



# Pollutants of Concern Monitoring - Data Report

*Water Year 2016*

*Submitted in compliance with Provision C.8.h.iii of NPDES Permit # CAS612008 (Order No. R2-2015-0049)*

**March 31, 2017**

*This report is submitted by the agencies participating in the*



City of Campbell

City of Cupertino

City of Los Altos

Town of Los Altos Hills

Town of Los Gatos

City of Milpitas

City of Monte Sereno

City of Mountain View

City of Palo Alto

City of San Jose

City of Santa Clara

City of Saratoga

City of Sunnyvale

County of Santa Clara

Santa Clara Valley Water District

*Prepared for:*

**Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)**

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## LIST OF ACRONYMS

BASMAA	Bay Area Stormwater Management Agency Association
BMP	Best Management Practice
CADDIS	Causal Analysis/Diagnosis Decision Information System
CEC	Contaminants of Emerging Concern
CEDEN	California Environmental Data Exchange Network
MRP	Municipal Regional Permit
NPDES	National Pollution Discharge Elimination System
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PFAS	Perfluoroalkyl Sulfonates
PFOS	Perfluorooctane Sulfonates
POC	Pollutant of Concern
RMP	Regional Monitoring Program
RWSM	Regional Watershed Spreadsheet Model
SAP	Sampling and Analysis Plan
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFEI	San Francisco Estuary Institute
SPoT	Statewide Stream Pollutant Trend Monitoring
SSC	Suspended Sediment Concentration
SSID	Stressor/Source Identification
STLS	Small Tributary Loading Strategy
SWAMP	Surface Water Ambient Monitoring Program
TOC	Total Organic Carbon
USEPA	US Environmental Protection Agency
WY	Water Year

# TABLE OF CONTENTS

*LIST OF ACRONYMS* ..... iii

*LIST OF FIGURES*..... v

*LIST OF TABLES*..... v

*LIST OF ATTACHMENTS*..... v

**1.0 INTRODUCTION**..... **1**

    1.1 POC Monitoring Requirements..... 1

    1.2 Third-Party Data ..... 2

**2.0 POC MONITORING RESULTS**..... **4**

    2.1 Statement of Data Quality..... 4

    2.2 PCBs and Mercury ..... 6

        2.2.1 Third Party POC Monitoring in WY 2016 ..... 8

        2.2.2 Comparison with Region-wide Storm Sampling Results..... 8

        2.2.3 WMA Update ..... 11

    2.3 Copper ..... 12

    2.4 Nutrients ..... 12

    2.5 Emerging Contaminants ..... 13

**3.0 COMPARISON TO APPLICABLE WATER QUALITY STANDARDS**..... **14**

**4.0 CONCLUSIONS AND RECOMMENDATIONS**..... **15**

**5.0 REFERENCES** ..... **17**

## LIST OF FIGURES

Figure 1. SCVURPPP and Third-Party POC Monitoring Stations in WY 2016. ....	5
Figure 2. PCB concentrations for water samples collected in large MS4s in the Bay Area .....	9
Figure 3. PCB particle ratios for water samples collected in large MS4s in the Bay Area .....	10
Figure 4. WMA map of Santa Clara County showing catchments sampled in WY 2016. ....	11

## LIST OF TABLES

Table 1. MRP Provision C.8.f Pollutants of Concern monitoring requirements. ....	3
Table 2. SCVURPPP and Third-Party POC Monitoring Accomplishments in WY 2016. ....	4
Table 3. POC monitoring stations in Santa Clara County, WY 2016. ....	6
Table 4. PCB, mercury, and suspended sediment concentrations in water samples collected by SCVURPPP, WY 2016. ....	7
Table 5. Descriptive statistics of POC water sample concentrations .....	10
Table 6. Total and dissolved copper concentrations in water samples collected by SCVURPPP, WY 2016. ...	12
Table 7. Nutrient concentrations in POC water samples collected by SCVURPPP, WY 2016. ....	13
Table 8. Comparison of WY 2016 Copper Monitoring Data to WQO that Applies to Receiving Water. ....	14

## LIST OF ATTACHMENTS

**Attachment 1.** Quality Assurance/Quality Control Report

## 1.0 INTRODUCTION

This Pollutants of Concern Monitoring - Data Report (POC Data Report) 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) 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 issued by the San Francisco Regional Water Quality Control Board (Regional Water Board) on November 19, 2015 as Order R2-2015-0049. This report fulfills the requirements of Provision C.8.h.iii of the MRP for reporting a summary of MRP provision C.8.f POC Monitoring conducted during Water Year (WY) 2016.<sup>1</sup>

This POC Data Report builds on the POC Monitoring Report that was submitted to the Regional Water Board on October 15, 2016. In accordance with Provision C.8.h.iv, the POC Monitoring Report included POC monitoring locations, number and types of samples collected, purpose of sampling (i.e., Management Questions addressed), and analytes measured (SCVURPPP 2016a). The October 15, 2016 POC Monitoring Report also described the allocation of sampling effort for POC monitoring planned for WY 2017.

This POC Data Report is included as an appendix to the WY 2016 Urban Creeks Monitoring Report (UCMR) which was submitted to the Regional Water Board on March 31, 2017. Consistent with MRP Provision C.8.h.ii, POC monitoring data generated from sampling of receiving waters (e.g., creeks) were submitted to the San Francisco Bay Area Regional Data Center for upload to the California Environmental Data Exchange Network (CEDEN).<sup>2</sup>

### 1.1 POC Monitoring Requirements

Provision C.8.f of the MRP requires monitoring of several POCs including polychlorinated biphenyls (PCBs), mercury, copper, emerging contaminants<sup>3</sup>, and nutrients. POC monitoring is conducted on a Water Year (WY) basis. Provision C.8.f specifies yearly (i.e., WY) and total (i.e., permit term) minimum numbers of samples for each POC. In addition, POC monitoring must address the five priority management information needs (i.e., Management Questions) identified in C.8.f:

1. **Source Identification** – identifying which sources or watershed source areas provide the greatest opportunities for reductions of POCs in urban stormwater runoff;
2. **Contributions to Bay Impairment** – identifying which watershed source areas contribute most to the impairment of San Francisco Bay beneficial uses (due to source intensity and sensitivity of discharge location);
3. **Management Action Effectiveness** – providing support for planning future management actions or evaluating the effectiveness or impacts of existing management actions;

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<sup>1</sup> Most hydrologic monitoring occurs for a period defined as a water year, which begins on October 1 and ends on September 30 of the names year. For example, water year 2016 (WY 2016) began on October 1, 2015 and concluded on September 30, 2016.

<sup>2</sup> CEDEN has historically only accepted and shared data collected in streams, lakes, rivers, and the ocean (i.e., receiving waters). In late-2016, we were notified that there were changes to the types of data that CEDEN would accept and share. However, there is still some uncertainty and until the changes are clarified, SCVURPPP will continue to submit only receiving water data to CEDEN.

<sup>3</sup> Emerging contaminant monitoring requirements will be met through participation in the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) special studies. The special studies will account for relevant Contaminants of Emerging Concern (CECs) in stormwater and will address at least PFOS, PFAS, and alternative flame retardants being used to replace PBDEs.

4. **Loads and Status** – providing information on POC loads, concentrations or presence in local tributaries or urban stormwater discharges; and
5. **Trends** – providing information on trends in POC loading to the Bay and POC concentrations in urban stormwater discharges or local tributaries over time.

The MRP specifies the minimum number of samples for each POC that must address each Management Question. For example, over the first five years of the permit, a minimum of 80 PCBs samples must be collected and analyzed. At least eight PCB samples must be collected each year. By the end of Year 4<sup>4</sup> of the permit term, each of the five Management Questions must be addressed with at least eight PCB samples. It is possible that a single sample can address more than one information need. POC Monitoring requirements are summarized in Table 1.

Other MRP provisions require studies or have information needs that could be addressed through Provision C.8.f (POC Monitoring) and for which related samples will count towards POC monitoring requirements. These other Permit provisions and their associated timelines are listed below.

- Provisions C.11.a.iii and C.12.a.iii require that Permittees provide a list of management areas (referred to in this report as Watershed Management Areas, or WMAs) in which new mercury and PCB control measures will be implemented during the permit term. Progress toward developing the list was reported on April 1, 2016 (SCVURPPP 2016b). A more complete list with identified control measures was provided with the 2016 Annual Report (SCVURPPP 2016c) on September 30, 2016 and will be updated with each subsequent Annual Report per Provision C.11.a.iii(3). Provision C.8.f (POCs Monitoring) supports C.11.a/12.a requirements by requiring monitoring directed toward source identification (i.e., identifying which WMAs provide the greatest opportunities for implementing controls to reduce loads of POCs in urban stormwater runoff and source areas within the WMAs).
- Provision C.12.e requires that Permittees collect at least 20 composite samples (region-wide) of the caulks and sealants used in storm drains or roadway infrastructure in public rights-of-way. Results of the investigation must be reported with the 2018 Annual Report, due by September 30, 2018. SCVURPPP is participating in a Bay Area Stormwater Management Agencies Association (BASMAA) regional project to address this requirement. Development of the monitoring plan is anticipated in 2017 with implementation in Fiscal Year 2017/18.

