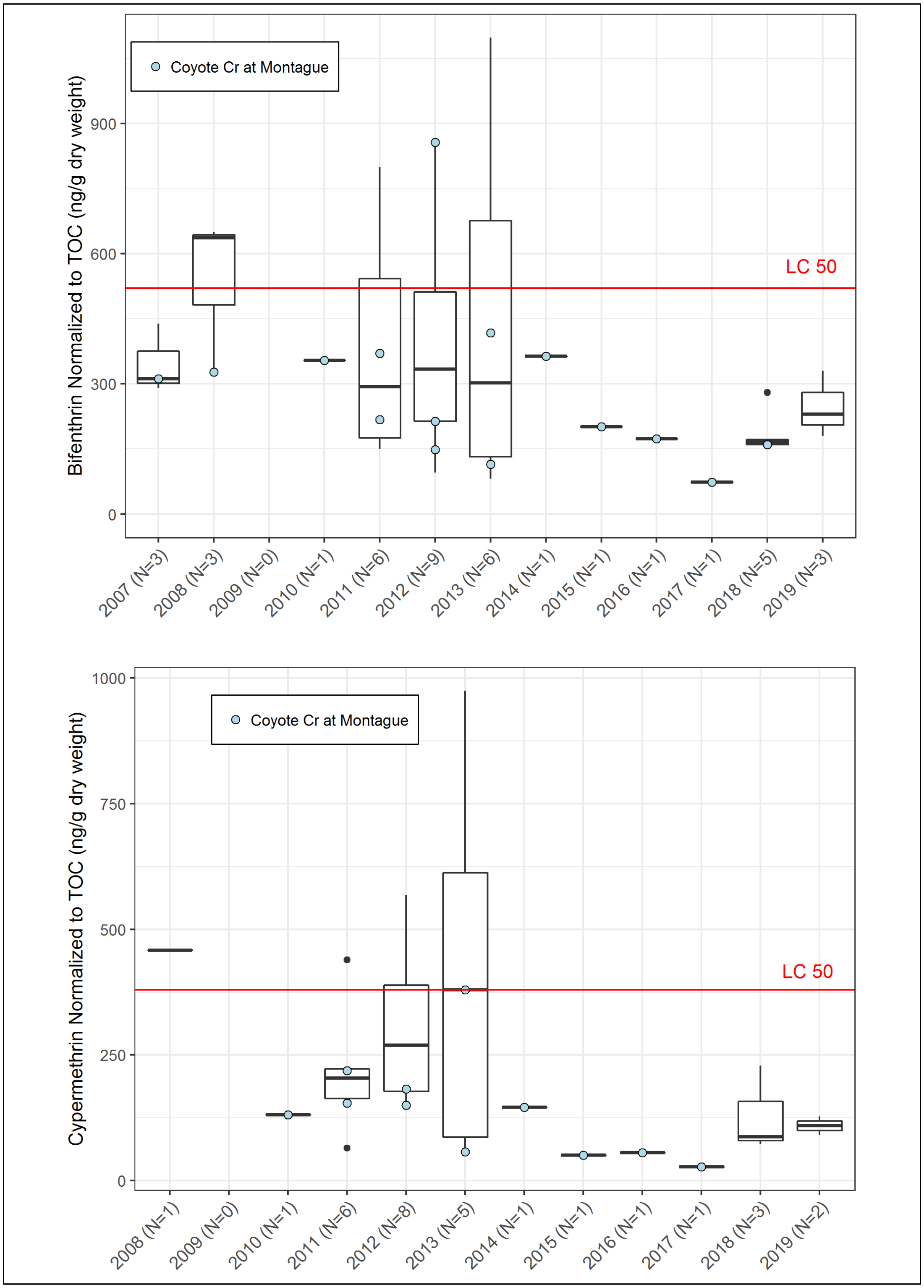

Figure 5. Pyrethroid pesticide concentrations (bifenthrin and cypermethrin) in sediment samples collected in Coyote Creek between 2008 and 2019. Sediment data collected by SWAMP SPoT program in 2018 and 2019 was not available for this analyses.

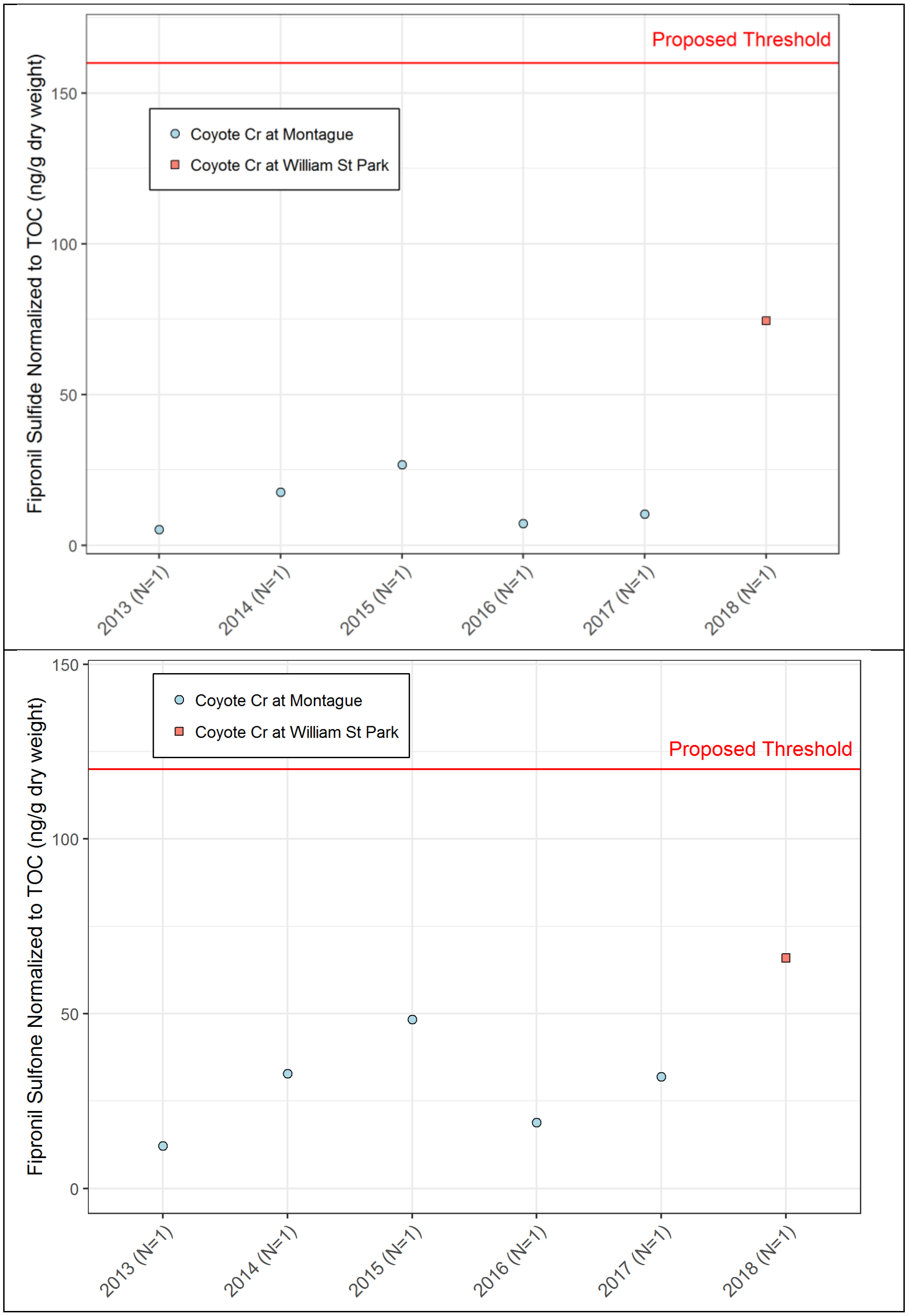

Figure 6. Fipronil degradate concentrations in sediment samples collected in Coyote Creek between 2013 and 2019. Sediment data collected by SWAMP SPoT program in 2018 and 2019 was not available for this analyses.

5.0 CONCLUSIONS AND RECOMMENDATIONS

The Coyote Creek Toxicity SSID Project was designed to identify the cause(s) of sediment toxicity to *Hyalella azteca* measured in samples collected in 2008 and 2009, which was the evidence used by the Water Board to add Coyote Creek to the 303(d) list. Because *Hyalella azteca* is particularly sensitive to pyrethroid pesticides, this study focused on pyrethroids as a potential cause of *Hyalella azteca* toxicity. However, there was an overall lack of toxicity observed in the Coyote Creek Toxicity SSID study samples (collected 2018 – 2019). Furthermore, review of toxicity data from Coyote Creek for the 2006 – 2019 period of record suggests a declining trend in toxicity to *Hyalella azteca*. The reduction in toxicity may be explained by the gradual decline over time in pyrethroid concentrations in sediment samples.

This study also explored sediment toxicity to *Chironomum dilutus*, a test organism that is sensitive to fipronil. A low level of toxicity was observed in one sample during the two year study. However, these results were ambiguous due to an outlier (no significant toxicity occurred when outlier was excluded). Concentrations of fipronil and its degradates were at low concentrations that were generally below method detection limits.

The results of this SSID Study and review of toxicity data collected over the past 14 years suggest that sediment toxicity is generally not present in Coyote Creek. Based on these results and analyses, the Coyote Creek Toxicity SSID Project is considered complete.

