URBAN CREEKS MONITORING REPORT

SAN MATEO COUNTY MRP PERMITTEES

Water Year 2020

EXECUTIVE SUMMARY



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

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program

A Program of the City/County Association of Governments

March 31, 2021

CREDITS

This report is submitted by the participating agencies in the

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
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City of San Carlos
City of San Mateo
City of South San Francisco
Town of Woodside
County of San Mateo
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Table E-1. Water Year 2020 Creek Status Monitoring Station Summary Table

In compliance with Provision C.8.h.iii(1), this table of all creek status monitoring stations sampled in Water Year 2020 is provided immediately following the Table of Contents.

Map ID [1]	Station ID	Bayside or Coastside	Watershed	Creek Name	Land Use	Latitude	Longitude	Bioassessment, Nutrients, General WQ	Chlorine	Pesticides & Toxicity	Temp[2]	Cont WQ[3]	Pathogen Indicators
1308	202R01308	Coastal	Pilarcitos Creek	Pilarcitos Creek	U	37.4684	-122.4363	X	X				
4568	202R04568	Coastal	San Pedro Creek	San Pedro Creek	U	37.5808	-122.4798	X	X				
5464	202R05464	Coastal	San Pedro Creek	San Pedro Creek	U	37.5869	-122.4953	X	X				
680	204R00680	Bayside	Redwood Creek	Redwood Creek	U	37.4379	-122.2410	X	X				
1256	204R01256	Bayside	Redwood Creek	Arroyo Ojo de Agua	U	37.4545	-122.2505	X	X				
2228	204R02228	Bayside	San Mateo Creek	San Mateo Creek	U	37.5610	-122.3374	X	X				
3272	204R03272	Bayside	San Mateo Creek	San Mateo Creek	U	37.5339	-122.3503	X	X				
3528	204R03528	Bayside	San Mateo Creek	San Mateo Creek	U	37.5483	-122.3463	X	X				
4884	204R04884	Bayside	San Mateo Creek	San Mateo Creek	U	37.5406	-122.3499	X	X				
5176	204R05176	Bayside	Laurel Creek	Laurel Creek	U	37.5333	-122.3045	X	X				
ADMS	ADMS	Coastal	San Pedro Creek	San Pedro Creek	U	37.5869	-122.4954						X
USSH	USSH	Coastal	San Pedro Creek	San Pedro Creek	U	37.5872	-122.4959						X
PRLT	PRLT	Coastal	San Pedro Creek	San Pedro Creek	U	37.5885	-122.4994						X
SHAO	SHAO	Coastal	San Pedro Creek	Shamrock Creek	U	37.5879	-122.4987						X
SPCM	SPCM	Coastal	San Pedro Creek	San Pedro Creek	U	37.5962	-122.5056						X
070	204SMA070	Bayside	San Mateo Creek	San Mateo Creek	U	37.5609	-122.3374				X		
080	204SMA080	Bayside	San Mateo Creek	San Mateo Creek	U	37.5481	-122.3463				X	X	
090	204SMA090	Bayside	San Mateo Creek	San Mateo Creek	U	37.5403	-122.3499				X		
108	204SMA108	Bayside	San Mateo Creek	Polhemus Creek	U	37.5305	-122.3486				X		
110	204SMA110	Bayside	San Mateo Creek	San Mateo Creek	U	37.5331	-122.3505				X	X	
008	205BCR008	Bayside	San Francisquito Cr	Bear Creek	U	37.4112	-122.2411			X			

U = urban, NU = non-urban
[1] Map ID applies to Figure 1.1 of Part A of this Urban Creeks Monitoring Report
[2] Temperature monitoring was conducted continuously (i.e., hourly) April through September.
[3] Continuous water quality monitoring (temperature, dissolved oxygen, pH, specific conductivity) was conducted during two 2-week periods (spring and late summer).

INTRODUCTION AND BACKGROUND

This *Urban Creeks Monitoring Report* (UCMR) for Water Year 2020 was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP). SMCWPPP is a program of the City/County Association of Governments (C/CAG) of San Mateo County. Each incorporated city and town in the county and the County of San Mateo share a common 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 (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). The next iteration of the MRP (i.e., MRP 3.0) is currently under development and is anticipated to become effective July 1, 2022.

This UCMR, including all appendices and attachments, fulfills the requirements of Provision C.8.h.ii. of the MRP for reporting all data collected in Water Year 2020 (WY 2020; October 1, 2019 – September 30, 2020) pursuant to Provision C.8. Data presented in this report were also submitted in electronic SWAMP-comparable formats by SMCWPPP to the Regional Water Board on behalf of San Mateo County Permittees and pursuant to Provision C.8.h.ii. of the MRP and may be obtained via the California Environmental Data Exchange Network (CEDEN).

Water quality monitoring required by Provision C.8 of the MRP is intended to assess the condition of water quality in Bay Area receiving waters (creeks and the Bay); identify and prioritize stormwater runoff associated impacts, stressors, sources, and loads; identify appropriate management actions; and detect trends in water quality over time and the effects of stormwater control measure implementation.

Provision C.8.a. (Compliance Options) of the MRP allows Permittees to address monitoring requirements through a "regional collaborative effort," their countywide stormwater program, and/or individually. On behalf of San Mateo County Permittees, SMCWPPP conducts creek water quality monitoring and monitoring projects in collaboration with the Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition (RMC). Furthermore, SMCWPPP actively participates in the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), which focuses on assessing Bay water quality and associated impacts. In compliance with Provision C.8.c. of the MRP (San Francisco Estuary Receiving Water Monitoring), SMCWPPP also provides financial contributions towards implementing the RMP.[1]

Monitoring data were collected in accordance with the BASMAA RMC Quality Assurance Project Plan (QAPP; BASMAA 2020) and the BASMAA RMC Standard Operating Procedures (SOPs; BASMAA 2016). Where applicable, and in compliance with Provision C.8.b. of the MRP (Monitoring Protocols and Data Quality), methods described in the QAPP and SOP are comparable with methods specified by the California Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Program Plan (QAPrP).

[1] See https://www.sfei.org/programs/sf-bay-regional-monitoring-program for details on the RMP.

This UCMR consists of three "Parts" (A-C) that address the major sub-provisions of MRP Provision C.8. The following sections of this Executive Summary summarize each UCMR Part:

- Part A: Creek Status and Pesticides & Toxicity Monitoring
- Part B: Stressor/Source Identification Projects
- Part C: Pollutants of Concern Monitoring

PART A: CREEK STATUS AND PESTICIDES & TOXICITY MONITORING

Part A of the UCMR presents all data collected in compliance with Provision C.8.d. (Creek Status Monitoring) and Provision C.8.g. (Pesticides & Toxicity Monitoring) during WY 2020. The monitoring strategy implemented by SMCWPPP in compliance with these provisions is consistent with the BASMAA RMC's Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). The strategy includes regional ambient/probabilistic monitoring and local targeted monitoring. The probabilistic monitoring design was developed to remove bias from site selection such that ecosystem conditions can be objectively assessed on local (i.e., San Mateo County) and regional (i.e., RMC) scales. The targeted monitoring design focuses on sites selected based on the presence of significant fish and wildlife resources, as well as historical and/or recent indications of water quality concerns. Monitoring results are compared to "triggers" listed in the MRP. Some triggers are equivalent to regulatory Water Quality Objectives (WQOs), while others are thresholds above (or below) which potential impacts to aquatic life or other beneficial uses may occur. Sites where triggers are exceeded (or not met) are considered for future stressor/source identification (SSID) projects.

A.1 Bioassessment

During WY 2020, SMCWPPP conducted biological assessments at ten stream sites, all classified as "urban" in the RMC sample frame. Of these sites, four were selected using the probabilistic design and six were targeted. Bioassessments include the collection of benthic macroinvertebrate and algae samples, measurement of general water quality and physical habitat parameters, and collection of water samples for laboratory analysis (i.e., nutrients). The California Stream Condition Index (CSCI), a statewide tool that translates benthic macroinvertebrate data into an overall measure of stream health, was used to assess biological condition.

The CSCI scores across the ten bioassessment sites sampled in WY 2020 ranged from 0.42 to 0.67, with all ten sites having scores below the MRP trigger threshold of 0.795, which corresponds to the two lower condition categories (*likely altered* and *very likely altered*). The two sites with the lowest CSCI scores were in channel reaches with armored beds and/or banks. Bioassessment sites and condition categories based on CSCI scores are shown in Figure E-1.

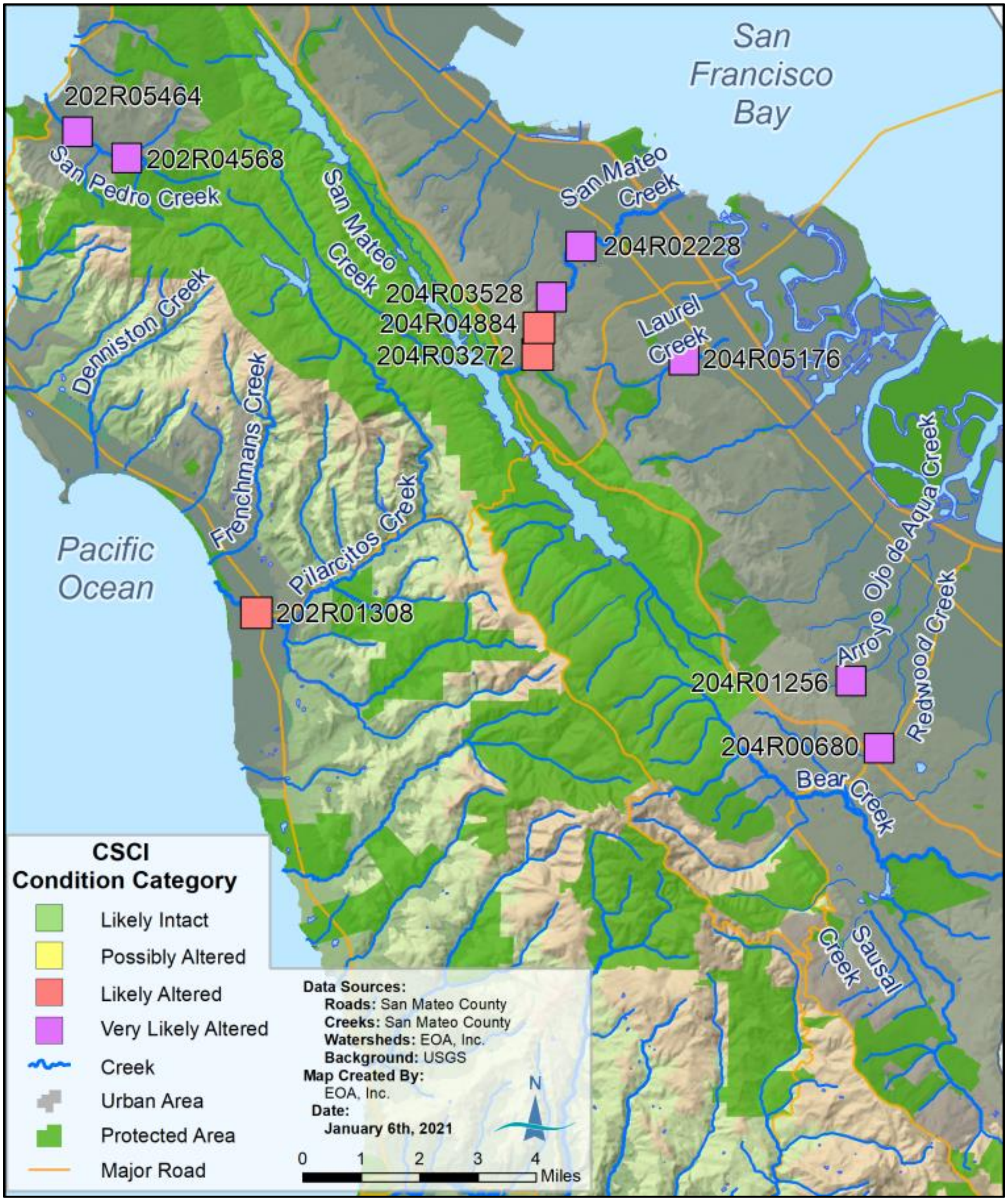

Figure E-1. Biological condition categories based upon CSCI scores for 10 bioassessment sites in San Mateo County, WY 2020.

All six targeted bioassessment surveys were conducted at sites previously monitored by SMCWPPP. CSCI scores for WY 2020 were compared to scores from prior years; however, there was no consistent trend in biological condition. Three sites had higher CSCI scores and three had lower scores compared to previous scores.

Four of the bioassessment surveys were conducted along a 3.4-mile reach in San Mateo Creek downstream of Crystal Springs Dam. Three of these sites had been previously monitored by SMCWPPP and one is also part of a long-term monitoring program being implemented by the San Francisco Public Utilities Commission (SFPUC). The SFPUC is monitoring in this reach in compliance with a National Marine Fisheries Services (NMFS) Biological Opinion issued as a condition of approval for the SFPUC project to improve the Crystal Springs Dam and implement a program of water release on a defined schedule beginning in 2015 (NMFS 2010).

Data collected by SMCWPPP and SFPUC were evaluated for temporal and geographic trends:

- There are no apparent temporal trends in biological conditions at any of the stations at this time. However, this is not unexpected as it could potentially take a long time period (e.g., decadal) to observe any improvements to aquatic habitat resulting from the water release program.
- There does appear to be a geographic pattern to biological conditions. Sites that are farther downstream and lower in elevation have lower CSCI scores compared to upstream, higher-elevation sites. The one exception to this pattern is the site directly below the Crystal Springs Dam, which had the lowest median CSCI score.
- CSCI scores for San Mateo Creek sites were relatively low (i.e., four sites had median CSCI scores below 0.063 in the *very likely altered* condition category, and the other two were in the *likely altered* condition category). However, there were several sensitive taxa present in the benthic macroinvertebrate samples collected in WY 2020, which generally indicates good conditions.
- New Zealand Mud Snails, a non-native invasive species, are consistently found in BMI samples collected from San Mateo Creek.

A.2 Continuous Temperature and Water Quality Monitoring

Continuous monitoring of water temperature and general water quality in WY 2020 was conducted in compliance with MRP Provision C.8.d.iii. – iv.. Hourly temperature measurements were recorded at five sites from April through September. Continuous (15-minute) general water quality measurements (pH, dissolved oxygen, specific conductance, temperature) were recorded at two sites during two 1 to2-week periods in spring (Event 1) and summer (Event 2). All WY 2020 continuous monitoring stations were located in San Mateo Creek below Crystal Spring Dam. This section of San Mateo Creek supports migration, rearing and spawning habitat for an existing steelhead population. Temperature, pH, specific conductance, and DO levels followed predictable daily and seasonal patterns, and were generally consistent across the sites. Overall water quality and temperature do not appear to be limiting factors for steelhead trout in San Mateo Creek.

A.3 Pathogen Indicator Monitoring

Pathogen indicator monitoring in WY 2020 was conducted in compliance with Provision C.8.d.v. of the MRP. Samples for pathogen indicator analysis were collected during one monitoring event at five sites, four on the mainstem of San Pedro Creek and one in a small tributary. The sites were selected from the list of sites sampled by the San Mateo Resource Conservation District (SMRCD) on behalf of the County and Pacifica in compliance with Provision C.14 of the MRP, which implements the San Pedro Creek and Pacifica State Beach Indicator Total Maximum Daily Load (TMDL). The overall goal of pathogen indicator monitoring in WY 2020 was to assess whether WQOs are being met, i.e., are the water bodies supportive of water contact recreation (REC-1) Beneficial Uses, and to compare results from the two analytical laboratories contracted by SMCWPPP and the SMRCD. Although water contact recreation is unlikely to occur at the targeted sites, they drain to Pacifica State Beach, a popular surfing location.

There was one measurement that exceeded the MRP trigger and WQO for *E. coli*, and three that exceeded the MRP trigger for enterococci (the enterococci WQO does not apply to freshwaters). Overall, samples lower in the watershed had higher pathogen indicator concentrations; however, the highest concentrations were measured in the sample from the tributary stream. Although this single monitoring event is not sufficient to confirm geographic sources of bacteria, it does suggest that the Shamrock Watershed should be evaluated as part of the TMDL characterization monitoring program.

It is important to recognize that pathogen indicators do not directly represent actual pathogen concentrations and do not distinguish among sources of bacteria. Potential sources of pathogen indicator bacteria in the San Pedro Creek watershed include homeless encampments, wildlife, livestock, pets, leaking septic systems/sanitary sewers, and regrowth of bacteria in the environment. Bacteria from human sources are more likely to be associated with human health risks during water contact recreation. As a result, the comparison of pathogen indicator results to WQOs may not always be meaningful and should be interpreted cautiously.

A.4 Chlorine Monitoring

In compliance with Provision C.8.c.ii., free chlorine and total chlorine residual were measured at ten sites concurrent with bioassessment surveys. While chlorine residual has generally not been a concern in San Mateo County creeks, prior monitoring results suggest there are occasional trigger exceedances of free chlorine and total chlorine residual in the County. In WY 2020, the total chlorine residual concentration in the sample collected at Stulsaft Park on Arroyo Ojo de Agua Creek exceeded the MRP trigger. The exceedance was immediately reported to the Redwood City illicit discharge contact. Trigger exceedances may be the result of one-time potable water discharges, and it is generally challenging to determine the source of elevated chlorine from such episodic discharges.

A.5 Pesticides & Toxicity Monitoring

Toxicity testing of water and sediment samples and sediment chemistry monitoring, collectively referred to as pesticides and toxicity monitoring, were conducted during WY 2020 in compliance with MRP Provision C.8.g.. In WY 2020, samples were collected from Bear Creek in the Town of Woodside. Statistically significant toxicity was not observed in the water or sediment samples. Pesticide concentrations in the sediment sample were all very low, with most results below the method detection limit (MDL). The exceptions were bifenthrin and permethrin. When normalized to the total organic carbon (TOC) concentration in the sample, the toxic unit (TU) equivalents calculated for bifenthrin and permethrin were 0.1 and 0.02, respectively. These results suggest that pesticides are not causing impairments to aquatic life in Bear Creek.

A.6 Creek Status and Pesticides & Toxicity Monitoring Recommendations

Impacts to urban streams identified through creek status monitoring are likely the result of long-term changes in stream hydrology, channel geomorphology, in-stream habitat complexity, and other modifications associated with urban development and associated impervious surfaces, and, to a lesser extent, pollutants typically found in urban watersheds. San Mateo County MRP Permittees are actively implementing many stormwater runoff management programs to address these stressors and pollutants found in local creeks and the Bay, with the goal of protecting these natural resources and their Beneficial Uses. Through the continued implementation of MRP-associated Best Management Practices and other watershed management programs, SMCWPPP anticipates that stream conditions and water quality in local creeks and the Bay will continue to improve over time.

Recommendations presented in Part A of the WY 2020 UCMR are directed towards the implementation of monitoring requirements in provisions C.8.d. and C.8.g. through the remainder of term during which MRP 2.0 remains in effect. At this time, it is anticipated that MRP 2.0 will be replaced with MRP 3.0 beginning July 2022. Thus, the current monitoring requirements will likely be in effect throughout the entirety of WY 2021 and most of WY 2022. SMCWPPP is currently working with other members of the RMC and Regional Water Board staff through the MRP 3.0 Steering Committee and the Provision C.8 Water Quality Monitoring Workgroup to develop future monitoring requirements. SMCWPPP's anticipated monitoring approach during WY 2021 will include the following:

- The probabilistic sample draw for urban sites in San Mateo County has been exhausted. Therefore, SMCWPPP will select WY 2021 bioassessment sites on a targeted basis according to guidance provided by Regional Water Board staff. Targeted sites will be selected to fill in spatial data gaps, undertake watershed studies, and/or assess the impact of land use changes on biological condition.

- Continuous monitoring for temperature and general water quality has been an effective tool in supporting SSID studies and evaluating cold water habitat. It can also complement targeted biological condition assessments. SMCWPPP recommends continued implementation of this approach in WY 2021.

- SMCWPPP will continue to comply with Provision C.8.d.v. requirements by collecting five samples for pathogen indicator analysis.

- SMCWPPP will continue to comply with Provision C.8.d.ii. requirements by measuring free and total chlorine in ten samples. Measurements will be made synoptic with bioassessment monitoring.

- Pesticides and Toxicity Monitoring will be conducted during the dry season at a bottom-of-the-watershed station. In order to continue expanding the geographic extent of these data, a new station will be selected.

PART B: STRESSOR/SOURCE IDENTIFICATION (SSID) PROJECTS

Part B of the UCMR provides a status update on SSID projects. In compliance with the MRP, Permittees must initiate a minimum number of SSID projects during the permit term. SSID projects are intended to identify and isolate potential sources and/or stressors associated with observed water quality concerns. These projects are intended lead to action(s) that alleviate stressors and reduce sources of pollutants. During MRP 2.0, SMCWPPP initiated one San Mateo County-specific SSID project and participated in one regional project. These SSID projects are briefly summarized below:

- The Pillar Point Harbor Watershed Pathogen Indicator SSID Project investigated FIB sources from the MS4 to receiving waters. Results showed that FIB densities are highly variable and do not follow predictable patterns. Furthermore, very few human or dog markers were present, suggesting that FIB conveyed by the MS4 may be challenging to control. However, the data available at this time are limited, introducing uncertainty into the conclusions reached to-date. The Revised Final Project Report, submitted June 30, 2020, recommended additional public outreach and other measures to reduce FIB discharges from the MS4. On February 10, 2021, the Regional Water Board adopted a resolution approving a Basin Plan amendment for the Beaches in Pillar Point Harbor and Venice Beach Bacteria TMDL. The TMDL will become effective after State Water Board adoption and USEPA approval.
- 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 Total Maximum Daily Load (TMDL) for PCBs in 2008. Subsequent PCBs monitoring by the BASMAA RMC partners and the RMP suggests that diffuse sources of PCBs are present throughout the region, with one potential source being releases and spills from electrical utility equipment. The work plan, developed in WY 2018, presents a framework to investigate electrical utility equipment as a source of PCBs to urban stormwater runoff and identify appropriate actions and control measures to reduce the water quality impacts of this source. In WYs 2019 and 2020, the RMC partners gathered information from municipally-owned electrical utilities in the MRP area to improve current estimates of PCBs loadings to MS4s and identify opportunities to develop improved spill response and reporting procedures. The final project report was submitted with SMCWPPP's FY 2019/20 Annual Report on September 30, 2020. Consistent with MRP procedures, SMCWPPP, along with its RMC partners is seeking approval of the completion of the Electrical Utilities SSID Study from the Regional Water Board Executive Officer.

PART C: POLLUTANTS OF CONCERN (POC) MONITORING

Pollutants of Concern (POC) monitoring is intended to assess inputs of POCs to the Bay from local tributaries and urban runoff, provide information to support implementation of TMDL water quality restoration plans and other pollutant control strategies, assess progress toward achieving wasteload allocations (WLAs) for TMDLs, and help resolve uncertainties associated with loading estimates for POCs. In WY 2020, SMCWPPP conducted POC monitoring for PCBs, mercury, copper, and nutrients.

Specific monitoring stations sampled in WY 2020 are mapped in Figure E-2. Figure E-3 is a more comprehensive map of POC monitoring stations in San Mateo County, showing WYs 2014 – 2020 nutrients and copper monitoring stations, and PCBs/mercury stations from the early 2000s through WY

2020. These PCBs stations are presented in the context of evaluating progress to-date towards identifying PCBs source areas and properties in San Mateo County.

Part C of the UCMR reports on and interprets POC monitoring data and fulfills the requirements of MRP Provision C.8.h.iii. for reporting a summary of Provision C.8.f. POC Monitoring conducted during WY 2020. In addition, consistent with MRP Provision C.8.h.ii., WY 2020 POC monitoring data generated by SMCWPPP's sampling of receiving waters (e.g., creeks) were submitted to the San Francisco Bay Area Regional Data Center for upload to CEDEN. Highlights from the POC monitoring program include the following:

- In WY 2020, SMCWPPP continued to collect and analyze POC samples in compliance with MRP Provision C.8.f. Yearly minimum sampling requirements specified in Provision C.8.f. were met for all POC monitoring parameters.
- SMCWPPP's PCBs and mercury monitoring has generally focused on San Mateo County urban catchments of interest (Watershed Management Areas or WMAs) containing high interest parcels with land uses potentially associated with PCBs. Consistent with MRP requirements, the focus has been on PCBs, with ancillary and secondary benefits assumed to be realized for mercury. Part C summarized progress to-date towards identifying PCBs source areas and properties (see Section 5.0). In this context, it evaluated all the relevant and readily available sediment and stormwater runoff PCBs chemistry data collected in San Mateo County, ranging back to the early 2000s. This included POC monitoring data collected directly by SMCWPPP and appropriate data collected by third parties such as the RMP's STLS.
- To-date, composite samples of stormwater runoff have been collected from the bottom of 49 San Mateo County WMAs and over 400 individual and composite grab samples of sediment have been collected within priority WMAs. All of these samples were analyzed for PCBs and mercury to help characterize the catchments and identify source areas and properties. Most samples were collected in the public ROW. The grab sediment samples were collected from a variety of types of locations, including manholes, storm drain inlets, driveways, streets, and sidewalks, often adjacent to or nearby high interest parcels with land uses associated with PCBs and/or other characteristics potentially associated with pollutant discharge (e.g., poor housekeeping, unpaved areas). SMCWPPP's PCBs and mercury monitoring program has also included collecting sediment samples in the public ROW (e.g., from streets and the MS4) by every known PCBs remediation site in San Mateo County, to the extent applicable and feasible.
- Four previously unknown potential source properties have been identified in San Mateo County, all in WMA 210 (Pulgas Creek Pump Station South) in the City of San Carlos. The four properties are located at the following San Carlos addresses:
    1. 1411 Industrial Road
    2. 1030 Washington Street
    3. 1029 Washington Street
    4. 1030 Varian Street

- In WY 2020, SMCWPPP collected eight additional sediment samples in the area where three of the above small properties (1030 Washington Street, 1029 Washington Street, and 1030 Varian Street) are located, including upstream and downstream samples. Accounting for the normal variability in this type of sampling, the results were very consistent with past results, and continue to suggest that three small properties may be PCBs sources. Along with 1411 Industrial Road, SMCWPPP is working with the City of San Carlos to determine next steps for these properties, including potential referral to the Regional Water Board.
- Figure ES-4 is a map illustrating the current status of WMAs in San Mateo County, based upon the monitoring data collected through WY 2020. Based upon total PCBs concentration in sediment and/or PCBs particle ratio in stormwater runoff samples, each WMA is placed in one of the following categories, to help prioritize future efforts to conduct additional monitoring and implement PCBs controls:
    1. Samples > 0.5 mg/kg PCBs, source properties identified.
    2. Samples > 0.5 mg/kg PCBs, source properties not identified.
    3. Samples 0.2 – 0.5 mg/kg PCBs.
    4. Samples <0.2 mg/kg PCBs.
    5. No samples collected.
- Low PCBs concentrations in composite stormwater runoff samples from the bottom of some WMA catchments have suggested that either PCBs sources are not prevalent in the catchment or the samples are "false negatives." False negatives could be the result of low rainfall/runoff rates failing to mobilize sediments from source areas and/or other factors. Only a few stormwater runoff sampling stations in San Mateo County have been resampled, but the results from two such stations in South San Francisco, as described by SMCWPPP (2018), suggested small storm sizes may have resulted in false negatives. SMCWPPP, in collaboration with the SCVURPPP, has preliminarily developed a method to normalize results from this type of stormwater runoff monitoring based upon storm intensity. However, the high variability in many of the parameters involved led to a high degree of uncertainty in the evaluation results. SMCWPPP and the SCVURPPP will continue to evaluate normalization methods and results as more data become available in future years, in coordination with related efforts by the RMP (referred to as the RMP's "Advanced Data Analysis").

- In WY 2020, SMCWPPP collected two grab creek water samples in July 2020 that were analyzed for copper, thus meeting the yearly minimum number of copper samples required by MRP Provision C.8.f. The samples were collected from Arroyo Ojo de Agua at Stulsaft Park (City of Redwood City) and Pilarcitos Creek downstream of Highway 101 (City of Half Moon Bay). Total and dissolved copper concentrations measured in WY 2020 were within the ranges measured in prior years. It should also be noted that the requirement to have a cumulative total of four samples addressing Management Question No. 4 (Loads and Status) and No. 5 (Trends) by year four of the Permit (i.e., WY 2019) has also been satisfied (SMCWPPP 2020).

- In WY 2020, SMCWPPP collected two grab creek water samples in July 2020 that were analyzed for nutrients, thus meeting the yearly minimum number of copper samples required by MRP Provision C.8.f. The samples were collected from the same stations as the above copper samples, Arroyo Ojo de Agua at Stulsaft Park (City of Redwood City) and Pilarcitos Creek downstream of Highway 101 (City of Half Moon Bay). The results of these summer sampling events were compared with results from nutrient samples collected in the spring synoptic with biological assessment monitoring. There was very little difference between the spring and summer concentrations of nitrate, nitrate, dissolved orthophosphate, and phosphorus. In contrast, TKN concentrations were lower in the summer samples compared to the spring samples, and the ammonia concentrations were higher in the summer samples compared to the spring samples. It should also be noted that the requirement to have a cumulative total of 20 nutrient samples addressing Management Question No. 4 (Loads and Status) by year four of the Permit (i.e., WY 2019) has also been satisfied (SMCWPPP 2020).
- In accordance with MRP requirements, a comprehensive QA/QC program was implemented by SMCWPPP covering all aspects of POC monitoring conducted during WY 2020. Overall, the results of the QA/QC review suggest that the data generated during WY 2020 POC monitoring were of sufficient quality for the purposes of this program. While some data were flagged in the project database based on the MQOs and DQOs identified in the QAPPs, none of the data was rejected.
- MRP provision C.8.h.i. requires Permittees 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 WY 2020 by SMCWPPP were compared to applicable numeric Water Quality Objectives (WQOs) included in the Basin Plan (SFBRWQCB 2017). Of the WY 2020 POC monitoring analytes, promulgated WQOs for the protection of aquatic life only exist for dissolved copper and unionized ammonia. None of the WY 2020 sample results exceeded the applicable WQOs.
- MRP Provision C.12.g. requires Permittees to conduct or cause to be conducted studies concerning the fate, transport, and biological uptake of PCBs discharged from urban runoff to San Francisco Bay margin areas. The provision states: "the specific information needs include understanding the in-Bay transport of PCBs discharged in urban runoff, the sediment and food web PCBs concentrations in margin areas receiving urban runoff, the influence of urban runoff on the patterns of food web PCBs accumulation, especially in Bay margins, and the identification of drainages where urban runoff PCBs are particularly important in food web accumulation." C.12.g. requires Permittees to report in this IMR "the findings and results of the studies completed, planned, or in progress as well as implications of studies on potential control measures to be investigated, piloted or implemented in future permit cycles." Attachment 1 provides a summary of a multi-year project by the San Francisco Bay (Bay) Regional Monitoring Program (RMP) that is addressing the requirements of Provision C.12.g. The project:
    - Identified four PMUs for initial study that are located downstream of urban watersheds where PCBs management actions are ongoing and/or planned;
    - Is developing conceptual and PCBs mass budget models for each of the four PMUs; and
    - Is conducting monitoring in the PMUs to evaluate trends in pollutant levels and track responses to pollutant load reductions.