## 1.2 Third-Party Data

SCVURPPP strives to work collaboratively with our water quality monitoring partners to find mutually beneficial monitoring approaches. Provision C.8.a.iii of the MRP allows Permittees to use data collected by third-party organizations to fulfill monitoring requirements, provided the data are demonstrated to meet the required data quality objectives. For example, samples collected in Santa Clara County through the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP) and the State's Stream Pollution Trends (SPoT) Monitoring Program may supplement the Program's efforts towards achieving Provision C.8.f monitoring requirements. Third party monitoring conducted by the RMP and SPoT also provide context for reviewing and interpreting SCVURPPP monitoring results.

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<sup>4</sup> Note that the minimum sampling requirements addressing information needs must be completed by the end of year four of the permit (i.e., WY 2019); whereas, the minimum number of total samples does not need to be met until the end of year five of the permit (i.e., WY 2020).

**Table 1.** MRP Provision C.8.f Pollutants of Concern monitoring requirements.

Pollutant of Concern	Media	Total Samples by the End of Year Five <sup>d</sup>	Yearly Minimum	Minimum # of Samples that Must be Collected for Each Information Need by the End of Year Four				
				Source Identification	Contributions to Bay Impairment	Management Action Effectiveness	Loads and Status	Trends
PCBs	Water or sediment	80	8	8	8	8	8	8
Total Mercury	Water or sediment	80	8	8	8	8	8	8
Total & Dissolved Copper	Water	20	2	--	--	--	4	4
Nutrients <sup>a</sup>	Water	20	2	--	--	--	20	--
Emerging Contaminants <sup>b</sup>	--	--	--	--	--	--	--	--
Ancillary Parameters <sup>c</sup>	--	--	--	--	--	--	--	--

<sup>a</sup>. Ammonium<sup>5</sup>, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, total phosphorus (analyzed concurrently in each nutrient sample).

<sup>b</sup>. Must include perfluorooctane sulfonates (PFOS, in sediment), perfluoroalkyl sulfonates (PFAS, in sediment), alternative flame retardants. The Permittee shall conduct or cause to be conducted a special study that addresses relevant management information needs for emerging contaminants. The special study must account for relevant CECs in stormwater and would address at least PFOS, PFAS, and alternative flame retardants being used to replace PBDEs.

<sup>c</sup>. Total Organic Carbon (TOC) should be collected concurrently with PCBs data when normalization to TOC is deemed appropriate. Suspended sediment concentration (SSC) should be collected in water samples used to assess loads, loading trends, or BMP effectiveness. Hardness data are used in conjunction with copper concentrations collected in fresh water.

<sup>d</sup>. Total samples that must be collected over the five-year Permit term.

<sup>5</sup> There are several challenges to collecting samples for “ammonium” analysis. Therefore, samples will be analyzed for total ammonia which is the sum of un-ionized ammonia (NH<sub>3</sub>) and ionized ammonia (ammonium, NH<sub>4</sub><sup>+</sup>). Ammonium concentrations will be calculated by subtracting the calculated concentration of un-ionized ammonia from the measured concentration of total ammonia. Un-ionized ammonia concentrations will be calculated using a formula provided by the American Fisheries Society that includes field pH, field temperature, and specific conductance. This approach was approved by Regional Water Board staff in an email dated June 21, 2016.

## 2.0 POC MONITORING RESULTS

In compliance with Provision C.8.f of the MRP, the Program conducted POC monitoring in WY 2016 for PCBs, mercury, copper, and nutrients. Monitoring for PCBs, mercury, and copper was conducted in accordance with the SCVURPPP WY 2016 POC Sampling and Analysis Plan (SAP; SCVURPPP 2015a) which describes monitoring goals, methods, and quality assurance/quality control (QA/QC) procedures. The MRP-required yearly minimum number of samples was met or exceeded for all POCs. The total number of samples collected for each POC, the agency conducting the monitoring, and the Management Questions addressed are listed in Table 2. Specific monitoring stations are listed in Table 3 and illustrated in Figure 1. The sections below describe the results of the monitoring accomplished in WY 2016. Compliance with applicable water quality standards is described in Section 3.0.

### 2.1 Statement of Data Quality

A comprehensive QA/QC program was implemented by SCVURPPP covering all aspects of POC monitoring. Monitoring for PCBs, mercury, copper, and nutrients was performed according to protocols specified or referenced in the WY 2016 POC SAP (SCVURPPP 2015a). The Monitoring Plan references the CW4CB Quality Assurance Project Plan (QAPP; AMS 2012) as the basis for (QA/QC) procedures.

Overall, the results of the QA/QC review suggest that the POC monitoring data generated during WY 2016 were of sufficient quality. Although, some data were flagged in the project database, none were rejected. Details of the QA/QC review are provided in Attachment 1.

**Table 2.** SCVURPPP and Third-Party POC Monitoring Accomplishments in WY 2016.

Pollutant of Concern/ Agency	Number of Samples (WY 2016)	Management Question Addressed <sup>a</sup>					Sample Type and Comments
		1. Source Identification	2. Contributions to Bay Impairment	3. Management Action Effectiveness	4. Loads and Status	5. Trends	
<b>PCBs &amp; Mercury</b>							
SCVURPPP	9	9	9	--	9	--	Stormwater runoff samples to characterize high interest catchments
RMP STLS	6	6	6	--	6	--	Stormwater runoff samples to characterize high interest catchments
<b>Copper</b>							
SCVURPPP	4	--	--	--	4	--	Copper analyzed on a subset of PCBs/Hg stormwater runoff samples
<b>Nutrients</b>							
SCVURPPP	2	--	--	--	2	--	Water samples collected from SSID study stations

<sup>a</sup>. Individual samples can address more than one Management Question simultaneously.