In FY 2018-19, SCVURPPP conducted an evaluation of pesticide source control actions implemented by SCVURPPP and its Permittees. The results of the evaluation are described in the Pesticide Source Control Actions Effectiveness Evaluation Report which was included in the FY 2018-19 SCVURPPP Annual Report. As described in the Report, SCVURPPP will continue to implement the pesticide toxicity control measures described in MRP Provision C.9. These include:

- Implement Integrated Pest Management (IPM) policies/ordinances and established pesticide application SOPs. All SCVURPPP Permittees have adopted IPM policies/ordinances requiring the use of IPM techniques on municipal properties.
- Train all municipal staff that apply pesticides on the IPM policy and SOPs.
- Require contractors to follow the IPM Policy and implement IPM.
- Collaborate with the County Household Hazardous Waste (HHW) Program to ensure that adequate pesticide disposal services are available to all residents.
- Implement the Our Water Our World (OWOW) Program in local retail stores and nurseries to provide less toxic pest control information to residents at the point of purchase. Conduct trainings for store employees to educate them on the availability of less-toxic pesticide products.
- Educate residents about pesticides and IPM, using media advertising, website and social media postings, and distribution of outreach materials at events.
- Conduct the Santa Clara Valley Green Gardener training to educate professional landscapers on other sustainable landscaping practices, including IPM.
- Educate pest control professionals on IPM and water quality issues by sending them informational letters and publishing articles in the Santa Clara County Department of Agriculture's newsletter.

- Encourage new development and redevelopment sites to use “beneficial landscaping” techniques that minimize pesticides, fertilizers, irrigation, and runoff.
- Work with the California Stormwater Quality Association (CASQA) to communicate to the USEPA Office of Pesticide Programs and the California Department of Pesticide Regulation the need to fully consider the impact on water quality during the pesticide approval and registration process.

Consistent with MRP procedures, the Program seeks approval of the completion of the Coyote Creek Sediment Toxicity SSID Study from the Water Board Executive Officer.

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Attachment 3

Lower Silver SSID Project Work Plan

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program

Lower Silver-Thompson Creek Watershed Stressor Source Identification Project

Work Plan - Water Year 2019 - 2020

July 30, 2019

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1 INTRODUCTION

The purpose of this work plan is to describe the design and tasks to complete a Stressor/Source Identification (SSID) project required by Provision C.8.e.iii of the San Francisco Bay Region Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Stormwater Permit (MRP) (Order No. R2-2015-0049). The Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) is working with the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) to collectively initiate eight new SSID projects during the five-year term of the MRP (i.e., 2016 – 2020).

SSID projects typically follow-up on monitoring conducted in compliance with MRP Provision C.8 (or monitoring conducted through other programs) with results that exceed trigger thresholds identified in the MRP. Trigger thresholds are not necessarily equivalent to Water Quality Objectives (WQOs) established in the San Francisco Bay Basin (Region 2) Water Quality Control Plan (Basin Plan, SFRWQCB 2017) by the San Francisco Bay Regional Water Quality Control Board (Water Board); however, sites where triggers are exceeded may indicate potential impacts to aquatic life or other Beneficial Uses.

The Program will conduct two SSID projects during MRP 2.0. The Coyote Toxicity SSID Project was initiated during WY 2018 and will continue through WY 2019. The project entails an investigation of the magnitude and extent of potential sediment related toxicity in an urban reach of the Coyote Creek mainstem. In addition, the project will evaluate potential causes and sources of toxicity (if found). A final report will be submitted to the Water Board by March 31, 2020.

In WY 2019, the Program will initiate the second and final SSID project for MRP 2.0. The Lower Silver-Thompson Creek SSID Project was triggered by creek status/condition data suggesting Lower Silver Creek and Thompson Creek have reduced biological integrity. In addition, existing water chemistry data collected during bioassessments indicate elevated nutrient concentrations at most of the monitoring locations. Nutrients are biostimulatory substances that may cause eutrophic conditions that can influence biological conditions.

The Lower Silver – Thompson Creek SSID work plan (this document) describes the steps that will be taken during WY 2019 and WY 2020 to investigate potential causes of low biological integrity in Lower Silver-Thompson Creek, San Jose, California.

1.1 SSID Regulatory Background

SSID projects are intended to be oriented toward taking action(s) to alleviate stressors and reduce sources of pollutants. MRP Provision C.8.e.iii requires that SSID projects are conducted in a stepwise process:

Step 1: Develop a work plan. The work plan must:

- Define the problem (e.g., magnitude and temporal and geographic extent) to the extent known;
- Describe the SSID project objectives, including the management context within which the results of the investigation will be used;
- Consider the problem within a watershed context and look at multiple types of related indicators, where possible (e.g., basic water quality data and biological assessment results);
- List candidate causes of the problem (e.g., biological stressors, pollutant sources, and physical stressors);

- Establish a schedule for investigating the cause(s) of the trigger stressor/source to begin upon completion of the work plan. Investigations may include evaluation of existing data and/or collection of new data.
- Conduct a site specific study (or non-site specific if the problem is wide-spread) in a stepwise process to identify and isolate the cause(s) of the trigger stressor/source. Study approaches are listed depending on the stressor being investigated.

Step 2: Conduct SSID investigations according to the schedule in the work plan and report on the status of the SSID investigation annually in the Urban Creeks Monitoring Report (UCMR) that is submitted to the Regional Water Board on March 31 of each year.

Step 3: Follow-up actions:

- If it is determined that discharges to the municipal separate storm sewer system (MS4) contribute to an exceedance of a water quality standard (WQS) or an exceedance of a trigger threshold such that the water body's beneficial uses are not supported, submit a report in the UCMR that describes Best Management Practices (BMPs) that are currently being implemented and additional BMPs that will be implemented to prevent or reduce the discharge of pollutants that are causing or contributing to the exceedance of WQS. The report must include an implementation schedule.
- If it is determined that MS4 discharges are not contributing to an exceedance of a WQS, the SSID project may end. The Executive Officer must concur in writing before an SSID project is determined to be completed.
- If the SSID investigation is inconclusive (e.g. the trigger threshold exceedance is episodic or reasonable methods do not reveal a stressor/source), the Permittee may request that the Executive Officer consider the SSID project complete.

1.2 **SSID Work Plan Organization**

This work plan fulfills **Step 1** of the SSID process presented in Section 1.1 and describes the steps that will be conducted to investigate potential sources and impacts to biological integrity in Lower Silver-Thompson Creek. The work plan is organized according to the work plan elements required by MRP Provision C.8.e.iii as described in Step 1.

Section 2.0 Problem Definition and Study Objectives

Section 4.0 Study Area, Existing Data, and Candidate Causes

Section 5.0 SSID Monitoring Approach and Schedule

Section 6.0 References

2 PROBLEM DEFINITION AND STUDY OBJECTIVES

2.1 Problem Definition

This SSID project was triggered by creek status/condition data suggesting Lower Silver-Thompson Creek watershed has reduced biological integrity. Specifically, the California Stream Condition Scores (CSCI), based on benthic macroinvertebrate data collected at six bioassessment sites on Lower Silver and Thompson Creek, were below the MRP threshold for CSCI scores. In addition, existing water chemistry data show that nutrient concentrations in the water column were elevated during the spring season when biological conditions were assessed. Furthermore, algal biomass measurements at selected sites indicate the potential for eutrophication. Excess nutrients may be problematic under certain conditions (e.g., sunlight exposure, high temperatures) that result in algal production. Increase in algal biomass can result in poor water quality or changes in food availability, resulting in reduced biological conditions.

An evaluation of bioassessment data collected in California stream and rivers suggests potential correlation between nutrients (i.e., total nitrogen and total phosphorus) and biological condition index scores (Mazor, *et al*. in prep). However, these associations are highly variable, indicating that confounding stressors may co-occur, especially in urban streams. Thus, the linkage between nutrients and biological conditions is not always clear.

An evaluation of five years of bioassessment data collected in San Francisco Bay watersheds (BASMAA 2019) identified physical habitat and landscape variables as the primary factors affecting variability of CSCI scores. In contrast, indices measuring health of benthic algae were more correlated to water quality variables.

Existing bioassessment data indicate that sampling locations in Lower Silver – Thompson Creek are likely impacted by multiple urban stressors. The majority of locations were modified channels with poor physical habitat conditions. In addition, five of the six sampling locations were in highly urban watersheds, with percent imperviousness in the surrounding landuse ranging from 31% to 53%.

2.2 Study Objectives

The objective of this SSID project is to focus on potential causes of reduced biological conditions in Lower Silver-Thompson Creek. Specifically, the study is designed to help answer the following questions:

1. What sources are contributing nutrients to the creek?
2. Are high nutrient concentrations contributing to the low biological quality in the creek?
3. Is euthropication occurring, and if so what conditions are potential contributing factors?
4. What other conditions might contribute to the low biological quality in the creek?

The data collected during this study will be combined with existing data (Section 3.2) to support a more robust characterization and evaluation of conditions and potential stressors and sources in the subwatershed.

3 STUDY AREA, EXISTING DATA, CANDIDATE CAUSES

3.1 Study Area

The Lower Silver – Thompson Creek subwatershed is the largest tributary (approximately 42 square miles) within the Coyote Creek watershed area below Anderson Dam. Thompson Creek originates in the Diablo Range foothills at an elevation of about 2,300 feet and flows northerly to its confluence with Lower Silver Creek at the eastern edge of the Santa Clara Valley.The transition from Thompson Creek to Lower Silver Creek orrurs just upstream of Lake Cunningham. There is no hydrological connection between the creek and the lake. Historically, with its gentle slopes and poorly drained soils, Lower Silver Creek flowed in an ill-defined channel; most of the flatter areas were swampy and prone to ponding and frequent floods. In the early 1950s, prior to urbanization, Lower Silver Creek was placed in an earthen channel and diverted to its present alignment (SCVURPPP 2003) to flow within an earthen levee around the western edge of Lake Cunningham. From there, it continues to flow in a northwesterly direction in a flood control channel to its confluence with Coyote Creek.