- During WY 2020, SMCWPPP continued working with other Bay Area stormwater programs to help oversee RMP special studies that satisfy the POC monitoring requirement for CECs within Provision C.8.f.
- In WY 2021, SMCWPPP will continue to collect samples for PCBs, mercury, copper, and nutrients analysis in compliance with provision MRP C.8.f.
- In WY 2021, SMCWPPP will continue to participate in the RMP's STLS and the RMP's CEC Strategy.

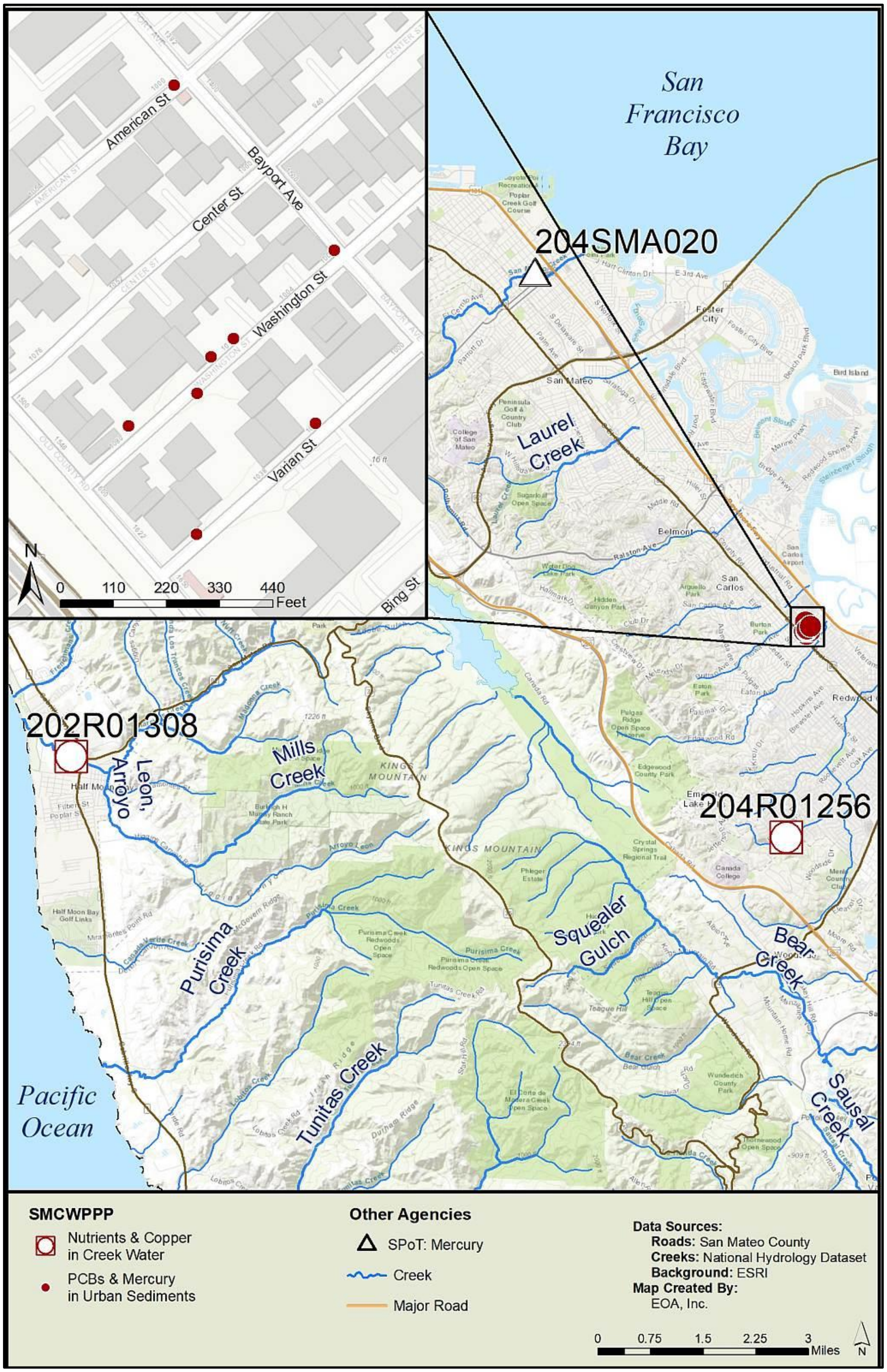

Figure E-2. Pollutants of Concern (POC) Monitoring stations in San Mateo County, WY 2020. Inset: locations where urban sediment samples were collected for PCBs and mercury analysis.

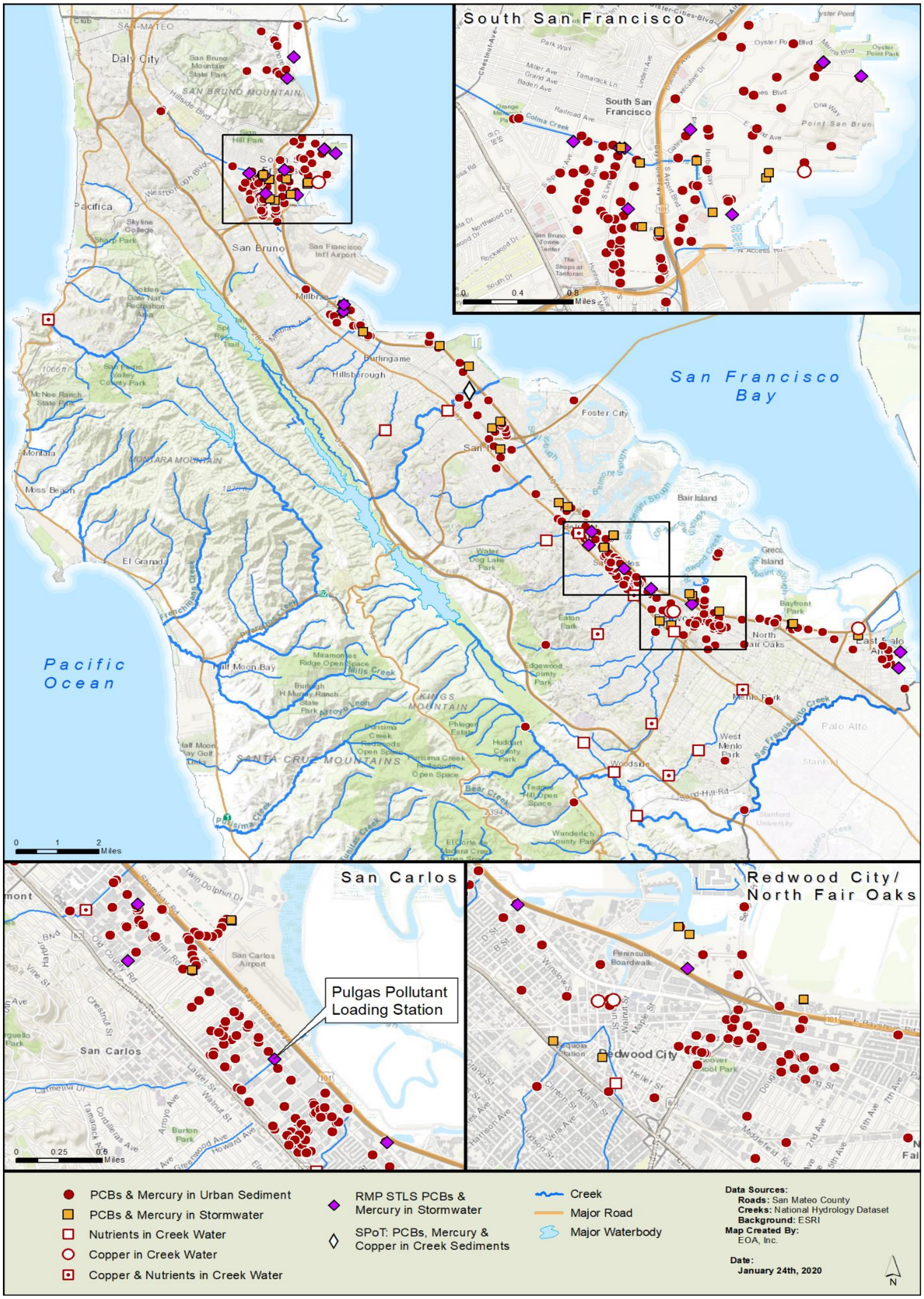

Figure E-3. Pollutants of Concern (POC) monitoring stations in San Mateo County, including nutrients and copper samples collected WYs 2014 – 2020 and PCBs/mercury samples collected early 2000s through WY 2020. Insets at bottom zoom in to areas sampled more densely to show additional detail.

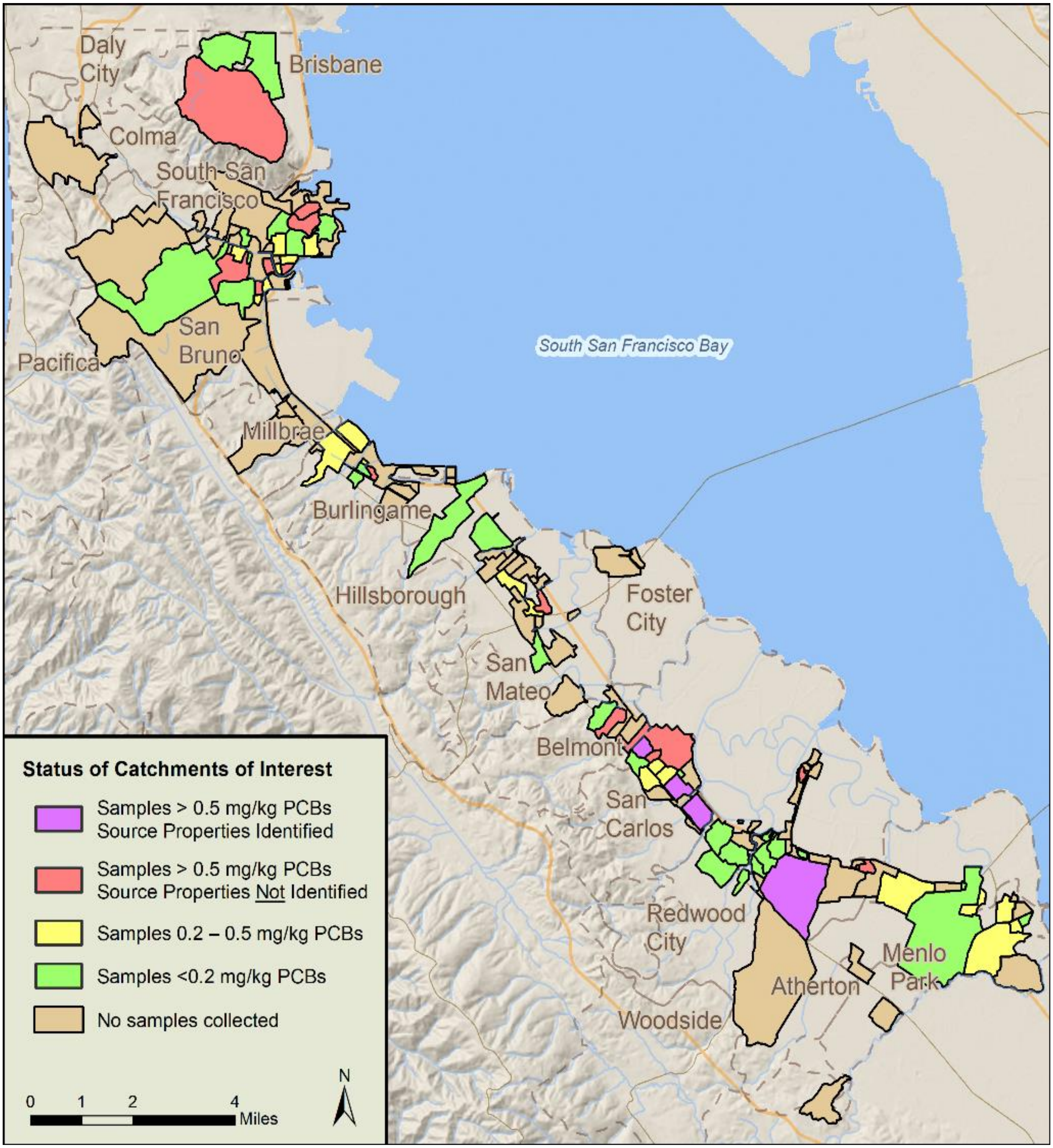

Figure E-4. Status of PCBs source property investigations in San Mateo County Watershed Management Areas (WMAs), based upon total PCBs concentrations in sediment samples and/or PCBs particle ratio in stormwater runoff samples collected from the WMAs through WY 2020.

REFERENCES

BASMAA (Bay Area Stormwater Management Agency Association). 2016. Creek Status and Pesticides & Toxicity Monitoring Standard Operating Procedures, Final Version 3. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 190 pp.

BASMAA (Bay Area Stormwater Management Agency Association) Regional Monitoring Coalition (RMC). 2020. Creek Status and Pesticides & Toxicity Monitoring Quality Assurance Project Plan, Final Version 4. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 79 pp plus appendices.

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NMFS (National Oceanic and Atmospheric Administration National Marine Fisheries Services). 2010. Biological Opinion for the San Francisco Public Utilities Commission's proposed Lower Crystal Springs Dam Improvements (Corps File #30317S), Crystal Springs/San Andreas Transmission System Upgrade (Corps File #400143S), and San Joaquin Pipeline System (Corps File #2008-01001) projects in San Mateo and San Joaquin counties, California.

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URBAN CREEKS MONITORING REPORT

PART A: CREEK STATUS AND PESTICIDES & TOXICITY MONITORING IN SAN MATEO COUNTY

Water Year 2020



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

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program

A Program of the City/County Association of Governments

March 31, 2021

CREDITS

This report is submitted by the participating agencies in the

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.
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City of Belmont	City of Half Moon Bay	City of San Carlos
City of Brisbane	Town of Hillsborough	City of San Mateo
City of Burlingame	City of Menlo Park	City of South San Francisco
Town of Colma	City of Millbrae	Town of Woodside
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Preface

In early 2010, several members of the Bay Area Stormwater Agencies Association (BASMAA) joined together to form the Regional Monitoring Coalition (RMC), to coordinate and oversee water quality monitoring required by the Municipal Regional National Pollutant Discharge Elimination System (NPDES) Stormwater Permit (in this document the permit is referred to as MRP)[1]. The RMC is comprised of the following participants:

- Alameda Countywide Clean Water Program (ACCWP)
- Contra Costa Clean Water Program (CCCWP)
- San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
- Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
- Fairfield-Suisun Urban Runoff Management Program (FSURMP)
- City of Vallejo and Vallejo Flood and Wastewater District (Vallejo)

This Urban Creeks Monitoring Report (UCMR) Part A: Creek Status and Pesticides & Toxicity Monitoring, Water Year (WY) 2020 complies with Provision C.8.h.iii of the MRP for reporting of all data collected during the foregoing October 1 – September 30 period (i.e., WY 2020; October 1, 2019 through September 30, 2020). Data were collected pursuant to Creek Status Monitoring and Pesticides & Toxicity Monitoring requirements of MRP Provision C.8. Data presented in this report were developed under the direction of the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) and in collaboration with the RMC, using probabilistic and targeted monitoring designs as described herein.

Consistent with the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), monitoring data were collected in accordance with the most recent versions of the BASMAA RMC Quality Assurance Project Plan (QAPP; BASMAA, 2020) and BASMAA RMC Standard Operating Procedures (SOPs; BASMAA, 2016). Where applicable, monitoring data were derived using methods comparable with methods specified by the California Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Program Plan (QAPrP)[2]. Data presented in this report were also submitted in electronic SWAMP-comparable formats by SMCWPPP to the San Francisco Bay Regional Water Quality Control Board on behalf of San Mateo County Permittees and pursuant to Provision C.8.h.ii of the MRP.

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[1] The San Francisco Bay Regional Water Quality Control Board (SFRWQCB or Regional Water Board) issued the MRP to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFRWQCB 2009). On November 19, 2015, the Regional Water Board updated and reissued the MRP (SFRWQCB 2015). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees as well as the cities of Antioch, Brentwood, and Oakley, which are not named as Permittees under the MRP but have voluntarily elected to participate in MRP-related regional activities.

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

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List of Acronyms

ACCWP	Alameda Countywide Clean Water Program
AFDM	Ash Free Dry Mass
AFS	American Fisheries Society
ASCI	Algae Stream Condition Index
BASMAA	Bay Area Stormwater Management Agency Association
BMI	Benthic Macroinvertebrate
BMP	Best Management Practices
C/CAG	City/County Association of Governments
CCCWP	Contra Costa Clean Water Program
CDC	Center for Disease Control
CDFW	California Department of Fish and Wildlife
CEDEN	California Data Exchange Network
COLD	Cold Freshwater Habitat
CSCI	California Stream Condition Index
D_ASCI	Diatom Algae Stream Condition Index
DF	Detection Frequency
DO	Dissolved Oxygen
DPR	Department of Pesticide Regulation
EMAP	Environmental Monitoring and Assessment Program
FSURMP	Fairfield Suisun Urban Runoff Management Program
GIS	Geographic Information Systems
GM	Geometric Mean
GRTS	Generalized Random Tessellation Stratified
GSI	Green Stormwater Infrastructure
IMR	Integrated Monitoring Report
IPI	Index Physical Habitat Integrity
IPM	Integrated Pest Management
LID	Low Impact Development
MDL	Method Detection Limit
MIGR	Fish Migration
MMI	Multimetric Index
MPC	Monitoring and Pollutants of Concern Committee
MPN	Most Probable Number
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
MUN	Municipal and Domestic Water Supply Beneficial Use
MWAT	Maximum Weekly Average Temperature
MWMT	Maximum Weekly Maximum Temperature
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
O/E	Observed to Expected
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PEC	Probable Effects Concentrations
PHAB	Physical Habitat Assessments
pMMI	Predictive Multimetric Index
PSA	Perennial Streams Assessment
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
RARE	Preservation of Rare and Endangered Species
REC-1	Water Contact Recreation
RM	Reporting Module

RMC	Regional Monitoring Coalition
RWB	Reach-wide Benthos
RWQC	Recreation Water Quality Criteria
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCAPE	Stream Classification and Priority Explorer
SCCWRP	Southern California Coastal Water Research Project
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SMC	Southern California Monitoring Coalition
SMCWPPP	San Mateo County Water Pollution Prevention Program
SOP	Standard Operating Protocol
SPoT	Stream Pollution Trends Program
SPWN	Fish Spawning
SRP	Stormwater Resource Plan
SSID	Stressor/Source Identification
SWAMP	Surface Water Ambient Monitoring Program
SWPP	Surface Water Protection Program
TEC	Threshold Effects Concentrations
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TST	Test of Significant Toxicity
TU	Toxicity Unit
UCMR	Urban Creeks Monitoring Report
USEPA	Environmental Protection Agency
WARM	Warm Freshwater Habitat
WQO	Water Quality Objective
WY	Water Year

1.0 Introduction

This *Urban Creeks Monitoring Report (UCMR) Part A: Creek Status and Pesticides & Toxicity Monitoring, Water Year*[3] *(WY) 2020* was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP). SMCWPPP is a program of the City/County Association of Governments (C/CAG) of San Mateo County. Each incorporated city and town in the county and the County of San Mateo share a common 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). The next iteration of the MRP (i.e., MRP 3.0) is currently under development and is anticipated to become effective July 1, 2022.

This report fulfills the requirements of Provision C.8.h.iii of the current MRP for interpreting and reporting all Creek Status and Pesticides & Toxicity monitoring data collected during WY 2020 by SMCWPPP. Data presented in this report were collected pursuant to water quality monitoring requirements in provisions C.8.d. (Creek Status Monitoring) and C.8.g. (Pesticides & Toxicity Monitoring) of the MRP.[4] Data presented in this report were submitted electronically to the Regional Water Board by SMCWPPP and may be obtained via the California Environmental Data Exchange Network (CEDEN).

Sections of this report are organized according to the following topics:

- **Section 1.0** – Introduction including overview of SMCWPPP goals, background, monitoring approach, and statement of data quality
- **Section 2.0** – Biological condition assessment and stressor analysis at probabilistic sites
- **Section 3.0** – Continuous water quality monitoring (temperature, general water quality)
- **Section 4.0** – Pathogen indicators
- **Section 5.0** – Chlorine monitoring
- **Section 6.0** – Pesticides & Toxicity monitoring
- **Section 7.0** – Conclusions and recommendations
- **Section 8.0** – Summary of stormwater management programs

[3] 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 2020 (WY 2020) began on October 1, 2019 and concluded on September 30, 2020.

[4] Monitoring data collected pursuant to other C.8 provisions (e.g., Pollutants of Concern Monitoring, Stressor/Source Identification Monitoring Projects) are reported in other Parts of the SMCWPPP Urban Creeks Monitoring Report (UCMR) for WY 2020.

1.1 COVID-19 Emergency

During WY 2020, Program management activities were impacted by the COVID-19 public health emergency and issuance of State and local orders requiring that residents of San Mateo County reduce the spread of the disease by staying home as much as possible. The County Shelter in Place (SIP) order has generally been more restrictive than the State order and has required extended restrictions for all activity, travel, and governmental and business functions not deemed “essential.” On March 20, 2020, the State Water Resources Control Board (State Water Board) informed the regulated community, via a website post[5], that timely compliance with all Water Board orders, including NPDES Permits, is generally considered to be an essential function during the COVID-19 response. As a result, activities necessary to implement MRP monitoring requirements were conducted by SMCWPPP consistent with SIP directives and in consideration of the State Water Board communications.

To control the spread of COVID-19 during implementation of monitoring activities, SMCWPPP monitoring consultants developed Standard Operating Procedures (SOPs) based on Center for Disease Control (CDC) guidance. The SOPs consist of hygiene and social distancing practices, and are updated as needed when new information regarding COVID-19 becomes available and/or when State and local SIP orders are revised.

In spite of the challenges presented by the COVID-19 public health emergency, SMCWPPP successfully completed all WY 2020 water quality monitoring requirements described in provisions C.8.d. (Creek Status Monitoring) and C.8.g. (Pesticides & Toxicity Monitoring) of the MRP. Implementation of the COVID-19 SOPs did not impact sampling results or data quality.

1.2 Monitoring Goals

Provision C.8.d of the MRP requires Permittees to conduct creek status monitoring that is intended to answer the following management questions:

1. ***Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, rivers, and tributaries?***
2. ***Are conditions in local receiving water supportive of or likely supportive of beneficial uses?***

The first management question is addressed primarily through the evaluation of probabilistic and targeted monitoring data with respect to the triggers defined in the MRP. Sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses and are considered for future evaluation via Stressor/Source identification (SSID) projects.

The second management question is addressed by assessing indicators of beneficial uses. For example, the indices of biological integrity based on benthic macroinvertebrate and algae data are direct measures of the condition of aquatic life beneficial uses. Continuous monitoring data (temperature, dissolved oxygen, pH, and specific conductance) are evaluated with respect to COLD and WARM Beneficial Uses. Pathogen indicator data are used to assess REC-1 (water contact recreation) Beneficial Uses.

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[5] https://www.waterboards.ca.gov/resources/covid-19_updates/index.html

Creek Status and Pesticides & Toxicity monitoring parameters, methods, occurrences, durations and minimum number of sampling sites are described in Provisions C.8.d. and C.8.g. of the MRP, respectively.

The monitoring requirements in MRP 2.0 (SFRWQCB 2015) are similar to MRP 1.0 (SFRWQCB 2009) requirements (which began implementation on October 1, 2011) and build upon earlier monitoring conducted by SMCWPPP. Creek Status and Pesticides & Toxicity monitoring is coordinated through the Bay Area Stormwater Agencies Association (BASMAA) Regional Monitoring Coalition (RMC). Monitoring results are evaluated to determine whether triggers are met, and further investigation should be considered as part of a potential SSID Project, as described in Provision C.8.e. of the MRP.

Results of Creek Status and Pesticides & Toxicity Monitoring conducted in Water Years 2012 through 2019 were detailed in prior reports (SMCWPPP 2020, SMCWPPP 2019a, SMCWPPP 2018, SMCWPPP 2017, SMCWPPP 2016, SMCWPPP 2015, SMCWPPP 2014).

1.3 Regional Monitoring Coalition

Provision C.8.a (Compliance Options) of the MRP allows Permittees to address monitoring requirements through a regional collaborative effort, their Stormwater Program, and/or individually. The RMC was formed in early 2010 as a collaboration among a number of the BASMAA members and MRP Permittees (Table 1.1) to develop and implement a regionally coordinated water quality monitoring program to improve stormwater management in the region and address water quality monitoring required by the MRP[6]. Implementation of the RMC's Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012) allows Permittees and the Regional Water Board to improve their ability to collectively answer core management questions in a cost-effective and scientifically rigorous way. Participation in the RMC is facilitated through the BASMAA Monitoring and Pollutants of Concern (MPC) Committee.

[6] The Regional Water Board issued the first five-year MRP to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (MRP 1.0; SFRWQCB 2009). On November 19, 2015, the Regional Water Board updated and reissued the MRP (MRP 2.0; SFRWQCB 2015). The BASMAA programs supporting MRP Regional Projects include all MRP Permittees.

Table 1.1. Regional Monitoring Coalition 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
Alameda Countywide Clean Water Program (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 and Sea Level Rise Resiliency 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 Flood and Wastewater District

The goals of the RMC are to:

1. Assist Permittees in complying with requirements in MRP Provision C.8 (Water Quality Monitoring);

2. Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area, through the improved coordination among RMC participants and other agencies (e.g., Regional Water Board) that share common goals; and

3. Stabilize the costs of creek monitoring by reducing duplication of effort and streamlining reporting.

The RMC's monitoring strategy for complying with Creek Status Monitoring is described in the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). The strategy includes regional ambient/probabilistic monitoring and local "targeted" monitoring. The combination of these two components allows each individual RMC participating program to assess the status of beneficial uses in local creeks within its jurisdictional area, while also contributing data to answer management questions at the regional scale (e.g., differences between aquatic life condition in urban and non-urban creeks). The current MRP (MRP 2.0) specifically prescribes the probabilistic/targeted approach and most of the other details of the RMC Creek Status and Long-Term Trends Monitoring Plan. Table 1.2 provides a list of which monitoring parameters are included in the probabilistic versus the targeted programs. This report includes data collected in San Mateo County under both monitoring components. Data are organized into report sections that reflect the format of monitoring requirements in the MRP.

Table 1.2. Monitoring parameters of MRP Provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides & Toxicity Monitoring) and associated monitoring component.

Monitoring Elements	Monitoring Component		Report Section
	Regional Ambient (Probabilistic)	Local (Targeted)	
Creek Status Monitoring (C.8.d)			
Bioassessment & Physical Habitat Assessment	X	X[1]	2.0
Nutrients	X	X[1]	2.0
General Water Quality (Continuous)		X	3.0
Temperature (Continuous)		X	3.0
Pathogen Indicators		X	4.0
Chlorine	X	X[2]	5.0
Pesticides & Toxicity Monitoring (C.8.g)			
Water Toxicity		X	6.0
Water Chemistry		X	6.0
Sediment Toxicity		X	6.0
Sediment Chemistry		X	6.0

Notes:
[1] Provision C.8.d.i.(6) allows for up to 20% of sample locations to be selected on a targeted basis.
[2] Provision C.8.d.ii.(2) provides options for probabilistic or targeted site selection. In WY 2012 - 2020, chlorine was measured at probabilistic and targeted bioassessment sites.

1.4 Monitoring and Data Assessment Methods

1.4.1 Monitoring Methods

Water quality data were collected in accordance with California Surface Water Ambient Monitoring Program (SWAMP) comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and the associated Quality Assurance Project Plan (QAPP; BASMAA 2020). These documents are updated as needed to stay current and optimize applicability. Where applicable, monitoring data were collected using methods comparable to those specified by the SWAMP Quality Assurance Program Plan (QAPrP)[7], and were submitted in SWAMP-compatible format to the Regional Water Board. The SOPs were developed using a standard format that describes health and safety cautions and considerations, relevant training, site selection, and sampling methods/procedures, including pre-fieldwork mobilization activities to prepare equipment, sample collection, and de-mobilization activities to preserve and transport samples.

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

1.4.2 Laboratory Analysis Methods

RMC participants, including SMCWPPP, agreed to use the same laboratories for individual parameters (except pathogen indicators), developed standards for contracting with the labs, and coordinated quality assurance samples. All samples collected by RMC participants that were sent to laboratories for analysis were analyzed and reported per SWAMP-comparable methods as described in the BASMAA QAPP (BASMAA 2020). Analytical laboratory methods, reporting limits and holding times for chemical water quality parameters are also described in the BASMAA QAPP (2020). Analytical laboratory contractors in WY 2020 included:

- BioAssessment Services, Inc. – Benthic macroinvertebrate (BMI) identification
- EcoAnalysts, Inc. – Algae identification
- CalTest, Inc. – Sediment chemistry, nutrients, chlorophyll a, ash free dry mass
- Pacific EcoRisk, Inc. – Water and sediment toxicity
- Alpha Analytical – Pathogen indicators

1.4.3 Data Analysis Methods

Monitoring data generated during WY 2020 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions, including exceedances of water quality objectives (WQOs). Creek Status Monitoring and Pesticides & Toxicity Monitoring data are evaluated with respect to numeric thresholds (i.e., triggers) specified in the MRP (SFRWQCB 2015). Sites with monitoring data that do not meet WQOs and/or exceed MRP trigger thresholds require consideration for further evaluation as part of a Stressor/Source Identification project. SSID projects are intended to be oriented toward taking action(s) to alleviate stressors and reduce sources of pollutants. A stepwise process for conducting SSID projects is described in Provision C.8.e.iii. of the MRP.

In compliance with Provision C.8.e.i of the MRP 2.0, all monitoring results exceeding trigger thresholds are added to a list of candidate SSID projects that will be maintained throughout the permit term. Follow-up SSID projects are selected from this list.

1.5 Setting

There are 34 watersheds in San Mateo County draining an area of about 450 square miles. The San Mateo Range of the Santa Cruz Mountains runs north/south and divides the county roughly in half. The eastern half of the county (“Bayside”) drains to San Francisco Bay and is characterized by relatively flat, urbanized areas along the Bay. To varying degrees, portions of all Bayside watersheds within the urban zone have been engineered or placed within underground culverts. The western half of the county (“coastside”) drains to the Pacific Ocean and consists of approximately 50 percent parkland and open space, with agriculture and relatively small urban areas.

The complete list of probabilistic and targeted monitoring sites sampled by SMCWPPP in WY 2020 in compliance with Provisions C.8.d. (Creek Status Monitoring) and C.8.g. (Pesticides & Toxicity Monitoring) is presented in Table 1.3. Probabilistic station numbers, generated from the RMC Sample Frame, are provided for all bioassessment locations. Targeted stations numbers, based on SWAMP station numbering methods (BASMAA 2016), are provided for all targeted monitoring sites. Monitoring locations with monitoring parameter(s) from WY 2020 are mapped in Figure 1.1.

Table 1.3. Sites and parameters monitored in WY 2020 in San Mateo County.