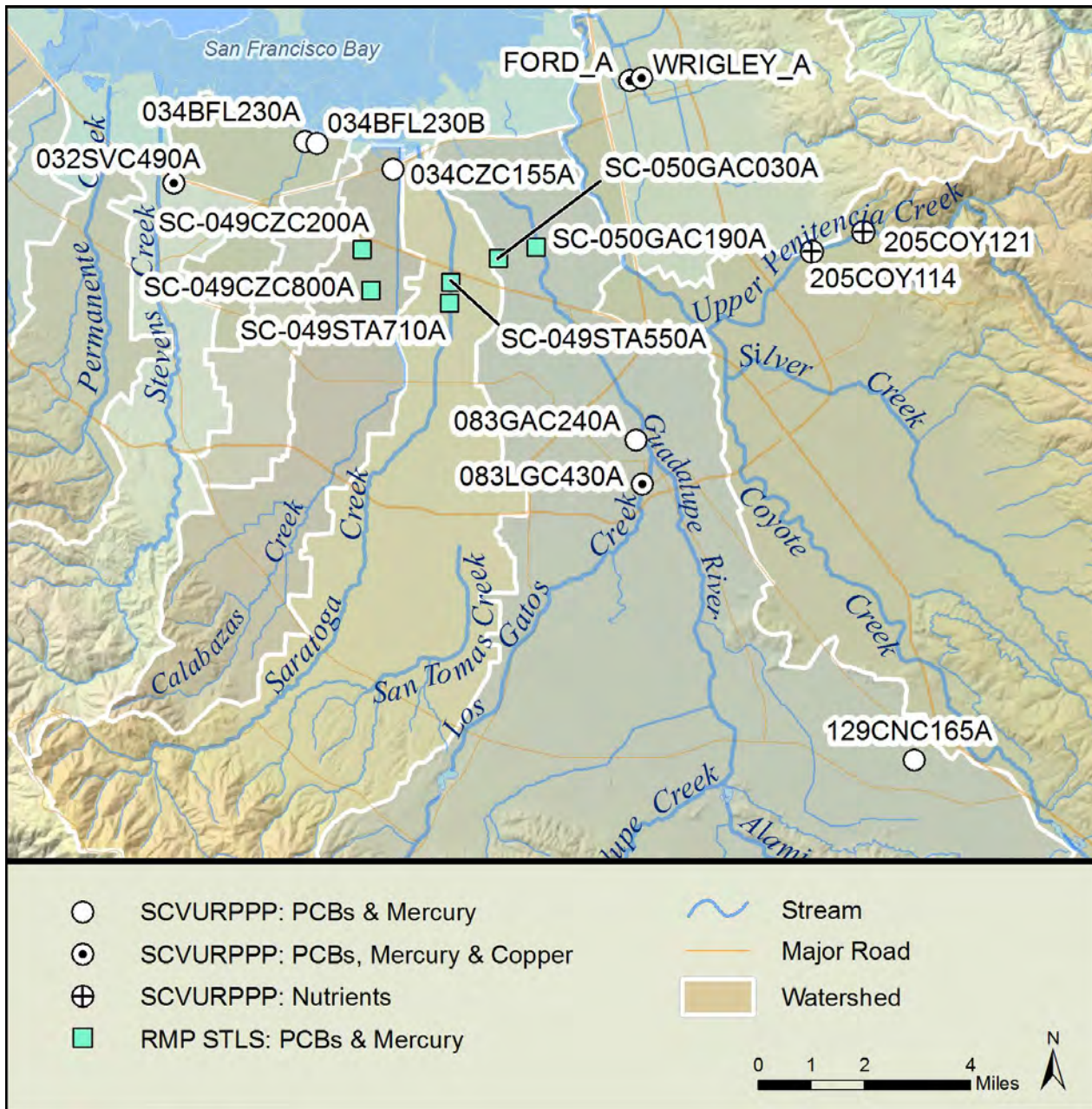


Figure 1. SCVURPPP and Third-Party POC Monitoring Stations in WY 2016.

**Table 3.** POC monitoring stations in Santa Clara County, WY 2016.

Agency	Station Code	Sample Date	Latitude	Longitude	Matrix	PCBs	Mercury	Suspended Sediment Concentration	Total Copper	Dissolved Copper	Hardness as CaCO3	Nutrients <sup>b</sup>
SCVURPPP	032SVC490A	1/5/2016	37.4058	-122.0639	water	x	x	x	x	x	x	
SCVURPPP	083LGC430A	1/19/2016	37.3257	-121.9019	water	x	x	x	x	x	x	
SCVURPPP	FORD_A	1/17/2016	37.4358	-121.9066	water	x	x	x	x	x	x	
SCVURPPP	WRIGLEY_A	1/17/2016	37.4358	-121.9065	water	x	x	x	x	x	x	
SCVURPPP	034BFL230A	3/5/2016	37.4177	-122.0191	water	x	x	x				
SCVURPPP	034BFL230B	3/5/2016	37.4172	-122.0163	water	x	x	x				
SCVURPPP	034CZC155A	1/17/2016	37.4106	-121.989	water	x	x	x				
SCVURPPP	083GAC240A	3/11/2016	37.3376	-121.9042	water	x	x	x				
SCVURPPP	129CNC165A	1/6/2016	37.2514	-121.8075	water	x	x	x				
RMP STLS	SC-049CZC800 (049CZC800A)	(a)	37.3774	-121.9957	water	x	x	x				
RMP STLS	SC-049STA550 (049STA550A)	(a)	37.3799	-121.9684	water	x	x	x				
RMP STLS	SC-049CZC200 (049CZC200A)	(a)	37.3885	-121.999	water	x	x	x				
RMP STLS	SC-050GAC030 (050GAC030A)	(a)	37.3866	-121.9522	water	x	x	x				
RMP STLS	SC-049STA710 (049STA710A)	(a)	37.3742	-121.9687	water	x	x	x				
RMP STLS	SC-050GAC190 (050GAC19A)	(a)	37.3899	-121.9395	water	x	x	x				
SCVURPPP	205COY114	6/9/2016	37.3898	-121.8449	water							x
SCVURPPP	205COY121	6/9/2016	37.3953	-121.8275	water							x

a. Specific sample dates have not yet been provided by the RMP STLS.

b. Ammonia (for ammonium), nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus are analyzed concurrently in each nutrient sample.

## 2.2 PCBs and Mercury

During WY 2016, the Program collected nine<sup>6</sup> samples for PCBs and mercury analysis. An additional six samples were collected in Santa Clara County through the RMP's Small Tributary Loading Strategy (STLS). These combined 15 samples address POC Management Questions #1 (Source Identification) and #2 (Contributions to Bay Impairment). Data will also be used to improve calibration of the Regional Watershed Spreadsheet Model (RWSM) which is a land use based planning tool for estimation of overall POC loads from small tributaries to San Francisco Bay at a regional scale (i.e.,

<sup>6</sup> The Program had planned to collect up to 25 samples in WY 2016; however, a lack of rainfall in the study area relative to the rest of the Bay Area limited monitoring opportunities. The industrial areas of Santa Clara County are located in the rain shadow of the Santa Cruz Mountains.

## Management Question #4 – Loads and Status).

PCBs and mercury monitoring by the Program in WY 2016 was conducted in accordance with the *Water Year 2016 Pollutant of Concern Monitoring - Sampling and Analysis Plan* (SCVURPPP 2015a). The primary goal of the monitoring, as described in the SAP, is to provide information to identify Watershed Management Areas (WMAs) where control measures could be implemented to comply with MRP requirements for load reductions of PCBs and mercury. WY 2016 PCBs and mercury monitoring was focused on collection of storm composite samples from high interest WMAs that may contain PCB and/or mercury source properties. High interest WMAs were identified and prioritized for sampling by evaluating several types of data, including: PCBs and mercury concentrations from prior sediment and water sampling efforts, land use data showing old industrial parcels, municipal storm drain data showing pipelines and access points (e.g., manholes, outfalls, pump stations), catchment areas delineated from municipal storm drain data, and logistical/safety considerations (SCVURPPP 2015b).

Composite samples consisting of six to eight aliquots collected during the rising limb and peak of the storm hydrograph (as determined through field observations) were analyzed for the “RMP 40” PCB congeners (method EPA 1668C), total mercury (method EPA 1631E), and SSC (method ASTM D3977-97). A subset of the samples was also analyzed for total and dissolved copper (method EPA 200.8) and hardness (method SM 2340C). See Section 2.3 for a discussion of copper results.

Table 4 lists PCBs, mercury, and SSC monitoring results collected by SCVURPPP in WY 2016<sup>7</sup>. “Total PCBs” were calculated as the sum of the RMP 40 congeners. The “PCB Particle Ratio” and “Hg Particle Ratio” is calculated by dividing Total PCBs and Total Mercury by SSC. The PCB Particle Ratio and Hg Particle Ratio addresses the fact that PCBs are generally bound to sediment and is used to compare and rank monitoring stations. A sample that has a relatively low concentration but a high particle ratio may be because the storm that was sampled was relatively small, and the rainfall was not enough to mobilize much sediment. A larger storm may mobilize more sediment and PCBs, so catchments with an elevated concentration or particle ratio may be considered for a source investigation.

For the nine samples that were collected by SCVURPPP in WY 2016, mercury concentrations ranged from 4.0 ng/L to 35.7 ng/L and Hg Particle Ratios ranged from 128 ng/g to 962 ng/g. Total PCB concentrations ranged from 0.584 ng/L to 9.04 ng/L and PCB Particle Ratios ranged from 30.1 ng/g to 367 ng/g. Section 2.2.2 describes PCB monitoring results within the context of other water samples analyzed for PCBs in Santa Clara County and region-wide.

**Table 4.** PCB, mercury, and suspended sediment concentrations in water samples collected by SCVURPPP, WY 2016.

Station Code	Sample Date	SSC (mg/L)	Total PCBs (ng/L) <sup>a</sup>	PCB Particle Ratio (ng/g) <sup>b</sup>	Hg (ng/L)	Hg Particle Ratio (ng/g) <sup>b</sup>
032SVC490A	1/5/2016	38.4	1.75	45.6	7.7	201
034BFL230A	3/5/2016	19.4	0.584	30.1	4.0	206
034BFL230B	3/5/2016	24.6	9.04	367	8.0	325
034CZC155A	1/17/2016	25.3	2.76	109	3.9	154
083GAC240A	3/11/2016	70.2	2.72	38.7	20	286
083LGC430A	1/19/2016	37.1	5.38	145	36	962
129CNC165A	1/6/2016	57.9	2.14	37.0	20	342
FORD_A	1/17/2016	43.8	1.92	43.8	5.6	128
WRIGLEY_A	1/17/2016	26.1	2.63	101	5.0	192

<sup>a</sup> Total PCBs calculated as sum of RMP 40 congeners.

<sup>b</sup> PCB and Hg Particle Ratios calculated by dividing Total PCBs and Hg concentrations by SSC.