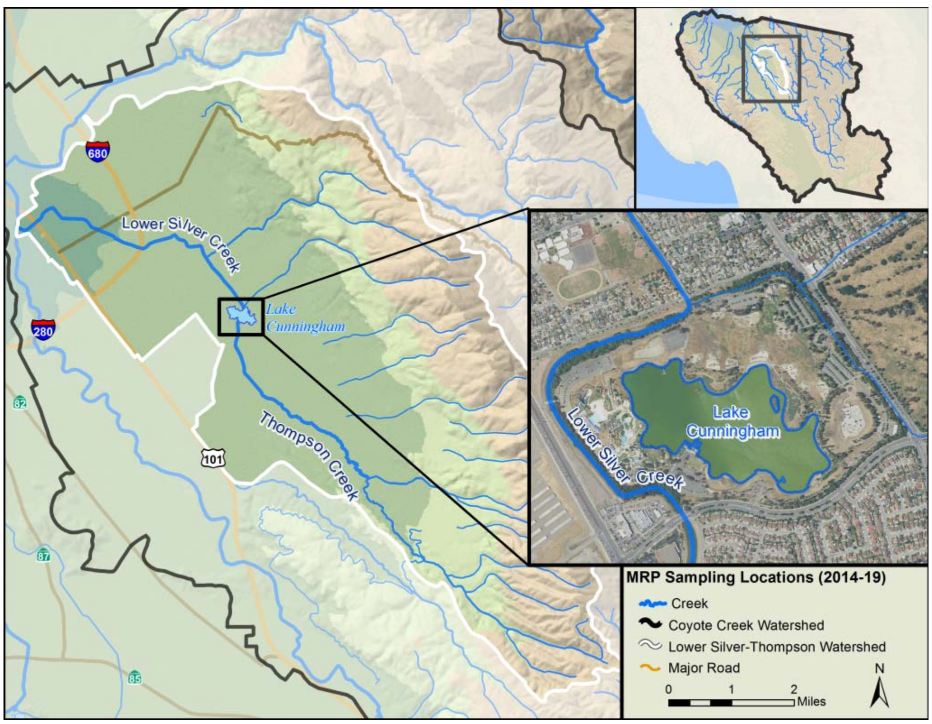

Figure 1. Lower Silver – Thompson Creek watershed, San Jose, California.

Existing land uses in the Lower Silver - Thompson Creek subwatershed are predominantly urban. The upland areas are devoted to uses ranging from rangelands to wildlife habitat, and are largely located outside of the City of San Jose's Urban Service Area boundary and in unincorporated areas of Santa Clara County. Two drop structures are present upstream and downstream of Quimby Road along Thompson Creek. Further upstream, the channel includes levees, rock slope protection, box culverts, and storm drain outfalls. Stream flow is typically intermittent throughout Thompson Creek and perennial in Lower Silver Creek (below Lake Cunningham).

The Lower Silver Creek Flood Protection Project, initiated by Valley Water[1] in early 2000, has resulted in major changes to the channel and physical habitat in the Lower Silver Creek. The primary goal of the

[1] Formerly known as Santa Clara Valley Water District.

project was to reduce potential flooding in the area by removing sediments from the channel to increase conveyance of flow during flood events. Sediment removal in the reach between Coyote Creek confluence and I-680 was completed in 2005. Sediment removal from the remaining section of creek, between I-680 and Lake Cunningham, was completed in 2017. The flood control project also included new levee walls, wider flood plain areas and vegetated banks. In addition, Valley Water has been working on a project to increase the capacity of Lake Cunningham to capture excess water during peak flow events by building a flood wall adjacent to Cunningham Avenue and White Road. Valley Water has also been working on bank stabilization projects in Thompson Creek to reduce erosion and sediment supply to the lower reaches.

3.2 Existing Data

Since 2014, the Program has conducted Creek Status Monitoring (CSM) and Pollutants of Concern (POC) Monitoring in Lower Silver-Thompson Creek to meet requirements under the MRP.

As part of the CSM, the Program conducted bioassessments at six locations in the watershed between 2014 and 2018 (Table 1 and Figure 2). The majority of the bioassessment sites were in low-gradient channels with adjacent urban/suburban land uses. All sites in Lower Silver Creek were within the channelized flood control channel, bordered by earthen levees. Due to recent channel construction associated with the Lower Silver Creek Flood Protection Project (see Section 3.1), riparian vegetation was relatively immature and provided minimal stream shading. Thompson Creek sites consisted of smaller channels with mature riparian forest providing shade and habitat complexity. Reach photos for each bioassessment site are provided in Attachment A.

The Program also collected nutrient samples at three locations in the Lower Silver-Thompson Creek watershed as part of the POC Monitoring (Table 1 and Figure 2). As shown on the map, two of the sample sites were co-located with a CSM site.

CSM and POC results are summarized below.

Table 1. Sampling locations in Lower Silver-Thompson Creek associated with Creek Status and Pollutant of Concern Monitoring.

Program	Creek Name	Station ID	Map ID	Site Location Description	Latitude	Longitude
Creek Status Monitoring	Thompson	205R03825	3825	Flowering Meadow Ln	37.28070	-121.75540
		205R00915	915	Aborn Rd	37.31470	-121.79620
	Lower Silver	205R02771	2771	S. Jackson Rd	37.35228	-121.83543
		205R01747	1747	Kammerer	37.35200	-121.84200
		205R00979	979	Lausett Ave	37.35400	-121.84660
		205R03795	3795	Plata Arroyo Park	37.35770	-121.85820
Pollutants of Concern Monitoring	Thompson	205COY205	205	Aborn Rd	37.31376	-121.79468
	Lower Silver	205COY185	185	S. Jackson Ave	37.35186	-121.83600
		205COY180	180	Wooster Av	37.35544	-121.87083

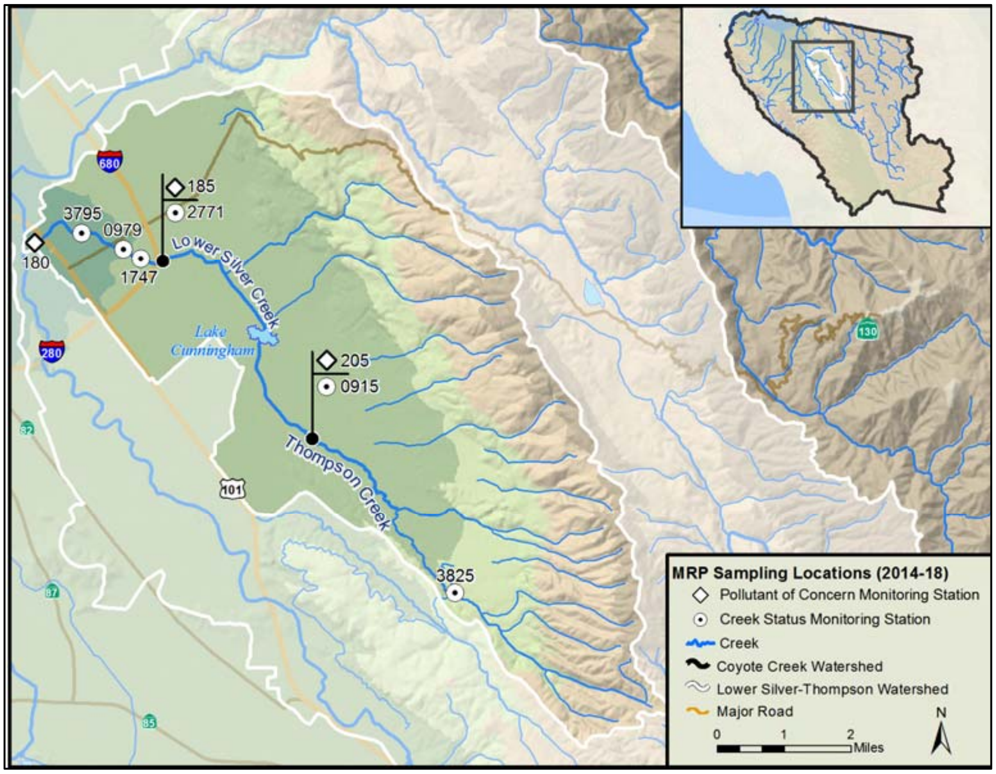

Figure 2. CSM and POCM monitoring stations in Lower Silver-Thompson Creek (2014 through 2018).

3.2.1 Biological and Physical Habitat Conditions

Benthic macroinvertebrate (BMI) and algae samples were collected during the spring season and evaluated as indicators for biological condition. BMI results were interpreted using the California Stream Condition Index (CSCI) (Mazor 2015). Algae results were interpreted using the hybrid Algae Stream Condition Index (ASCI), which integrates soft-bodied algae and diatom metrics (Theroux et al. in prep). The CSCI, ASCI and qualitative score for physical habitat condition (PHAB) at each site are presented in Table 2. Methods for calculating both indices for biological condition and Total PHAB are described in SCVURPPP 2019.

Table 2. Biological condition scores for bioassessment sites sampled in Lower Silver-Thompson Creek (2014 – 2018). Sites are ordered in upstream to downstream direction (from top to bottom of the table).

Station ID	Sampling Date	Elev. (m)	Flow Regime[1]	Benthic Macroinvertebrates		Algae	
				CSCI Score [2]	Condition Category	ASCI Hybrid Score	Condition Category
205R03825	5/1/2018	157	I	0.43	Very Likely Altered	0.64	Very Likely Altered
205R00915	4/24/2014	59	I	0.43	Very Likely Altered	0.68	Very Likely Altered
205R02771	6/3/2016	34	P	0.49	Very Likely Altered	0.49	Very Likely Altered
205R01747	5/18/2015	31	P	0.37	Very Likely Altered	0.56	Very Likely Altered
205R00979	4/24/2014	30	P	0.46	Very Likely Altered	0.78	Likely Altered
205R03795	5/30/2018	25	P	0.40	Very Likely Altered	0.61	Very Likely Altered

[1] Flow Regime: I = Intermittent; P = Perennial

[2] A CSCI score below 0.795 is appropriate for a Stressor Source Identification project as defined in MRP Provision C.8.e.