Map ID [1]	Station ID	Bayside or Coastside	Watershed	Creek Name	Land Use	Latitude	Longitude	Bioassessment, Nutrients, General WQ	Chlorine	Pesticides & Toxicity	Temp[2]	Cont WQ[3]	Pathogen Indicators
1308	202R01308	Coastal	Pilarcitos Creek	Pilarcitos Creek	U	37.4684	-122.4363	X	X				
4568	202R04568	Coastal	San Pedro Creek	San Pedro Creek	U	37.5808	-122.4798	X	X				
5464	202R05464	Coastal	San Pedro Creek	San Pedro Creek	U	37.5869	-122.4953	X	X				
680	204R00680	Bayside	Redwood Creek	Redwood Creek	U	37.4379	-122.2410	X	X				
1256	204R01256	Bayside	Redwood Creek	Arroyo Ojo de Agua	U	37.4545	-122.2505	X	X				
2228	204R02228	Bayside	San Mateo Creek	San Mateo Creek	U	37.5610	-122.3374	X	X				
3272	204R03272	Bayside	San Mateo Creek	San Mateo Creek	U	37.5339	-122.3503	X	X				
3528	204R03528	Bayside	San Mateo Creek	San Mateo Creek	U	37.5483	-122.3463	X	X				
4884	204R04884	Bayside	San Mateo Creek	San Mateo Creek	U	37.5406	-122.3499	X	X				
5176	204R05176	Bayside	Laurel Creek	Laurel Creek	U	37.5333	-122.3045	X	X				
ADMS	ADMS	Coastal	San Pedro Creek	San Pedro Creek	U	37.5869	-122.4954						X
USSH	USSH	Coastal	San Pedro Creek	San Pedro Creek	U	37.5872	-122.4959						X
PRLT	PRLT	Coastal	San Pedro Creek	San Pedro Creek	U	37.5885	-122.4994						X
SHAO	SHAO	Coastal	San Pedro Creek	Shamrock Creek	U	37.5879	-122.4987						X
SPCM	SPCM	Coastal	San Pedro Creek	San Pedro Creek	U	37.5962	-122.5056						X
070	204SMA070	Bayside	San Mateo Creek	San Mateo Creek	U	37.5609	-122.3374				X		
080	204SMA080	Bayside	San Mateo Creek	San Mateo Creek	U	37.5481	-122.3463				X	X	
090	204SMA090	Bayside	San Mateo Creek	San Mateo Creek	U	37.5403	-122.3499				X		
108	204SMA108	Bayside	San Mateo Creek	Polhemus Creek	U	37.5305	-122.3486				X		
110	204SMA110	Bayside	San Mateo Creek	San Mateo Creek	U	37.5331	-122.3505				X	X	
008	205BCR008	Bayside	San Francisquito Cr	Bear Creek	U	37.4112	-122.2411			X			

U = urban, NU = non-urban

[1] Map ID applies to Figure 1.1.

[2] Temperature monitoring was conducted continuously (i.e., hourly) April through September.

[3] Continuous water quality monitoring (temperature, dissolved oxygen, pH, specific conductivity) was conducted during two 2-week periods (spring and late summer).

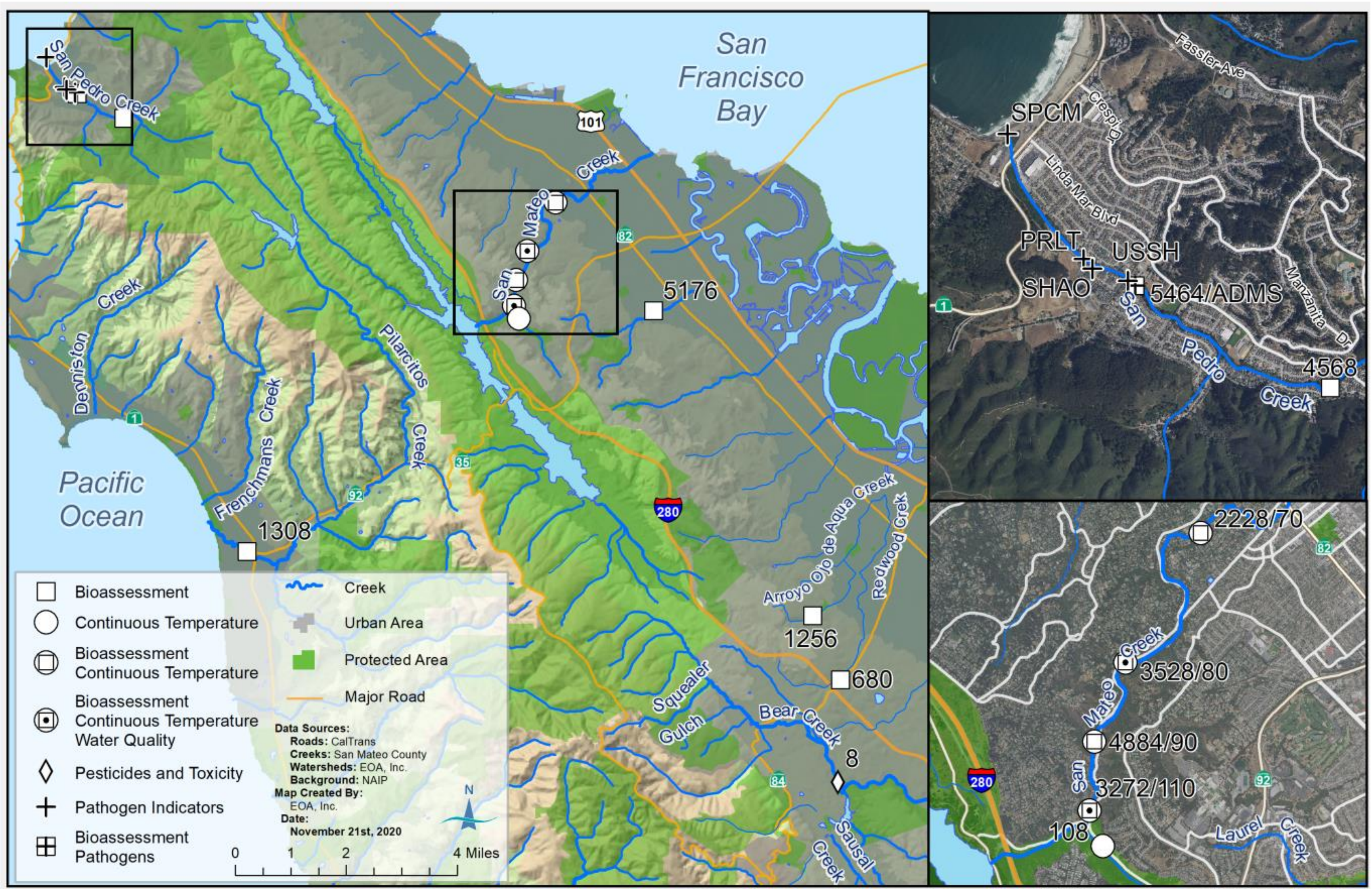

Figure 1.1. SMCWPPP Program Area, major creeks, and sites monitored in WY 2020.

1.5.1 Designated Beneficial Uses

Beneficial Uses in San Mateo County creeks are designated by the Regional Water Board for specific water bodies and serve as the basis for establishing WQOs designed to protect those uses (SFBRWQCB 2017). All creeks in San Mateo County, except a few coastal creeks, are designated as having warm freshwater habitat (WARM) Beneficial Use. Nearly all coastal creeks and a few bayside creeks, such as San Mateo Creek and San Francisquito Creek, are designated as having cold freshwater habitat (COLD) Beneficial Use, meaning they historically or currently support trout, anadromous salmon, and/or steelhead fisheries. Dissolved oxygen WQOs are more stringent in creeks with COLD beneficial uses because these species are relatively intolerant to environmental stresses. Virtually all creeks in the region are designated as having water contact recreation (REC-1) beneficial uses, such as swimming where ingestion of water is considered reasonably possible; however, for most creeks this is a presumed Use that has not been documented and may not actually exist. Fecal indicator bacteria WQOs are identified to protect the REC-1 Beneficial Use. Several coastal creeks, as well as Bear Gulch Creek and Crystal Springs Reservoir in the San Mateo Creek watershed, are designated as having the municipal and domestic supply (MUN) Beneficial Use, due to the presence of drinking water reservoirs and/or diversions for these purposes. The Basin Plan identifies WQOs for several constituents of concern that apply only to waters with the MUN Beneficial Use, i.e., chloride and nitrate. Beneficial Uses for creeks monitored in WY 2020 are listed in Table 1.4.

Table 1.4. Beneficial Uses designated by the Regional for creeks monitored in WY 2020 in the San Mateo County (SFBRWQCB 2017).

Creek	Receiving Water	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
Arroyo Ojo de Agua	SF Bay															E	E	E	E	
Bear Creek	SF Bay									E			E	E	E	E	E	E	E	
Laurel Creek	SF Bay															E	E	E	E	
Pilarcitos Creek	Coastal	E	E							E			E	E	E	E	E	E	E	
Redwood Creek	SF Bay															E	E	E	E	
San Mateo Creek	SF Bay			E						E			E	E	E	E	E	E	E	
San Pedro Creek	Coastal		E							E			E	E	E	E	E	E	E	

Notes:
E = Existing Use

1.5.2 Climate

San Mateo County experiences a Mediterranean-type climate with cool, wet winters and hot, dry summers. The area is characterized by microclimates created by topography, ocean currents, fog exposure, and onshore winds which can result in large differences in temperature and rainfall within relatively short distances. The wet season typically extends from October through April with local long-term, mean annual precipitation ranging from 20 inches near the Bay to over 40 inches along the highest ridges of the San Mateo Mountain Range (PRISM Climate

Group 30-year normals, 1981-2010[8]). Figure 1.2 illustrates the geographic variability of mean annual precipitation in the area based on statistical models; actual measured precipitation each year rarely equals the statistical average. Figure 1.3 illustrates the temporal variability in annual precipitation measured at the San Francisco International Airport (SFO) from WY 1946 to WY 2020. This record illustrates that extended periods of drought are common and often punctuated by above average years. Creek Status Monitoring in compliance with the MRP began in WY 2012 which was the first year of a severe statewide drought that persisted through WY 2016. WY 2020 rainfall was below average at SFO, but it was preceded by a relatively wet year in WY 2019.

The overall Bay Area climate and the specific conditions within any given year are influenced by global climate change. The Climate Change Assessment report for the Bay Area highlights several impacts of climate change that are already being felt: the Bay Area's average annual maximum temperature increased by nearly 1°C from 1950 – 2005, coastal fog along the coast may be less frequent, and sea level in the Bay Area has risen over eight inches (Ackerly et al. 2018). These changes are projected to increase significantly in the coming decades. As a consequence, heat extremes, high year-to-year variability in precipitation, droughts, intense storms, wildfire and other events will likely also increase.

Climate patterns (e.g., extended droughts) and individual weather events (e.g., extreme storms, hot summers) influence biological communities (i.e., vegetation, wildlife) and their surrounding physical habitat and water quality. They should therefore be considered when evaluating the type of data collected by the Creek Status Monitoring Program. For example, periods of drought (rather than individual dry years) can result in changes in riparian and upland vegetation communities. Long drought periods are associated with increased streambed sedimentation, which can persist directly or indirectly for many years, depending on the occurrence and magnitude of flushing flow events. Furthermore, in response to prolonged drought, the relative proportion of pool habitat can increase at the expense of riffle habitat.

It is uncertain what effect these factors have on indices of biotic integrity that are calculated using data collected by the Creek Status Monitoring Program, such as benthic macroinvertebrates or algae. A study evaluating 20 years of bioassessment data collected in northern California showed that, although benthic macroinvertebrate taxa with certain traits may be affected by dry (and wet) years and/or warm (and cool) years, indices based on these organisms appear to be resilient (Mazor et al. 2009, Lawrence et al. 2010). However, this study did not specifically examine the impact of longer *periods* of extended drought or heat on biological indices, which would require analysis of a dataset with a much longer period of record. The Herbst Lab at the Sierra Nevada Aquatic Research Laboratory, University of California Santa Barbara recently completed a study exploring how flooding and droughts vary taxa metrics in the Sierra Nevada streams. While species diversity and density remained relatively unchanged during flooding, extreme dry weather conditions significantly impacted benthic macroinvertebrate population structure. These differences were exacerbated with continued exposure to drought (Herbst et al. 2019). Similar changes to the benthic macroinvertebrate community in San Mateo County streams may have occurred during the WY 2012 – WY 2016 drought but have not been evaluated.

[8] http://www.prism.oregonstate.edu/normals/

Figure 1.2. Average annual precipitation in San Mateo County, modeled by the PRISM Climate Group for the period of 1981-2010.

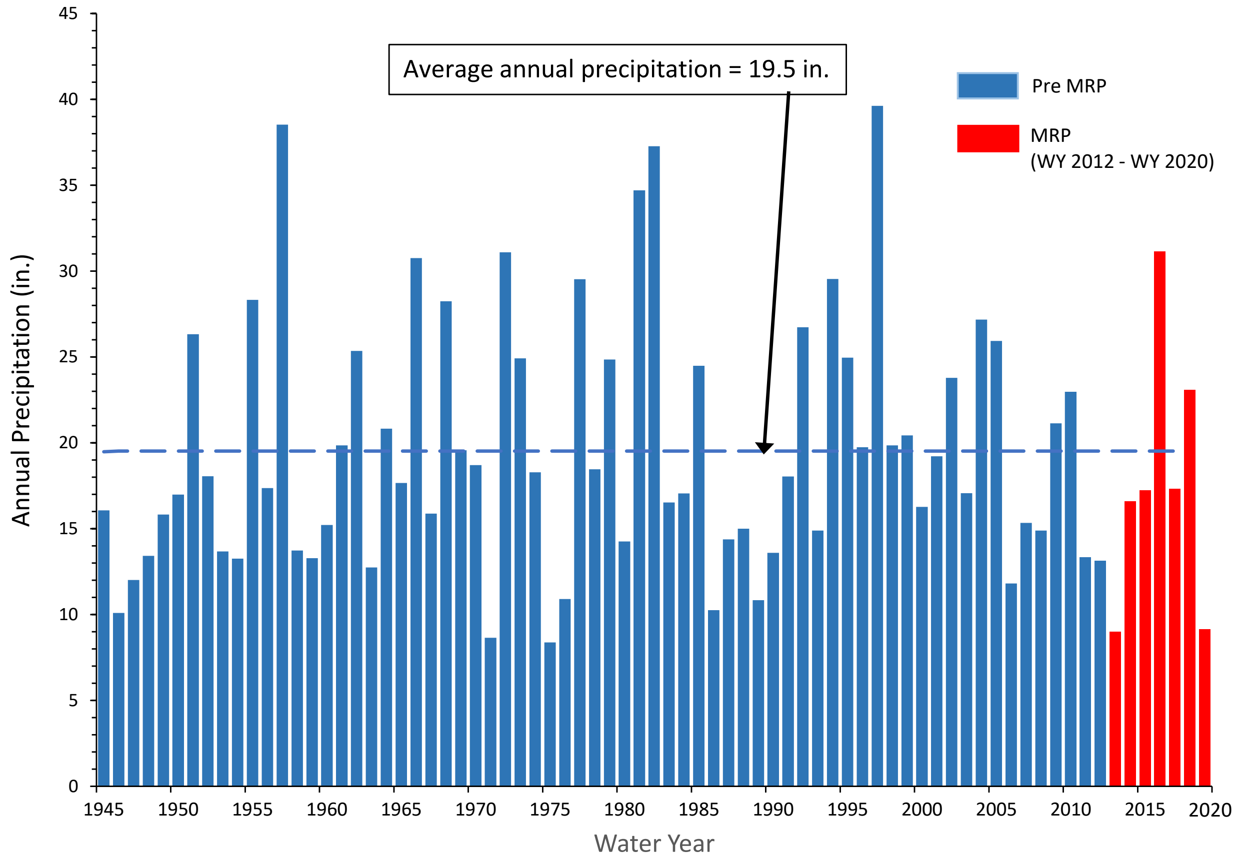

Figure 1.3. Annual rainfall recorded at the San Francisco International Airport, WY 1946 – WY 2020.

1.6 Statement of Data Quality

A comprehensive Quality Assurance/Quality Control (QA/QC) program was implemented by SMCWPPP covering all aspects of Creek Status and Pesticides & Toxicity monitoring. In general, QA/QC procedures were implemented as specified in the BASMAA RMC QAPP (BASMAA, 2020) and monitoring was performed according to protocols specified in the BASMAA RMC SOPs (BASMAA 2016). Both of these documents were adapted from the methods detailed in the SWAMP QAPrP[9].

Overall, the results of the QA/QC review suggests that the Creek Status and Pesticides & Toxicity Monitoring data generated during WY 2020 were of sufficient quality for the purposes of this monitoring program, in comparison to objectives outlined in the QAPP. However, some data were rejected or flagged in accordance with QA/QC protocols. A summary of the QA/QC analysis is provided below:

[9] The current SWAMP QAPrP is available at:
http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf

- All ammonia concentrations are potentially biased high, but data were not flagged or rejected until this finding can be confirmed and the source identified. A small-scale investigation of ammonia analytical methods is planned for WY 2021.
- All of the continuous pH data collected at station 204SMA0110 and all of the specific conductivity data collected at station 204SMA080 during the September 2020 deployment were rejected due to failed calibration checks upon equipment removal.
- Some data were flagged for reasons such as results below the reporting limit but above the detection limit (free chlorine and total chlorine residual), and field duplicates exceeding relative percent difference objectives (chlorophyll a, ammonia, lead).

A detailed QA/QC report for WY 2020 data is included as Attachment 1.

2.0 Biological Condition Assessment

2.1 Introduction

SMCWPPP has conducted bioassessment monitoring since WY 2012 in San Mateo County creeks in compliance with Creek Status Monitoring Provisions C.8.c. of MRP 1.0 and C.8.d.i. of MRP 2.0. Nearly all bioassessment monitoring has been performed at randomly selected sites using a probabilistic monitoring design. The probabilistic monitoring design allows each individual RMC participating program to objectively assess creek ecosystem conditions within its program area (i.e., county jurisdictional area) while contributing data to answer regional management questions about water quality and beneficial use condition in San Francisco Bay Area creeks. The probabilistic design provides an unbiased framework for condition assessment of ambient aquatic life uses within known estimates of precision. The monitoring design was developed to address management questions for RMC participating counties and the overall RMC area:

1. *What is the condition of aquatic life in creeks in the RMC area; are water quality objectives met and are beneficial uses supported?*
   - i. *What is the condition of aquatic life in the urbanized portion of the RMC area; are water quality objectives met and are beneficial uses supported?*
   - ii. *What is the condition of aquatic life in RMC participant counties; are water quality objectives met and are beneficial uses supported?*
   - iii. *To what extent does the condition of aquatic life in urban and non-urban creeks differ in the RMC area?*
   - iv. *To what extent does the condition of aquatic life in urban and non-urban creeks differ in each of the RMC participating counties?*
2. *What are major stressors to aquatic life in the RMC area?*
   - i. *What are major stressors to aquatic life in the urbanized portion of the RMC area?*
3. *What are the long-term trends in water quality in creeks over time?*

The first question (i.e., *What is the condition of aquatic life in creeks in the RMC area?*) is addressed by assessing indicators of aquatic biological health at probabilistic sampling locations. Once a sufficient number of samples have been collected, ambient biological condition can be estimated for streams at a regional (or countywide) scale. Over the past nine years (WY 2012 through WY 2020), SMCWPPP and the Regional Water Board have sampled 91 probabilistic and 9 targeted sites[10] in San Mateo County. The number of probabilistic samples is sufficient to estimate ambient biological condition for urban streams countywide (66 sites)[11]. There is still an insufficient number of probabilistic samples to accurately assess the ambient biological condition of countywide non-urban streams (25 sites) as well as individual watersheds and smaller jurisdictional areas (i.e., cities).

[10] MRP 2.0 allows for up to 20% of bioassessment surveys at targeted sites to address other types of management questions.

[11] For each of the strata, it is necessary to obtain a sample size of at least 30 in order to evaluate the condition of aquatic life within known estimates of precision. This estimate is defined by a power curve from a binomial distribution (BASMAA 2012).

During site evaluation process in WY 2020, the complete list of San Mateo County probabilistic urban sites from the RMC Sample Frame was evaluated for sampling[12]. As a result, bioassessment surveys were conducted at a combination of probabilistic and targeted sites to meet MRP requirements for bioassessments to be conducted at ten sites each year. A total of six targeted sites were selected. All six targeted sites were previously sampled probabilistic sites and three of these were in San Mateo Creek.

The second question (i.e., *What are major stressors to aquatic life in the RMC area?*) is addressed by evaluation of physical habitat and water chemistry data collected at the probabilistic sites, as potential stressors to biological health. The stressor levels can be compared to biological indicator data through correlation and random forest models. Assessing the extent and relative importance of stressors in predicting biological condition can help prioritize stressors at a regional scale and inform local management decisions.

The third question (i.e., *What are the long-term trends in water quality in creeks over time?*) is addressed by assessing the change in biological condition over several years. Understanding changes in biological condition over time can help evaluate the effectiveness of management actions. Although, long-term trend analysis for the probabilistic survey will require more than nine years of data collection, preliminary trend analysis of biological condition may be possible for some stream reaches using a combination of historical targeted data with the probabilistic data.

All three management questions were comprehensively evaluated using eight years of bioassessment data (WY 2012 – WY 2019) and reported in SMCWPPP's WY 2019 Integrated Monitoring Report (IMR) (SMCWPPP 2020). Results presented in the IMR were similar to findings from an analysis of regional probabilistic data collected during WY 2012 – WY 2016 (BASMAA 2019).

This section of the report presents bioassessment results from WY 2020. In compliance with Provision C.8.d.i.(8) of the MRP, WY 2020 data are compared to triggers and WQOs identified in the MRP. Sites with results exceeding trigger thresholds were added to the list of candidate SSID projects.

2.2 Methods

2.2.1 Probabilistic Survey Design

In WY 2020, SMCWPPP sampled four sites that were selected using the RMC probabilistic design. The RMC probabilistic design was created using the Generalized Random Tessellation Stratified (GRTS) approach developed by the United States Environmental Protection Agency (USEPA) and Oregon State University (Stevens and Olsen 2004). GRTS offers multiple benefits for coordinating among monitoring entities, including the ability to develop a spatially balanced design that produces statistically representative data with known confidence intervals. The GRTS approach has been implemented in California by several organizations including the statewide Perennial Streams Assessment (PSA) conducted by Surface Water Ambient Monitoring Program (Ode et al. 2011) and the Southern California Stormwater Monitoring

[12] A high proportion of probabilistic sites that were evaluated in WY 2020 could not be sampled due to an exceptionally dry winter wet season and a resulting lack of stream flow.

Coalition's (SMC) regional monitoring program conducted by municipal stormwater programs in Southern California (SCCWRP 2007).

Monitoring sites were selected using the GRTS approach from a sample frame consisting of a creek network geographic information system (GIS) data set within the 3,407-square mile RMC area (BASMAA 2012). The sample frame includes non-tidally influenced perennial and non-perennial creeks within five management units representing areas managed by the stormwater programs associated with the RMC (see Table 1.1). There is approximately one site for every stream kilometer in the sample frame. The National Hydrography Plus Dataset (1:100,000) was selected as the creek network data layer to provide consistency with both the Statewide PSA and the SMC, and the opportunity for future data coordination with these programs.

Once the master draw was performed, the list of sites was classified by county and land use (i.e., urban and non-urban) to allow for comparisons between these strata. Urban areas were delineated by combining urban area boundaries and city boundaries defined by the U.S. Census (2000). Non-urban areas were defined as the remainder of the RMC area. Some sites classified as urban fall near the non-urban edge of the city boundaries and have little upstream development. For consistency, these urban sites were not re-classified. Therefore, data values within the urban classification represent a wide range of conditions.

The RMC participants weight their annual sampling efforts so that approximately 80% are in in urban areas and 20% in non-urban areas. In addition, between WY 2012 and WY 2015, SWAMP conducted 34 bioassessments throughout the RMC region at non-urban sites selected from the sample frame, including 10 sites in San Mateo County.

2.2.2 Site Evaluations

Sites identified in the master draw are evaluated by each RMC participant in chronological order using the process described in RMC Standard Operating Procedure FS-12 (BASMAA 2016) which is consistent with the procedure described by Southern California Coastal Water Research Project (SCCWRP 2012). Each site is evaluated to determine if it meets RMC sampling location criteria (e.g., not tidally influenced, sufficient flow, safe accessibility, landowner permission to access site). Site evaluation information is stored in a database and analyzed to determine the statistical significance of local and regional average ambient conditions calculated from the multi-year dataset.

2.2.3 Field Sampling Methods

Bioassessment survey methods were consistent with the BASMAA RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016). In accordance with the RMC QAPP (BASMAA 2020) bioassessments were planned during the spring index period (approximately April 15 – July 15) with the goal to sample a minimum of 30 days after any significant storm (defined as at least 0.5-inch of rainfall within a 24-hour period). The 30-day grace period allows diatom and soft algae communities to recover from peak flows that may scour benthic algae from the bottom of the stream channel.[13] In WY 2020, bioassessment sampling occurred from May 18 to 27, 2020.

[13] The BASMAA 30-day grace period is more conservative than the 21-day grace period described in the SWAMP SOP (Ode et al. 2016).

The last significant storm of the season occurred on April 6, 2020, which was approximately 40 days prior to bioassessment sampling.

Each bioassessment sampling site consisted of a 150-meter stream reach that was divided into 11 equidistant transects placed perpendicular to the direction of flow. Benthic macroinvertebrate (BMI) and algae samples were collected at each of the 11 evenly spaced transects using the Reach-wide Benthos (RWB) method described in the SWAMP SOP (Ode et al. 2016). The most recent SWAMP SOP (i.e., Ode et al. 2016) combines the BMI and algae methods that are referenced in the MRP (Ode 2007, Fetscher et al. 2009), provides additional guidance, and adds two new physical habitat analytes (assess scour and engineered channels). The full suite of physical habitat data was collected within the sample reach using methods described in Ode et al. (2016).

Immediately prior to biological and physical habitat data collection, water samples were collected for nutrients, conventional analytes, ash free dry mass, and chlorophyll a analysis using the Standard Grab Sample Collection Method as described in SOP FS-2 (BASMAA 2016). Water samples were also collected and analyzed in the field for free chlorine and total chlorine residual using a Pocket Colorimeter™ II and DPD Powder Pillows according to SOP FS-3 (BASMAA 2016) (see Section 5.0 for chlorine monitoring results). In addition, general water quality parameters (dissolved oxygen, pH, specific conductance and temperature) were measured at or near the centroid of the stream flow using a pre-calibrated multi-parameter probe.

Biological and water samples were sent to laboratories for analysis. The laboratory analytical methods used for BMIs followed Woodard 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 were analyzed following SWAMP protocols (Stancheva et al. 2015). The taxonomic resolution for all data was compared SWAMP master taxonomic list. All BMI and algal taxa identified in samples collected over the eight-year monitoring period were consistent with the taxa listed on the SWAMP Master List, which was then included in the data submittal each year.

2.2.4 Data Analysis

Biological condition indicator data and stressor data for all bioassessment sites surveyed in WY 2020 were compiled into a master spreadsheet for data analyses. The master spreadsheet is included with this report as Attachment 2. BMI and algae data were analyzed to assess the biological condition (i.e., aquatic life Beneficial Uses) of the sampled reaches using condition index scores. Physical habitat data were used to assess biological condition and were evaluated as potential stressors. Water chemistry data were evaluated as potential stressors to biological health using triggers and WQOs identified in the MRP (see Stressor Variable section below). Data analysis methods for biological indicators and stressors are described below.

2.2.4.1 Biological Indicators

<u>Benthic Macroinvertebrates</u>

The benthic (i.e., bottom-dwelling) macroinvertebrates collected through this monitoring program are organisms that live on, under, and around the rocks and sediment in the stream bed. Examples include dragonfly and stonefly larvae, snails, worms, and beetles (Figure 2.1).

Each BMI species has a unique response to water chemistry and physical habitat condition. Some are relatively sensitive to poor habitat and pollution; others are more tolerant. Therefore, the abundance and variety of BMIs in a stream is an indicator of the biological condition of the stream.

The California Stream Condition Index (CSCI) is an assessment tool that was developed by the State Water Board support the development of California's statewide Biological Integrity Plan[14]. The CSCI translates benthic macroinvertebrate data into an overall measure of stream health. The CSCI was developed using a large reference data set that represents the full range of natural conditions in California and site-specific models for predicting biological communities. The CSCI combines two types of indices: 1) taxonomic completeness, as measured by the ratio of observed-to-expected taxa (O/E); and 2) ecological structure and function, measured as a predictive multimetric index (pMMI) that is based on reference conditions. The CSCI score is computed as the average of the sum of the O/E and pMMI.

Figure 2.1. Examples of benthic macroinvertebrates.

CSCI scores for each station are calculated using a combination of biological and environmental data following methods described in Rehn et al. (2015). Biological data consist of the BMI data collected and analyzed using the protocols described in the previous section. Environmental predictor data are generated in GIS using drainage areas upstream of each BMI sampling

[14] The Biological Integrity Assessment Implementation Plan has been combined with the Biostimulatory Substances Amendment project. The State Water Board is proposing to adopt statewide WQOs for biostimulatory substances (e.g., nitrate) in freshwater along with a program of implementation. A draft policy document for public review is anticipated in late 2021.

location. The environmental predictors and BMI data were formatted into comma delimited files and used as input for the RStudio statistical package and the necessary CSCI program scripts, developed by Southern California Coastal Water Research Project (SCCWRP) staff (Mazor et al. 2016).

The State Water Board is continuing to evaluate the performance of CSCI in a regulatory context. In Provision C.8.d. of MRP 2.0, the Regional Water Board defines a CSCI score of 0.795 as a trigger threshold for identifying sites with potentially degraded biological condition that may be considered as candidates for a Stressor/Source Identification project.

<u>Benthic Algae</u>

Similar to BMI's, the abundance and type of benthic algae species living on a streambed are an indicator of stream health. When evaluated with the CSCI, biological indices based on benthic algae can provide a more complete picture of the streams biological condition because algae respond more directly to nutrients and water chemistry. In contrast, BMIs are more responsive to physical habitat. Figure 2.2 shows examples of benthic algae common in Bay Area streams.