<sup>7</sup> RMP STLS results are reported separately by the San Francisco Estuary Institute (SFEI).

### 2.2.1 Third Party POC Monitoring in WY 2016

The RMP's STLS Team typically conducts annual monitoring for POCs on a region-wide basis. SCVURPPP is an active participant in the STLS and works with other Bay Area municipal stormwater programs to identify opportunities to direct RMP funds and monitoring activities towards meeting both short- and long-term municipal stormwater permit requirements. During WY 2013 – WY 2014 POC monitoring activities by the STLS focused on pollutant loading monitoring at six region-wide stations including two stations in Santa Clara County. In WY 2015, the loading stations were discontinued and STLS monitoring shifted to wet weather characterization in catchments of interest. In WY 2016, the STLS Team continued wet weather characterization sampling using a similar approach to the PCBs and mercury sampling that was implemented by the Program. Six catchments (i.e., six storm composite samples) were sampled for PCBs and mercury by the RMP's STLS in Santa Clara County in WY 2016 and eight catchments were sampled in WY 2015.

### 2.2.2 Comparison with Region-wide Storm Sampling Results

Previous reports prepared by SCVURPPP and other BASMAA RMC partners describe PCB concentrations in *sediment* from samples collected throughout the region (SCVURPPP 2016d). There are over 1,200 region-wide sediment samples that have been analyzed for PCBs. The large sediment dataset was evaluated by the BASMAA RMC to develop the sediment concentration thresholds that have been used to identify WMAs and/or PCB source areas where new PCBs and mercury control measures will be implemented. Although sediment sampling efforts have been and will continue to be very informative in this process, there are some limitations to sediment sampling that can be resolved by collecting storm composite water samples. For example, sediment is not always found at the identified sampling stations. Furthermore, storm composite water samples can integrate POC sources over time and space within a catchment. For these reasons, WY 2016 monitoring focused on storm composite water samples.

Storm composite water sampling presents many source identification opportunities. However, the dataset for water samples is not as large or robust as the sediment sample dataset. Therefore, the BASMAA RMC has not established water concentration or PCB Particle Ratio thresholds for evaluating and categorizing catchments. As a preliminary step towards developing thresholds for water samples, SCVURPPP worked with the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) to review the PCBs monitoring data collected by SCVURPPP and SMCWPPP in WY 2016 with data from water samples collected throughout the region. The analysis includes data from RMP STLS monitoring (Gilbreath et al. 2017).

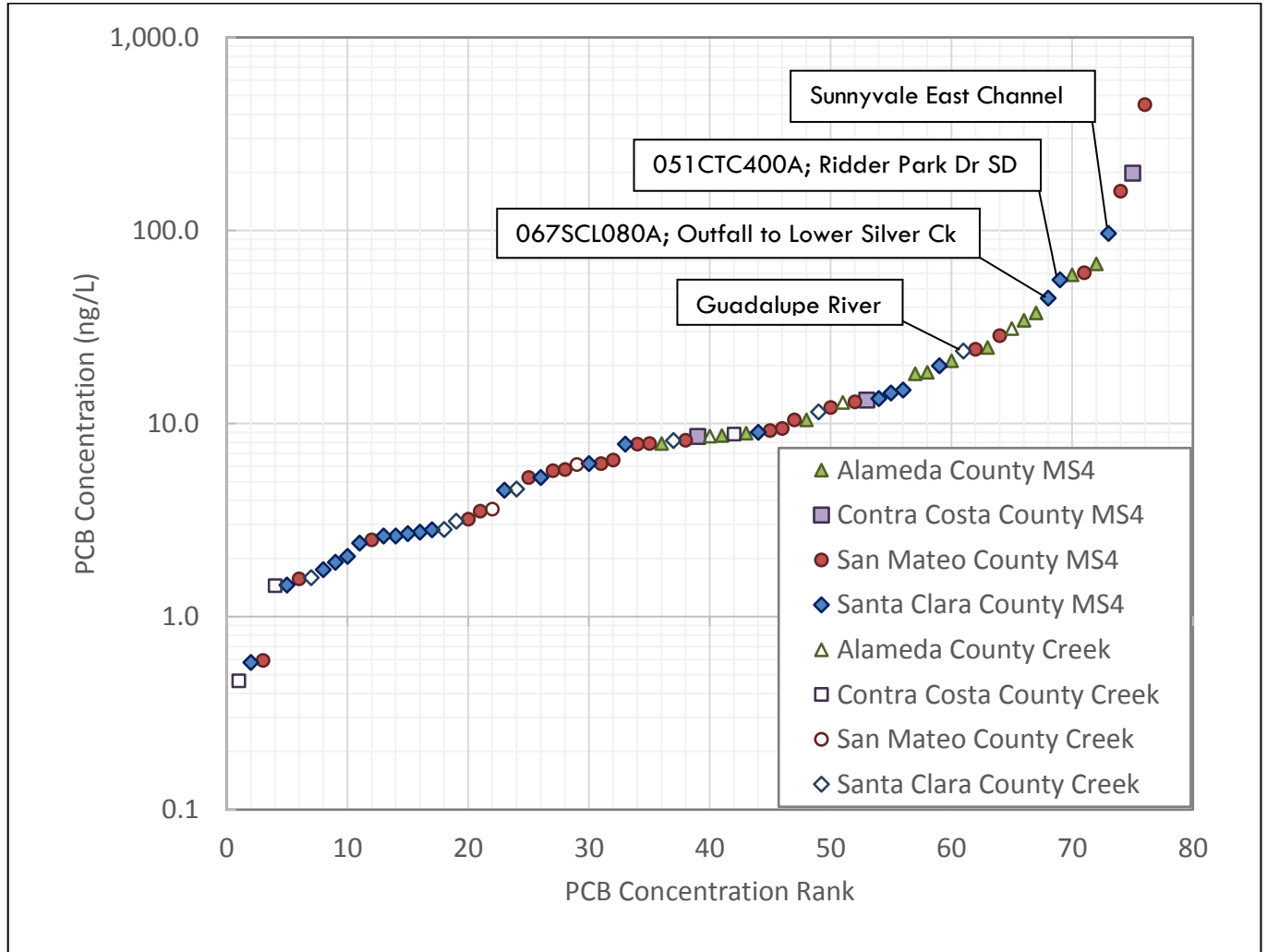
The storm sample dataset includes samples collected from 61 MS4 catchments and 15 natural waterways throughout the Bay Area. The MS4 catchment sites include storm drain manholes, outfalls, pump stations, and artificial channels.<sup>8</sup> The 15 sites in natural waterways have watersheds ranging in size from less than 3,000 acres (i.e., Lower Penitencia Creek) to the entire Sacramento–San Joaquin River Delta watershed (i.e., Mallard Island). Many of the sites have been sampled more than once and/or have multiple sample results reported for individual storm events. Eight of the 61 MS4 sites have multiple sample results (4 to 80). All the natural waterway sites have multiple sample results (3 to 125). For sites with more than one sample, the particle ratio is calculated by dividing the sum of PCB concentrations by the sum of suspended sediment concentrations. Performing the calculation in this way is effectively the equivalent of compositing all the individual samples that have been collected at a site. This is consistent with the RMP STLS approach to data evaluation (Gilbreath et al. 2017).

PCB concentrations in water samples for the Bay Area dataset (n=76) is plotted in Figure 2. PCB particle ratios are plotted in Figure 3. Figures 2 and 3 identify sites by location (i.e., County) and sample type (i.e., MS4 or natural waterway/creek). There are 30 sites in Santa Clara County. Nine of the sites were sampled by SCVURPPP in WY 2016, thirteen sites were sampled by the RMP STLS in WY 2015 and WY 2016, and eight sites were sampled multiple times by the RMP in prior water years.