As shown in Table 2, the CSCI scores were relatively consistent across sites, ranging from 0.37 to 0.49. The ASCI hybrid score varied more, ranging from 0.49 to 0.78. All six bioassessment sites were in the Very Likely Altered or Likely Altered condition category for both CSCI and ASCI Hybrid Indices. Furthermore, all sites had a CSCI score below 0.795. MRP Provision C.8.d(8) states that sites with a CSCI score below 0.795 are considered appropriate for a SSID project.

Selected physical habitat variables measured at the six bioassessments sites in Lower Silver – Thompson Creek are summarized in Table 3. The Physical Habitat (PHAB) Assessment score consists of three attributes that are assessed for the entire bioassessment reach. These include channel alteration, epifaunal substrate, and sediment deposition. Each attribute is individually scored on a scale of 0 to 20, with a score of 20 representing good condition. The total PHAB score is the sum of three individual attribute scores with a score of 60 representing the highest possible score. The most highest elevation site had a total score of 41. The five remaining monitoring sites had PHAB scores ranging from 15 to 27.

Physical habitat endpoints (or metrics) were obtained using the SWAMP Bioassessment Reporting Module (SWAMP RM), which calculates metrics using reach-scale averages of transect-based measurements and observations. Three of the calculated metrics are shown in Table 3. The habitat metric scores indicate that most of the sites are deep with slow moving habitat (e.g, pools and glides), resulting in relatively high depsotion of sand and fine substrate.

Table 3. Physical habitat and landscape data for bioassessment sites sampled in Lower Silver-Thompson Creek (2014 – 2018). Sites are ordered in upstream to downstream direction (from top to bottom of the table

Station ID	Qualitative Physical Habitat Assessment				Quantitative Habitat Metric Score			Landscape
	Channel Alteration Score	Epifaunal Substrate Score	Sediment Deposition Score	Total Score[1]	Wetted Width to Depth Ratio	Slow Water Habitat (%)	Substrate Smaller than Sand (%)	Watershed Impervious area (%)
205R03825	18	10	13	41	34	60	50	6
205R00915	9	4	3	16	52	90	26	16
205R02771	5	9	10	24	29	86	39	21
205R01747	5	9	13	27	26	98	66	23
205R00979	4	2	16	22	29	88	7	24
205R03795	4	7	4	15	16	100	77	25

[1] Total PHAB score is the sum of three individual attribute scores.

Land use and transportation data layers were overlayed with the drainage areas to calculate landscape variables, such as percent impervious area in the area draining to the bioassessment location. With the exception of the highest elevation site (205R03825) which had a 6% impervious area, the bioassessment locations had relatively high percent impervious area, ranging from 16% to 25% (Table 3).

3.2.2 Nutrient Data

Water samples were collected during spring season at all CSM bioassessment locations and analyzed for nutrients. The total nitrogen and total phosphorus concentrations ranged from 1.8 to 8.2 mg/L and <.001 to 0.2 mg/L, respectively, across all sites (Table 4). Un-ionized ammonia concentrations are also presented in Table 34

Table 4. Nutrient concentrations measured at six bioassessment sites.

Project	Station ID	Sampling Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Un-ionized Ammonia (ug/L)
Creek Status Monitoring	205R03825	5/1/2018	1.8	0.05	0.6
	205R00915	4/24/2014	2.2	0.20	2.4
	205R02771	6/3/2016	4.5	0.08	4.1
	205R01747	5/18/2015	3.4	0.13	8.3
	205R00979	4/24/2014	3.9	0.09	3.2
	205R03795	5/30/2018	8.2	< 0.01	8.7

Water samples collected as part of POC monitoring during wet and spring seasons at three locations in Lower Silver-Thompson Creek were also analyzed for nutrients. Two of the POC stations were located at previously sampled CSM bioassessment stations. The total nitrogen and total phosphorus concentrations ranged from 3.3 to 5.8 mg/L and .051 to 0.88 mg/L, respectively, across all sites and samples (Table 5). Total nitrogen concentrations in samples collected in the spring season were slightly higher than concentrations in samples collected in the wet season. In contrast, total phosphorus concentrations in the "wet season" samples were higher than those in the "spring season" samples.

Table 5. Nutrient concentrations measured at POC sites.

Project	POCM Station ID	CSM Station ID	Sampling Date	Total Nitrogen (mg/L)	Total Phosphorus (mg/L)	Unionized Ammonia (ug/L)
Pollutant of Concern Monitoring	205COY205[1]	205R00915	1/09/2017	4.6	0.43	2.2
	205COY185	205R02771	1/09/2017	3.4	0.87	1.6
			6/01/2017	4.9	0.1	7.3
	205COY180	NA	1/09/2017	3.3	0.88	1.6
			6/01/2017	5.6	.051	6.7

[1] Sample was not collected during the dry season due to no flow.

An evaluation of existing nutrient concentration data collected in rivers and streams at different trophic states within the United States identified threshold concentrations for total nitrogen and total phosphorus in eutrophic conditions to be 1.5 mg/L and 0.75 mg/L, respectively (Dobbs and Smith 2016). All Lower Silver-Thompson Creek total nitrogen concentrations exceeded the threshold. Phosporus concentrations were below the threshold except two samples from separate POC locations collected during the wet season (See Table 5).

The data evaluation by Dobbs and Smith (2016) also found a strong statistical link between total nitrogen and total phosphorus and benthic algal biomass. Furthermore, they found strong evidence that anthropogenic sources of nitrogen and phosphorus have a large influence on eutrophication-related water quality in rivers and streams.

3.2.3 Eutrophication Indicator Data

The benthic algae samples collected during the spring CSM bioassessments were analyzed for biomass indicators, including ash free dry mass (AFDM) and chlorophyll a (Table 6). In addition, the relative amount of macroalgae cover at each site was estimated during pebble counts as part of the physical habitat condition assessment. These measurements are used as indicators of organic matter accumulation, which is one of the symptoms of eutrophication.

Temperature, dissolved oxygen, and pH readings were also taken from water quality grab samples collected during the bioassessments (Table 6). Reduced concentrations of dissolved oxygen (DO) are another indicator of eutrophication. While the grab sample results are presented in Table 6, it's important to mention that continuous water quality readings are more suitable to understand diurnal fluctuations in temperature and dissolved oxygen and therefore necessary for understanding eutrophication.

Table 6. Eutrophication indicator data measured at CSM bioassessment sites in Lower Silver-Thompson Creek between 2014 and 2018.

Station ID	Sampling Date	Water Temperature C	Dissolved Oxygen (mg/L)	pH	Ash Free Dry Mass (g/m^2)	Chlorophyll a (mg/m^2)	Macroalgae Cover (%)
205R03825	5/1/2018	14	8.5	8.12	135	96	33
205R00915	4/24/2014	15	7.2	8.07	224	47	10
205R02771	6/3/2016	21	9.0	8.08	736	123	34
205R01747	5/18/2015	17	9.9	8.15	350	3	28
205R00979	4/24/2014	18	13.3	8.09	1034	137	32
205R03795	5/30/2018	20	7.7	7.45	305	89	50

The data in Table 6 do not show a consistent pattern between the various eutrophication indicators. For example, there was no association between chlorophyll a or AFDM with percent macroalgae cover. The data also do not indicate a consistent pattern along the creek (upstream to downstream) (Figure 3).

Dobbs and Smith (2016) identified mean and maximum threshold levels for benthic chlorophyll a concentrations for rivers and streams in eutrophic conditions as 70 mg/m^2 and 200 mg/m^2, respectively. Chlorophyl a concentrations in samples from four of the six CSM bioassessment sites in Lower Silver-Thompson Creek exceeded the mean threshold concentration but all concentrations were below the maximum threshold for chlorophyll a. It is important to note, however, that biomass concentrations were measured during spring season and not during the dry season, when sunlight, temperature and flow conditions may be more conducive to the development of eutrophic conditions.

3.2.4 Association between Eutrophication Indicator Data and Biological Conditions

The biological indicator scores for BMI (CSCI) and algae (ASCI) are plotted for the six bioassessment sites sampled in Lower Silver-Thompson Creek in Figure 3. The sites are organized from left to right along the x-axis by decreasing elevation (i.e. from upstream on the left of the x-axis to downstream on the right). The nutrient concentrations and indicators of organic matter accumulation are also presented to allow visual comparison with the biological condition scores.

The CSCI and ASCI hybrid scores for six bioassessment sites are plotted with nutrient concentrations and biomass indicators in Figures 4 and 5. Due to the small number of samples, statistical tests for significance were not conducted. The ASCI hybrid scores show negative association with increasing concentrations of total nitrogen and ammonia, but a positive relationship with total phosphorus. The CSCI scores show very little response to changes in nutrient concentrations. Both the CSCI and ASCI hybrid indices show positive increase with both AFDM and Chl-a as biomass indicators. These data analyses should be interpreted with caution due to the small sample size and the number of factors (e.g., water quality, hydromorphology, etc) that may have confounding influence on biological conditions.