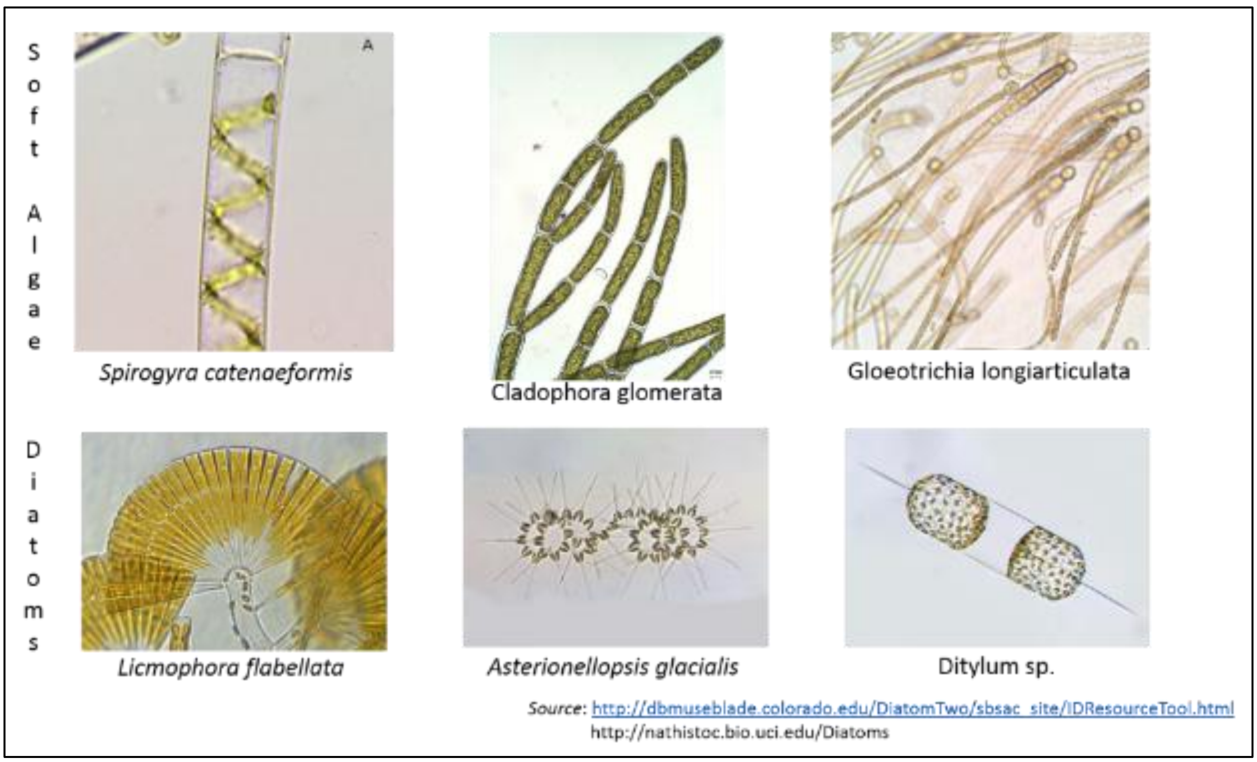

Figure 2.2. Examples of soft algae and diatoms.

The State Water Board and SCCWRP recently updated and finalized the Algae Stream Condition Index (ASCI)[15] which uses benthic algae data as a measure of biological condition for

[15] Previously reported ASCI scores summarized in the SMCWPPP IMR (SMCWPPP 2020) have been superseded.

streams in California (Theroux et al. 2020*).* The ASCI uses predictive multimetric indices to evaluate ecological conditions. There are three versions of the ASCI pMMI: an index for diatoms, one for soft-bodied algae and a hybrid index using both assemblages. Using a statewide data set, all three indices were evaluated by Theroux et al. for precision, accuracy, responsiveness, and regional bias. The diatom and hybrid indices were found to be the most sensitive to anthropogenic stressor gradients.

ASCI scores for the diatom and hybrid indices were generated using an RStudio based reporting module developed by SCCWRP. However, at the time of the data analysis for this report, the available reporting module was not correctly calculating the hybrid ASCI score (Andy Rehn, CDFW, personal communication, 2020). Therefore, only the diatom ASCI index (i.e., D_ASCI) was used to analyze algae samples collected at twenty bioassessment sites in WY 2020.

Additional study is needed to determine the best approach to apply the ASCI tools to evaluate bioassessment data. For example, it is not clear if the ASCI should be used as a second line of evidence to understand CSCI scoring results, or if it would be more effective as an independent indicator to evaluate different types of stressors (e.g., nutrients) to which BMIs are not very responsive. The ASCI is currently under review by the Biostimulatory-Biointegrity Policy Science Advisory Panel and the State Water Board.

2.2.4.2 Physical Habitat Indicators

The condition of the physical habitat within the riparian corridor is a major contributor to stream ecosystem health. Physical habitat components such as streambed substrate, channel morphology, microhabitat complexity, in-stream cover-type complexity, and riparian vegetation cover contribute to the overall physical and biological integrity of a stream. The physical characteristics of a stream reach are affected by both natural factors (e.g., climate, slope, geology) and human disturbance (e.g., channelization, development, stream crossings, hydromodification).

Physical habitat conditions are evaluated using endpoint variables, or metrics, which are calculated using reach-scale averages of transect-based measurements and observations. The State Water Board has developed a SWAMP Bioassessment Reporting Module (SWAMP RM), a custom Microsoft Access™ application, that produces approximately 170 different metrics that are based on physical habitat measurements collected using both USEPA's Environmental Monitoring and Assessment Program (EMAP) for freshwater wadeable streams (Kaufmann et al. 1999) and the SWAMP "Full" habitat protocol (Ode et al. 2016) that was implemented by SMCWPPP at bioassessment stations. The metrics are classified into five thematic groups representing different physical attributes: substrate, riparian vegetation (including structure and shading), flow habitat variability, in-channel cover, and channel morphology.

The State Water Board recently developed the Index of Physical Habitat Integrity (IPI) as an overall measure of physical habitat condition. Similar to the CSCI, the IPI is calculated using a combination of physical habitat data collected in the field and environmental data generated in GIS following the methods described in Rehn et al. (2018). The IPI is based on 12 of the metrics generated by the SWAMP RM (Table 2.1). The metrics were selected for their ability to discriminate between reference and stressed sites and provide unbiased representation of waterbodies across the different ecoregions of California. Scoring for these metrics were then calibrated using environmental variables that were associated with drainage areas for each sampling location.

Table 2.1. Physical habitat metrics calculated from bioassessment data collected in WY 2020. The 12 metrics used to calculate IPI scores are also shown.

Type/Class	Metric/Variable Name	Variables used for IPI Score
Channel Morphology	Mean Bankfull Width (SBKF_W)	x
	Mean Slope of Reach (XSLOPE)	x
	Percent Stable Banks (PBM_S)	
Flow Habitat	Evenness of Flow Habitat Types (Ev_FlowHab)	x
	Percent Pools in Reach (PCT_POOL)	x
	Shannon Diversity (H) of Aquatic Habitat Types (H_AqHab)	x
	Percent Fast Water (PCT_FAST)	
Instream Cover	Mean Filamentous Algae Cover (XFC_ALG)	x
	Natural Shelter cover – SWAMP (XFC_NAT_SWAM)	
	Mean Undercut Banks Cover (XFC_UCB)	
Riparian Cover	Mean Upper Canopy Trees and Saplings (XC)	x
	Riparian Cover Sum of Three Layers (SCMG)	x
Substrate	Percent Concrete/Asphalt (PCT_RC)	x
	Percent Sand (PCT_SA)	x
	Percent Gravel – coarse (PCT_GC)	
	Percent Substrate Smaller than Sand (<2 mm) (PCT_SAFN)	x
	Shannon Diversity (H) of Natural Substrate Types (H_SubNat)	x
	Median Particle Size (d50) (SB_PT_D50)	

2.2.4.3 Biological and Physical Habitat Condition Thresholds

Existing thresholds for CSCI scores (Mazor 2015) and ASCI scores (Theroux et al. 2020) were used to evaluate the BMI and algae data collected in San Mateo County and analyzed in this report (Table 2.2). Provisional thresholds for IPI scores (Rehn et al. 2018) were used to evaluate physical habitat conditions. The thresholds for all three indices were based on the distribution of scores for data collected at reference calibration sites located throughout California. Four condition categories are defined by these thresholds: “likely intact” (greater than 30th percentile of reference site scores); “possibly intact” (between the 10th and the 30th percentiles); “likely altered” (between the 1st and 10th percentiles); and “very likely altered” (less than the 1st percentile).

A CSCI score below 0.795 is referenced in the MRP as a threshold indicating a potentially degraded biological community, and thus should be considered for a SSID Project. The MRP threshold is at the division between the “possibly intact” and “likely altered” condition categories described in Mazor (2015). Further investigation is needed to evaluate the applicability of this threshold to sites in highly urban watersheds and/or modified channels that are common throughout the Bay Area.

Table 2.2. Condition categories used to evaluate CSCI, D_ASCI, and IPI scores.

Biological Indicator	Tool	Likely Intact	Possibly Intact	Likely Altered	Very Likely Altered
BMI	CSCI	≥ 0.92	≥ 0.79 to < 0.92	≥ 0.63 to < 0.79	< 0.63
Diatoms	ASCI	≥ 0.94	≥ 0.86 to < 0.94	≥0.75 to < 0.86	< 0.75
Physical Habitat	IPI	≥ 0.94	≥ 0.84 to < 0.94	≥0.71 to < 0.83	< 0.70

2.2.4.4 Stressor Variables

Attachment A includes biological condition scores (CSCI, D_ASCI, IPI) and potential stressor data for bioassessment sites monitored in WY 2020. Stressors are conditions that affect the biological condition of a stream. They include, but are not limited to, the types of physical habitat, landscape characteristics, general water quality, and water chemistry data that are collected during bioassessment surveys. The IMR evaluated the relationship between potential stressors and biological condition (i.e., CSCI and ASCI scores) for the WY 2012 through WY 2019 probabilistic dataset (SMCWPPP 2020) using statistical analyses such as correlation and random forest models. Those analyses were not updated to include WY 2020 data because the findings are unlikely to change with the addition of four new probabilistic sites. Potential stressors included in Appendix A are:

- ***Physical habitat*** stressor variables include metrics developed by the SWAMP RM (described above) and physical habitat variables from the reach-wide qualitative assessments that are conducted in compliance with the BASMAA (BASMAA 2016) and SWAMP (Ode et al. 2016) SOPs. The reach-wide assessment includes three separate attributes: 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 optimal condition. The total “PHAB” score is the sum of the three individual attribute scores, with a score of 60 representing the highest possible score.

- ***Land Use*** variables are calculated in GIS by overlaying land use and transportation layers with the drainage area upstream of the sampling location. Appendix A includes percent urban area, percent impervious area, and road density.

- ***Water quality*** stressor variables include the general parameters measured in the field (i.e., dissolved oxygen, pH, temperature and specific conductivity, free chlorine and total chlorine residual) and water chemistry analyzed at laboratories (nutrients and anions). Additional water quality variables included chlorophyll a and ash free dry mass, both measured from filtration of the benthic algae composite samples.

  Some of the water quality stressor variables used in the analysis were calculated or converted from other analytes or units of measurement:

  - Unionized ammonia is calculated from measured concentrations of total ammonia, pH, temperature, and specific conductance using a formula provided by the American Fisheries Society (AFS; https://fisheries.org/wp-content/uploads/2016/03/Copy-of-pub_ammonia_fwc.xls).

- Total nitrogen concentration was calculated by summing nitrate, nitrite, and Total Kjeldahl Nitrogen concentrations.
- The volumetric concentrations (mass/volume) for ash free dry mass and chlorophyll a (as measured by the laboratory) were converted to an area concentration (mass/area). Calculations required using both algae sampling grab size and composite volume.

2.2.4.5 Trigger Thresholds

In compliance with Provision C.8.h.iii.(4) of the MRP, water chemistry data collected at the bioassessment sites during WY 2020 were compared to MRP trigger thresholds and applicable water quality standards (Table 2.3). Thresholds for pH, specific conductance, dissolved oxygen (DO), and temperature (for waters with COLD Beneficial Use only) are listed in Provision C.8.d.iv of the MRP. Except for temperature and specific conductance, these conform to WQOs in the Basin Plan (SFRWQCB 2017). Of the eleven nutrients analyzed synoptically with bioassessments, WQOs only exist for three: ammonia (unionized form), and chloride and nitrate (for waters with MUN Beneficial Use only).

Ammonia, specifically unionized ammonia, is toxic to aquatic life. Therefore, the Basin Plan states that discharge of wastes shall not cause receiving waters to contain annual median concentrations of un-ionized ammonia in excess of 0.025 mg/L or maximum concentrations above 0.4 mg/L in the Lower Bay, which includes creeks in San Mateo County that drain to the Bay (SFBRWQCB 2017). Conversion of measured total ammonia to the more toxic form of unionized ammonia was calculated to compare with the WQOs in the San Francisco Basin Water Quality Control Plan (Basin Plan) (SFRWQCB 2017).

Table 2.3. MRP trigger thresholds and WQOs for nutrient and general water quality variables.

	Units	Threshold	Direction	Source
Nutrients and Ions				
Nitrate as N [a]	mg/L	10	Increase	Basin Plan
Unionized Ammonia, annual median [b]	mg/L	0.025	Increase	Basin Plan
Unionized Ammonia, maximum	mg/L	0.4	Increase	Basin Plan
Chloride [a]	mg/L	250	Increase	Basin Plan
General Water Quality				
Oxygen, Dissolved[d]	mg/L	5.0 or 7.0	Decrease	Basin Plan
pH	--	6.5 and 8.5	Both	Basin Plan
Temperature, instantaneous maximum [c]	°C	24	Increase	MRP
Specific Conductance [c]	µS/cm	2000	Increase	MRP

[a] Nitrate and chloride WQOs only apply to waters with MUN designated Beneficial Uses.
[b] This threshold is an annual median value and is not typically applied to individual samples.
[c] The MRP thresholds (or triggers) for temperature and specific conductance apply when 20 percent of instantaneous results are in exceedance. Application to individual samples is provisional.
[d] The WQO for WARM and COLD Beneficial Use is 5.0 and 7.0, respectively.

2.2.4.6 SCAPE Modeling to Assess CSCI Scores

Biological conditions, based on CSCI scores, for the ten bioassessment sampling locations in San Mateo County were compared to a landscape model developed for streams in California that estimates ranges of likely scores for CSCI scores based on the level of landscape alteration within the sampling reach watershed (Beck et al. 2019). The landscape model was created using data from StreamCat, which is a national dataset that includes attributes characterizing watershed development (Hill at al. 2015).

The predictive model was developed to support management decisions, such as identifying reaches for restoration or enhanced protection based on how observed scores relate to the model expectation. It has been integrated into a publicly available web-based application called the Stream Classification and Priority Explorer (SCAPE). The SCAPE tool can be used to compare measured/calculated CSCI scores with the predictive scores produced by the model (https://sccwrp.shinyapps.io/scape/).

The SCAPE model was obtained from SCCWRP as a GIS shapefile. Stream/channel attributes in the shapefile include stream classifications using three thresholds for CSCI (1st, 10th, and 30th percentile of reference sites) and a prediction interval (ranging from the 10th to the 90th percentiles of the quantile predictions). There are four possible stream classifications in the model: "likely unconstrained", "possibly constrained", "possibly unconstrained" and "likely unconstrained". The model predicts a range of CSCI scores for each stream reach and an expected median score. Observed CSCI scores at a site are compared to the model expectations and characterized as over-scoring, expected or under-scoring. See section 2.3.2 for application of the SCAPE model to CSCI scores at bioassessment sites in San Mateo County.

2.3 Results and Discussion

The results for bioassessment monitoring in WY 2020 are presented in the sections below.

- **Section 2.3.1** presents a summary of biological assessment data collected at ten sites in San Mateo County during WY 2020.
- **Section 2.3.2** presents an evaluation of bioassessment results with the SCAPE model.
- **Section 2.3.3** presents a comparison of BMI and algae data collected during two sampling events at six targeted sites. Comparison of data from different years provides insight into the variability of biological conditions over time.
- **Section 2.3.4** presents a detailed evaluation of the bioassessment monitoring conducted at four bioassessment sites in San Mateo Creek.

Conclusions and recommendations for this section are presented in Section 7.0.

2.3.1 Bioassessment Results (WY 2020)

This section documents the biological condition and stressor data collected at ten sites in San Mateo County during WY 2020. Bioassessments were conducted at four new probabilistic sites derived from the RMC sample frame and six targeted sites.[16] All six targeted sites were probabilistic sites that were previously sampled by SMCWPPP and all WY 2020 sites are classified as urban in the RMC sample frame. The WY 2020 bioassessment sites are listed in Table 2.4 and mapped in Figure 2.3. More detailed analyses of the targeted bioassessment data from the San Mateo Creek site are provided in Section 2.3.4.

Table 2.4. Bioassessment sampling locations and dates in San Mateo County in WY 2020.

Station Code	Drainage Area	Creek Name	Sample Date	Site Elevation (m)	Latitude	Longitude	Probabilistic (New Sites)	Targeted (Re-sampled Probabilistic)
202R01308	Pacific Ocean	Pilarcitos Creek	5/18/2020	11	37.46843	-122.43626		x
202R04568		San Pedro Creek	5/27/2020	33	37.58077	-122.47982	x	
202R05464		San Pedro Creek	5/27/2020	13	37.58699	-122.49535	x	
204R00680	San Francisco Bay	Redwood Creek	5/19/2020	51	37.43792	-122.24130		x
204R01256		Arroyo Ojo De Agua	5/19/2020	59	37.45451	-122.25052		x
204R02228		San Mateo Creek	5/20/2020	12	37.56106	-122.33742		x
204R03272		San Mateo Creek	5/26/2020	39	37.53398	-122.35027		x
204R03528		San Mateo Creek	5/26/2020	27	37.5483	-122.34627		x
204R04884		San Mateo Creek	5/21/2020	32	37.54059	-122.34989	x	
204R05176		Laurel Creek	5/20/2020	15	37.53331	-122.30452	x	

2.3.1.1 Biological and Physical Habitat Conditions

Biological condition, as represented by CSCI and D_ASCI scores, for the ten sites sampled by SMCWPPP in WY 2020, is shown in Table 2.5. Physical habitat condition, as represented by IPI scores, is also shown in Table 2.5. Condition scores are mapped in Figure 2.3.

<u>CSCI Scores</u>

The CSCI scores ranged from 0.42 to 0.67 across the ten bioassessment sites sampled in WY 2020 (Table 2.5). All ten sites had CSCI scores that were below the MRP trigger threshold value of 0.795. Three sites had CSCI scores that were in the “likely altered” classification for biological condition. These include site 202R01308, located in Pilarcitos Creek, approximately 200 meters downstream of Highway 1, Half Moon Bay, and two sites in San Mateo Creek (204R03272 and 204R04884), both located within a one-mile reach downstream of Crystal Springs Reservoir. The remaining seven sites were in the “very likely altered” condition (< 0.63). All seven “very likely altered” sites were in stream reaches downstream of urban land uses (percent impervious area ranging from 7% to 38%) (Table 2.5). The two lowest scoring sites were in reaches with modified channels (i.e., channels having armored bed and banks); site 204R00680, Redwood Creek downstream of Interstate 280, and site 204R05176, Laurel Creek upstream of Alameda de las Pulgas. All ten sites will be considered as candidates for SSID projects.

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[16] During WY 2020, the SMCWPPP exhausted the list of San Mateo sites classified as urban in the RMC Sample Frame. As a result, previously sampled urban sites were used to obtain the minimum of ten bioassessment sites.

Table 2.5. Biological condition, presented as CSCI and D_ASCI scores, and physical habitat condition, presented as IPI score, for ten sites sampled in San Mateo during WY 2020. Overall condition scores, i.e., the sum of the three individual index scores, are also shown. The four sites with highest overall condition score are shown in bold. Site characteristics related to percent impervious watershed area and channel modification are also presented.

Station Code	Creek	Impervious Watershed Area (%)	Modified Channel	CSCI Score	D_ASCI Score	IPI Score	Overall Condition Score
202R01308	Pilarcitos Creek	3%	N	0.65	0.79	0.86	2.3
202R04568	San Pedro Creek	12%	N	0.50	0.71	1.17	2.38
202R05464	San Pedro Creek	13%	N	0.51	0.63	1.09	2.23
204R00680	Redwood Creek	23%	Y	0.44	0.52	0.90	1.86
204R01256	Arroyo Ojo De Agua	34%	N	0.54	0.46	1.14	2.14
204R02228	San Mateo Creek	9%	N	0.60	0.76	1.06	**2.42**
204R03272	San Mateo Creek	7%	N	0.64	0.77	1.13	**2.51**
204R03528	San Mateo Creek	7%	N	0.58	0.74	1.11	**2.43**
204R04884	San Mateo Creek	7%	N	0.67	0.75	1.12	**2.54**
204R05176	Laurel Creek	38%	Y	0.42	0.83	1.00	2.25

[1] Modified channel is defined as having armored bed and banks (e.g., concrete, gabion, rip rap) for majority of the reach or characterized as highly channelized earthen levee.

ASCI Diatom Scores

The D_ASCI scores ranged from 0.46 to 0.83 across the ten bioassessment sites sampled in WY 2020 (Table 2.5). Five sites had ASCI diatom scores in the “likely altered” condition category (≥ 0.75 to < 0.86). The remaining five sites were in the “very likely altered” condition (< 0.75). The four sites in San Mateo Creek had very similar biological conditions for diatoms, with D_ASCI scores ranging 0.74 to 0.77. There is no MRP trigger for the D_ASCI index.

IPI Scores

Physical habitat conditions, as represented by IPI scores, ranged from 0.86 to 1.17 across the ten bioassessment sites sampled in WY 2020 (Table 2.5). All ten sites, including the two sites with modified channels, had IPI scores that were in the top two condition categories (≥ 0.83).

Overall Condition

The overall site condition was calculated by summing the two biological condition index scores (CSCI and D_ASCI) and the physical habitat condition score (IPI). The four sites with the highest overall condition scores were all in San Mateo Creek (Table 2.5).

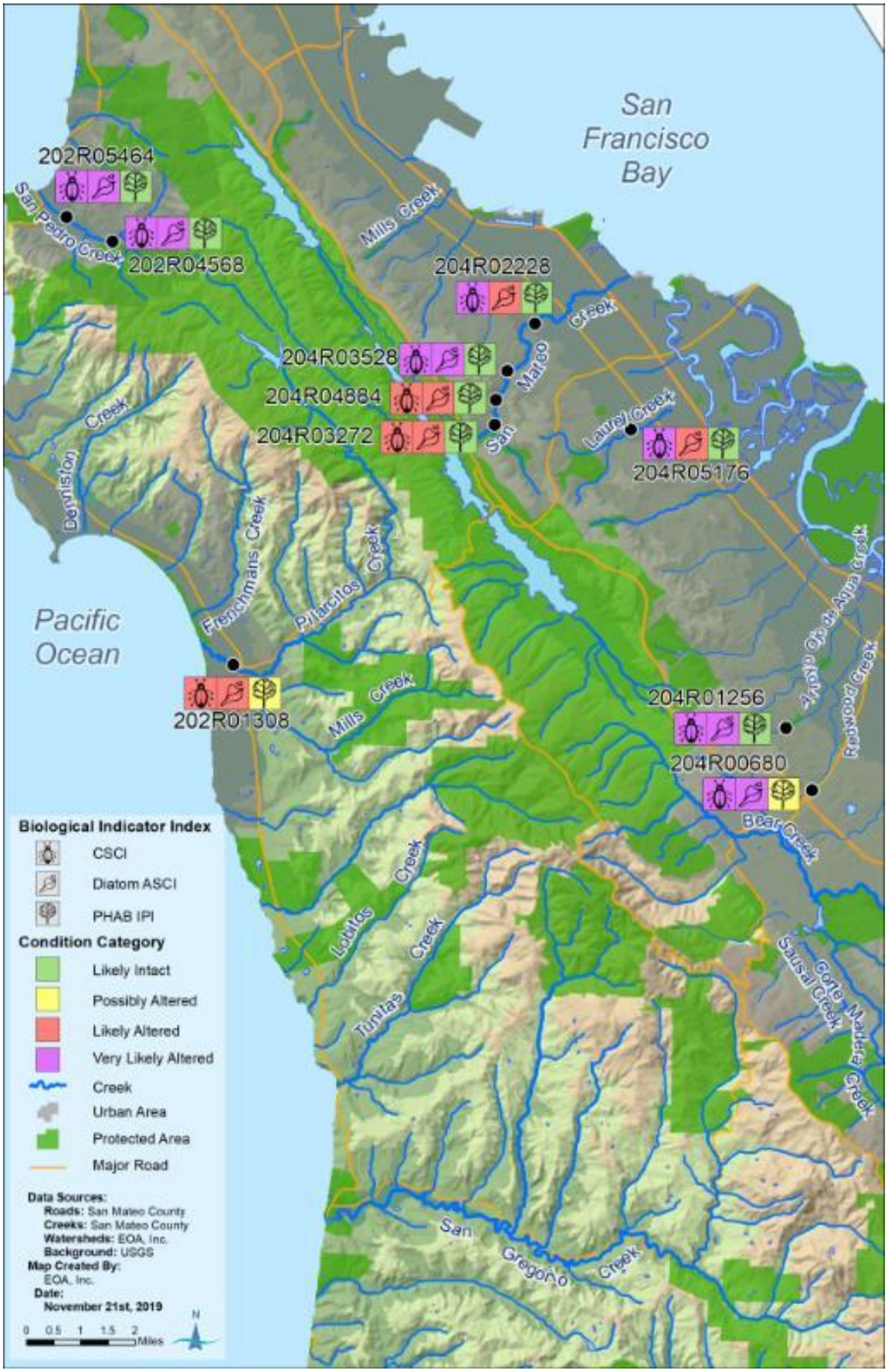

Figure 2.3. Condition category as represented by CSCI, D_ASCI and IPI Scores for ten bioassessment sites sampled in San Mateo County in WY 2020.

2.3.1.2 Stressor Assessment (WY 2020)

This section presents results for stressor data collected at the ten bioassessment sites in WY 2020. The comparison of WY 2020 stressor data to associated MRP triggers and/or WQOs is documented for the purposes of maintaining the list of sites with trigger exceedances for SSID project consideration.

General Water Quality

Results of general water quality measurements collected at the ten bioassessment sites in WY 2020 are listed in Table 2.6. None of the water quality measurements exceeded water quality objectives or MRP trigger thresholds.

Table 2.6. General water quality measurements for ten bioassessment sites in San Mateo County sampled in WY 2020.

Station Code	Creek Name	Temp (°C)	DO (mg/L)	pH	Specific Conductance (uS/cm)
202R01308	Pilarcitos Creek	14.3	10.2	7.3	438
202R04568	San Pedro Creek	13.7	9.6	7.6	430
202R05464	San Pedro Creek	16.2	9.4	8.0	427
204R00680	Redwood Creek	15	8.5	8.0	1111
204R01256	Arroyo Ojo De Agua	14.9	8.3	7.8	988
204R02228	San Mateo Creek	14.1	10.9	7.7	223
204R03272	San Mateo Creek	13.7	9.9	7.4	182
204R03528	San Mateo Creek	15.6	10.2	7.6	196
204R04884	San Mateo Creek	12.7	10.5	7.2	187
204R05176	Laurel Creek	14	7.6	7.5	671

Water Chemistry (Nutrients)

Nutrient and conventional analyte concentrations measured in water samples collected at the ten WY 2020 bioassessment sites are listed in Table 2.7. No WQOs or MRP trigger thresholds were exceeded.

Total nitrogen concentrations ranged from 0.17 to 0.72 mg/L. Total phosphorus concentrations ranged from 0.01 to 0.12 mg/L. The highest concentrations for both nutrients were measured in samples from Arroyo Ojo de Agua at Stulsaft Park located in Redwood City (site 204R01256).

Chlorophyll a and ash free dry mass (AFDM) are two indicators of biomass. The highest concentration of chlorophyll a (470 mg/m^2) was measured in Laurel Creek (site 204R05176). The highest concentration of AFDM (813 g/ m^2) was measured in San Pedro Creek at Sanchez Adobe County Park (site 202R05464).

Table 2.7. Nutrient and conventional constituent concentrations in water samples collected at ten sites in San Mateo County during WY 2020. Water quality objectives were not exceeded. See Table 2.1 for WQO values.

Station Code	Creek	Ammonia (as N)	Unionized Ammonia (as N)	Chloride	AFDM	Chlorophyll a	Nitrate (as N)	Nitrite (as N)	Total Kjeldahl Nitrogen (as N)	Total Nitrogen	Ortho-phosphate (as P)	Phosphorus	Silica (as SiO2)
		mg/L	*mg/L*	*mg/L*	*g/m2*	*mg/m2*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*	*mg/L*
	WQO:	*NA*	*0.025* [b]	*250* [a]	*NA*	*NA*	*10* [a]	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
202R01308	Pilarcitos Creek	0.12	0.001	33	191	4	0.39	0.002 J	0.11	0.50	0.074	0.09	18
202R04568	San Pedro Creek	0.11	0.001	24	210	14	0.25	0.005	0.04	0.30	0.017	0.027	18
202R05464	San Pedro Creek	0.11	0.003	25	813	387	0.31	0.001 J	0.04	0.35	0.039	0.039	17
204R00680	Redwood Creek	0.12	0.003	57	204	131	0.06 J	0.001 J	0.3	0.36	0.073	0.083	36
204R01256	Arroyo Ojo De Agua	0.09	0.001	37	101	82	0.31	0.003 J	0.41	0.72	0.110	0.12	66
204R02228	San Mateo Creek	0.12	0.001	15	784	74	0.1	0.002 J	0.04	0.14	0.019	0.021	5.3
204R03272	San Mateo Creek	0.10	0.001	13	415	147	0.14	0.001 J	0.04	0.18	0.009 J	0.012	4.2
204R03528	San Mateo Creek	0.11	0.001	14	39	19	0.13	0.001 J	0.08 J	0.21	0.010	0.01	4.6
204R04884	San Mateo Creek	0.12	< 0.001	13	342	14	0.13	0.001 J	0.04	0.17	0.003	0.015	4.5
204R05176	Laurel Creek	0.15	0.001	54	208	470	0.13	0.003 J	0.41	0.54	0.072	0.088	11
Number of exceedances		NA	0	0	NA	NA	0	NA	NA	NA	NA	NA	NA

AFDM = Ash Free Dry Mass, NA = Not Applicable

J = The reported result is an estimate. The value is less than the reporting limit but greater than the detection limit.

[a] Chloride and nitrate WQOs only apply to waters with MUN designated Beneficial Uses, i.e., Pilarcitos Creek and San Pedro Creek.

[b] This threshold is an annual median value and is not typically applied to individual samples.

Physical Habitat

There are no WQOs or MRP triggers associated with the physical habitat measurements that are collected during bioassessment surveys. However, physical habitat is an important factor that may influence biological conditions. The qualitative habitat (PHAB) scores, including individual scores for channel alteration, epifaunal substrate and sedimentation attributes[17], and the total PHAB score (sum of the three attributes scores) are shown in Table 2.8 with IPI scores provided for comparison. Total PHAB scores ranged from 27 to 49 (total possible is 60). In contrast to IPI scores which ranged from 0.86 to 1.14, the total PHAB scores show a much wider range of scores between the ten sites.

Table 2.8. Qualitative physical habitat scores for ten bioassessment sites in San Mateo County sampled in WY 2020. IPI scores are provided for comparison.

Station Code	Creek	Channel Alteration	Epifaunal Substrate	Sediment Deposition	Total PHAB Score	IPI Score
202R01308	Pilarcitos Creek	15	12	6	33	0.86
202R04568	San Pedro Creek	17	14	10	41	1.17
202R05464	San Pedro Creek	17	12	8	37	1.09
204R00680	Redwood Creek	7	12	13	32	0.9
204R01256	Arroyo Ojo De Agua	16	16	17	49	1.14
204R02228	San Mateo Creek	12	9	7	28	1.06
204R03272	San Mateo Creek	17	17	13	47	1.13
204R03528	San Mateo Creek	17	16	9	42	1.11
204R04884	San Mateo Creek	18	17	7	42	1.12
204R05176	Laurel Creek	11	8	8	27	1.0

[17] Channel alteration is measure of extent of reach that is armored/modified; Epifaunal substrate is measure of quantity and quality of physical habitat features (e.g., substrate, wood) that provide structure for colonization of biological communities; Sedimentation is a measure of the amount of sediment that has accumulated in the reach.