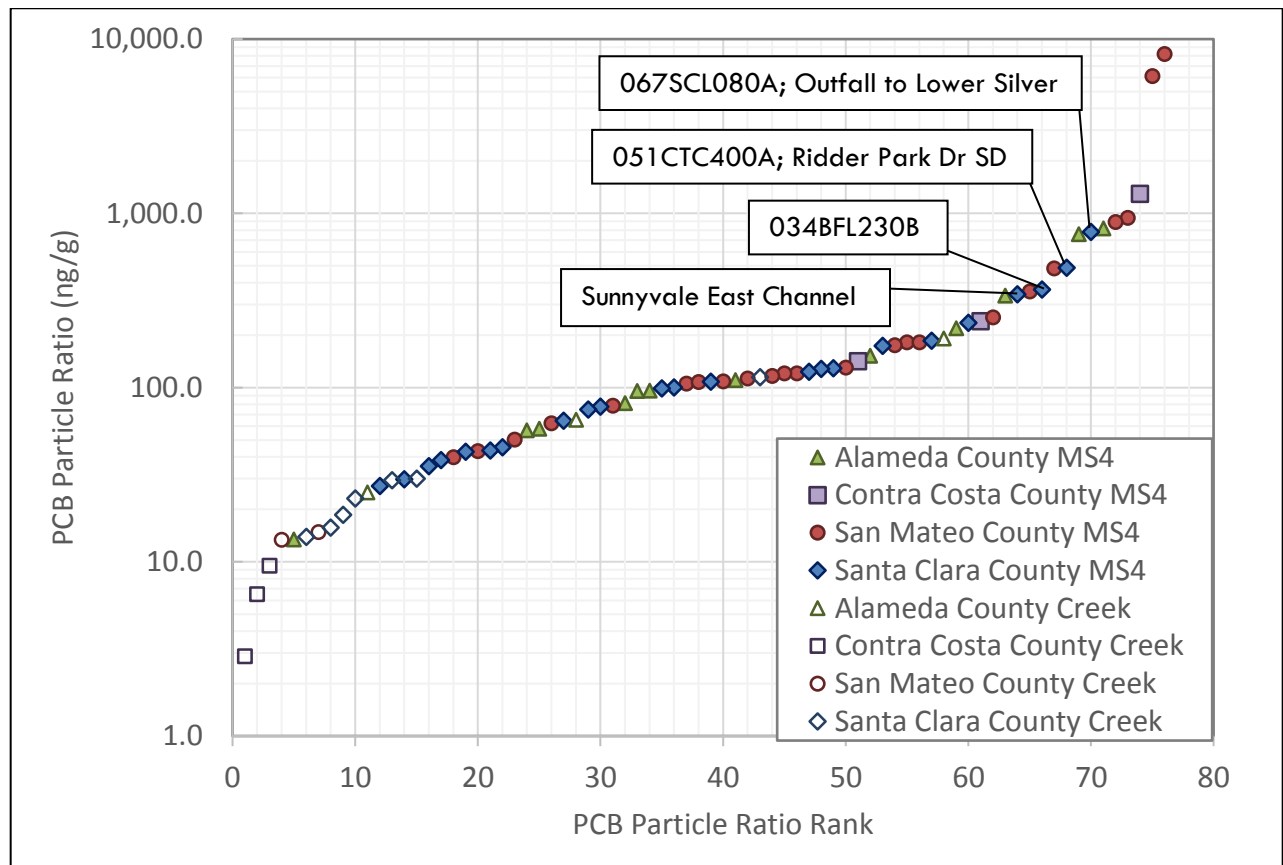
Overall, Santa Clara County has relatively low PCB concentrations and PCB particle ratios compared to the other three counties. The highest PCB concentrations in Santa Clara County have been measured at

<sup>8</sup> Stormwater samples have also been collected from inlets and/or LID systems as part of special studies. However, those were not included in this analysis.

Sunnyvale East Channel (96.6 ng/L), 051CTC400A (55.5 ng/L; Ridder Park Dr SD), 067SCL080A (44.6 ng/L; Outfall to Lower Silver Ck), and the Guadalupe River (23.7 ng/L). The sites with the highest PCB particle ratios are 067SCL080A (783 ng/g), 051CTC400A (488 ng/g), 034BFL230B (366 ng/g), and Sunnyvale East Channel (343 ng/g).



**Figure 2.** PCB concentrations for water samples collected in large MS4s in the Bay Area



**Figure 3.** PCB particle ratios for water samples collected in MS4s and small tributaries (i.e., creeks/streams) draining to the Bay.

Table 5 lists descriptive statistics on PCB and mercury concentrations for the Bay Area stormwater dataset (n=76). The median concentration of PCBs in water is 8.37 ng/L, and the mean is 23.9 ng/L. The median PCB particle ratio is 108 ng/g, and the mean is 366 ng/g. As can be seen in Figures 2 and 3, there are a few catchments with highly elevated samples that increase the average concentration statistic over the median (i.e., 50<sup>th</sup> percentile). Both SCVURPPP and the RMP are collecting additional stormwater composite samples in WY 2017 in an effort to grow this dataset. In future years, it may be informative to correlate measured concentrations to various factors such as storm size, rainfall intensity, antecedent dry weather, and land use characteristics.

**Table 5. Descriptive statistics of PCB and mercury concentrations in water and particle ratios.**

	PCBs (ng/L) <sup>a</sup>	Hg (ng/L)	SSC (mg/L)	PCB Particle Ratio (ng/g) <sup>b</sup>	Hg Particle Ratio (ng/mg) <sup>b</sup>
N	76	53	76	76	53
Min	0.464	3.9	10.0	2.88	0.13
10th Percentile	1.70	6.0	25.2	15.4	0.16
25th Percentile	3.14	11	43.4	42.9	0.25
50th Percentile	8.37	20	75.7	108	0.34
75th Percentile	18.4	41	153	190	0.55
90th Percentile	56.5	81	355	766	0.95
Max	448	440	1570	8220	5.3
Mean	23.9	38	151	366	0.53

<sup>a</sup> Total PCBs calculated as sum of RMP 40 congeners.

<sup>b</sup> PCB and Hg Particle Ratios calculated by dividing Total PCBs and Hg concentrations by SSC.

### 2.2.3 WMA Update

PCB and mercury sampling data are used to identify specific source properties and/or WMAs where control measures will be implemented. There are currently no thresholds established for classifying or prioritizing PCB or mercury concentrations in stormwater.<sup>9</sup> Therefore, the Program is applying the BASMAA RMC sediment concentration thresholds to PCB particle ratio data which can be expressed in the same units (mg/kg). A PCB particle ratio greater than 0.5 mg/kg (or 500 ng/g) is used as a preliminary threshold for classifying water samples as high, 0.2 – 0.5 mg/kg (200 – 500 ng/g) is moderate, and less than 0.2 mg/kg (200 ng/g) is low.

Based on WY 2016 sampling, no additional WMAs were identified as high priority catchments where source investigations should be considered. Sample 034BFL230B was the only sample collected in WY 2016 (out of a total 15 samples) that had a PCB particle ratio over 0.2 mg/kg, a threshold used to determine catchments that have *moderately elevated* levels of PCB. The current WMA map is illustrated in Figure 4, where the 15 catchments that were sampled in WY 2016 and the status of other WMAs is presented.

WY 2017 POC sampling will include the collection of sediment samples within nine WMAs to investigate suspected PCBs and mercury source properties. If WY 2017 sediment sampling results in the identification of source properties, the Program will work with local municipalities to cleanup and abate the properties, and/or refer these properties to Regional Water Board for follow up action.