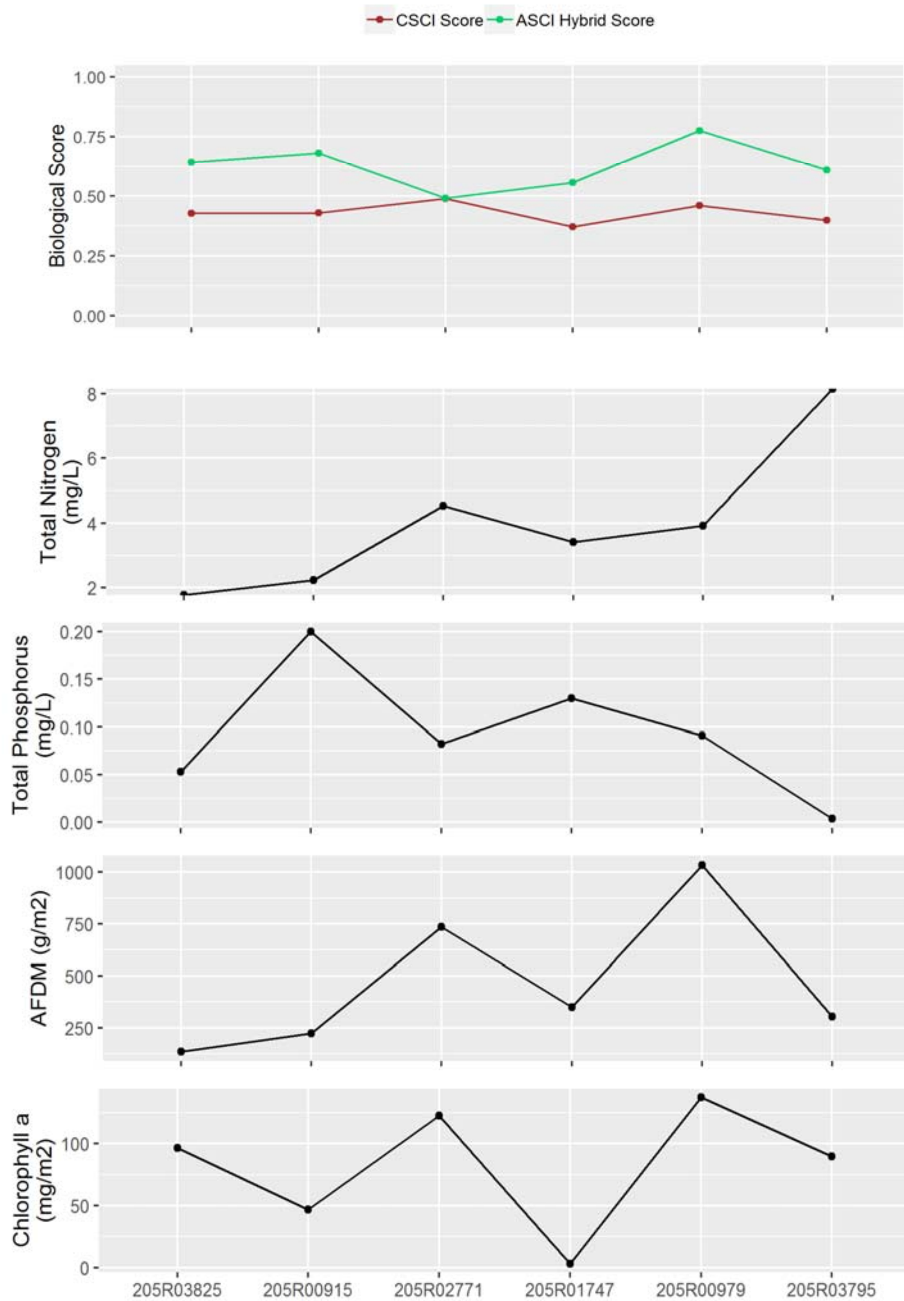

Figure 3. Biological indicator scores, nutrients and biomass indicators for six bioassessment sites in Lower Silver-Thompson Creek (2014-2018). Sites are orders upstream to downstream (right to left).

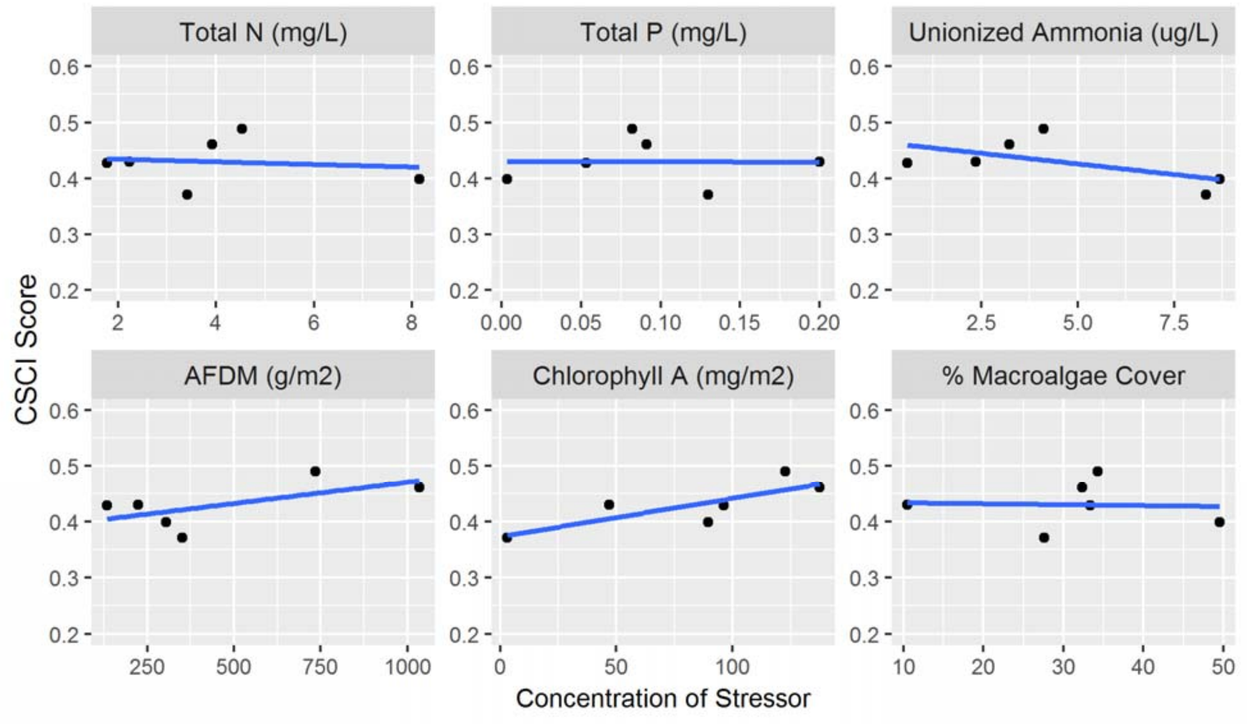

Figure 4. Scatter plots comparing CSCI score with nutrient concentrations (top three plots) and biomass indicators (bottom three plots). Trend lines are indicated, however due to small sample size, statistical test for significance was not conducted.

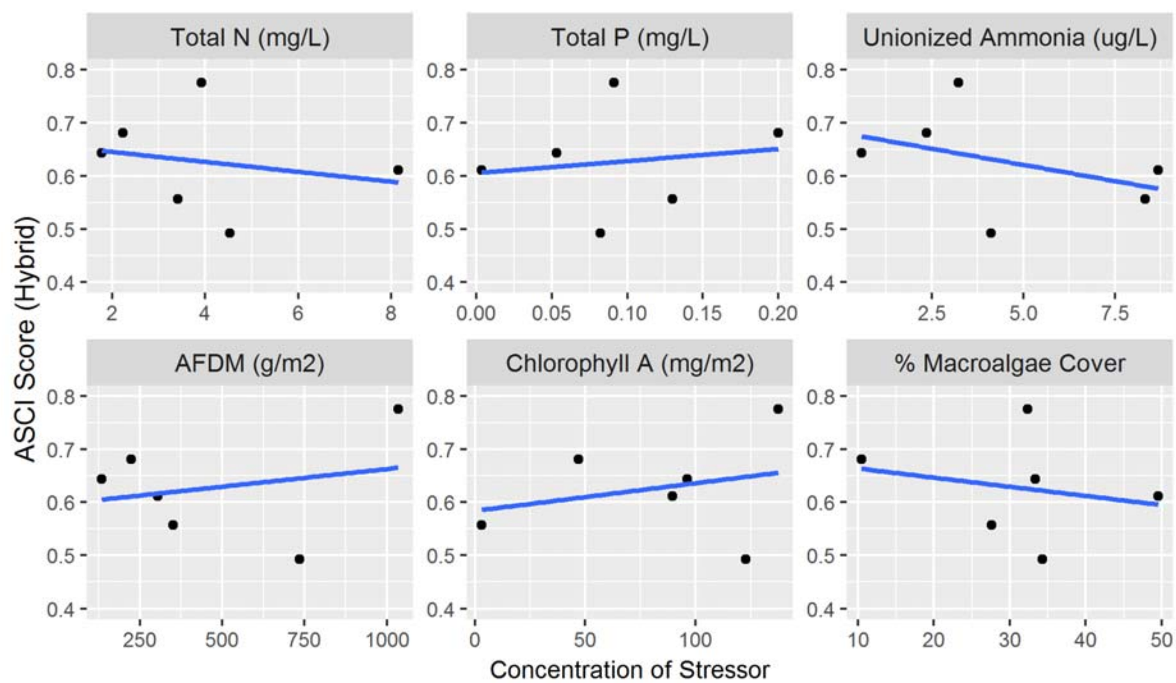

Figure 5. Scatter plots comparing ASCI hybrid score with nutrient concentrations (top three plots) and biomass indicators (bottom three plots). Trend lines are indicated, however due to small sample size, statistical test for significance was not conducted.

3.2.5 Association between Eutrophication Indicators and Physical Habitat

The physical habitat metric scores for wetted width to depth ratio were plotted against macroalgae cover measurements at the six CSM bioassessment sites (Figure 6). The figure indicates that percent algae cover increases with decreasing site depth (relative to width). Other physical habitat metrics and qualitative PHAB scores showed weak correlations with the eutrophication indicators.