2.3.2 SCAPE Tool Comparison

The SCAPE tool (discussed in Section 2.2.4.6 provides a context for evaluating stream health by estimating an expectation of biological condition for a given stream reach relative to landscape constraints. Biological condition, based on CSCI scores, can be compared to the reach expectation. As an example, CSCI scores for seven of the sites sampled in San Mateo County is WY 2020 were compared to the range of scores predicted by the SCAPE model[18] (Figure 2.4). The predicted range of CSCI scores for these sites are fall into two stream classifications: possibly constrained (light red), and likely constrained (dark red). The CSCI scores for bioassessment sites (i.e., Relative Site Score) are represented by either circles or triangles superimposed over the predicted range of CSCI scores estimated by the model. Sites that have CSCI scores higher than model predictions would be depicted by an up-pointing triangle symbol (i.e., "over scoring"); sites with CSCI scores lower than model predictions would be depicted by an inverted triangle (i.e., under scoring"). However, all CSCI scores fell within the predicted range and are therefore depicted by a circle.

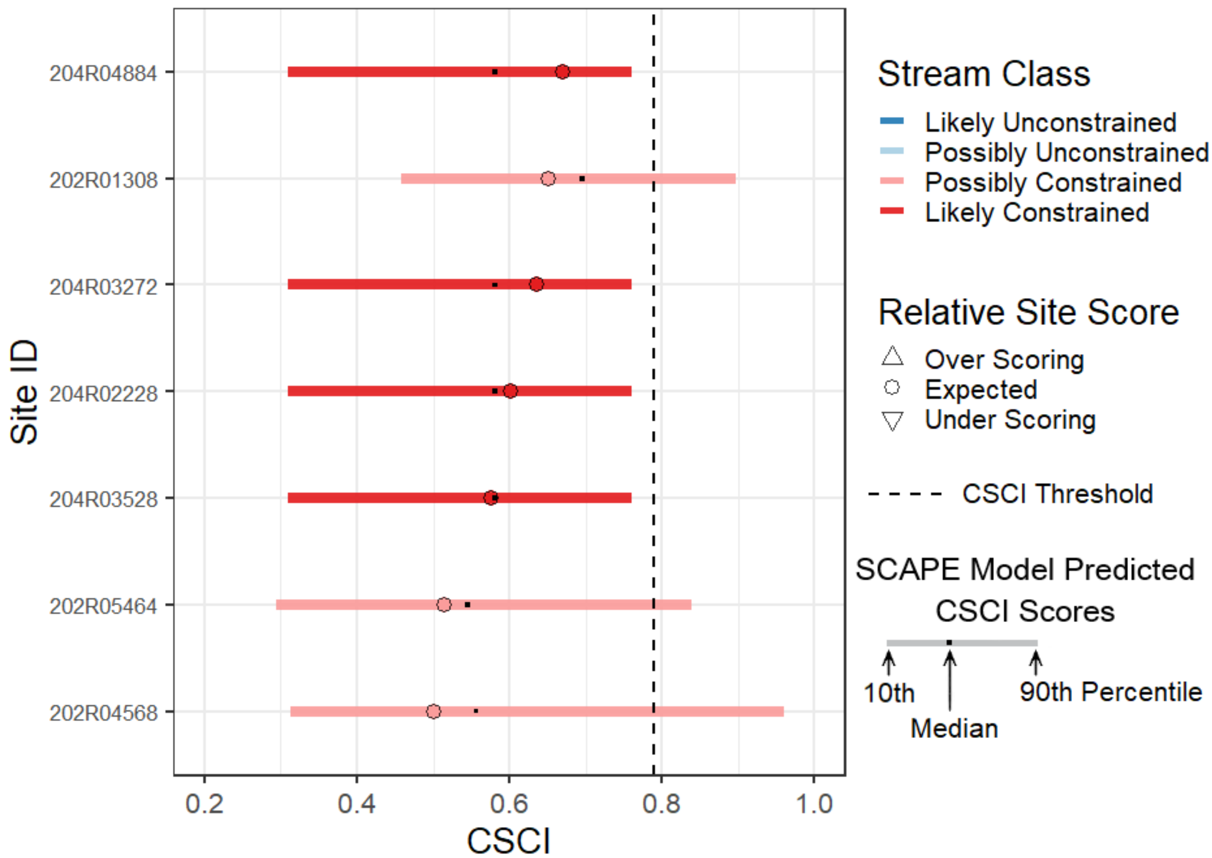

Figure 2.4. Comparison of CSCI scores for seven sites sampled in WY 2020 in San Mateo County with predicted scores based on SCAPE model (Beck et al. 2019).

All seven sites assessed using the SCAPE tool are located in urban sections of creeks that support steelhead fish populations (i.e., Pilarcitos Creek, San Pedro Creek and San Mateo

[18] The SCAPE model did not have data for three of the bioassessment sites in the Redwood Creek and Laurel Creek watersheds.

Creek). For example, San Pedro Creek at Linda Mar Road in the City of Pacifica (site 202R04568) is shown in Figure 2.5. The three coastal sites were classified as possibly constrained channels and the four sites in San Mateo Creek were classified as likely constrained. The biological conditions based on CSCI scores for all seven bioassessment sites were relatively close to the median value of conditions that were predicted by the SCAPE developed landscape model.

Figure 2.5. SMCWPPP field crew carrying out chlorine and water quality sampling in San Pedro Creek (site 202R04568).

2.3.3 Temporal Variability in Site Conditions

Biological conditions based on CSCI and D_ASCI scores for the six WY 2020 targeted sites were compared with scores from prior years (Table 2.9). The CSCI scores for the two sampling periods were similar at five of the six sites (i.e., between 0.03 and 0.07 difference). The site on Pilarcitos Creek (site 202R01308) had higher variability; the CSCI score was 0.34 points higher in WY 2020 compared to WY 2014. The D_ASCI diatom scores for the two sampling periods were very similar at three of the six sites (i.e., within 0.04). The remaining three sites had higher variability with D_ASCI score differences ranging from 0.1 to 0.36. There was no consistent trend for either biological index.

Table 2.9. Comparison of CSCI and D_ASCI scores for bioassessment data collected for two different sampling events at six targeted bioassessment sites. Score differences greater than 0.1 are shown in bold.

Station Code	Creek	Pre – WY 2020			WY 2020	
		Water Year	CSCI Score	D_ASCI Score	CSCI Score	D_ASCI Score
202R01308	Pilarcitos Creek	2014	**0.31**	0.80	**0.65**	0.79
204R00680	Redwood Creek	2013	0.51	0.55	0.44	0.52
204R01256	Arroyo Ojo De Agua	2014	0.51	**0.82**	0.54	**0.46**
204R02228	San Mateo Creek	2016	0.56	**0.61**	0.60	**0.76**
204R03272	San Mateo Creek	2017	0.63	**0.87**	0.64	**0.77**
204R03528	San Mateo Creek	2018	0.60	0.78	0.58	0.74

Biological conditions can be influenced by many factors that change from year to year, including: timing and magnitude of storm events during the sampling index period, variable antecedent conditions (e.g., precipitation, temperature), and changes in management actions (e.g., operations related to water releases from reservoirs or diversions). It is not clear, especially with such a small sample size, what factors, if any, might be associated with changes in biological conditions at these watersheds/sites.

2.3.4 Evaluation of Conditions in San Mateo Creek (WY 2020)

Targeted monitoring within a reach or subwatershed scale for the purposes of identifying water quality problems and potential management actions was one of the recommendations presented in the IMR for future considerations of Creek Status Monitoring. In WY 2020, SMCWPPP focused Creek Status Monitoring efforts in an urban reach of San Mateo Creek (Figure 2.6).

Bioassessments and continuous temperature and water quality monitoring were conducted at sampling locations within a 3.4-mile urban reach below the Crystal Springs Dam. These combined data can be evaluated as indicators for cold water habitat Beneficial Uses which are present in this reach. The section of San Mateo Creek downstream of Crystal Springs Reservoir supports migration, rearing and spawning habitat for an existing steelhead population.

<u>Watershed Description</u>

San Mateo Creek drains a 33-square mile watershed including parts of unincorporated San Mateo County, the City of San Mateo, and the Town of Hillsborough. The upper 88 percent of the watershed is characterized by the northwest/southeast trending ridges and valleys of the San Andreas Rift Zone and the Santa Cruz Mountains. Runoff from this undeveloped 29-square mile area drains to a system of reservoirs which were constructed in the late 1800s and are now owned and operated by the San Francisco Public Utilities Commission (SFPUC). These include the San Andreas Reservoir, Upper Crystal Springs Reservoir, and Lower Crystal Springs Reservoir, all of which are oriented along the northwest trending San Andreas Rift Zone.

Below the Lower Crystal Springs reservoir dam, the watershed encompasses approximately five square miles and is mostly urbanized with an overall imperviousness of approximately 38 percent (STOPPP 2002). Low and medium density residential land uses characterize the area upstream of El Camino Real, and high density residential and commercial land uses characterize the watershed downstream of El Camino Real. San Mateo Creek below the Lower Crystal Spring reservoir dam is approximately 5.5 miles in length and is nearly 50 percent modified (STOPPP 2002). There are several engineered reaches, including a 2,000-foot culvert that begins downstream of El Camino Real. There is one main tributary in this reach, Polhemus Creek which enters San Mateo Creek approximately 0.75 mile downstream of the dam. San Mateo Creek flows to San Francisco Bay at Ryder Park, just south of Coyote Point and is tidally influenced downstream of Highway 101.

SFPUC Aquatic Resource Monitoring

The Crystal Springs Reservoir System serves as the emergency water supply for San Mateo and San Francisco Counties. It is owned and operated by the SFPUC and consists of Upper and Lower Crystal Springs Reservoirs, San Andreas Reservoir, and various tunnels, pipes, pumps, and outlet structures. SFPUC's Water System Improvement Program (WISP) includes two related projects that affect baseflows in San Mateo Creek. Completed in January 2015, the Crystal Springs/San Andreas Transmission System Upgrade and the Lower Crystal Springs Dam Improvements projects repaired leaks in the system and set a schedule for controlled releases.

With completion of the projects, the SFPUC began implementation of a defined water release schedule intended to enhance habitat for steelhead and other native fish in lower San Mateo Creek. Release schedule baseflows, measured at the U.S. Geological Survey (USGS) gage located approximately 0.2 mile downstream of the dam (USGS Gage #11162753), must range from 3 to 17 cfs, depending on the water year type (e.g., dry, normal, wet) and the time of year (NMFS 2010). The release schedule was approved by the U.S. Army Corps of Engineers as part of the formal consultation process with the National Marine Fisheries Service (NMFS) and the California Department of Fish and Game (CDFG) for Endangered Species Act compliance for the WISP projects (San Francisco Planning Department 2010). In addition to maintaining minimum releases, the SFPUC began a ten-year aquatic resource monitoring program in June 2015. SFPUC monitoring in San Mateo Creek below the dam consists of water quality measurements (continuous temperature and DO, pH and turbidity grab samples), steelhead spawning surveys, smolt migrant trapping, fish population surveys, and benthic macro-invertebrate community sampling (ENTRIX/MSE 2009).

The results of the SFPUC monitoring activities conducted between 2015 and 2018 are presented in the San Mateo Creek 2018 Aquatic Resources Monitoring Report (SFPUC and Stillwater Sciences 2019). CSCI scores from macroinvertebrate sampling conducted between 2015 through 2018 by SFPUC at four sites downstream of the dam are presented in this report to compare with WY 2020 (and prior) bioassessment data collected by SMCWPPP in the same reach.

SMCWPPP WY 2020 Sampling Locations

SMCWPPP conducted bioassessments at four sites in San Mateo Creek during May 2020. One site (204R04884) was a new probabilistic site and the remaining three sites were targeted at previously sampled probabilistic sites. Sites are mapped in Figure 2.6 with SFPUC bioassessment stations shown for reference. In WY 2020, in compliance with MRP Provision C.8.d.iii and iv, SMCWPPP conducted continuous temperature monitoring at five site and continuous water quality monitoring at two sites. The continuous monitoring stations were located in the San Mateo Creek watershed and are also shown in Figure 2.5. Continuous temperature and water quality monitoring results are presented in section 3.0. The bullets below describe the bioassessment sampling stations (downstream to upstream):

- **Station 202R02228** (also referred to as 204SMA070) (3.4 miles downstream of dam) **–** Located about 200 meters upstream Stonehedge Road. The sampled reach is adjacent to South Elementary School and several residential properties in the Town of Hillsborough. This site was previously sampled in WY 2016.

- **Station 204R03528** (also referred to as 204SMA080) (2 miles downstream of dam) – The sampled reach is downstream of Crystal Springs Terrace. Crystal Springs Road is located along the north bank of this reach, and the south bank is undeveloped. This site was previously sampled in WY 2017.

- **Station 204R04884** (1.3 miles downstream of dam) – The sampled reach is downstream of the Tartan Trail Road crossing. In contrast to site 204R03528, Crystal Springs Road is located along the south bank of this reach, and the north bank is undeveloped. See Figure 2.7 for a typical in-stream view of this site.

- **Station 204R03272** (also referred to as 204SMA110) (0.8 miles downstream of dam) – The sampled reach is between Crystal Springs Road and confluence of Polhemus Creek. Crystal Springs Road is located along the north bank and the south bank is undeveloped. This site was previously sampled in WY 2018. This site is one of the SFPUC bioassessment monitoring stations (SMC5.13).

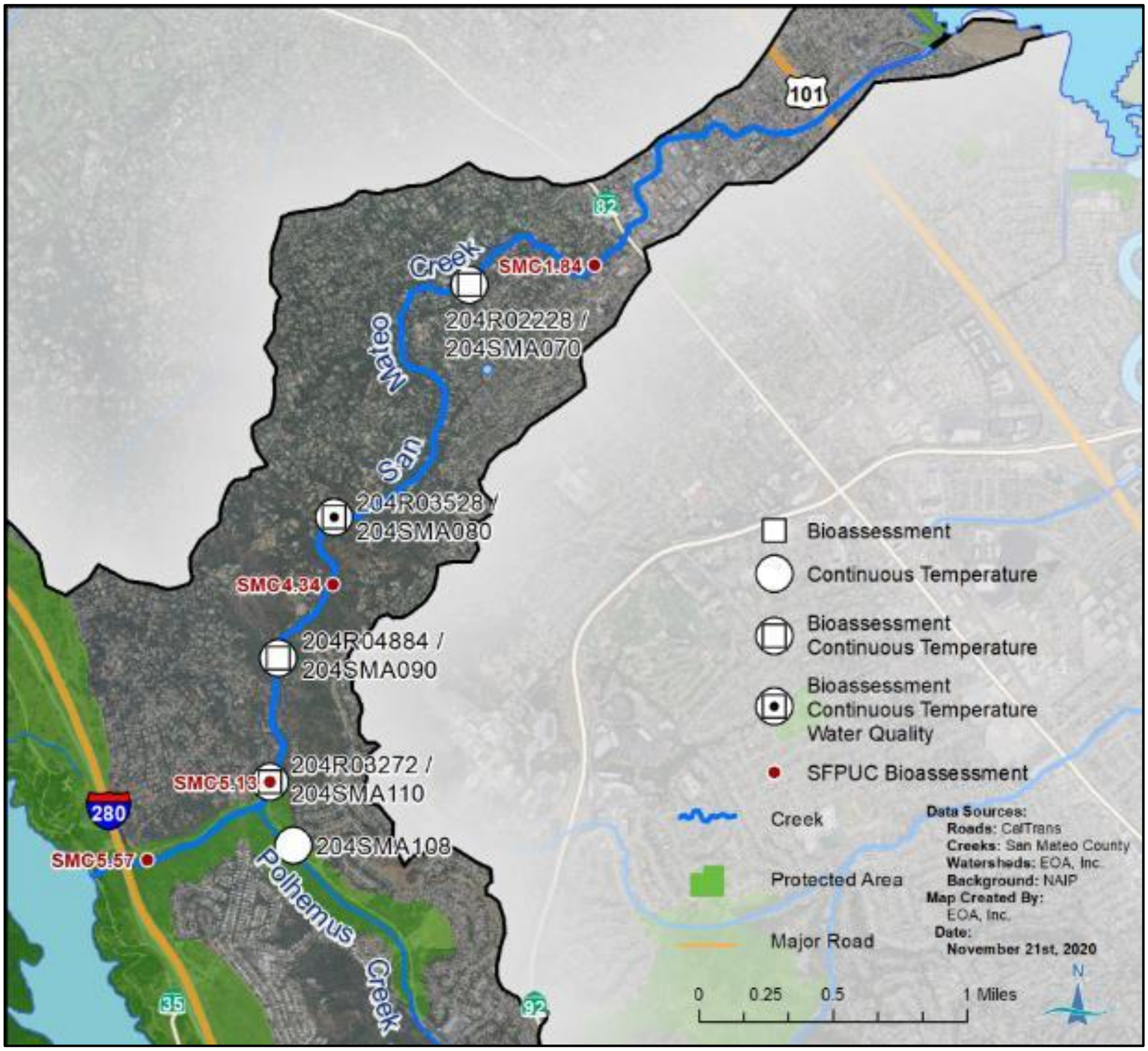

Figure 2.6. SMCWPPP Creek Status Monitoring sites in San Mateo Creek in WY 2020 Map includes SFPUC bioassessment stations.

Biological Condition Results

Biological conditions at the four sites in San Mateo Creek sampled during WY2020, as represented by CSCI and D_ASCI scores, are listed in Table 2.9. The CSCI scores ranged from 0.58 to 0.67, and the D_ASCI scores ranged from 0.74 to 0.77. For the three sites with prior monitoring results, the CSCI scores were consistent between the two time periods. Differences in CSCI scores ranged from 0.01 to 0.04. There was more year-to-year variability in D_ASCI scores with differences of 0.04 to 0.15.

Table 2.10. Biological condition, presented as CSCI and D_ASCI scores, for samples collected in San Mateo Creek by SMCWPPP between WY 2016 and WY 2020.

Station Code	Location	Pre – WY 2020			WY 2020	
		Water Year	CSCI Score	ASCI Diatom Score	CSCI Score	ASCI Diatom Score
204R02228	Stonehedge Rd	2016	0.56	0.61	0.60	0.76
204R03528	Crystal Springs Terrace	2018	0.60	0.78	0.58	0.74
204R04884	Tartan Trail Rd	NA	NA	NA	0.67	0.75
204R03272	Polhemus Rd	2017	0.63	0.87	0.64	0.77

Table 2.11 lists CSCI scores for bioassessment data collected by SFPUC (n=27) and SMCWPPP (n=7) from WY 2011 through WY 2020 in San Mateo Creek below Lower Crystal Springs Reservoir dam. See Figure 2.6 for station locations.

Table 2.11. CSCI scores for samples collected by SFPUC (n=27) and SMCWPPP (n=7) between 2011 and 2020 at six sites below Crystal Springs Dam on San Mateo Creek. CSCI scores for SMCWPPP samples are indicated in bold.

SFPUC Station ID	SMCWPPP Station ID	WY 2011	WY 2012	WY 2013	WY 2014	WY 2015	WY 2016	WY 2017	WY 2018	WY 2019	WY 2020	Median CSCI Score
SMC1.84	--	--	--	--	--	--	0.53	0.66	0.53	0.57	--	0.55
--	204R02228	--	--	--	--	--	**0.56**	--	--	--	**0.60**	0.58
--	204R03528	--	--	--	--	--	--	--	**0.60**	--	**0.58**	0.59
SMC4.34	--	--	--	0.58	0.65	0.66	0.62	0.56	0.63	0.64	--	0.62
--	204R04884	--	--	--	--	--	--	--	--	--	**0.67**	0.67
SMC5.13	204R03272	--	0.62	--	0.64	0.60	0.62	0.62 / **0.63**	0.69	0.69	**0.64**	0.63
SMC5.57	--	0.52	0.62	0.72	0.56	0.61	0.60	0.46	0.50	0.48	--	0.56

Based on the data presented in Table 2.11, there are no apparent temporal trends in biological conditions at any of the stations. This is not unexpected, as it can take decades for the improvements in stormwater quality and quantity implemented by municipal programs to be observed in receiving waters. Biological condition response to the new reservoir release schedule implemented by SFPUC in 2015 may also be delayed. Other factors, such as urbanization in the watershed, variability in precipitation and temperature, and sediment load may also obfuscate temporal changes.

There does appear to be a geographic pattern to biological conditions, as presented by CSCI scores. Sites that are farther downstream and lower in elevation (e.g., SMC1.84, 204R02228) have lower median CSCI scores compared to upstream, higher-elevation sites (e.g., SMC4.34/204R04884, SMC5.13/204R03272). The one exception to this spatial pattern is at SFPUC station SMC5.57, which has one of the lowest median CSCI scores and the lowest

CSCI scores in the overall dataset. Site SMC5.57 location directly below the Lower Crystal Springs Reservoir dam may explain its relatively low CSCI scores.

Despite relatively low CSCI scores for San Mateo Creek sites (i.e., four sites had median CSCI scores below 0.063 in the “very likely altered” condition category, and the other two were in the “likely altered” condition category), there were several sensitive taxa present in the BMI samples collected in WY 2020, which generally indicates good conditions. These taxa included the stonefly *Malenka* (two sites), glossosomatid caddisflies (three sites), the caddisfly *Parapsyche* (one site), and the caddisfly *Lepidostoma* (all sites). However, the presence of these taxa was not enough to influence the overall community structure when compared to BMI community structures for minimally disturbed reference sites, as defined by the CSCI tool.

Figure 2.7. SMCWPPP field crew collecting benthic macroinvertebrate samples in San Mateo Creek downstream of the Tartan Trail Road crossing (site 202R04884). The CSCI score at this site was 0.67.

Another aspect of the BMI assemblages for the San Mateo Creek sites was the presence of New Zealand Mud Snail (NZMS) (*Potamopyrgus antipodarum*), a non-native invasive species. The total number of NZMS and overall percent of organisms in BMI samples for the four San

Mateo Creek sites sampled by SMCWPPP is presented in Table 2.12. In WY 2020, the highest number of NZMS (173), approximately 28% of the entire sample, occurred at site 204R04884. The sample with the overall highest number of NZMS (270) was collected at site 204R02228 in WY 2016. NZMS were first documented in California in 2000, but it is unknown when they initially colonized San Mateo Creek.

Table 2.12. Total number of New Zealand Mud Snail (*Potamopyrgus antipodarum*) and overall percent of organisms in sample (parenthesis) for seven BMI samples collected by SMCWPPP in San Mateo Creek between WY 2016 and WY 2020.

Site	WY 2016	WY 2017	WY 2018	WY 2020
204R02228	270 (42)	NS	NS	58 (10)
204R03528	NS	NS	118 (19)	17 (2)
204R04884	NS	NS	NS	173 (28)
204R03272	NS	59 (10)	NS	116 (19)

Water Chemistry and Continuous Water Quality Results

Water chemistry was collected synoptically during bioassessments. Results are presented in Section 2.3.1.2. In general, all sites exhibited low concentrations of nutrients that are well below threshold levels associated with eutrophic stream conditions. Total nitrogen and phosphorus concentrations were equal or below 0.21 mg/L and 0.021 mg/L, respectively, across all four San Mateo Creek sites. Chlorophyll a concentrations, an indicator of algal biomass, were between 14 and 147 mg/m2, with the highest concentration at site 204R03272.

Continuous temperature and water quality data collected at bioassessment locations during WY 2020 did not exceed WQOs or MRP triggers and were at levels supportive of Aquatic Life Beneficial Uses. Results are presented in Section 3.0. These results are consistent with temperature data measured by SFPUC (SFPUC 2019).

Physical Habitat Results

Regional and countywide analysis of bioassessment data have shown that CSCI scores are positively correlated with some indicators of physical habitat condition (BASMAA 2019; SMCWPPP 2020). Two types of physical habitat data can be used to evaluate conditions: 1) qualitative assessment of three attributes assessed over the entire reach (summed to obtain total PHAB score); and 2) qualitative and quantitative measurements made at equally spaced transects, which are used to generate physical habitat metric scores using a reporting module. Five of these habitat metrics are used to calculate the IPI score. The total PHAB score and physical habitat metric scores associated with IPI Score for the four bioassessment sampling locations in San Mateo Creek in WY 2020 are presented in Table 2.13. CSCI scores are also shown for comparison.

Table 2.13. Physical habitat data for four bioassessment sites in San Mateo County sampled in WY 2020.

Station Code	Qualitative Attributes Used to Calculate PHAB Score (Assessed over entire reach)			Total PHAB Score	Physical Habitat Metrics Used to Calculate IPI Score[1] (Assessed at each transect/inter-transect)					IPI Score	CSCI Score
	Channel Alteration	Epifaunal Substrate	Sediment Deposition		Evenness Flow Habitat	Substrate Size <2 mm (%)	Shannon Diversity Aquatic Habitat Types	Sum Riparian Cover	Shannon Diversity Natural Substrate Types		
204R02228	12	9	7	28	0.79	35	1.7	172	1.55	1.06	0.60
204R03528	17	16	9	42	0.75	37	1.55	207	1.68	1.11	0.58
204R04884	18	17	7	42	0.97	46	1.77	209	1.54	1.12	0.67
204R03272	17	17	13	47	0.91	32	1.55	169	1.66	1.13	0.64

[1] Physical habitat metrics are increasing metrics (increase in score represents better habitat conditions), with the exception of "Substrate size < 2 mm", which is decreasing metric score.

Based only on IPI scores, all four sites were classified in the "likely intact" condition category. However, the lowest elevation/downstream most site (204R0228) had much lower total PHAB score (28) compared to remaining three sites (score range 42 – 47). Based on both total PHAB and IPI scores, the best overall physical habitat conditions occurred at site 204R03272, the highest elevation/upstream most site. Although overall physical habitat metric scores were high, the substrate < 2 mm (silt and sand) metric ranged between 32% and 46%, which indicates relatively high levels of fine substrate in San Mateo Creek.

Discussion

Several factors may be contributing to the consistently low CSCI scores for sites in San Mateo Creek. These factors may include proximal location downstream of a large reservoir (Lower Crystal Springs), watershed urbanization, excessive fine sediment deposition from sources below the dam, and the presence of NZMS (*Potamopyrgus antipodarum*).

Factors associated with the reservoir could include alterations in temperature and flow regimes, fluvial geomorphic processes, food resources available to BMIs, and basic water quality. These factors have been well documented for other BMI communities at sites downstream of large reservoirs (Alan and Castillo 2008, Rehn 2008). Reservoir impact on biological conditions typically decrease with increasing distance downstream of the reservoir. However, in San Mateo Creek, there is also increasing watershed imperviousness downstream of the reservoir, which may confound interpretation of biological conditions. Increasing watershed imperviousness has been associated with "flashy" hydrographs and mobilized surface street residues, all of which can affect the quality of BMI communities.

Hillside erosion below Caltrans outfall west of Interstate 280 has resulted in large sediment deposits in San Mateo Creek (SFPUC 2019). Sediment monitoring between 2012 and 2014 by SFPUC indicates that the increase in sediment is more than the system has the capacity to transport. Furthermore, the sediment loading appears to have a significant negative effect on biological conditions in San Mateo Creek.

NZMS effects on native BMI communities have been well documented in the Western United States (Vinson et al. 2007)[19]. It appears that NZMS populations are now consistently present in the BMI assemblages of San Mateo Creek. Monitoring the BMI assemblage should continue to assess changes in NZMS population and potential impacts to the native biota.

[19] See also http://ucanr.edu/sites/uccenzms/ and https://wildlife.ca.gov/Conservation/Invasives/Species/NZmudsnail.

3.0 Continuous Water Quality Monitoring

3.1 Introduction

During WY 2020 water temperature and general water quality were monitored in compliance with Creek Status Monitoring Provisions C.8.d.iii. – iv. of the MRP. Monitoring was conducted at selected sites using a targeted design based on the directed principle[20] to address the following management questions:

1. *What is the spatial and temporal variability in water quality conditions during the spring and summer season?*
2. *Do general water quality measurements indicate potential impacts to aquatic life?*

The first management question is addressed primarily through evaluation of water quality results in the context of existing aquatic life uses. Temperature and general water quality data were evaluated for potential impacts to different life stages and overall population of fish community present within monitored reaches.

The second management question is addressed primarily through the evaluation of targeted data with respect to water quality objectives and thresholds from published literature. Sites where exceedances occur may indicate potential impacts to aquatic life or other beneficial uses and are considered as candidates for future Stressor/Source Identification projects.

The sections below summarize methods and results from continuous temperature and water quality monitoring conducted in WY 2020. Conclusions and recommendations for continuous monitoring are presented in Section 7.0.

3.2 Methods

Continuous temperature and water quality data were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and associated QAPP (current version is BASMAA 2020). Data were evaluated with respect to the MRP provision C.8.d “Follow-up” triggers for each parameter.

3.2.1 Continuous Temperature

Digital temperature loggers (Onset HOBO Water Temp Pro V2) were programmed to record data at 60-minute intervals. The loggers were deployed at targeted sites from April through September. Procedures used for calibrating, deploying, programming and downloading data are described in RMC SOP FS-5 (BASMAA 2016). SMCWPPP typically deploys temperature loggers at more than minimum number of sites in anticipation of field equipment being stolen or washed downstream.

3.2.2 Continuous General Water Quality

Water quality monitoring equipment recording dissolved oxygen, temperature, conductivity, and pH (Eureka Manta+35 water probes and/or YSI 6600 data sondes) were programmed to record

[20] Directed Monitoring Design Principle: A deterministic approach in which points are selected deliberately based on knowledge of their attributes of interest as related to the environmental site being monitored. This principle is also known as "judgmental," "authoritative," "targeted," or "knowledge-based."

data at 15-minute intervals. The sondes were deployed at targeted sites for two 1 to 2-week events: spring season (Event 1) and late-summer season (Event 2). Procedures for calibrating, deploying, programming and downloading data are described in RMC SOP FS-4 (BASMAA 2016).

3.2.3 Data Evaluation

Continuous temperature and water quality data generated during WY 2020 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions, including exceedances of WQOs. Provision C.8.d of the MRP identifies trigger criteria as the principal means of evaluating the creek status monitoring data to identify sites where water quality impacts may have occurred. Sites with targeted monitoring results exceeding the trigger criteria are identified as candidate SSID projects. The relevant trigger criteria for continuous temperature and water quality data are listed in Table 3.1.

Table 3.1. Water Quality Objectives and thresholds used for trigger evaluation.

Monitoring Parameter	Objective/Trigger Threshold	Units	Source
Temperature	Two or more weekly average temperatures exceed the Maximum Weekly Average Temperature (MWAT) threshold of 17.0°C for a Steelhead stream, or 20% of the results at one sampling station exceed the instantaneous maximum of 24°C.	°C	MRP Provision C.8.d.iii. Sullivan et al. 2000
General Water Quality Parameters[1]	20% of results at each monitoring site exceed one or more established standard or threshold - applies individually to each parameter		
Conductivity	2000	uS/cm	MRP Provision C.8.d.iii.
Dissolved Oxygen	WARM < 5.0, COLD < 7.0	mg/L	SF Bay Basin Plan Ch. 3, p. 3-4
pH	> 6.5, < 8.5 [2]	pH	SF Bay Basin Plan Ch. 3, p. 3-4
Temperature	Same as Temperature (See Above)		

[1] Triggers are associated with continuous general water quality data.
[2] Special consideration will be used at sites where imported water is naturally causing higher pH in receiving waters.