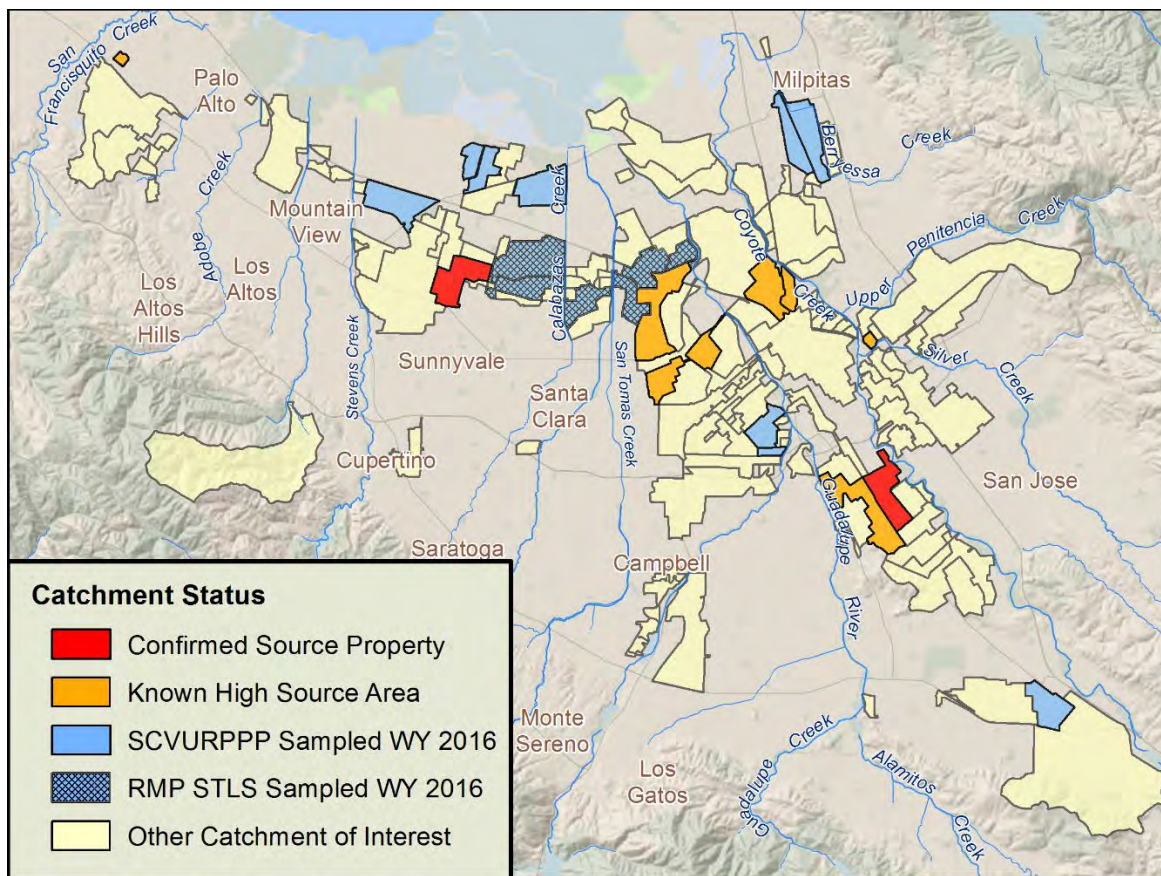


Figure 4. SCVURPPP current Watershed Management Area (WMA) map showing catchments sampled in WY 2016.

<sup>9</sup> SFEI has suggested that sites be ranked region-wide based on a combination of concentration and particle ratios. See Appendix E to the WY 2016 UCRM for additional information.

## 2.3 Copper

In WY 2016, SCVURPPP collected copper samples concurrently within a subset (four) of the PCBs and mercury storm composite samples.<sup>10</sup> This approach provides a relatively efficient means of collecting copper samples during wet weather when copper is most likely to be discharged from the urban landscape. The goal of this approach is to address Management Question #4 (Loads and Status) by characterizing copper concentrations in stormwater runoff from highly urban catchments. Samples were analyzed for total copper, dissolved copper, and hardness. Results are listed in Table 6. Comparisons to freshwater water quality objectives are described in Section 3.0.

**Table 6.** Total and dissolved copper concentrations in water samples collected by SCVURPPP, WY 2016.

Station Code	Sample Date	Total Copper (µg/L)	Dissolved Copper (µg/L)	Hardness as CaCO <sub>3</sub> (mg/L)
032SVC490	1/5/2016	10.5	4.32	30
083LGC430	1/19/2016	11.8	4.4	20
Ford Creek	1/17/2016	7.17	2.4	172
Wrigley Creek	1/17/2016	7.38	2.94	164

## 2.4 Nutrients

Nutrient monitoring addresses Management Question #4 (Loads and Status). Nutrients were included in the POC monitoring requirements to support Regional Water Board efforts to develop nutrient numeric endpoints (NNE) for the San Francisco Bay Estuary. The “Nutrient Management Strategy for San Francisco Bay” is part of a statewide initiative to address nutrient over-enrichment in State waters (Regional Water Board 2012). The suite of nutrients required in the MRP (i.e., ammonium, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus) closely reflects the list of analytes measured by the RMP and BASMAA partners at the six regional loading stations monitored in WY 2012 and WY 2013. The prior data were used by the Nutrient Strategy Technical Team to develop and calibrate nutrient loading models.

In WY 2016, POC monitoring for nutrients in Santa Clara County was conducted synoptically with bioassessment monitoring in Upper Penitencia Creek as part of a Stressor/Source Identification (SSID) study. The SSID Work Plan was submitted to the Regional Water Board with the WY 2014 Urban Creeks Monitoring Report (SCVURPPP 2015b). The Upper Penitencia Creek SSID Project is investigating low creek status condition scores (i.e., California Stream Condition Index) and high temperatures following the Causal Analysis/Diagnosis Decision Information System (CADDIS) framework developed by the USEPA. The SSID Project Report is included with the SCVURPPP WY 2016 UCMR to which this POC Data Report is also appended.

Results of nutrient monitoring are listed in Table 7. The downstream station (205COY114) had higher concentrations of all nutrient species compared to the upstream station (205COY121). More information about the differences between the two stations is provided in the SSID Project Report. Comparisons to applicable freshwater water quality objectives are described in Section 3.0.

<sup>10</sup> In order to simplify the field effort and reduce the risk of sample contamination, SCVURPPP requested that the analytical laboratory conduct the sample filtration required for dissolved copper analysis. The hold time for sample filtration is 24 hours and the laboratory is not staffed for this work on weekends. Therefore, only samples collected Monday through Thursday could be submitted for copper analysis. This constraint limited copper monitoring efforts to four samples.

**Table 7.** Nutrient concentrations in POC water samples collected by SCVURPPP, WY 2016.

Constituent	Units	205COY114	205COY121
Nitrate as N	(mg/L)	0.30	0.042
Nitrite as N	(mg/L)	0.008	0.001
Total Kjeldahl Nitrogen (TKN)	(mg/L)	1.1	0.88
Ammonia as N	(mg/L)	0.11	0.043
Un-ionized Ammonia as N <sup>a</sup>	(mg/L)	0.010	0.003
Ammonium <sup>b</sup>	(mg/L)	0.10	0.04
Total Nitrogen <sup>c</sup>	(mg/L)	1.41	0.92
Dissolved Orthophosphate as P	(mg/L)	0.14	0.006
Phosphorus as P	(mg/L)	0.28	0.089

<sup>a</sup> Un-ionized ammonia calculated using formula provided by the American Fisheries Society Online Resources.

<sup>b</sup> Ammonium = ammonia – un-ionized ammonia.

<sup>c</sup> Total nitrogen = TKN + nitrate + nitrite. Non-detects valued at 1/2 method detection limit in calculation.

## 2.5 Emerging Contaminants

Emerging contaminant monitoring is being addressed through Program participation in the RMP. The RMP investigated Contaminants of Emerging Concern (CECs) since 2001 and established the RMP Emerging Contaminants Work Group (ECWG) in 2006 to provide direction and oversight of these efforts. The goal of the ECWG is to identify CECs that have the potential to impact beneficial uses in the Bay and to develop cost-effective strategies to identify and monitor, and minimize impacts. The RMP published a CEC Strategy “living” document in 2013 (Sutton et al. 2013; Sutton and Sedlak 2015) which is scheduled for a full revision in the near future. The CEC Strategy document guides RMP special studies on CECs using a tiered risk and management action framework.

### 3.0 COMPARISON TO APPLICABLE WATER QUALITY STANDARDS

MRP provision C.8.h.i requires RMC participants to assess all data collected pursuant to Provision C.8 for compliance with applicable water quality standards. In compliance with this requirement POC data collected in WY2016 by SCVURPPP were compared to applicable numeric water quality objectives (WQOs) included in the SF Bay Water Quality Control Plan.

When conducting a comparison to applicable WQOs/criteria, certain considerations should be taken into account to avoid the mischaracterization of water quality data:

**Discharge vs. Receiving Water** – WQOs apply to receiving waters, not discharges. WQOs are designed to represent the maximum amount of pollutants that can remain in the water column without causing any adverse effect on organisms using the aquatic system as habitat, on people consuming those organisms or water, and on other current or potential beneficial uses. The majority of the PCB and mercury samples were collected within the engineered storm drain network, not receiving waters. Dilution is likely to occur when the MS4 discharges urban stormwater (and non-stormwater) runoff into the local receiving water. Therefore, it is unknown whether discharges that exceed WQOs result in exceedances in the receiving water itself, the location where there is the potential for exposure by aquatic life.

**Freshwater vs. Saltwater** - POC monitoring data were collected in freshwater, above tidal influence and therefore comparisons were made to freshwater WQOs/criteria.

**Aquatic Life vs. Human Health** - Comparisons were primarily made to objectives/criteria for the protection of aquatic life, not objectives/criteria for the protection of human health to support the consumption of water or organisms. This decision was based on the assumption that water and organisms are not likely being consumed from the stations monitored.

**Acute vs. Chronic Objectives/Criteria** - Monitoring for PCBs, mercury, and copper was conducted during episodic storm events and results do not likely represent long-term (chronic) concentrations of monitored constituents. POC monitoring data were therefore compared to “acute” WQOs/criteria for aquatic life that represent the highest concentrations of an analyte to which an aquatic community can be exposed briefly (e.g., 1-hour) without resulting in an unacceptable effect.