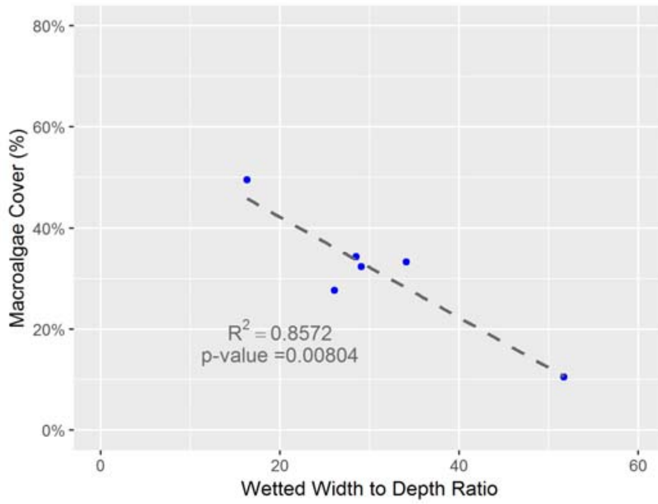

Figure 6. Scatter plots comparing macroalgae cover and wetted width to depth ratio at six bioassessment sites in Lower Silver – Thompson Creek.

3.2.6 Regional Data Comparison

The bioassessment data for the Lower Silver - Thompson Creek dataset were compared to data collected by the Program in other Santa Clara Basin watersheds between WY 2012 and WY 2018. The median CSCI score (0.43) and ASCI hybrid score (0.63) for the six bioassessment sites in Lower Silver-Thompson Creek were generally lower than the median scores for other Santa Clara Basin watersheds (Figures 7 and 8) and the median concentrations for total nitrogen (3.7 mg/L) and total phosphorus (0.087 mg/L) at six sites in Lower Silver-Thompson Creek watershed were higher than median concentrations in other Santa Clara Basin watersheds (Figures 9 and 10).

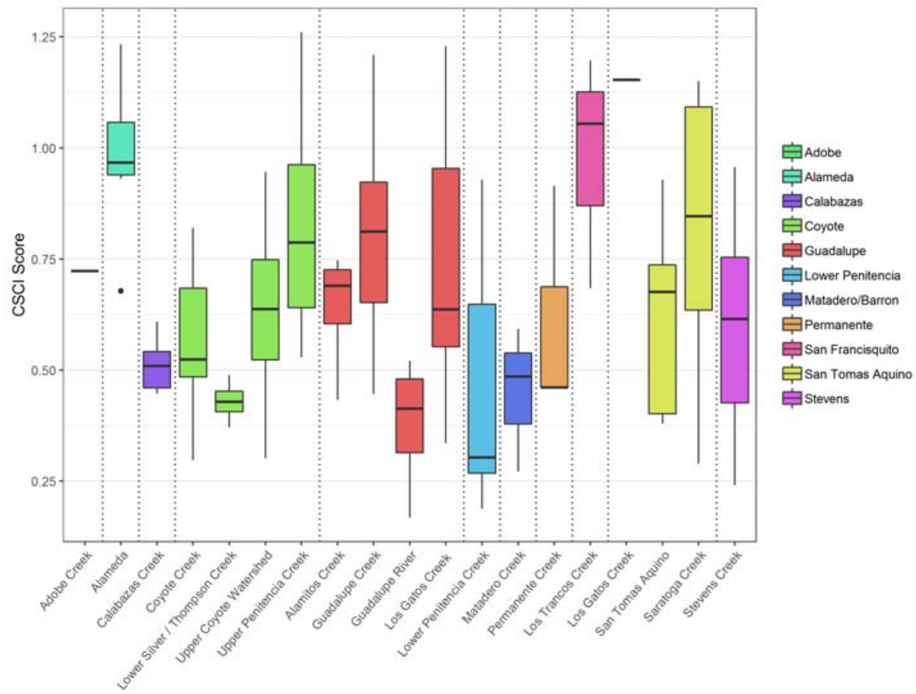

Figure 7. Box plot of CSCI scores for bioassessment sites, grouped by watershed/subwatershed, sampled between 2012 and 2018.

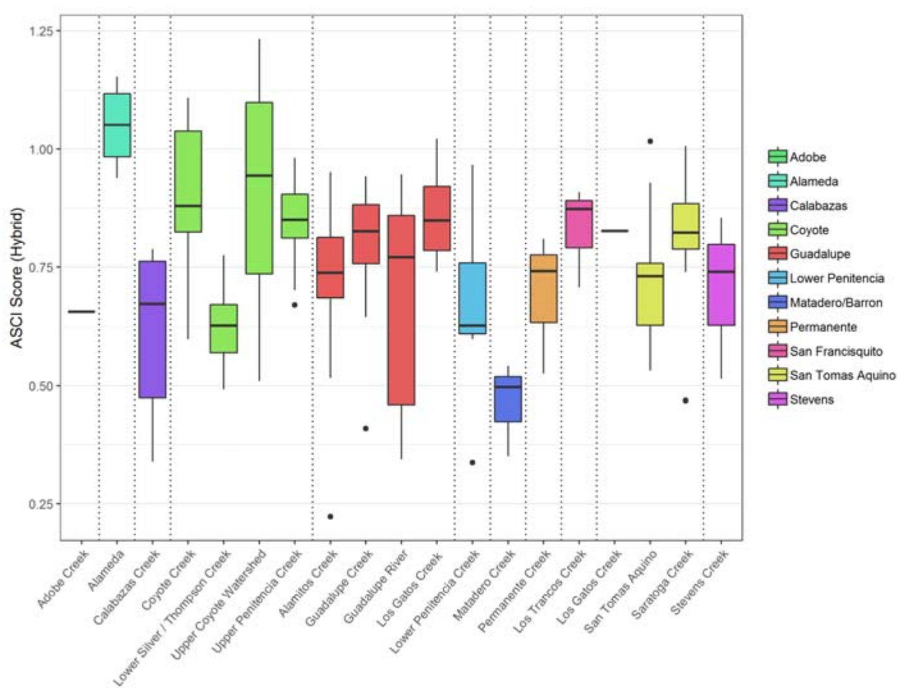

Figure 8. Box plot of ASCI hybrid scores for bioassessment sites, grouped by watershed/subwatershed, sampled between 2012 and 2018.

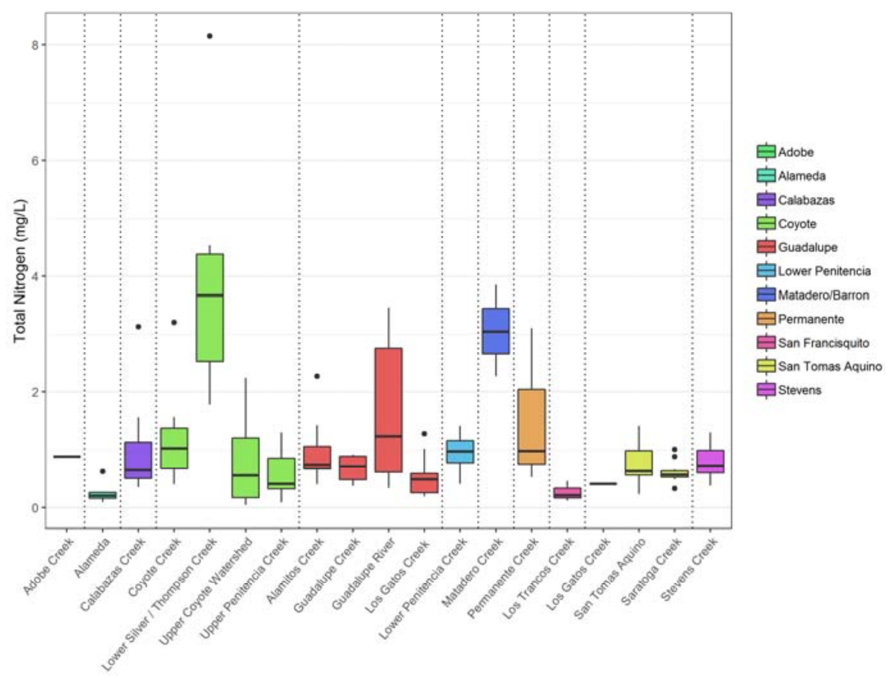

Figure 9. Box plot of total nitrogen concentrations for bioassessment sites, grouped by watershed/subwatershed, sampled between 2012 and 2018.

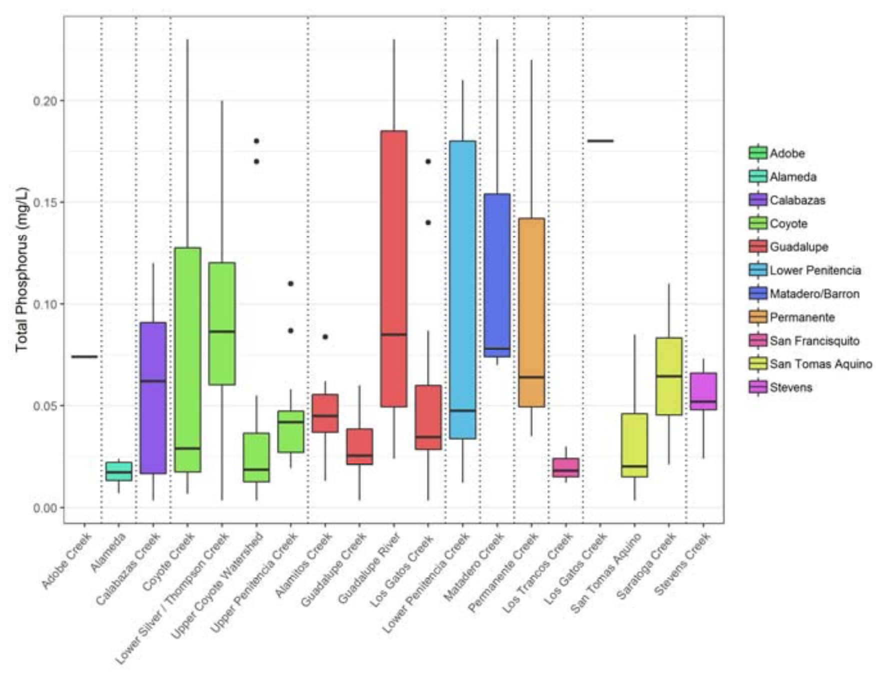

Figure 10. Box plot of total phosphorus concentrations for bioassessment sites, grouped by watershed/subwatershed, sampled between 2012 and 2018.