3.3 Study Area

In compliance with the MRP, continuous temperature monitoring was conducted at a minimum of four sites, and continuous general water quality monitoring at two sites. All sites were located in the San Mateo Creek watershed (Figure 3.1). The targeted monitoring design focuses on sites selected based on the presence of significant fish and wildlife resources as well as historical and/or recent indications of water quality concerns.

Continuous temperature and water quality monitoring was at sampling locations within a 3.4-mile urban reach of San Mateo Creek below the Crystal Springs Reservoir dam. This reach of San Mateo Creek, which supports migration, rearing and spawning habitat for an existing steelhead population, was also targeted for bioassessment monitoring in WY 2020. The watershed characteristics and results of the bioassessment monitoring are described in Section 2.3.4).

Continuous (hourly) temperature measurements were recorded from May 1 through October 1, 2020, at five locations[21] in the San Mateo Creek Watershed. One station, SMA108 was located on Polhemus Creek, a tributary to San Mateo Creek, approximately 250 meters upstream of the confluence. Continuous (15-minute) general water quality measurements (temperature, dissolved oxygen, pH, specific conductance) were recorded at two of the temperature stations during two 1 to 2-week sampling events (Events 1 and 2). Sampling Event 1 occurred from May 1 through May 15, 2020; sampling Event 2 occurred from September 17 through October 1, 2020. Temperature and general water quality monitoring stations as well as the four WY 2020 bioassessment locations are shown in Figure 3.1. See Figure 2.7 for a photo of a typical riparian corridor along San Mateo Creek.

[21] SMCWPPP typically monitors water temperature at more stations than the MRP requires to mitigate for potential equipment loss.

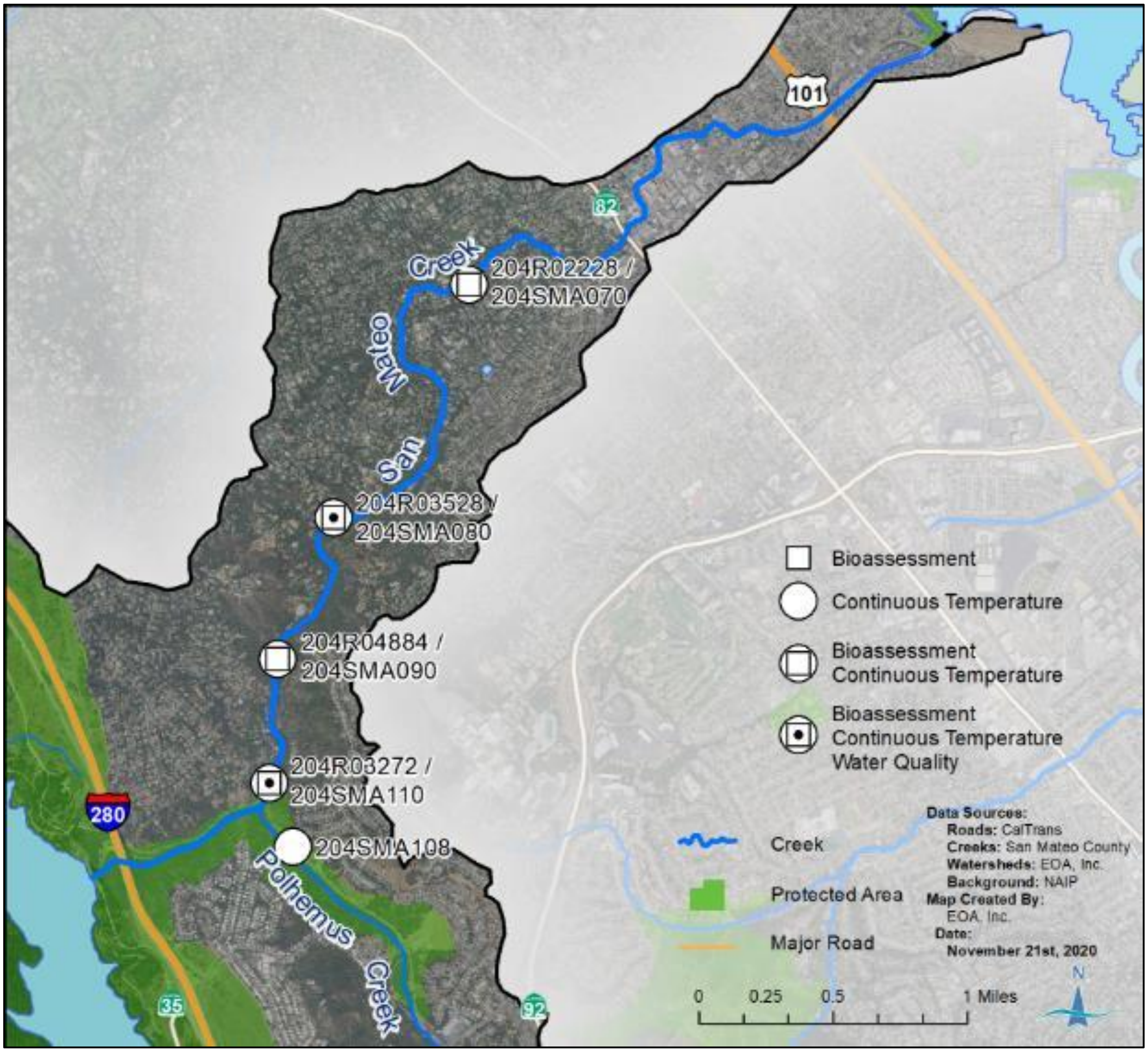

Figure 3.1. Continuous temperature and water quality stations in the San Mateo Creek watershed, San Mateo County, WY 2020.

3.4 Results and Discussion

The section below summarizes results from continuous temperature and water quality monitoring conducted during WY 2020. Conclusions and recommendations for this section are presented in Section 7.0.

3.4.1 Continuous Temperature

Temperature loggers were deployed at five sites in the San Mateo Creek watershed on May 1, 2020; checked and downloaded on July 14, 2020; and removed on October 1, 2020. Summary statistics for continuous water temperature data collected at the five sites are listed in Table 3.2. Instantaneous temperatures ranged from a low of 10.5°C to high of 20.8°C, both recorded at station SMA108 in Polhemus Creek. At stations on the main stem San Mateo Creek temperatures ranged from 11.5°C and 20.4°C. None of the recorded temperatures exceeded the instantaneous maximum temperature trigger of 24°C.

Table 3.2 Descriptive statistics for continuous water temperature measured between May 1 through October 1, 2020 at five sites in the San Mateo Creek watershed, San Mateo County.

		San Mateo Creek (downstream ---------------------------- upstream)				Polhemus Creek
	Site ID	**204SMA070**	**204SMA080**	**204SMA090**	**204SMA110**	**204SMA108**
	Start Date	5/1/2020	5/1/2020	5/1/2020	5/1/2020	5/1/2020
	End Date	10/1/2020	10/1/2020	10/1/2020	10/1/2020	10/1/2020
Temperature (°C)	Minimum	12.1	11.5	11.8	12.1	10.5
	Median	16.1	15.5	15.3	15.2	15.9
	Mean	16.2	15.5	15.4	15.4	15.9
	Maximum	20.4	19.5	19.5	19.6	20.8
	N (# individual measurements)	3674	3674	3673	3673	3673
	# Measurements > 24°C	0	0	0	0	0

Maximum Weekly Average Temperature (MWAT) values were calculated for each of the five monitoring sites (Table 3.3 and Figure 3.2). Consistent with MRP requirements, the MWAT was calculated for non-overlapping, seven-day periods. The MRP trigger is exceeded if two or more weeks exceed the MWAT threshold of 17.0°C. The MWAT values across all the sites ranged from 13.2 °C to 16.7 °C between May and early August. Starting August 13, a multiday heatwave occurred in the Bay Area with some of the highest temperatures recorded during WY 2020. For example, at San Francisco International Airport (SFO) approximately five miles north of San Mateo Creek, maximum air temperatures ranged between 82°F and 99°F from August 13 to August 18 (Figure 3.4). As a result, for the seven-day period starting on August 14 MWAT temperatures exceeded the 17.0°C threshold at all stations except SMA090 and SMA110. Water temperatures remained above the MWAT threshold at stations SMA070 and SMA108 during the following week, thus exceeding the MRP trigger of two weeks above the MWAT threshold. Exceedances of the MWAT threshold also occurred during September at station SMA110 and three times at station SMA070. Due to exceedances of the MRP trigger, stations SMA070 and SMA108 will be added to the list of candidate SSID studies. However, it is unlikely that these temperatures negatively impact COLD beneficial uses in the San Mateo Creek watershed. The 17°C threshold is based on streams of the Pacific Northwest and may not be an appropriate trigger for Bay Area streams. Alternative data evaluation thresholds, such as the Maximum Weekly Maximum Temperature (MWMT) threshold of 20°C used by the National Marine Fisheries Service (NMFS) in the Central Coast Steelhead Recovery Plan (NMFS 2016) were not exceeded.

Table 3.3. MWAT values for water temperature data collected at five stations in the San Mateo Creek watershed, WY 2020. Values that exceed the MWAT threshold (17°C) are indicated in bold.

	San Mateo Creek (downstream ---------------------------- upstream)				Polhemus Creek
Station	204SMA070	204SMA080	204SMA090	204SMA110	204SMA108
Date	Weekly Average Temperature (°C)				
5/1/2020	14.2	13.8	13.9	14.0	13.2
5/8/2020	14.5	14.0	14.0	14.1	13.7
5/15/2020	15.0	14.5	14.5	14.5	14.8
5/22/2020	15.9	15.0	14.9	14.8	15.2
5/29/2020	16.0	15.2	15.0	14.9	15.8
6/5/2020	15.3	14.7	14.6	14.6	14.9
6/12/2020	15.6	15.0	14.9	14.8	15.4
6/19/2020	16.3	15.4	15.2	15.1	15.9
6/26/2020	15.8	15.0	14.9	14.9	15.5
7/3/2020	15.7	15.0	15.0	14.9	15.5
7/10/2020	16.1	15.3	15.2	15.1	15.8
7/17/2020	16.2	15.5	15.4	15.3	16.3
7/24/2020	16.3	15.6	15.5	15.4	16.2
7/31/2020	16.3	15.7	15.6	15.5	16.4
8/7/2020	16.7	16.0	15.9	15.8	16.5
8/14/2020	**18.5**	**17.4**	17.0	16.7	**18.8**
8/21/2020	**17.1**	16.1	15.7	15.5	**17.7**
8/28/2020	16.3	15.9	15.9	15.9	16.0
9/4/2020	**17.4**	16.8	16.6	16.5	16.7
9/11/2020	16.2	15.8	15.7	15.7	16.1
9/18/2020	**17.1**	16.8	16.9	16.9	16.4
9/25/2020	**17.2**	16.9	16.9	17.0	16.2
Total Weeks	22	22	22	22	22
Max MWAT	18.5	17.4	17.0	17.0	18.8
Number >17°C	5	1	0	0	2
> MRP Trigger	**Y**	N	N	N	**Y**

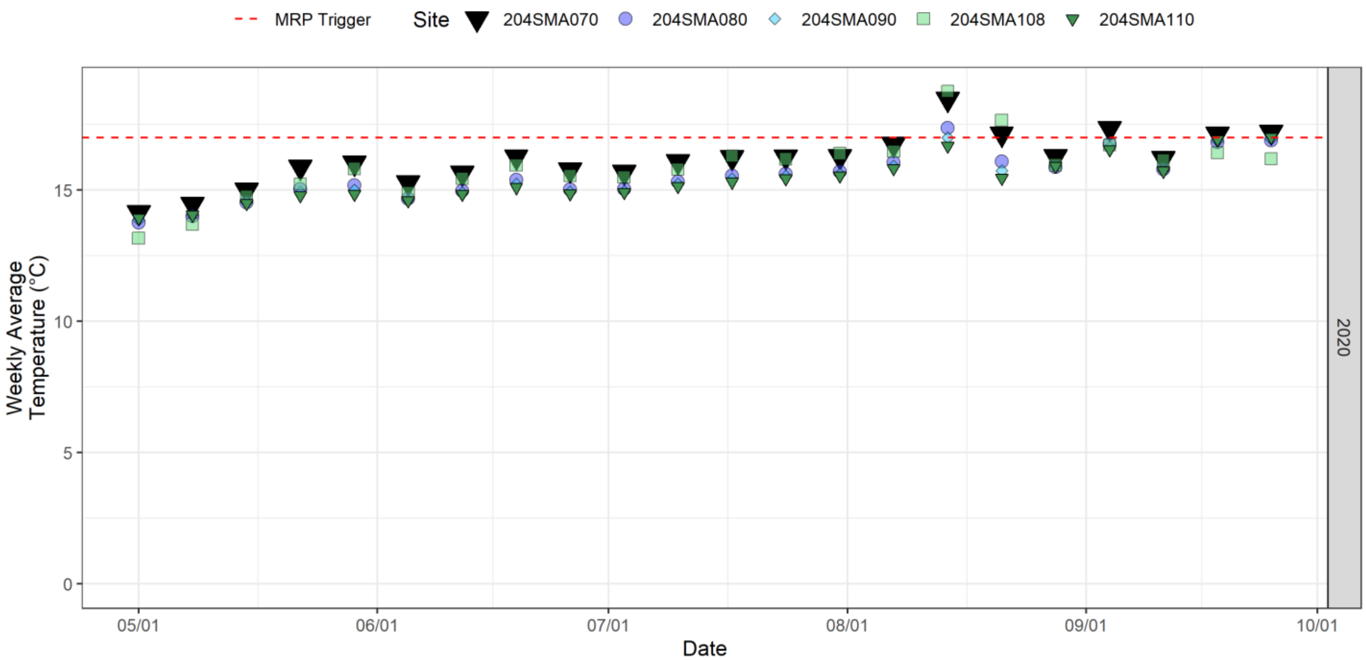

Figure 3.2. Maximum Weekly Average Temperature (MWAT) values calculated for water temperature collected at five sites in the San Mateo Creek watershed over 22 weeks of monitoring in WY 2020. The MWAT threshold (17°C) is shown for comparison.

Water temperature data, calculated as a daily average, for monitoring sites in San Mateo Creek and Polhemus Creek collected during WY 2020, are shown in Figure 3.3. In WY 2020, water temperatures generally increased through the sampling period from April to September. Temperature peaks occurred in late-May/early-June, mid-August, and early-September. The increases in water temperature closely correspond to the air temperatures observed during the sampling period. Maximum daily air temperatures recorded at SFO, approximately five miles north of San Mateo Creek are shown in Figure 3.4.

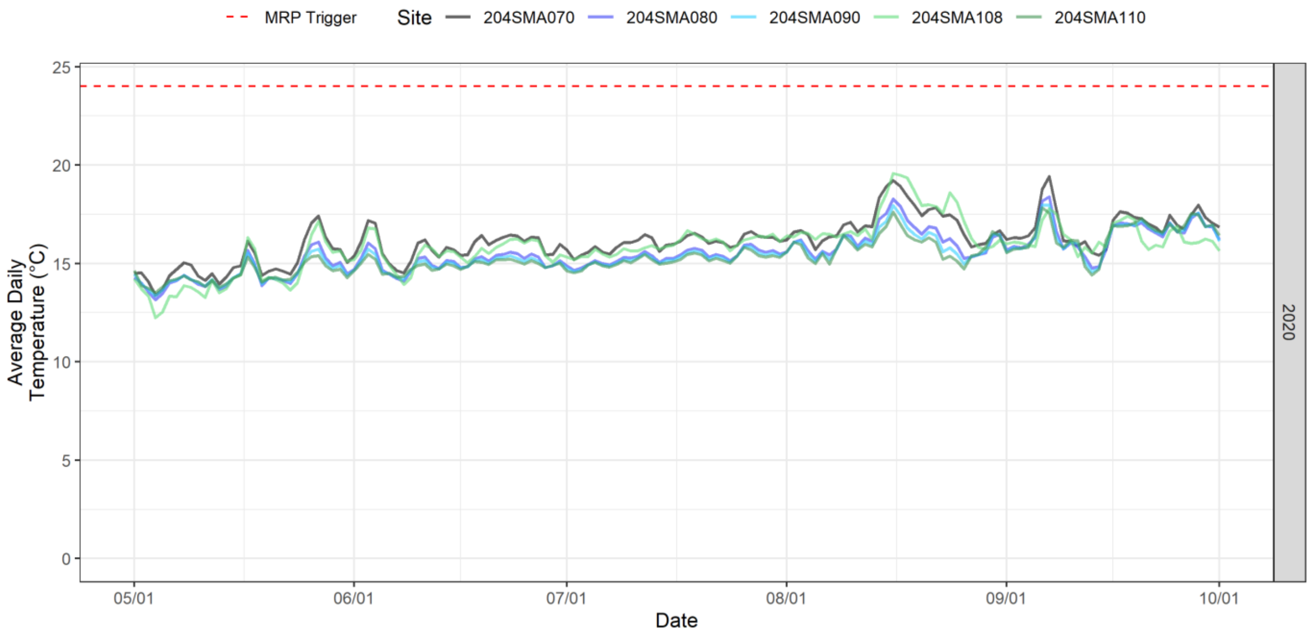

Figure 3.3 Water temperature, shown as daily average, collected between May and September 2020 five sites in San Mateo Creek and Polhemus Creek, San Mateo County. The MRP trigger threshold (25°C) is shown for comparison.

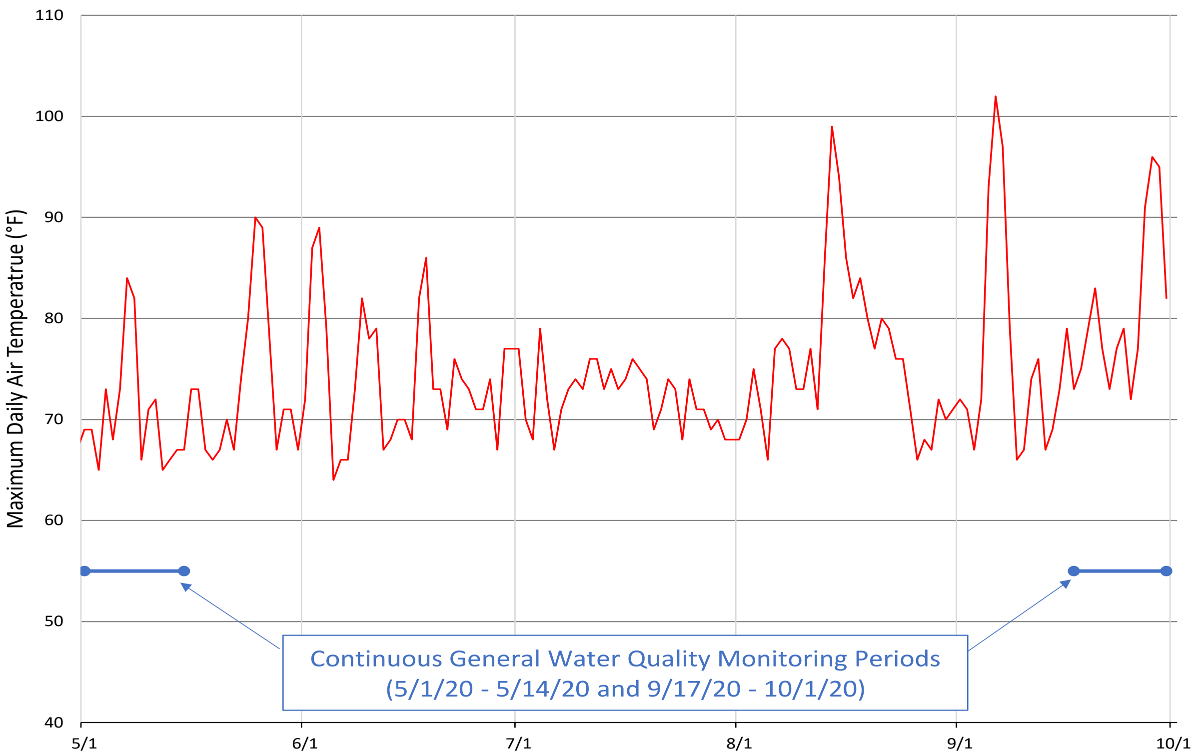

Figure 3.4 Maximum daily air temperature at San Francisco International Airport, May -September 2020 (NOAA station USW00023234).

3.4.2 General Water Quality

Summary statistics for general water quality measurements (dissolved oxygen, pH, specific conductance, temperature) collected at two stations in San Mateo Creek are listed in Table 3.4. Station locations are mapped in Figure 3.1. For Event 1, sondes were deployed on May 1 and retrieved on May 15, 2020. For Event 2, sondes were deployed on September 17 and retrieved on October 1, 2020. Some data from Event 2 were rejected due to high levels of equipment drift as evidenced by post-deployment calibration checks. Plots for all accepted water quality data measured during Events 1 (spring) and 2 (fall) are shown Figure 3.5.

Table 3.4. Descriptive statistics for continuous (15-minute) water temperature, dissolved oxygen, pH, and specific conductance measured at two San Mateo Creek sites during WY 2020.

Parameter	Data Type	204SMA80		204SMA110	
		Event 1	Event 2	Event 1	Event 2
		5/1 – 5/14	9/17 – 10/1	5/1 – 5/14	9/17 – 10/1
Temperature (°C)	Minimum	11.4	14.7	11.9	15.5
	Median	14.0	17.0	13.7	16.8
	Mean	13.8	16.8	13.8	16.9
	Maximum	15.9	18.7	16.2	18.9
	% > 24	0%	0%	0%	0%
Dissolved Oxygen (mg/L)	Minimum	9.4	8.8	9.2	8.8
	Median	10.0	9.3	9.7	9.1
	Mean	10.0	9.3	9.7	9.1
	Maximum	10.7	9.8	10.1	9.4
	% < 7	0%	0%	0%	0%
pH	Minimum	7.8	7.2	7.6	NA
	Median	7.9	7.4	7.7	NA
	Mean	7.9	7.4	7.7	NA
	Maximum	8.0	7.6	8.1	NA
	% < 6.5 or > 8.5	0%	0%	0%	NA
Specific Conductivity (uS/cm)	Minimum	190	NA	176	136
	Median	209	NA	186	140
	Mean	212	NA	189	141
	Maximum	286	NA	294	210
	% > 2000	0%	NA	0%	0%

Figure 3.5 Continuous water quality data (temperature, specific conductance, pH, and dissolved oxygen) collected during two monitoring events at two sites in San Mateo Creek.

Dissolved Oxygen

Dissolved oxygen (DO) concentrations ranged from 8.8 mg/L to 10.7 mg/L across both sites and both monitoring events, never dropping below the WQO of 7 mg/L (Table 3.4). At both stations DO concentrations followed a typical diurnal pattern with higher concentrations measured in the afternoon as a result of photosynthesis activity throughout the day and lower concentrations measured at night as a result of aquatic plant and animal respiration (Figure 3.5).

pH

Measured pH values ranged from 7.2 to 8.1 across both sites and both events, never dropping below to exceeding the WQO (i.e., < 6.5 or > 8.5). During Event 1, pH values were similar at the two stations. At station SMA080, pH values were slightly lower during Event 2 compared to Event 1. The pH data collected during Event 2 at station SMA110 were rejected, so a seasonal comparison could not be made for that station. However, given the proximity between the two stations and the similar data results for other parameters, it is likely that pH at SMA110 during Event 2 would have closely tracked station SMA080.

Specific Conductivity

Specific conductance ranged from 136 µS/cm to 294 µS/cm across both sites and both events, never exceeding the MRP trigger of 2000 µS/cm (Table 3.4). During Event 1 specific conductance levels were similar at the two stations. Specific conductance levels were also similar during the two events at station SMA110. The specific conductance data collected during Event 2 at station SMA080 were rejected, so a seasonal comparison could not be made for that station. However, given the proximity between the two stations and the similar data results for other parameters, it is likely that specific conductance at SMA080 during Event 2 would have closely tracked station SMA110.

Temperature

Water temperature data collected with the sondes ranged between 11.4°C and 16.2°C during Event 1 and 14.7°C and 18.9°C during Event 2, never exceeding the MRP trigger threshold of 24°C. Both stations were also instrumented with temperature loggers to collect data from May 1 to October 1, 2020. See Section 3.4.1 for a full discussion of the water temperature monitoring results.

With the exception of the MRP trigger for MWAT, there were no exceedances of WQOs or MRP triggers in the continuous temperature and general water quality monitoring data collected in WY 2020 in the San Mateo Creek watershed. Overall measured water quality constituents (pH, DO, specific conductivity) and temperature do not appear to be limiting factors for steelhead trout in San Mateo Creek.

4.0 Pathogen Indicator Monitoring

4.1 Introduction

This section describes the results of pathogen indicator monitoring that was in compliance with Creek Status Monitoring Provision C.8.d.v of the MRP. In WY 2020, monitoring sites were selected to supplement bacteria monitoring being conducted by the County of San Mateo (County) and the City of Pacifica (Pacifica) in compliance with Provision C.14 of the MRP which implements the San Pedro Creek and Pacifica State Beach Fecal Indicator Bacteria Total Maximum Daily Load (TMDL).

Data were compared to trigger thresholds identified in the MRP and WQOs adopted by the State Water Board. Sites where exceedances occur may indicate potential impacts to water contact recreation (REC-1) or other Beneficial Uses and are considered as candidates for future Stressor Source Identification projects. Program data were also evaluated with respect to County and Pacifica monitoring results for the purposes of laboratory comparison.

In compliance with the MRP, five samples were collected in WY 2020. The sections below summarize methods and results from pathogen indicator monitoring conducted during the current year. Conclusion and recommendations for this section are presented in Section 7.0.

4.2 Methods

4.2.1 Sample Collection

Pathogen indicator samples were collected during the dry season in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and QAPP (BASMAA 2020). Sampling techniques for pathogen indicators (*E. coli*, enterococci) include direct filling of sterile containers and transfer of samples to the analytical laboratory (Alpha Analytical in Livermore, CA) within specified holding time requirements. Procedures for sampling and transporting samples are described in RMC SOP FS-2 (BASMAA 2016).

Samples were collected concurrently or in succession with samples collected by the San Mateo Resource Conservation District (SMRCD) on behalf of the County and Pacifica. The SMRCD followed similar sampling protocols but submitted their samples to a different analytical laboratory (CelAnalytical in San Francisco, CA) for *E. coli* and total coliform analysis (County of San Mateo and City of Pacifica 2020).

4.2.2 Data Evaluation

Pathogen indicator data were evaluated with respect to trigger thresholds identified in the MRP and WQOs adopted by the State Water Board on August 7, 2018 and approved by the USEPA on March 22, 2019. Pathogen indicator trigger thresholds and WQOs are listed in Table 4.1. Data were also compared to County and Pacifica monitoring results for the purposes of laboratory comparison.

The MRP triggers and the adopted WQOs are both based on the 2012 USEPA recommended recreational water quality criteria (RWQC). The 2012 RWQC offers two sets of numeric thresholds for *E. coli* and enterococci intended to protect water contact recreation where immersion and ingestion are likely. The two sets of criteria are based on estimated rates of gastrointestinal illness (estimated illness rate of 36 per 1,000 recreators and estimated illness rate of 32 per 1,000 recreators). The MRP specifies the illness rate of 36/1,000 as a trigger threshold; whereas the State Water Board adopted the more conservative set of criteria based on the illness rate of 32/1,000.

The WQOs adopted by the State Water Board use *E. coli* as the sole indicator organism for freshwaters (i.e., salinity is equal to or less than 1 part per thousand (ppth) 95 percent or more of the time) and enterococci as the sole indicator for marine and brackish waters (i.e., salinity is greater than 1 ppth more than 5 percent of the time).

The WQOs consist of both a geometric mean (GM) and a Statistical Threshold Value (STV). The GM criteria is applied when there are at least five samples distributed over a six-week period. The STV criteria should not be exceeded by more than 10 percent of the samples taken in a month, and therefore the STV approximates a single sample maximum. Because pathogen indicator samples collected in compliance with the MRP are not repeated, results are compared to the STV criteria. Also, in this evaluation, the Most Probable Number (MPN) of bacteria colonies given by the analytical method is compared directly with the Colony Forming Units (CFU) of the USEPA recommendations.

Table 4.1. Bacteriological trigger thresholds and water quality objectives for water contact recreation.

	State Water Board WQO (Estimated Illness Rate 32/1,000) *		MRP Trigger Threshold (Estimated Illness Rate 36/1,000)	
Pathogen Indicator	GM	STV	GM	STV
E. coli (cfu/100 mL)	100	320	125	410
Enterococci (cfu/100 mL)	30	110	35	130

* The State Water Board WQOs use *E. coli* as the indicator for freshwater and enterococci as the indicator for marine and brackish water.

4.3 Study Area

Pathogen indicator samples were collected during one sampling event (July 20, 2020) at five sites. Sites were selected from the list of sites sampled by the SMRCD on behalf of the County and Pacifica in compliance with Provision C.14 of the MRP. Figure 4-1 shows pathogen indicator monitoring sites and associated site IDs. All sites are located in the San Pedro Creek watershed; four on the mainstem and one (SHAO) at the outfall to the mainstem of a small unnamed tributary referred to as Shamrock Creek. One of the sites (ADMS) was also surveyed by SMCWPPP for bioassessment in WY 2020. A second WY 2020 bioassessment site is located in San Pedro Creek upstream of the pathogen indicator sites.

San Pedro Creek is a perennial stream that flows westward to the Pacific Ocean through the City of Pacifica in San Mateo County. The creek drains roughly eight square miles and has five major tributaries, all of which contain perennial flows fed by springs. The North, Middle and South Forks extend into the upper reaches of the watershed. The North Fork headwaters are comprised of several steep first order streams that drain into an extensive network of underground culverts flowing through an urbanized valley. The Middle and South Fork tributaries also drain steep hillsides into a low gradient stream flowing through the upper end of San Pedro Valley; however, their subwatersheds are entirely within public open space (e.g., San Pedro Valley County Park). The main stem of San Pedro Creek flows for about 2.5 miles through a broad valley floor, which is mostly developed to the banks of the creek. San Pedro Creek contains the northern-most population of naturally producing steelhead trout (*Oncorhynchus mykiss*) in San Mateo County. Although degradation of physical habitat and the presence of fish barriers such as bridge culverts may threaten the steelhead population, restoration efforts are helping to reestablish and enhance habitat.

San Pedro Creek and the Pacific Ocean where the creek discharges (Pacifica State Beach) are listed as impaired water bodies on the Clean Water Act (CWA) 303(d) list due to high densities of fecal indicator bacteria (FIB) (e.g., fecal coliform, total coliform, *E. coli*, enterococcus) measured in water samples. In 2012, the Regional Water Board adopted the San Pedro Creek and at Pacifica State Beach Bacteria TMDL to address the FIB-based impairments. The San Pedro Creek and Pacifica State Beach Bacteria TMDL establishes load allocations and wasteload allocations in terms of allowable exceedances of TMDL-specific WQOs for indicator bacteria in marine and freshwater measured at two compliance points (the mouth of San Pedro Creek and Pacific State Beach). Provision C.14 of the MRP specifies how the TMDL should be implemented. Specific microbial control and prevention measures are required (e.g., dog waste clean-up stations, public outreach) and a bacteria water quality monitoring plan must be implemented to 1) better characterize bacteria contributions; and 2) to assess compliance with wasteload allocations. A TMDL status and monitoring report was submitted to the Regional Water Board in May 2020 (County and Pacifica 2020).

Figure 4.1. Pathogen indicator monitoring sites in WY 2020, San Pedro Creek Watershed, City of Pacifica.