Of the analytes monitored at POC stations in WY 2016, WQOs or criteria for the protection of aquatic life have only been promulgated for total mercury, dissolved copper, and unionized ammonia. In Water Year 2016, there were no exceedances of applicable water quality standards for these analytes in samples collected in receiving waters. Details of the analysis are provided below.

- **Total Mercury.** All mercury concentrations measured in SCVURPPP samples in Water Year 2016 were well below the freshwater acute objective for mercury of 2.4 ug/L (see Table 4).
- **Nutrients.** All un-ionized ammonia concentrations measured in SCVURPPP samples were below the annual median objective for un-ionized ammonia of 0.025 mg/L (see Table 7).
- **Dissolved Copper.** Acute (1-hour average) WQOs for copper are expressed in terms of the dissolved fraction of the metal in the water column and are hardness dependent. The acute copper WQO was calculated using the hardness values measured at the sample station and the dissolved copper concentrations measured at those stations were compared to the calculated WQO. Neither receiving water station exceeded the calculated WQO for copper.

**Table 8.** Comparison of WY 2016 Monitoring Data to the Copper WQO.

Station Code	Sample Date	Hardness as CaCO <sub>3</sub> (mg/L)	Acute WQO for Dissolved Copper at Measured Hardness (µg/L)	Dissolved Copper (µg/L)
Ford Creek	1/17/2016	172	23.3	2.4
Wrigley Creek	1/17/2016	164	22.3	2.94

## 4.0 CONCLUSIONS AND RECOMMENDATIONS

In WY 2016, SCVURPPP collected and analyzed POC samples in compliance with Provision C.8.f of the MRP. Yearly minimum requirements were met for all monitoring parameters. In addition, SCVURPPP worked with the RMP's STLS to supplement WY 2016 monitoring accomplishments.

**Conclusions** from WY 2016 POC monitoring include the following:

- SCVURPPP collected nine wet weather samples from high interest catchments for PCBs and mercury analysis. Results from SCVURPPP monitoring were compiled with results from RMP STLS monitoring to potentially identify new high interest WMAs in which new PCB or mercury source investigations should be considered. The preliminary PCB particle ratio threshold for *high source areas* (0.5 mg/kg) was not exceeded and therefore no new WMAs were added to the list of high interest catchments at this time.
- A subset (four of nine) of the wet weather samples were analyzed for total and dissolved copper. Two of these samples were collected in the MS4 and two in small creeks/channels. The receiving water samples did not exceed applicable water quality standards.
- Two samples were collected in Upper Penitencia Creek during the dry season for nutrient analysis. Results of the analysis supported the Upper Penitencia SSID Project that investigated low ecological integrity at a specific segment of the creek. The SSID Project Report is included as Appendix C to the SCVURPPP WY 2016 UCMR.

**Recommendations** for WY 2017 POC monitoring include the following:

- SCVURPPP and the RMP's STLS will continue to conduct PCB and mercury monitoring with the goal of identifying WMAs and specific source properties where new PCB and mercury control measures can be implemented during the permit term.
- At least eight samples that address Management Question #3 (Management Action Effectiveness) must be collected by the end of year four of the permit. SCVURPPP is currently working with BASMAA to develop a regional project to design a Monitoring Plan for POC Management Action Effectiveness. The goal is to finalize the Monitoring Plan/study design in WY 2017 and implement the plan in WY 2018. A major consideration for the regional Management Action Effectiveness Monitoring Plan and other future monitoring efforts will be collection of data in support of conducting the Reasonable Assurance Analysis (RAA) that is required by Provision C.12.c.iii.(3) of the MRP and which must be submitted with the 2020 Annual Report (September 30, 2020).
- At least eight samples that address Management Question #5 (Trends) must be collected by the end of year four of the permit. SCVURPPP will continue to participate in the STLS Trends Strategy Team to meet this requirement. The STLS Trends Strategy Team, initiated in WY 2015, is currently developing a regional monitoring strategy to assess trends in POC loading to San Francisco Bay from small tributaries. The STLS Trends Strategy will initially focus on PCBs and mercury, but will not be limited to those POCs. The preliminary design concept includes additional monitoring at one or two of the region-wide loadings stations to gain a better understanding of the variability in PCBs concentrations/loadings in the existing dataset. The variability of PCB concentrations in stormwater runoff will predict the number and frequency of samples needed to depict given load reductions over given periods of time. STLS Trends Strategy monitoring could begin as early as WY 2017 and will likely continue through the Permit term, however, the monitoring design is still being developed.
- SCVURPPP will continue to work with work with the SPoT Program to address Management Question #5 (Trends). The *SPoT Monitoring Program* conducts annual dry season monitoring (subject to funding constraints) of sediments collected from a statewide network of large rivers. The goal of the SPoT Program is to investigate long-term trends in water quality (Management Question #5 – Trends). Sites are targeted in bottom-of-the-watershed locations with slow water flow and appropriate

micromorphology to allow deposition and accumulation of sediments, including two stations in Santa Clara County (Coyote Creek and Guadalupe River). In most years, sediments are analyzed for PCBs, mercury, toxicity, pesticides, and organic pollutants (Phillips et al. 2014). In WY 2016, SPoT monitoring in Santa Clara County did not include PCBs or mercury; however, those constituents are anticipated for WY 2017.

- A subset of the wet weather PCB and mercury samples collected in WMAs with suspected sources will continue to be analyzed for total and dissolved copper in WY 2017.
- Nutrient samples will be collected from mixed land use watersheds. Nutrient monitoring efforts should be increased above the minimum number of yearly samples in order to make more progress towards the total number of samples required by the end of year five of the MRP.
- SCVURPPP will continue to participate in the RMP and the RMP's CEC Strategy.

## 5.0 REFERENCES

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## **Attachment 1**

### Quality Assurance/Quality Control Report

# Pollutants of Concern Monitoring - Quality Assurance/Quality Control Report, WY 2016

## 1.0 INTRODUCTION

Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) conducted Pollutants of Concern (POC) Monitoring in Water Year (WY) 2016 to comply with Provision C.8.f (Pollutants of Concern Monitoring) of the National Pollutant Discharge Elimination Program (NPDES) Municipal Regional Permit for the San Francisco Bay Area (i.e., MRP). Monitoring included analysis for polychlorinated biphenyls (PCBs), total mercury, total and dissolved copper, suspended sediment concentration (SSC), and nutrients (i.e., ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus). Monitoring was performed according to the project Sampling and Analysis Plan (SAP; SCVURPPP 2015).

This project utilized the Clean Watersheds for Clean Bay Project (CW4CB) Quality Assurance Project Plan (QAPP; AMS 2012) as a basis for Quality Assurance and Quality Control (QA/QC) procedures. Missing components were supplemented by the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) QAPP (BASMAA 2016), specifically for nutrient samples. Data were assessed for seven data quality attributes, which include (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Contamination, (6) Accuracy, and (7) Precision. These seven attributes are compared to Data Quality Objectives (DQOs), which were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data – representativeness and comparability are qualitative while completeness, sensitivity, precision, accuracy, and contamination are quantitative assessments. Specific DQOs are based on Measurement Quality Objectives (MQOs) for each analyte.

The MQOs for each of the POC data types are summarized in Table 1. As there was no reporting limit listed in the QAPP for copper, results were compared the SWAMP-recommended reporting limits for inorganic analytes in freshwater. Overall, the results of the QA/QC review suggest that the data generated during this study were of sufficient quality for the purposes of the project. While some data were flagged in the project database, none of the data were rejected. Further details regarding the QA/QC review are provided in the sections below.