3.2.7 Data Evaluation for SSID Project

Based on the existing data, the following conclusions were drawn to inform monitoring design of the SSID Project:

Biological Conditions

1. Biological conditions below the MRP threshold (CSCI Score 0.795) indicate a substantially degraded biological community at all six bioassessment sites sampled between 2014 - 2018 in the Lower Silver - Thompson Creek watershed.
2. The median CSCI and ASCI hybrid scores at sites in Lower Silver-Thompson Creek were generally lower than median scores for other Santa Clara Basin watersheds.
3. Consistently low CSCI scores may reflect generally poor habitat conditions within a highly modified creek in an urban watershed. ASCI hybrid scores showed more variability across sites, indicating that other stressors (e.g., water quality, nutrients) may be impacting benthic algae community at some locations.

Stressor Data

1. In general, total nitrogen and un-ionized ammonia concentrations increased across sites in an upstream to downstream direction.
2. Limited wet season samples suggest that concentrations of total phosphorus are higher in the wet season than in the spring season. Spring season total phosphorus concentrations were highest at the Thompson Creek location upstream from Lake Cunningham ; concentrations generally decreased between sample locations along Lower Silver Creek.
3. Nutrient concentrations at most sites in Lower Silver-Thompson Creek are at levels that are associated with eutrophic rivers and streams (Dobbs and Smith, 2016).
4. Biomass indicators (AFDM, chlorophyll a, macroalgae cover) were highly variable among the bioassessment sites, indicating that site conditions (e.g., exposure to sunlight, flow conditions) may be important factors influencing algae production.
5. Biomass indicators were measured during spring season. Sampling was not conducted during the late summer season, when sunlight, temperature and flow conditions may be more conducive to the development of eutrophic conditions.
6. Physical habitat data indicate that a majority of the sites were deep, slow moving, and with a high percentage of sand and fine substrate at the time that data were collected.
7. Continuous water quality data were not available to evaluate as an indicator for eutrophication conditions.

Association of Stressors and Biological Conditions and Physical Habitat

8. Existing data indicate that different stressors may be impacting biological conditions at the different CSM bioassessment sites.
9. Biological indices results (CSCI, ASCI) in the Lower Silver - Thompson Creek watershed do not appear to be correlated to site elevation or flow regime.
10. Shallow physical habitat conditions (lower width to depth ratios) were significantly correlated with percent macroalgae cover.

3.3 Candidate Causes

Based on the available information, the candidate causes, or stressors, for poor biological conditions to be evaluated in the Lower Silver - Thompson Creek SSID Project include:

- Elevated nutrient (N, P) concentrations
- Increase in biomass (algae production)
- Water quality (changes to dissolved oxygen, pH)
- Altered physical habitat and stream flow

The focus of the SSID Project will be on evaluating sources of and impacts from nutrients. However, additional stressors associated with altered physical habitat and water quality will also be assessed. As shown in Figure 11, many of these stressors are interrelated. For example, physical habitat (channel) alteration can lead to increased delivery and/or residence time of nitrogen and phosphorus to the receiving water. And increased algal growth as a result of increased nutrient concentrations in the water can lead to reduced dissolved oxygen concentrations.

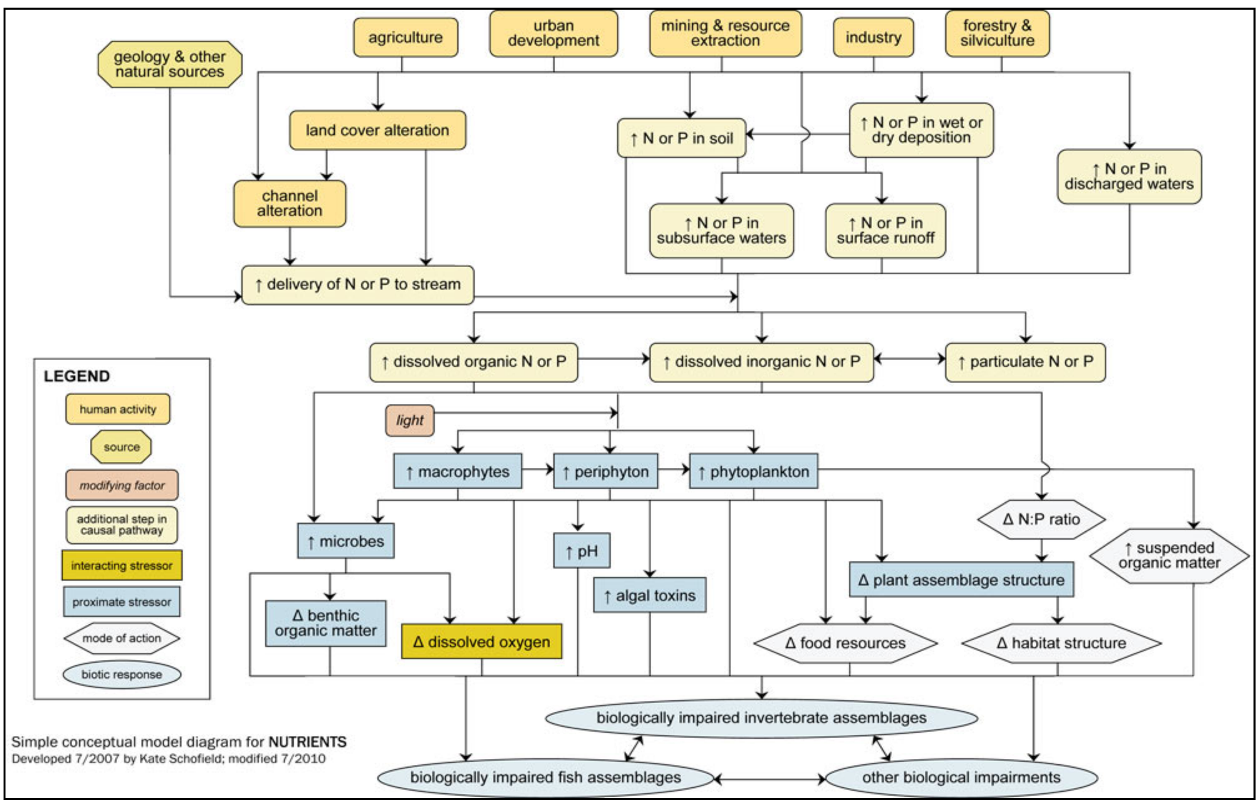

Figure 11. Conceptual model showing different causal pathways for nutrients to impact biological communities.

4 SSID MONITORING APPROACH AND SCHEDULE

The monitoring program described in this section has been designed to collect data in support of the study objectives outlined in Section 2.2 of this work plan. The program will consist of the following field data collection components:

- Nutrient Source Study
- Continuous Water Quality and Temperature Monitoring
- Biological Conditions Evaluation
- Eutrophication Assessment

The proposed schedule for each of these components is presented in Table 7 and the proposed approach is discussed in the sections below. The data will be evaluated to determine potential sources of nutrients in the watershed which can then inform potential management actions to reduce nutrient levels in the Lower Silver – Thompson Creek watershed. The monitoring data will also be evaluated to determine what, if any, correlation may existing between biological conditions and the stressor data (e.g., biomass, low dissolved oxygen).

4.1 Sample Frequency

Field sampling will occur over three seasonal time periods across two water years: dry season (WY 2019), and both spring and dry season (WY 2020) (Table 7). Water chemistry (nutrient) sampling and continuous water quality monitoring will occur during all three seasonal periods. Two nutrient sampling events will occur during both dry seasons, but only one event is planned during the spring season. The first nutrient dry season event will occur at 9 sampling locations; the subsequent sampling events will occur at 6 locations (Table 7). The continuous water quality and temperature monitoring will occur at 3 locations for all sampling periods. The biological assessments will occur at six locations during the spring of WY 2020. Eutrophication assessment will occur at the same six locations during the dry season of 2020.

Table 7. SSID Work Plan Field Data Collection Components and Schedule.

Sampling Timeframe	Water Chemistry (Nutrients)	Continuous Water Quality Monitoring	Continuous Temperature	Biological Conditions Evaluation	Eutrophication Assessment
Dry Season (WY 2019)	9 (2X)	3	3	-	-
Spring Season (WY 2020)	6	3	3	6	-
Dry Season (WY 2020)	6 (2X)	3	3	-	6
Total Samples	30	9	9	6	6

WY = water year .

4.2 Sampling Locations

The nutrient monitoring sites will be established within stream reaches that represent different channel types (flood control, natural) and hydrologic conditions (outfalls, tributary confluences). Proposed study reaches are presented in Table 8. Existing monitoring stations previously sampled by the Program as part of CSM or POC monitoring activities are shown in Figure 12. Potential new monitoring stations are indicated for study reaches above and below Lake Cunningham that do not have existing data (sites T-1 and T-2). All sampling stations will be confirmed following a field reconnaissance to verify that flow conditions are suitable for collecting water samples and/or conducting biological assessments. Additional sites may be added where suspected sources (e.g., outfall discharges) are observed. There may be no sampling locations in the lower section of Thomspon Creek (Quimby Road to Yerba Buena), due to intermittent flow conditions.

Table 8. Proposed study reaches and monitoring locations for Lower Silver – Thompson SSID Project.