4.4 Results and Discussion

Pathogen indicator (*E. coli* and enterococci) densities measured in grab samples collected on July 20, 2020 are listed in Table 4.2, along with monitoring results from samples collected concurrently by the SMRCD. Stations are mapped in Figure 4.1.

There was one measurement that exceeded the MRP trigger and WQO for *E. coli*, and three that exceeded the MRP trigger for enterococci (the enterococci WQO does not apply to freshwaters). The highest bacteria densities were measured at Station SHAO (Shamrock Watershed Outfall). The two stations downstream of the outfall (PRLT and SPCM) had bacteria densities an order of magnitude lower than SHAO, but higher than upstream stations. Although this single monitoring event is not sufficient to confirm geographic sources of bacteria, it does suggest that the Shamrock Watershed should be evaluated as part of the TMDL characterization monitoring program. Potential sources of pathogen indicators throughout the San Pedro Creek Watershed include, but are not limited to, dog kennel facilities, horse facilities, pet waste, wildlife, bacterial growth within the creek bed and conveyance systems, homeless encampments, and leaking public and private sewer lines or onsite wastewater treatment systems.

The County and Pacifica are actively conducting actions to control discharges of bacteria through implementation of the TMDL for Fecal Indicator Bacteria in San Pedro Creek and at Pacifica State Beach, as required by Provision C.14 of the MRP. Examples of these measures include increased inspections and enforcement actions at horse and dog kennel facilities, installation and maintenance of dog waste clean-up stations, enhanced pet waste public outreach and education, and ongoing review of characterization and compliance monitoring results (County and Pacifica 2020).

Table 4.2. Enterococci and *E. coli* levels measured in San Mateo County during WY 2020 (July 20, 2020). Results exceeding the MRP trigger are highlighted. Results exceeding the more conservative WQO are bold.

Site ID	Creek Name	Site Name	*Enterococci (cfu/100ml) (MPN/100ml)* [1]	*E. Coli (cfu/100ml) (MPN/100ml)* [1]	
			SMCWPPP	SMCWPPP	SMRCD
MRP Trigger Threshold (USEPA 2012; 36 per 1000 recreators)			130	410	NA
Statewide WQO (based on 32 per 1000 recreators)			110 [2]	320	320
SPCM	San Pedro Creek	San Pedro Creek Mouth	196.8	133.4	NS
PRLT	San Pedro Creek	Peralta Bridge Mainstream	206.3	198.9	197
SHAO	Unnamed Small Tributary to San Pedro Creek	Shamrock Watershed Drainage Outfall	>2419.6	**>2419.6**	**24196**
USSH	San Pedro Creek	Upstream of Shamrock Drainage	123.4	98.9	96
ADMS	San Pedro Creek	Adobe Drive Mainstream	88.4	101.4	75

NA = not applicable; NS = not sampled by SMRCD

[1] USEPA 2012 water quality criteria are given in cfu/100 mL; whereas, the analytical method used by SMCWPPP gives results in MPN/100 mL. These units are used interchangeably in this analysis.

[2] Statewide WQOs for enterococci do not apply to freshwaters.

Four stations had *E. coli* results from SMCWPPP (Alpha Analytical) and SMRCD (CelAnalytical). The relative percent difference between the SMCWPPP and SMRCD data ranged from 1% to 26%[22]. These differences are below the 200% threshold for acceptance of duplicate data that is required by the BASMAA RMC QAPP (BASMAA 2020), suggesting excellent agreement between the two analytical laboratories.

It is important to recognize that "most strains of *E. coli* and enterococci do not cause human illness (that is, they are not human pathogens); rather, they indicate the presence of fecal

[22] The results from Station SHAO are not included this this evaluation because the analytical method used by SMCWPPP has an upper reporting limit of 2,419.6 MPN/100 mL. The method used by SMRCD includes a dilution step which increases the upper reporting limit to 24,196 MPN/100 mL.

contamination" because they often co-occur with pathogens (USEPA 2012). Thus, pathogen indicators do not directly represent actual pathogen concentrations, nor do they distinguish among sources of bacteria. Testing water samples for specific pathogens is generally not practical for a number of reasons (e.g., concentrations of pathogens from fecal contamination may be small and difficult to detect but still of concern, laboratory analysis is often difficult and expensive, and the number of possible pathogens to potentially test for is large). Therefore, the presence of pathogens is inferred by testing for "pathogen indicator" organisms. The USEPA recommends using *E. coli* and enterococci as indicators of fecal contamination based on historical and recent epidemiological studies (USEPA 2012). Although animal fecal waste contributes to the pathogen indicator load, it is much less likely to contain pathogens of concern to human health than human sources. In most cases, it is the human sources that are associated with REC-1 health risks rather than wildlife or domestic animal sources (USEPA 2012). As a result, the comparison of pathogen indicator results to pathogen indicator thresholds may not be meaningful and should be interpreted cautiously.

5.0 Chlorine Monitoring

5.1 Introduction

Chlorine is added to potable water supplies and wastewater to kill microorganisms that cause waterborne diseases in humans. However, the same chlorine can be toxic to aquatic species if unmanaged. Chlorinated water may be inadvertently discharged to the MS4s and/or urban creeks from residential activities, such as pool dewatering, over-watering landscaping, or from municipal activities such as hydrant flushing or water main breaks.

In compliance with Provision C.8.d.ii of the MRP and to assess whether chlorine in receiving waters is present at concentrations potentially toxic to the aquatic life, SMCWPPP field staff measured free chlorine and total chlorine residual in creeks where bioassessments were conducted. Total chlorine residual is comprised of “combined” chlorine and free chlorine and should theoretically be greater than or equal to the free chlorine residual. Combined chlorine is the chlorine that has reacted with ammonia or organic nitrogen to form chloramines, while free chlorine is the chlorine that remains unbound. Both can be toxic to aquatic life, but chlorine dissipates into the atmosphere more quickly than chloramine.

5.2 Methods

In accordance with the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), WY 2020 field testing for free chlorine and total chlorine residual was conducted at all ten bioassessment sites concurrent with spring bioassessment sampling (May). Bioassessment site selection is described in Section 2.0.

Field testing for free chlorine and total chlorine residual conformed to methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016), which are comparable to those specified in the SWAMP QAPP. Per SOP FS-3 (BASMAA 2016), water samples were collected and analyzed for free and total chlorine using a Pocket Colorimeter™ II and DPD Powder Pillows, which has a manufacturer reported method detection limit of 0.02 mg/L. If concentrations exceed the MRP trigger criteria of 0.1 mg/L, the site was immediately resampled. If the resample also exceeds the trigger, the site is added to the list of candidate SSID projects. Provision C.8.d.ii(4) of the MRP also specifies that “Permittees report the observation to the appropriate Permittee central contact point for illicit discharges so that the illicit discharge staff can investigate and abate the associated discharge in accordance with its Provision C.5.e – Spill and Dumping Complaint Response Program.

5.3 Results and Discussion

In WY 2020, SMCWPPP monitored the ten bioassessment sites for free chlorine and total chlorine residual. These measurements were compared to the MRP trigger threshold of 0.1 mg/L. Results are listed in Table 5.1. The trigger threshold for total chlorine residual was exceeded at one station (204R01256) at Stulsaft Park on Arroyo Ojo de Agua in the City of Redwood City. The exceedance was immediately reported to the Redwood City illicit discharge contact.

For unknown reasons, the free chlorine result was greater than the total residual chlorine result at three stations (Table 5.1). Inverted results such as these have been occasionally noted through the WY 2012 – WY 2020 monitoring program (SMCWPPP 2020). Potential causes for these inverted results include matrix interferences, colorimeter user error, and concentrations near the detection limit. According to Hach, the supplier of the equipment and reagents, the free chlorine could have false positive results due to a pH exceedance of 7.6 and/or an alkalinity exceedance of 250 mg/L. The pH was measured concurrently with the chlorine sample, but alkalinity was not measured. At several stations, the pH exceeded 7.6. It is unlikely that the higher free chlorine readings were caused by user error. The field crew is well-trained and aware of potential problems with this testing method, such as wait times between adding reagents and taking the readings and keeping the free chlorine and total residual chlorine samples separate. The cause of the inverted free chlorine and total chlorine residual results (compared to expected) is unknown. However, it should be noted that colorimetric field instruments are generally not considered capable of providing accurate measurements of free chlorine and total chlorine residual below 0.13 mg/L, regardless of the method detection limit provided by the manufacturer. For this reason, the Statewide General Permit for drinking Water Discharges (Order WQ 2014-0194-DWQ) uses 0.1mg/L as a reporting limit for field measurements of total chlorine residual.

Table 5.1. Chlorine testing results compared to MRP trigger of 0.1 mg/L, WY 2020. Results exceeding the MRP trigger are bold.

Site ID	Date	Creek	Free Chlorine (mg/L) [1, 2]	Total Chlorine Residual (mg/L) [1, 2]
202R01308	5/18/2020	Pilarcitos Creek	< 0.02	0.03
202R04568	5/27/2020	San Pedro Creek	0.04	0.06
202R05464	5/27/2020	San Pedro Creek	0.06	< 0.02
204R00680	5/19/2020	Redwood Creek	0.04	0.05
204R01256	5/19/2020	Arroyo Ojo de Agua	0.04	**0.23 / 0.25**
204R02228	5/20/2020	San Mateo Creek	0.04	< 0.02
204R03272	5/26/2020	San Mateo Creek	0.03	0.03
204R03528	5/26/2020	San Mateo Creek	0.05	0.05
204R04884	5/21/2020	San Mateo Creek	< 0.02	0.03
204R05176	5/20/2020	Laurel Creek	< 0.02	0.06

[1] The method detection limit is 0.02 mg/L; however, the Statewide General Permit for Drinking Water Discharges (Order WQ 2014-0194-DWQ) uses 0.1 mg/L as a reporting limit (minimum level) for field measurements of total chlorine residual.

[2] The MRP trigger threshold of 0.1 mg/L applies to both free chlorine and total chlorine residual.

Figure 5.1 Chlorine sample stations in San Mateo County, WY 2020.

6.0 Toxicity and Sediment Chemistry Monitoring

6.1 Introduction

This section describes the results of toxicity testing, sediment chemistry monitoring, and water column pesticides monitoring, collectively referred to as pesticides and toxicity monitoring, conducted during WY 2014 through WY 2020 in compliance with Provisions C.8.c of MRP 1.0 and C.8.g of MRP 2.0. It is an update to the findings of the IMR (SMCWPPP 2020) with the addition of WY 2020 monitoring data. The following discussion also presents local pesticides and toxicity monitoring results from projects external to SMCWPPP to inform management efforts for San Mateo County urban creeks with respect to achievement of WQOs and support of beneficial uses.

Toxicity testing provides a tool for assessing the toxic effects (acute and chronic) of all chemicals in samples of receiving waters or sediments and allows the cumulative effect of the pollutant present in the sample to be evaluated. Because different test organisms are sensitive to different classes of chemicals and pollutants, several different organisms are monitored. Sediment and water chemistry monitoring for a variety of potential pollutants is conducted synoptically with toxicity monitoring to provide preliminary insight into the possible causes of toxicity should it be observed.

Wet and dry weather monitoring of pesticides and toxicity in urban creeks was required during both the MRP 1.0 and MRP 2.0 permit terms. During MRP 1.0, SMCWPPP selected monitoring sites from the list of sites that were monitored for biological condition. During MRP 2.0, SMCWPPP targeted sites in a different watershed each year to expand the geographic scope of pesticides and toxicity monitoring data.

Dry Weather

In WY 2014 and WY 2015, Provision C.8.c of MRP 1.0 required that two sites be sampled for pesticides and toxicity each year during the dry weather period. SMCWPPP selected these two sites from the list of sites where bioassessment was conducted during the same WY. MRP 1.0 dry weather monitoring included:

- Toxicity testing in water using four species: *Ceriodaphnia dubia* (chronic survival and reproduction), *Pimephales promelas* (larval survival and growth), *Selenastrum capricornutum* (growth), and *Hyalella azteca* (survival).
- Toxicity testing in sediment using one species: *Hyalella azteca* (survival)[23].
- Sediment chemistry analysis for pyrethroids, chlordane, dieldrin, endrin, heptachlor epoxide, lindane, dichloro-diphenyl-trichloroethanes (DDT), metals, polycyclic aromatic hydrocarbons (PAHs), total organic carbon (TOC), and sediment grain size.

In WY 2016 through WY 2020, Provision C.8.g of MRP 2.0 required SMCWPPP to sample one site each year during the dry season for pesticides and toxicity. The permit provides examples

[23] Although the chronic (growth) endpoint for *Hyalella azteca* was not required by the MRP, it was provided by the laboratory and reported in the UCMRs.

of possible monitoring location types, including sites with suspected or past toxicity results, existing bioassessment sites, or creek restoration sites. MRP 2.0 dry weather monitoring includes:

- Toxicity testing in water using five species: *Ceriodaphnia* dubia (chronic survival and reproduction), *Pimephales promelas* (larval survival and growth), *Selenastrum capricornutum* (growth), *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Toxicity testing in sediment using two species: *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Sediment chemistry analysis for pyrethroids, fipronil, carbaryl, total polycyclic aromatic hydrocarbons (PAHs), metals, TOC, and sediment grain size.

Wet Weather

In WY 2014 and WY 2015, MRP 1.0 required wet weather toxicity testing at the same two sites where dry season toxicity and sediment chemistry monitoring was conducted. The wet weather toxicity monitoring was based on the same four species as were used in the dry season monitoring. No wet weather water chemistry monitoring for pesticides or other potential pollutants was required during MRP 1.0.

Provision C.8.g.iii.(3) of MRP 2.0, covering WY 2016 through WY 2020, requires a collective total of ten wet weather toxicity and water chemistry samples if the wet weather monitoring is conducted by the RMC on behalf of all Permittees. MRP 2.0 states that the monitoring locations should be representative of urban watersheds (i.e., at the bottom of watersheds). At the RMC Monitoring Workgroup meeting on January 25, 2016, RMC members agreed to collaborate on implementation of the wet weather monitoring requirements. MRP 2.0 wet weather monitoring requirements include collection of water column samples during storm events for toxicity testing using the same five organisms required for dry weather testing and analysis of pyrethroids, fipronil, imidacloprid, and indoxacarb[24]. All ten wet weather samples were collected in WY 2018 during a single storm event on January 8, 2018. SCVURPPP and ACCWP each collected three samples, and SMCWPPP and CCCWP each collected two samples.

6.2 Methods

6.2.1 Site Selection

In WY 2014 and WY 2015, under MRP 1.0, the two annual pesticides and toxicity monitoring sites were selected from the list of ten probabilistic sites where bioassessment surveys were conducted. See Section 2.2 of this report for a description of the probabilistic survey design. Sites were identified based on the likelihood that they would be safe to access during storm events and that fine depositional sediments would be present during the dry season.

In WY 2016 through WY 2020, under MRP 2.0, sites were selected to represent mixed-land use in urban watersheds not already being monitored for toxicity or pesticides by other programs, such as the SWAMP Stream Pollution Trends (SPoT) program. A different watershed was

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[24] Standard analytical methods for indoxacarb are not currently available. Indoxacarb analysis will not be required until the water year following notification by the Executive Officer that a method is available.

targeted each year with the goal of eventually developing a geographically diverse dataset. Specific monitoring locations within the identified creeks were based on the likelihood that they would contain fine depositional sediments during the dry season and would be safe to access during wet weather sampling, if relevant. During WY 2020, Bear Creek in the Town of Woodside (see Figure 6.1) was selected for monitoring.

In WY 2018, in compliance with Provision C.8.g.iii of MRP 2.0, water toxicity and pesticides samples were collected from two sites during wet weather: San Pedro Creek in the City of Pacifica and Cordilleras Creek near the City of San Carlos. San Pedro Creek was selected because it was monitored for dry weather pesticides and toxicity in WY 2017. Cordilleras Creek was selected because it was targeted for dry weather monitoring in WY 2018. The goal was to compare dry and wet weather monitoring results.

All stations monitored by SMCWPPP for wet and dry weather pesticides and toxicity during WY 2014 through WY 2020 are mapped in Figure 6.1. The SPoT station on San Mateo Creek is also mapped.

6.2.2 Sample Collection

Water and sediment samples for pesticides and toxicity monitoring were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016) and the associated QAPP (BASMAA 2020). Before sampling, field personnel conduct a qualitative assessment of the proposed sampling site to identify appropriate sampling locations. This is particularly necessary for sediment sampling, which requires the presence of fine-sediment depositional areas that can support at least five sub-sites within a 100-meter reach.

Water samples were collected using standard grab sampling methods. The required number of labeled amber glass bottles were filled and placed on ice to cool to < 6C. The laboratory was notified of the impending sampling delivery to meet sample hold times. Procedures used for sampling and transporting water samples are described in SOP FS-2 (BASMAA 2016).

Sediment samples were collected after any water samples were collected. Sediment samples were 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 disturbance of sediment at collection sub-sites. Sediment samples were placed in a compositing container, thoroughly homogenized, and then aliquoted into separate jars for chemical or toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016).

Samples were submitted to respective laboratories under RMC SOP FS-9 Chain of Custody procedures and field data sheets were reviewed per SOP FS-13 (BASMAA 2016).

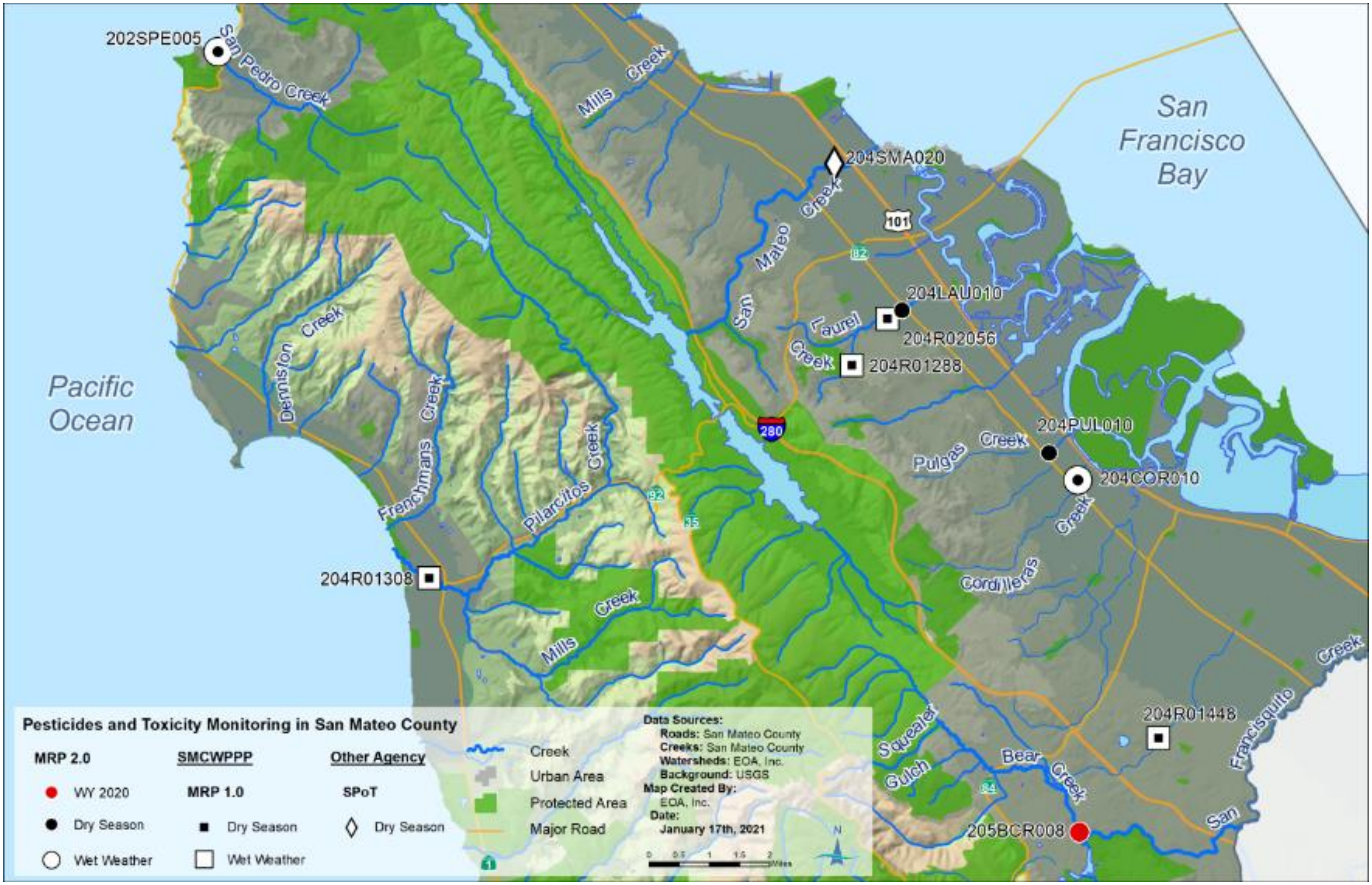

Figure 6.1 Pesticide and toxicity sampling locations in San Mateo County during WY 2014 through WY 2020.

6.2.3 Data Evaluation

Water and Sediment Toxicity

Toxicity data evaluation required by MRP 1.0 and MRP 2.0 involves first assessing whether the samples are toxic to the test organisms relative to the laboratory control treatment via statistical comparison. MRP 2.0 specifies using the Test of Significant Toxicity (TST) statistical approach to compare the sample to the laboratory control. For samples with toxicity (i.e., those that "failed" the TST), the Percent Effect is evaluated. The Percent Effect compares sample endpoints (survival, reproduction, growth) to the laboratory control endpoints. Both the statistical comparison (e.g., TST) and the comparison of the sample results to the laboratory control (e.g., Percent Effect) are determined by the laboratory.

For WY 2014 and WY 2015 data, Table 8.1 of MRP 1.0 identified toxicity results of less than 50% of the laboratory control as requiring follow-up action for water toxicity tests. For sediment toxicity tests in these years, MRP 1.0 Table H-1 identified toxicity results of greater than 20% less than the control as requiring follow-up action.

For WY 2016 through WY 2020 data, Provision C.8.g of MRP 2.0 identified toxicity results reported as "fail" via the TST approach and a Percent Effect of ≥ 50% as requiring follow-up action for water and sediment tests.

MRP 2.0 (WY 2016 – WY 2020) requires that the site is resampled if any toxicity test result exceeds the threshold. MRP 1.0 (WY 2014 and WY 2015) required resampling for water toxicity tests only, not sediment tests. If both the initial and follow-up sample exceed the threshold, the site is added to the list of candidate SSID projects.

Sediment Chemistry

In compliance with MRP Provision C.8.g.iv, sediment sample results 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). All results where a PEC or TEC quotient is equal to or greater than 1.0 are identified and added to the list of candidate SSID projects.

PECs and TECs are listed in MacDonald et al. (2000) for total PAHs, rather than the individual PAHs that are reported by the laboratory. Total PAH concentrations were calculated by summing the concentrations of 24 individual PAHs. Concentrations equal to one-half of the respective laboratory method detection limits were substituted for non-detect data so that calculations and statistics could be computed. Therefore, some of the TEC and PEC quotients may be artificially elevated (and contribute to trigger exceedances) due to the method used to account for filling in non-detect data.

The TECs for bedded sediments are very conservative values that do not consider site specific background conditions, and are therefore not very useful in identifying real water quality concerns in receiving waters. All sites in San Mateo County are likely to have at least one TEC quotient equal to or greater than 1.0. This is due to high levels of naturally-occurring chromium and nickel in geologic formations (i.e., serpentinite) and soils that contribute to TEC and PEC quotients. These conditions will be considered when making decisions about SSID projects.

The current MRP does not require consideration of pyrethroid, fipronil, or carbaryl sediment chemistry data for follow-up SSID projects, perhaps because pyrethroids are ubiquitous in the urban environment and little is known about fipronil and carbaryl distribution. However, SMCWPPP computed toxicity unit (TU) equivalents for individual pyrethroid results based on available literature values for pyrethroids in sediment LC50 values.[25,26] 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 total organic carbon (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.

Water Chemistry

Provision C.8.g.iv of MRP 2.0 requires that chemical pollutant data from water and sediment monitoring be compared to the corresponding WQOs in the Basin Plan for each analyte sampled. If concentrations in the samples exceed their WQOs, then the site at which the exceedances were observed will be added to the list of candidate SSID projects. However, the Basin Plan does not contain numeric WQOs for the chemical analytes encompassed within the wet weather pesticide monitoring.

6.3 Results and Discussion

In WY 2014 and WY 2015, a total of four sites (two sites per year) were monitored for water and sediment toxicity and sediment chemistry during the wet and dry seasons. In WY 2014, sites in the Laurel Creek and Pilarcitos Creek watersheds were selected for monitoring. In WY 2015, sites in the Laurel Creek and Atherton Creek watersheds were selected for monitoring. The monitoring sites were selected from a list of locations where bioassessment surveys had been conducted. The results of these monitoring efforts were compared to MRP 1.0 trigger thresholds.

WY 2016 through WY 2020 dry weather water and sediment toxicity and sediment chemistry monitoring was conducted to satisfy the requirements specified in MRP 2.0. Dry weather monitoring took place at one site per year and was located in varying watersheds throughout San Mateo County to shed light on spatial variations in water quality present within the County. The monitored sites from WYs 2016, 2017, 2018, 2019, and 2020 were located in Laurel Creek, San Pedro Creek, Cordilleras Creek, Pulgas Creek, and Bear Creek, respectively. In WY 2018, wet weather toxicity and water chemistry monitoring was conducted in San Pedro Creek and Cordilleras Creek to satisfy Provision C.8.g.iii of MRP 2.0.

Toxicity and pesticides monitoring results are described in the sections below. Conclusions and recommendations are provided in section 7.0.

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

[26] No LC50 is published for carbaryl in sediment.

6.3.1 Toxicity

WY 2020 Results

Details of the WY 2020 toxicity tests are listed in Table 6.1. Based on the WY 2020 toxicity test results, it is not necessary to add Bear Creek to the list of potential SSID projects. Neither the water nor the sediment samples were toxic to the any of the test organisms. Consistent with MRP requirements, no water chemistry samples were collected with the toxicity samples. The sediment chemistry, described in more detail in Section 6.3.2, did not result in any exceedances of MRP 2.0 triggers (i.e., TEC or PEC ≥ 1.0). The sediment chemistry findings are consistent with the lack of toxicity in the water and sediment samples.

Table 6.1. Summary of SMCWPPP dry weather water and sediment toxicity results, Bear Creek, WY 2020.

Site	Organism	Test Type	Unit	Results		% Effect	TST Value	Follow up needed (TST "Fail" and ≥50%)
				Lab Control	Organism Test			
205BCR008 (Bear Creek) July 22, 2020	**Water**							
	Ceriodaphnia dubia	Survival	%	100	100	0%	NA [1] (Pass)	No
		Reproduction	Num/Rep	34.4	31.8	7.6%	Pass	No
	Pimephales promelas	Survival	%	97.5	95	2.6%	Pass	No
		Growth	mg/ind	0.72	0.869	-21%	Pass	No
	Chironomus dilutus	Survival	%	90	100	-11%	Pass	No
	Hyalella azteca	Survival	%	96	98	-2.1%	Pass	No
	Selenastrum capricornutum	Growth	cells/ml	891000	1820000	-104%	Pass	No
	Sediment							
	Chironomus dilutus	Survival	%	93.8	97.5	-4.0%	Pass	No
	Hyalella azteca	Survival	%	96.3	90	6.5%	Pass	No

[1] TST analysis is not performed for survival endpoint - a percent effect <25% is considered a "Pass", and a percent effect ≥25% is considered a "Fail"

WY 2014 – WY 2020 Toxicity Summary

Toxicity results for WYs 2014 through WY 2020 are summarized in Table 6.2. Details of the WY 2014 to WY 2018 toxicity tests can be found in the Urban Creeks Monitoring Reports for each year (SMCWPPP 2018, SMCWPPP 2017, SMCWPPP 2016, SMCWPPP 2015). Details of the WY 2019 toxicity test results are compiled with prior years in the 2020 Integrated Monitoring Report (SMCWPPP 2020).

During WY 2014 through WY 2020, there were three toxicity tests with sample results having toxicity relative to the laboratory control *and* a Percent Effect exceeding the MRP trigger threshold (see Section 6.2.3 for an explanation of MRP 1.0 and 2.0 triggers). All three of these tests with trigger exceedances were conducted in WY 2014 and WY 2015 for the growth (chronic) endpoint of *H. azteca*, a test that was not required by the MRP but was reported by the analytical laboratory. With one exception, where the Percent Effect was below the MRP trigger threshold, the associated tests for the survival (acute) endpoint did not cause toxicity to *H. azteca. H. azteca* is known to be sensitive to pyrethroid pesticides and these pesticides are commonly detected in urban creek sediment samples throughout San Mateo County. Long-term monitoring of San Mateo Creek by the SPoT program suggests that pyrethroid concentrations in sediment have decreased since 2011/2012 (SMCWPPP 2019b), which may explain why no MRP 2.0 sediment samples were toxic to *H. azteca*.

Overall, there were 18 test results that had significant toxicity, but with a Percent Effect that did not exceed the MRP trigger thresholds. A majority of these toxicity results were found in water samples and were associated with either *C. dubia* reproduction (six samples), a chronic toxicity endpoint, or *H. azteca* survival (six samples), an acute toxicity endpoint. Five of the six water samples with toxicity to *H. azteca* were collected during wet season sampling events, suggesting that stormwater runoff is affecting *H. azteca*. The water samples with toxicity to *C. dubia* were more evenly dispersed between wet and dry season sampling events.

C. dubia Toxicity Analysis

As indicated in Table 6.2, chronic (reproductive) *C. dubia* toxicity was observed in six of the 15 water samples analyzed by SMCWPPP from WY 2014 – WY 2020. *C. dubia* is a water flea that is sensitive to a broad range of aquatic contaminants. However, the specific cause of the chronic *C. dubia* toxicity in the San Mateo County samples is unknown, not seemingly explained by the synoptic sediment chemistry results. It is possible that these toxicity results are erroneous artifacts of laboratory QA/QC procedures.

In preparation for reissuance of the SWAMP QAPrP in 2013, the SWAMP Toxicity Work Group examined conductivity tolerance in freshwater toxicity test species with respect to the relationship between sample water conductivity and observed toxicity. It was determined that *C. dubia* survival and reproduction are negatively affected at high and low conductivities. The SWAMP Toxicity Work Group (2013) recommended “appropriate controls” when sample water has high (>1900 µS/cm) or low (<100 µS/cm) conductivities because the *C. dubia* test organisms cultivated in the laboratory under standard laboratory conditions (e.g., 310 to 360 µS/cm) may perish or experience reduced reproduction when exposed to the sample water. In light of these findings, SMCWPPP compiled the results of conductivity measurements taken from sample water associated with toxicity monitoring from WY 2012 through WY 2020 to compare with the laboratory water used in these toxicity tests and the results of the tests themselves. In almost all cases, it was found that the sample water conductivity was higher or lower by several hundred µS/cm compared to the laboratory control samples (a mean difference of 433 µS/cm). However, no correlation was found between *C. dubia* toxicity and sample water/laboratory control water conductivity differences.