**Table 1. Measurement quality objectives from the Clean Watersheds for a Clean Bay (CW4CB) Quality Assurance Project Plan (AMS 2012) and BASMAA RMC Quality Assurance Project Plan (BASMAA 2016)**

Sample	PCBs <sup>1</sup>	Mercury <sup>2</sup>	Copper and Hardness <sup>2</sup>	SSC <sup>3</sup>	Nutrients <sup>4</sup>
Laboratory Blank	< Reporting Limit	< Reporting Limit	< Reporting Limit	< Reporting Limit	< Reporting Limit
Reference Material (Laboratory Control Sample)	50-150% recovery	75-125% recovery	75-125% recovery	80-120% recovery	80-120% recovery

<b>Matrix Spike</b>	50-150% recovery	75-125% recovery	75-125% recovery	NA	80-120% recovery
<b>Matrix Spike, Field, and Laboratory Duplicate<sup>4</sup></b>	Relative Percent Difference < 25%	Relative Percent Difference < 25%	Relative Percent Difference < 25%	Lab Dup Relative Percent Difference < 25%	Relative Percent Difference < 25%
<b>Reporting Limit</b>	0.002 µg/L (2000 pg/L)	0.0002 µg/L (0.2 ng/L)	0.10 µg/L <sup>5</sup>	0.5 mg/L	None Listed

<sup>1</sup> Synthetic Analytes in Water (CW4CB)

<sup>2</sup> Inorganic Analytes in Water (CW4CB)

<sup>3</sup> Conventional Analytes – Solids (CW4CB)  
Conventional Analytes in Water (BASMAA)

<sup>4</sup> NA if native concentration for either sample is less than the reporting limit

<sup>5</sup> No copper RL listed in CW4CQ QAPP. From SWAMP-recommended reporting limits for inorganic analytes in freshwater. ([http://www.waterboards.ca.gov/water\\_issues/programs/swamp/docs/tools/19\\_tables\\_fr\\_water/4\\_inorg\\_fr\\_water.pdf](http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/tools/19_tables_fr_water/4_inorg_fr_water.pdf))

## 2.0 REPRESENTATIVENESS

Data representativeness assesses whether the data were collected so as to represent actual conditions at each monitoring location. For this project, all samples are assumed to be representative if they are performed according to protocols specified in the Project SAP, CW4CB QAPP, and RMC QAPP. All field and laboratory personnel received and reviewed the SAP and QAPPs, and followed prescribed protocols including laboratory methods prescribed by the project SAP (SMCWPPP 2015). There was one minor deviation from the QAPP MQO for representativeness - the mercury analysis of one sample (station 032SVC490) was initially performed within the recommended holding time. However, analysis of the undiluted samples produced unacceptable MS/MSD results, and reanalysis at a dilution was required. The reanalysis was performed one day past the recommended holding time. The results from this second analysis were reported.

## 3.0 COMPARABILITY

Electronic data deliverables (EDDs) are submitted to the San Francisco Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by SWAMP, to ensure data comparability with the California Surface Water Ambient Monitoring Program (SWAMP). In addition, data entry follows SWAMP documentation specific to each data type, including the exclusion of qualitative values that do not appear on SWAMP’s look up lists<sup>1</sup>. Completed templates are reviewed using SWAMP’s online data checker<sup>2</sup>, further ensuring SWAMP-comparability.

## 4.0 COMPLETENESS

The project SAP (SCVURPPP 2016) specifies a goal of eight (8) PCB and mercury samples and four (4) copper and nutrients be collected during WY 2016. However, the SAP notes that these numerical targets are goals and allows for unforeseen field conditions which may hinder efforts.

<sup>1</sup> Look up lists available online at [http://swamp.waterboards.ca.gov/swamp\\_checker/LookUpLists.php](http://swamp.waterboards.ca.gov/swamp_checker/LookUpLists.php).

<sup>2</sup> Checker available online at [http://swamp.waterboards.ca.gov/swamp\\_checker/SWAMPUpload.php](http://swamp.waterboards.ca.gov/swamp_checker/SWAMPUpload.php)

During WY 2016, SCVURPPP achieved 100% completeness by collecting and analyzing the number of samples specified by the SAP, including one field duplicate.

## 5.0 SENSITIVITY

The project QAPP identified a reporting limit of 0.0002 ug/L or 0.2 ng/L for mercury, but the actual reporting limit was much higher at 5 ng/L. This elevated reporting limit was due to a high dilution factor (10), which was necessary to conduct the analysis. Copper samples met the SWAMP-recommended reporting limit of 0.1 µg/L for freshwater samples and PCB samples exceeded the reporting limit of 0.002 µg/L (2000 pg/L).

Nutrient analysis met the reporting limits listed in the RMC QAPP, except for nitrate whose target reporting limit 0.01 mg/L is slightly lower than the laboratory's reporting limit (0.05mg/L).

## 6.0 CONTAMINATION

The project SAP (SCVURPPP 2016) requires one field blank be analyzed for PCB and mercury, but due to staff oversight, no field blank was collected in WY 2016. However, the laboratory did analyze several laboratory blanks. All blank samples were analyzed for contamination, and results were compared to MQOs in Table 1 and the CW4CB QAPP, which require blanks to be less than the reporting limit.

Laboratory method blanks were less than reporting limits for most analytes with the exception of the following, which were flagged as "VIPRL" by the QA officer<sup>3</sup>:

- PCB 8
- PCB 18/30
- PCB 20/28
- PCB 31
- PCB 44/47/65
- PCB 52

Laboratory blanks that were run during nutrient analysis and all results were non-detect.

## 7.0 ACCURACY

Accuracy is assessed as the percent recovery of samples spiked with a known amount of a specific chemical constituent. The analytical laboratory evaluated and reported the percent recovery (PR) of laboratory control samples (LCS; in lieu of reference materials) and matrix spikes (MS), which were recalculated and compared to the target range in the CW4CB QAPP. If a QA sample did not meet MQOs, all samples in that batch for that particular analyte were flagged. For PCB, the CW4CB QAPP specifies a MQO of 50-150% recovery for both LCS and MS/MSD. For mercury and copper the MQO for recovery is 75-125% for both accuracy measurements.

None of the LCS or MS/MSD samples for mercury, copper, or PCBs exceeded their respective MQO ranges specified by the CW4CB QAPP. All nutrient laboratory LCS and MS/MSD samples were

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<sup>3</sup> None of the analytes detected in the laboratory method blanks above the reporting limit were flagged by the laboratory.

within the MQO specified by the BASMAA QAPP. Though the laboratory MQO ranges for copper, mercury, and PCBs were slightly different than the CW4CB MQO, all of the LCS results were within both MQO ranges and no data were qualified by either the laboratory or the QA officer for accuracy issues. See Table 2 for a comparison of QAPP and laboratory MQOs with the actual LCS range and Table 3 for the actual MS/MSD ranges.

**Table 2. Laboratory control sample results compared to quality assurance project protocol and laboratory measurement quality objectives.**

Analyte	QAPP MQO	Laboratory MQO	Results Range
Copper	75-125%	85-115	92-105%
Mercury	75-125%	77-123%	98-114%
PCBs	50-150%	60-135%	73-131%
Nutrients	80-120%	80-120% 90-110% <sup>a</sup>	90-110%

<sup>a</sup> Total Kjeldahl nitrogen, orthophosphate, phosphorus, nitrate

**Table 3. Matrix spike and matrix spike duplicate results compared to quality assurance project protocol and laboratory measurement quality objectives.**

Analyte	QAPP MQO	Laboratory MQO	Results Range
Copper	75-125%	70-130	97-99%
Mercury	75-125%	71-125	85-97%
PCBs	50-150%	50-150	91-119%
Nutrients	80-120%	80-120% 90-110% <sup>b</sup>	88-110%

<sup>b</sup> Phosphorus, orthophosphate

## 8.0 PRECISION

Precision is the repeatability of a measurement and is quantified by the relative percent different (RPD) of two duplicate samples. Three measures of precision were used for this project – matrix spikes duplicates (MSD), laboratory duplicates, and field duplicates. The MQO for RPD specified by both the CW4CB QAPP and the BASMAA QAPP is <25%.

### 8.1. Matrix Spike Duplicates

Matrix spike duplicates were analyzed for mercury, PCBs, and nutrients. The RPDs for all duplicate samples were well below the targeted range of < 25%.

### 8.2. Field Duplicates

One field duplicate was collected during this project at site 083LGC430 (labelled as 043CGL830). The duplicate sample was run as a blind duplicate by the laboratory. The RPD for copper and mercury met the CW4CB MQO (< 25%), but all the PCB RPDs were greater than the MQO (>25%).

A nutrient field duplicate was collected during creek status monitoring that is considered representative of nutrient sampling for POC monitoring. The field duplicate samples met the MQO for RPD for all analytes except for total Kjeldahl nitrogen. Refer to the SCVURPPP Creek Status Monitoring QA/QC Report for more information.

### 8.3. Lab duplicates

Laboratory duplicates were analyzed for copper and PCBs. All the copper duplicates (RPDs 1-5%) were well below the CW4CB MQO and the laboratory's internal RPD limit of 20%. Most of the PCB duplicates were less than 25% except for the following:

- PCB 30/18 (27%)
- PCB 20/28 (25%)
- PCB 49/69 (33%)
- PCB 83/99 (26%)
- PCB 90/101/113 (32%)
- PCB 195 (33%)

The laboratory RPD for PCBs was 50% and several samples were not flagged by the laboratory that exceeded the CW4CB MQO (< 25%). The PCB samples associated with these QA samples were flagged by the QA officer with "VIL".

All laboratory duplicates for nutrients were below the RPD MQO (< 25%).

## 9.0 REFERENCES

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