Creek	Study Reach	Potential Sample Location ID	Channel Type	Major Tributaries	Number of Outfalls > 36 inch diameter	Potential Nutrient Sources
Lower Silver Creek	Coyote Cr to I-680	3795, 979	Mix of Concrete channel and earth levee; flood control project completed 2005	Miguelita Creek	6	Residential; industrial land uses; illegal encampments
	I-680 to Cunningham Ave	2771, 467	Earth levee; flood control project completed 2017	Babb Cr	4	Residential
	Cunningham Ave to Tully Rd	T-1	Channel adjacent to Lake Cunningham; earth levee; flood prone area with mature riparian forest	Flint Creek; Ruby Creek	2	Lake Cunninham (overflow; groundwater)
	Tully Rd to Quimby Rd	T-2	Wetland type channel; sediment depositional area	Norwood Cr	3	Depositional Area/wetland
Thompson Creek	Quimby Rd to Yerba Buena Rd	915	Intermittent; incised with eroding banks;	Quimby Cr; Evergreen Cr	3	Residential/ Commercial
	Yerba Buena Rd to Silver Creek Rd	4418	Mostly flowing; meandering channel, narrow riparian buffer	Yerba Buena Cr, Cribari Cr	2	Residential; Golf Course
	Upstream Silver Creek Rd	4537	Rangeland	Dry Creek	0	Agriculture and range land

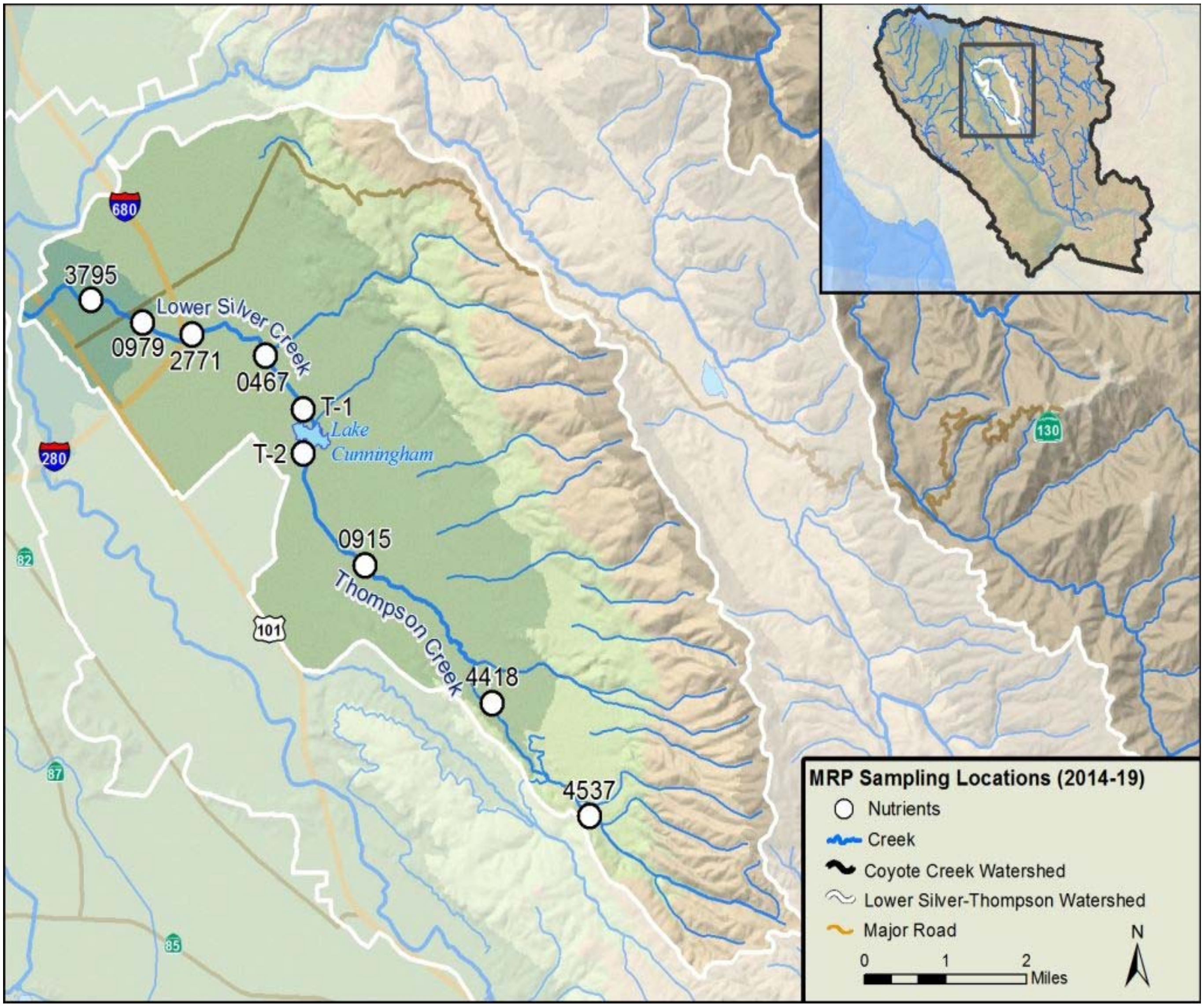

Figure 12. Proposed locations for water sampling and benthos/habitat assessment in Lower Silver-Thompson Creek.

4.3 Field Methods

4.3.1 Water Chemistry (nutrients)

Water samples will be collected at sites for nutrients and conventional analytes using the Standard Grab Sample Collection Method (BASMAA 2016a). Sample containers are rinsed using ambient water and completely filled and recapped below water surface whenever possible. An intermediate container is used to collect water for all sample containers with preservative already added in advance by the laboratory. A syringe filtration method is used to collect samples for analyses of Dissolved Ortho-Phosphate and Dissolved Organic Carbon. All sample containers will be labeled and stored on ice for transportation to laboratory.

4.3.2 Continuous Water Quality and Temperature Monitoring

Water quality monitoring equipment recording dissolved oxygen, temperature, conductivity, and pH at 15-minute intervals (YSI 6600 data sondes) will be deployed for 7-10 day period during each sampling event. Procedures used for calibrating, deploying, programming and downloading data are described in BASMAA (2016a).

Digital temperature loggers (Onset HOBO Water Temp Pro V2) will be programmed to record data at 60-minute intervals. The loggers will have pressure transducers to record water depths at same intervals as temperature data. Procedures used for calibrating, deploying, programming and downloading data are described in BASMAA (2016a).

4.3.3 Biological Conditions Evaluation

Each bioassessment sampling site will consist of an approximately 150-meter stream reach that will be divided into 11 equidistant transects placed perpendicular to the direction of flow. Benthic macroinvertebrate (BMI) and algae samples will be collected at 11 evenly spaced transects using the Reachwide Benthos (RWB) method described in the SWAMP SOP (Ode et al. 2016). The full suite of physical habitat data will be collected within the sample reach.

Biological samples will be sent to laboratories for analysis. The laboratory analytical methods for BMIs will follow Woodward et al. (2012), using the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) 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 will be analyzed following SWAMP protocols (Stancheva et al. 2015).

4.3.4 Eutrophication Assessment

The eutrophication assessment will include two components. The first component will be to conduct field reconnaissance at each of the study reaches to determine if eutrophic conditions are present (e.g., evidence of algal blooms, fish kills). A hand-held sonde will be used to take grab samples to measure water quality conditions. Sites of algal blooms and/or fish kills will be recorded on a map.

The second component will include a modified bioassessment method that includes only the collection of benthic algae and a physical habitat assessment (Ode et al. 2016). The benthic algae samples will be sent to laboratories for analysis of taxonomic composition and ash free dry mass and chlorophyll a.

4.4 Testing and Analytical Methods

Water chemistry samples will be analyzed using the methods and reporting limits shown in Table 9.

Table 9. Analytical constituents, methods and reporting limits used for water and biogical samples collected for the Lower Silver-Thompson Creek SSID Project.

Analyte	Method	CalTest MRL	Units
Water			
Phosphorus, Total	SM 4500-PE	0.01	mg/L
Orthophosphate as Phosphorus (dissolved)	SM 4500-PE	0.01	mg/L
Nitrogen, Total Kjeldahl	SM 4500-NH_3 C	0.1	mg/L
Nitrate as Nitrogen	EPA 300.0	0.05	mg/L
Nitrite as Nitrogen	SM4500-NO_2 B	0.005	mg/L
Ammonia as Nitrogen	SM 4500-NH_3 C	0.02	mg/L
Benthic			
Benthic Macroinvertebrates	SWAMP Bioassessment SOP (2016)	Not specified	
Benthic Algae			
Chlorophyll a	SM 10200 H-2b	5	mg/L
Ash Free Dry Weight	CALTEST B-AFDW	2	mg/L

4.5 Data Analysis Methods

The BMI and algae data will be used to assess the biological condition (i.e., aquatic life Beneficial Uses) of the sampled reaches using condition index scores described in SCVURPPP (2019). Physical habitat data will be used to characterize physical habitat conditions using a multimetric index scoring tool (SCVURPPP 2019). Physical habitat and water chemistry data will also be evaluated as potential stressors to biological health using triggers and water quality objectives identified in the MRP and existing thresholds from literature (Dobbs et al. 2016, Mazor et al. (in preparation)).

The association of stressors with biological indicator scores will be evaluated using simple regression models. Linear regressions will be tested between variables within each of the stressor data types (e.g., physical habitat and water chemistry) and biological conditions indicators (i.e., CSCI and ASCI scores). Scatter plots showing trend lines will be presented for some of the variables to show positive or negative correlation.

Potential sources of nutrients to the Lower Silver – Thompson creek will be identified using available land use data and observations collected during field work. Relationships between potential sources and nutrient concentrations and biological conditions as well as other physical habitat will be evaluated qualitatively and quantitively, to the extent possible.

4.6 Quality Assurance

Quality Assurance/Quality Control (QA/QC) analyses include levels of precision and accuracy, and tolerable levels of error as presented in detail in the RMC QAPP (BASMAA et al., 2016a). Caltest Laboratories will perform all chemical analyses in accordance with the RMC QAPP and their respective quality assurance programs.

4.7 Reporting

The Program will prepare a Final Report with data results and interpretation as an attachment to the WY 2020 Urban Creeks Monitoring Report, which will be submitted to the Water Board on March 31, 2021.

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