Statewide, there have been other reports of unexplained chronic *C. dubia* toxicity, within and between laboratory variability in the magnitude of toxicity, and suspicion of false positives. Recent analysis by SWAMP in conjunction with the Statewide Toxicity Provisions adopted by the State Water Board on December 1, 2020 indicates that *C. dubia* toxicity variability could arise from inconsistencies in QA procedures used by laboratories. A new Special Study requested by the State Water Board will be carried out in 2021 and 2022 with a work plan developed by SCCWRP and a report anticipated in December 2022. This study will contain recommendations for improvements to laboratory QA procedures associated with the *C. dubia* toxicity tests and may also yield related findings pertaining to the causes of spurious *C. dubia* toxicity (SWRCB 2020).

Table 6.2. Toxicity test result summary, WY 2014 – WY 2020, SMCWPPP. The Percent Effect is indicated for test results with toxicity relative to the lab control. Test results with toxicity exceeding the MRP 1.0 and MRP 2.0 trigger thresholds are shaded.

Station ID	Creek	Date	MRP	Sediment			Water						
				C. dilutus [2]	*H. azteca*		*C. dubia*		*P. promelas*		*C. dilutus* [2]	*H. azteca*	*S. capricornutum*
				Survival	Survival	Growth [2]	Survival	Reproduction	Survival	Growth	Survival	Survival	Growth
Dry Season Samples													
204R01288	Laurel Cr	6/4/2014	1.0	--	**Yes** (18%)	**Yes** (50%)	No	No	No	No	--	No	No
204R01308	Pilarcitos Cr	6/4/2014	1.0	--	No	**Yes** (43%)	No	**Yes** (33%) [1]	No	No	--	No	No
204R01448	Atherton Cr	7/7/2015	1.0	--	No	No	No	No	No	No	--	No	No
204R02056	Laurel C	7/7/2015	1.0	--	No	**Yes** (31%)	No	No	No	No	--	No	No
205LAU010	Laurel Cr	7/11/2016	2.0	**Yes** (14%)	No	--	No	**Yes** (31%)	No	No	**Yes** (10%)	**Yes** (29%)	No
202SPE005	San Pedro Cr	7/13/2017	2.0	No	No	--	No	**Yes** (46%)	**Yes** (18%)	No	No	No	No
204COR010	Cordilleras Cr	7/17/2018	2.0	No	No	--	No	No	No	No	**Yes** (11%)	No	No
204PUL010	Pulgas Cr	7/23/2019	2.0	No	No	--	No	**Yes** (20%)	No	No	No	No	No
205BCR008	Bear Cr	7/22/2020	2.0	No	No	--	No	No	No	No	No	No	No
Wet Weather Samples													
204R01288	Laurel Cr	2/8/2014	1.0	--	--	--	No	No	No	No	--	**Yes** (16%)	No
204R01308	Pilarcitos Cr	2/8/2014	1.0	--	--	--	No	No	No	No	--	No	No
204R01448	Atherton Cr	2/6/2015	1.0	--	--	--	No	**Yes** (30%)	No	No	--	**Yes** (24%)	No
204R02056	Laurel Cr	2/6/2015	1.0	--	--	--	No	**Yes** (22%)	No	No	--	**Yes** (45%)	No
202SPE005	San Pedro Cr	1/20/2018	2.0	--	--	--	No	No	No	**Yes** (23%)	No	**Yes** (16%)	No
204COR010	Cordilleras Cr	1/18/2018	2.0	--	--	--	No	No	No	No	No	**Yes** (20%)	No

Notes:
1 - The test response in one of the replicates for this test treatment was determined to be a statistical outlier; the results reported above are for the analysis of the data excluding the outlier.
2 - *Chironomus dilutus* testing was not required by MRP 1.0. *Hyalella azteca* growth was not required by either permit but is included here when reported by the lab.

6.3.2 Sediment Chemistry

Sediment chemistry results from WY 2020 were evaluated based on TEC and PEC quotients according to MRP trigger thresholds (see Section 6.2.3). SMCWPPP also evaluated TU equivalents of pyrethroids and fipronil to inform stormwater management.

WY 2020 Results

Table 6.3 lists concentrations and TEC quotients for sediment chemistry constituents (metals and total PAHs) collected in WY 2020 from Bear Creek. TEC quotients are calculated as the measured concentration divided by the highly conservative TEC value, per MacDonald et al. (2000)[27]. TECs are extremely conservative and are intended to identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed. There were no analytes from the Bear Creek sample with TEC quotients ≥ 1.0, meaning that the associated MRP 2.0 threshold was not exceeded.

Table 6.3 also lists PEC quotients for sediment chemistry constituents collected in WY 2020 from Bear Creek. PECs are intended to identify concentrations above which toxicity to benthic-dwelling organisms are predicted to be probable. Since no TEC quotients were found to be greater than 1.0, it follows that the less-stringent PEC quotients of 1.0 were also not exceeded this year.

Table 6.3. TEC and PEC quotients for WY 2020 sediment chemistry constituents, Bear Creek.

Constituent	205BCR008	TEC		PEC	
Metals (mg/kg DW)	Sample Concentration	TEC Threshold	TEC Quotient	PEC Threshold	PEC Quotient
Arsenic	3.5	9.79	0.36	33.0	0.11
Cadmium	0.28	0.99	0.28	4.98	0.06
Chromium	21	43.4	0.48	111	0.19
Copper	19	31.6	0.60	149	0.13
Lead	9.7	35.8	0.27	128	0.08
Nickel	22	22.7	0.97	48.6	0.5
Zinc	59	121	0.49	459	0.13
PAHs (ug/kg DW)					
Total PAHs	256	1610	0.16 [a]	22,800	0.01 [a]

a. Total calculated using 1/2 MDLs for some individual PAHs.

[27] MacDonald et al. (2000) does not provide TEC or PEC values for pyrethroids, fipronil, or carbaryl. Pesticides are compared to LC50 values in Table 6.5.

Table 6.4 lists the concentrations of pesticides measured in the sediment sample collected from Bear Creek in WY 2020, TOC-normalized concentrations, and TU equivalents for the pesticides for which there are published LC50 values in the literature. All of the pesticides except for permethrin were measured at concentrations below the method detection limit (MDL) or reporting limit (RL) of the analyte, and TU equivalents of analytes below the former were calculated using ½ the MDL concentration. The highest TU equivalent was for bifenthrin (0.10), which is considered to be the leading cause of pyrethroid-related toxicity in urban areas (Ruby 2013) and the most-commonly detected insecticide monitored by the California Department of Pesticide Regulation (DPR) Surface Water Protection Program Monitoring (SWPP) (Ensminger 2017).

Table 6.4. Pesticide concentrations and calculated toxicity unit (TU) equivalents, WY 2020.

			205BCR008 Bear Creek		
	Unit	**LC50** [c]	**Concentration**	**Normalized to TOC**	**TU Equivalent**
Total Organic Carbon	%	NA	1.2	NA	NA
Pyrethroids					
Bifenthrin	µg/g dw	0.52	0.0007 [b]	0.05	0.10
Cyfluthrin, total	µg/g dw	1.08	<0.0005 [a]	0.02	0.02
Cypermethrin, total	µg/g dw	0.38	<0.0004 [a]	0.02	0.04
Deltamethrin/Tralomethrin	µg/g dw	0.79	<0.0005 [a]	0.02	0.02
Esfenvalerate/Fenvalerate, total	µg/g dw	1.54	<0.0005 [a]	0.02	0.01
Cyhalothrin, Total lambda-	µg/g dw	0.45	<0.0003 [a]	0.01	0.02
Permethrin, Total	µg/g dw	10.83	0.0023	0.18	0.02
			Sum of TU Equivalents		**0.2**
Other MRP Pesticides of Concern					
Carbaryl	mg/Kg	NA [d]	<0.021	--	NA
Fipronil	ng/g dw	306	<0.0004	--	--
Fipronil Desulfinyl	ng/g dw	NA [d]	<0.0004	--	NA
Fipronil Sulfide	ng/g dw	435	<0.0004	--	--
Fipronil Sulfone	ng/g dw	158	<0.0004	--	--

a. Concentration was below the method detection limit (MDL). TU equivalents calculated using 1/2 MDL.
b. TU equivalents calculated from concentration below the reporting limit but above the MDL (J-flagged).
c. Sources: Amweg et al. 2005 and Maund et al. 2002 for pyrethroids; Maul et al. for fipronil compounds; no available LC50 value for Carbaryl or Fipronil Desulfinyl.

In compliance with the MRP, a grain size analysis was conducted on the sediment sample (Table 6.5). The sample was 5.5% fines (i.e., 1.5% clay and 4.0% silt).

Table 6.5. Summary of grain size for site 204PUL010 in San Mateo County, WY 2020.

Grain Size (%)		205BCR008
		Bear Creek
Clay	<0.0039 mm	10.7%
Silt	0.0039 to <0.0625 mm	11.6%
Sand	V. Fine 0.0625 to <0.125 mm	8.1%
	Fine 0.125 to <0.25 mm	19.0%
	Medium 0.25 to <0.5 mm	30.1%
	Coarse 0.5 to <1.0 mm	12.8%
	V. Coarse 1.0 to <2.0 mm	7.7%
Granule	2.0 to <4.0 mm	5.4%
Pebble	Small 4 to <8 mm	6.3%
	Medium 8 to <16 mm	0%
	Large 16 to <32 mm	0%
	V. Large 32 to <64 mm	0%

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

WY 2014 – WY 2020 Summary

Between WY 2014 and WY 2020, there were no PEC quotients calculated for the SMCWPPP sediment chemistry dataset that were ≥ 1.0 for analytes other than chromium and nickel. Chromium and nickel are excluded from this PEC/TEC analysis because they are contributed primarily by serpentine formations present in the watersheds where monitoring occurred. Excluding chromium and nickel, there were four samples with TEC quotients ≥ 1.0; the more conservative of the two evaluation criteria. The constituents and locations with TEC quotients ≥ 1.0 included:

- Legacy insecticide DDT compounds, which were monitored under MRP 1.0 but not under MRP 2.0, and exceeded the TEC in Laurel Creek WY 2014 and WY 2015 and in Atherton Creek in WY 2015;
- Individual PAHs, pyrene and chlordane, in Atherton Creek in WY 2015 and chlordane in Laurel Creek in WY 2015; and
- Copper and zinc in Pulgas Creek in WY 2019.

Table 6.6 lists TU equivalents for pesticides with LC50s available in the literature and concentrations for pesticides without LC50s for sediment samples collected in WY 2014 – WY 2020. The sum-of-pyrethroids TU equivalents ranged from 0.08 (San Pedro Creek in WY 2017) to 7.9 (station 204R01288 on Laurel Creek in WY 2014). The Laurel Creek sediment sample with the high pyrethroid TU equivalent was collected from a location relatively high in the watershed (Figure 6.1). Subsequent sampling at stations near the bottom of the Laurel Creek watershed in WY 2015 and WY 2016 had lower TU equivalents of 0.07 and 2.6, respectively. All three of these Laurel Creek sediment samples also had sediment toxicity (Table 6.2). The WY 2014 and WY 2015 samples had chronic (growth) toxicity to the pyrethroid-sensitive test organism, *H. azteca,* with Percent Effects exceeding the MRP 1.0 trigger threshold. The WY 2016 Laurel Creek sample was not toxic to *H. azteca* but was toxic to *C. dilutus* with a Percent Effect that did not exceed the MRP 2.0 trigger threshold. Four samples had sum-of-pyrethroid TU equivalents that exceeded the MRP 1.0 trigger threshold of 1.0: Pilarcitos Creek in WY 2014, Laurel Creek in WY 2014 and WY 2015, and Pulgas Creek in WY 2019.

Sampling for fipronil and carbaryl pesticides began in WY 2016 with adoption of MRP 2.0 and the fipronil degradates were added in WY 2017[28]. Carbaryl has not been detected in any of the sediment samples (Table 6.6). Fipronil and/or fipronil sulfone were detected in San Pedro Creek and Pulgas Creek at TOC normalized concentrations below the LC50.

[28] Fipronil degrades via UV exposure, oxidation, and hydrolysis to form four principal degradates: fipronil desulfinyl, fipronil sulfide, fipronil sulfone, and fipronil amide. The degradates tend to be more stable and persistent than the parent compound; therefore, SMCWPPP added the first three of the degradates to the monitoring program in WY 2017.

Table 6.6. TU equivalent summary for San Mateo County sediment samples, WY 2014 – WY 2020.

Analyte			Pyrethroids								Other MRP Pesticides of Concern				
			Bifenthrin	Cyfluthrin	Cypermethrin	Deltamethrin	Esfenvalerate	Lambda-cyhalothrin	Permethrin	**Sum Pyrethroids**	Carbaryl	Fipronil	Fipronil desulfinyl	Fipronil sulfide	Fipronil sulfone
		LC50 [c]	0.52 µg/g dw	1.08 µg/g dw	0.38 µg/g dw	0.79 µg/g dw	1.54 µg/g dw	0.45 µg/g dw	10.83 µg/g dw	-	NA [d]	306 ng/g dw	NA [d]	435 ng/g dw	158 ng/g dw
Station ID	**Creek**	**Date**													
MRP 1.0															
202R01308	Pilarcitos	6/4/2014	1.06	0.24	<MDL	0.22 [b]	<MDL	<MDL	0.15	**1.9** [a]	-	-	-	-	-
204R01288	Laurel	6/4/2014	5.19	1.02	0.58	0.66	<MDL	<MDL	0.32	**7.9** [a]	-	-	-	-	-
204R01448	Atherton	7/7/2015	0.56	0.06	<MDL	<MDL	<MDL	<MDL	0.03	**0.7** [a]	-	-	-	-	-
204R02056	Laurel	7/7/2015	0.51	0.07	<MDL	<MDL	<MDL	<MDL	<MDL	**0.7** [a]	-	-	-	-	-
MRP 2.0															
204LAU010	Laurel	7/11/2016	1.37	0.36	0.23 [b]	0.51	<MDL	0.09 [b]	0.05	**2.6** [a]	<MDL	<MDL	-	-	-
202SPE005	San Pedro	7/13/2017	0.04	<MDL	<MDL	<MDL	<MDL	<MDL	0.001 [b]	**0.08** [a]	<MDL	0.02 [b]	<MDL	<MDL	0.08 [b]
204COR010	Cordilleras	7/17/2018	0.25 [b]	<MDL	<MDL	0.10 [b]	<MDL	<MDL	0.08 [b]	**0.52** [a]	<MDL	<MDL	<MDL	<MDL	<MDL
204PUL010	Pulgas	7/23/2019	0.56	0.07 [b]	<MDL	0.42	<MDL	<MDL	0.02	**1.2** [a]	<MDL	<MDL	<MDL	<MDL	0.33 [b]
205BCR008	Bear	7/22/2020	0.10	<MDL	<MDL	<MDL	<MDL	<MDL	0.02	**0.2** [a]	<MDL	<MDL	<MDL	<MDL	<MDL

a. TU equivalent calculated using 1/2 MDL and total calculated using 1/2 MDLs for some individual pyrethroids.
b. TU equivalents calculated from concentration below the reporting limit (J-flagged).
c. Sources: Amweg et al. 2005 and Maund et al. 2002 for pyrethroids; Maul et al. 2008 for fipronil compounds
d. No available LC50 value for Carbaryl or Fipronil Desulfinyl.

6.3.3 Pesticides in Water

During WY 2018, wet weather water samples were collected for pesticide analysis at two sites in San Mateo County (San Pedro Creek and Cordilleras Creek) to fulfill Provision C.8.g.iii.(3) of MRP 2.0. Results were reported in the WY 2018 UCMR (SMCWPPP 2019a). The concentrations of most pesticides analyzed were below the MDL, meaning that these analytes were reported as non-detects. The neonicotinoid, imidacloprid was found at detectable levels at one of the two sites (Cordilleras Creek). Additionally, detectable levels of fipronil and its degradation products were found at both sites. However, the WY 2018 wet weather water samples were not toxic to *C. dilutus*, the test organism sensitive to neonicotinoids and fipronil.

There are no WQOs specified in the San Francisco Bay Basin Plan for the water column pesticide analytes. As a result, no WQO or MRP trigger threshold exceedance analysis was performed on wet weather pesticide data.

6.3.4 Additional Pesticide Monitoring Efforts

Throughout the monitoring period associated with the sampling results described in this report, several additional programs external to SMCWPPP and the RMC conducted similar pesticides and toxicity studies within California. These studies provide valuable data for comparison against SMCWPPP findings to view regional water quality in a broader spatial and temporal context, ultimately providing more accurate and complete answers to the management questions set forth by the MRP.

DPR SWPPP Monitoring

Mentioned previously in this document, the DPR SWPP is one of the largest pesticide monitoring and management efforts currently being undertaken in California. Pesticide studies conducted by the DPR SWPP evaluate the frequency of pesticide detections at any concentration and make use of USEPA aquatic benchmarks for many pesticide compounds. DPR provides web access to a number of their monitoring reports which contain detailed analyses of USEPA aquatic benchmark exceedance rates. DPR also maintains the Surface Water Database (SURF) to provide public access to quantitative pesticide data from a wide array of surface water monitoring studies. This database could be queried in the future to allow for the leverage of DPR monitoring data in more complex analyses of MRP pesticide data.

In WY 2017, DPR conducted two studies in Northern and Southern California that involved pesticides and toxicity monitoring at urban sites in Alameda, Contra Costa, Placer, Sacramento, Santa Clara (Guadalupe River – see Figure 6.1), Los Angeles, Orange, and San Diego Counties. Both water and sediment samples were collected and analyzed for a wide range of pesticide compounds. In both the Northern and Southern California studies, bifenthrin and fipronil were found to be among the most frequently detected pesticides. Additionally, pyrethroid concentrations were found to be above their USEPA minimum benchmarks for toxicity to aquatic life for the majority of samples with the exception of cyfluthrin. The studies also state that the detection frequencies of most pyrethroids have remained consistent over recent years. (Budd 2018 and Ensminger 2017)

In WY 2018, DPR again conducted two urban monitoring studies in Northern and Southern California that targeted watersheds in the same counties sampled during WY 2017 and involved the collection of water and sediment samples. Similar to WY 2017, bifenthrin was among the most frequently detected insecticides in water samples from both the Northern and Southern

California WY 2018 studies. In the Northern California study, bifenthrin was the most frequently detected insecticide and second most frequently detected compound in water samples with a detection frequency (DF) of 76%. In the Southern California study, bifenthrin was the most frequently detected pyrethroid insecticide and the fifth most frequently detected compound in water samples with a DF of 72%. Fipronil and its degradates were also detected at high rates in water samples from the Northern and Southern California studies. While fipronil itself only had a DF of 48% in the Northern California study, fipronil and its degradates collectively had a DF of 72%. Out of these compounds, fipronil sulfone was found at the highest rate with a DF of 70%. Fipronil was also found at a high rate during the Southern California study with a DF of 76%. Its degradates were also found in a large portion of samples, with fipronil sulfone again being the most found with a DF of 67%. Sediment samples from Northern and Southern California were collected and analyzed for bifenthrin and eight other pyrethroids, but concentrations of fipronil and its degradates were not measured. In both studies, bifenthrin was detected in all samples and was also responsible for the greatest magnitude of TUs. (Budd 2019 and Ensminger 2019)

Findings from the WY 2017 and WY 2018 DPR studies generally corroborate the results garnered from SMCWPPP pesticides monitoring. In particular, bifenthrin has been the most frequently detected pesticide in samples collected by SMCWPPP from WYs 2014 through 2020 and responsible for the high-magnitude TU equivalents. Similarly, fipronil and/or its degradates were found at detectable levels in 40% of SMCWPPP sediment samples.

SPoT Monitoring Program

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. Sites are targeted in bottom-of-the-watershed locations with slow water flow and appropriate micromorphology to allow deposition and accumulation of sediments, including a station near the mouth of San Mateo Creek (Figure 6.1). In most years, sediments are analyzed for toxicity, pesticides, metals, PCBs, mercury, and organic pollutants (Phillips et al. 2014). The most recent technical report prepared by SPoT program staff was published in 2020 and describes ten-year trends from the initiation of the program in 2008 through 2017 (Phillips et al. 2020).

Toxicity testing was conducted by SPoT in sediment samples collected from San Mateo Creek using indicator organisms *H. azteca*, which is sensitive to pyrethroids, and *C. dilutus*, added in 2015 to assess neonicotinoid and fipronil impacts. Toxicity samples were evaluated using the TST statistical approach (Phillips et al. 2020). Acute and chronic toxicity to *H. azteca* has been observed; however, the percent effect was less than 20%. Furthermore, there is a statistically significant decreasing trend in acute *H. azteca* toxicity in San Mateo Creek. Neither acute nor chronic *C. dilutus* toxicity have been observed since monitoring for this organism began in 2015. The SPoT findings are consistent with the SMCWPPP toxicity dataset summarized in Table 6.2.

The SPoT sediment chemistry results from San Mateo Creek do not show a statistically significant trend in sum-of-pyrethroid concentrations, but do show a decreasing trend in sum-of-fipronil-and-its-degradates concentrations over the 2008 – 2017 dataset reviewed by Philips et al. (2020).). A review of SPoT data from 2008 to 2018 downloaded from CEDEN suggests the following:

- **Pyrethroids.** Pyrethroid concentrations in San Mateo Creek peaked in 2011 (88.2 ng/g). This concentration was driven by a relatively high permethrin concentration that year (58 ng/g). In other years, the individual pyrethroid with the highest was bifenthrin.

- **Fipronil.** Although fipronil has only been detected once (2014) in the years it was monitored (2013 – 2018), two of its degradates (fipronil sulfide and fipronil sulfone) have consistently been found at measurable concentrations.

7.0 Conclusions and Recommendations

This section includes conclusions and recommendations from the review of WY 2020 Creek Status and Pesticides & Toxicity Monitoring data that are presented in the preceding chapters of this report.

In WY 2020, in compliance with Provisions C.8.d. and C.8.g. of MRP 2.0 and the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), SMCWPPP continued to implement a monitoring design that was initiated in WY 2012. The strategy includes a regional ambient/probabilistic bioassessment monitoring component and a component based on local targeted monitoring for general water quality parameters and pesticides/toxicity. The combination of these monitoring designs allows each individual RMC participating program (including SMCWPPP) to assess the status of Beneficial Uses in local creeks within its jurisdictional area, while also contributing data to eventually answer management questions at the regional scale (e.g., differences between aquatic life condition in urban and non-urban creeks).

Conclusions from Creek Status and Pesticides & Toxicity Monitoring conducted during WY 2020 in San Mateo County are based on the management questions from the MRP presented in Section 1.0 of this report:

1) *Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, rivers, and tributaries?*
2) *Are conditions in local receiving water supportive of or likely supportive of beneficial uses?*

The first management question is addressed primarily through the evaluation of monitoring data with respect to WQOs and triggers defined in the MRP. A summary of trigger exceedances observed for each WY 2020 site is presented in Table 7.1. In compliance with Provision C.8.e.i. of the MRP, SMCWPPP coordinates with the RMC to maintain a comprehensive list of all monitoring results from the region exceeding trigger thresholds. Sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses and are considered for future evaluation via Stressor/Source Identification projects.

The second management question is addressed primarily by assessing indicators of aquatic biological health using benthic macroinvertebrate and algae data. The indices of biological integrity based on BMI and algae data (i.e., CSCI and ASCI) are direct measures of aquatic life beneficial uses. Biological condition scores are compared to physical habitat and water quality data collected synoptically with bioassessments to evaluate whether any correlations exist that may help explain the variation in biological condition scores. Continuous monitoring data (temperature, dissolved oxygen, pH, and specific conductance) are evaluated with respect to COLD and WARM Beneficial Uses. Finally, pathogen indicator data are used to assess REC-1 (water contact recreation) Beneficial Uses.

All monitoring and data validation were conducted using methods consistent with the BASMAA RMC QAPP (BASMAA 2020) and SOPs (BASMAA 2016). Recommendations for future monitoring are described in Section 7.3.

7.1 Conclusions

7.1.1 Biological Condition Assessment

In WY 2020, bioassessment monitoring was conducted at ten sites in compliance with provision C.8.d.i of the MRP. Sites were sampled for benthic macroinvertebrates, benthic algae, and nutrients. Physical habitat and general water quality parameters were also measured at each site. In WY 2020, four of the ten bioassessment surveys were conducted at sites selected randomly using the regional probabilistic monitoring design, and six were conducted at targeted sites. All sites are classified as urban in the RMC sample frame.

The probabilistic monitoring design allows each individual RMC participating program to objectively assess stream ecosystem conditions within its jurisdictional area while contributing data to answer regional management questions about water quality and beneficial use condition in San Francisco Bay Area creeks. The monitoring design was developed to address the following management questions from the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012):

1. *What is the condition of aquatic life in creeks in the RMC area; are water quality objectives met and are beneficial uses supported?*
2. *What are major stressors to aquatic life in the RMC area?*
3. *What are the long-term trends in water quality in creeks over time?*

The first question (i.e., *What is the condition of aquatic life in creeks in the RMC area; are water quality objectives met and are beneficial uses supported?*) was addressed by assessing indicators of aquatic biological health at probabilistic sampling locations. Over the past nine years (WY 2012 through WY 2020), SMCWPPP and the Regional Water Board have sampled 91 probabilistic sites in San Mateo County, providing a sufficient sample size to estimate ambient biological condition for urban streams within known estimates of precision. Stream condition is assessed using three different types of indices/tools: the BMI-based CSCI, the benthic diatom-based D_ASCI, and the physical habitat-based IPI. Of these three, the CSCI is the only tool with an MRP trigger threshold for follow-up SSID consideration.

The second question (i.e., *What are major stressors to aquatic life in the RMC area?*) was addressed by the evaluation of physical habitat and water chemistry data collected at the probabilistic sites, as potential stressors to biological condition. Assessing the extent and relative risk of stressors can help prioritize stressors and inform local management decisions.

The third question (i.e., *What are the long-term trends in water quality in creeks over time?*) was addressed by assessing the change in biological condition over several years. Changes in biological condition over time can help evaluate the effectiveness of management actions.

All three management questions were comprehensively evaluated using eight years of bioassessment data (WY 2012 – WY 2019) and reported in SMCWPPP's WY 2019 Integrated Monitoring Report (SMCWPPP 2020); whereas this report primarily focuses on WY 2020 data.

Biological Condition Assessment

The CSCI scores across the ten bioassessment sites sampled in WY 2020 ranged from 0.42 to 0.67, with all ten sites having scores below the MRP trigger threshold of 0.795. The two sites with the lowest CSCI scores were in channel reaches with armored beds and/or banks. The D_ASCI scores across the ten sites ranged from 0.46 to 0.83, which corresponds to the two lowest condition categories for this index, "likely altered" and "very likely altered." Physical habitat condition, as represented by IPI scores, ranged from 0.86 to 1.17. All ten sites, including the two sites with modified channels, had IPI scores that were in the top two condition categories (≥ 0.83). There is no MRP trigger for the D_ASCI or IPI indices.

SCAPE Tool Comparison

The CSCI scores were compared to predicted scores generated from the SCAPE model, which is based on land use within the sampling reach watershed (Beck et al. 2019). SCAPE model data were available for seven of the ten bioassessment sites. All CSCI scores fell within the predicted range from the SCAPE model.

Temporal Variability in Biologic Condition

Six of the WY 2020 bioassessment surveys were conducted at sites previously monitored by SMCWPPP. CSCI and D_ASCI scores for WY 2020 were compared with scores from prior years; however, there was no consistent trend for either biological index.

Evaluation of Conditions in San Mateo Creek

SMCWPPP conducted bioassessments at four sites along a 3.4-mile reach in San Mateo Creek downstream of Crystal Springs Dam. Three of the sites had been previously monitored by SMCWPPP and one of these is also part of a long-term monitoring program being implemented by SFPUC. Although the San Mateo Creek watershed above Crystal Springs Dam is largely undeveloped, the area below the dam is characterized by residential and urban development. Flows in lower San Mateo Creek are controlled by releases from the dam which was upgraded in 2015. Implementation of a program of water release on a defined schedule began following completion of the upgrade project.

Data collected by SMCWPPP and SFPUC were evaluated for temporal and geographic trends.

- There are no apparent temporal trends in biological conditions at any of the stations at this time. However, this is not unexpected as it could potentially take a long time period (e.g., decadal) to observe any improvements to aquatic habitat resulting from the water release program to be observed.

- There does appear to be a geographic pattern to biological conditions. Sites that are farther downstream and lower in elevation have lower median CSCI scores compared to upstream, higher-elevation sites. The one exception to this pattern is the site directly below the Crystal Springs Dam, which had the lowest median CSCI score.

Despite relatively low CSCI scores for San Mateo Creek sites (i.e., four sites had median CSCI scores below 0.63 in the "very likely altered" condition category, and the other two were in the "likely altered" condition category), there were several sensitive taxa present in the BMI samples collected in WY 2020, which generally indicates good conditions. However, New Zealand Mud

Snails, a non-native invasive species, are consistently found in BMI samples collected from San Mateo Creek.

7.1.2 Continuous Monitoring for Temperature and General Water Quality

Continuous monitoring of water temperature and general water quality in WY 2020 was conducted in compliance with Provision C.8.d.iii. – iv. of the MRP. Hourly temperature measurements were recorded at five sites from April through September. Continuous (15-minute) general water quality measurements (pH, DO, specific conductance, temperature) were recorded at two sites during two 1 to 2-week periods in spring (Event 1) and summer (Event 2). Monitoring was conducted to address the following management questions from the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012):

1. *What is the spatial and temporal variability in water quality conditions during the spring and summer season?*
2. *Do general water quality measurements indicate potential impacts to aquatic life?*

Sites with continuous monitoring results exceeding the MRP trigger criteria and/or WQOs are identified as candidate SSID projects.

Monitoring sites were selected based on the presence of significant fish and wildlife resources as well as historical and/or recent indications of water quality concerns. In WY 2020, San Mateo Creek below Crystal Springs Reservoir was targeted for continuous monitoring. This section of San Mateo Creek supports migration, rearing and spawning habitat for an existing steelhead population. Temperature, pH, specific conductance, and DO levels followed predictable daily and seasonal patterns, and were generally consistent across the sites. With the exception of the MRP trigger for MWAT, there were no exceedances of WQOs or MRP triggers in the continuous temperature and general water quality monitoring data collected in WY 2020 in the San Mateo Creek watershed. Overall water quality and temperature do not appear to be limiting factors for steelhead trout in San Mateo Creek.

7.1.3 Pathogen Indicator Monitoring

Pathogen indicator monitoring in WY 2020 was conducted in compliance with Provision C.8.d.v. of the MRP. Samples for pathogen indicator analysis were collected during one monitoring event at five sites, four on the mainstem of San Pedro Creek and one in a small tributary. The sites were selected from the list of sites sampled by the SMRCD on behalf of the County and Pacifica in compliance with Provision C.14 of the MRP, which implements the San Pedro Creek and Pacifica State Beach Indicator Bacteria TMDL. The overall goal of pathogen indicator monitoring in WY 2020 was to assess whether WQOs are being met, i.e., supportive of water contact recreation (REC-1) Beneficial Uses, and to compare results from the two analytical laboratories contracted by SMCWPPP and the SMRCD. Although water contact recreation is unlikely to occur at the targeted sites, they drain to Pacifica State Beach, a popular surfing location.

There was one measurement that exceeded the MRP trigger and WQO for *E. coli*, and three that exceeded the MRP trigger for enterococci (the enterococci WQO does not apply to freshwaters). Overall, samples lower in the watershed had higher pathogen indicator concentrations; however, the highest concentrations were measured in the sample from the tributary stream. Although this single monitoring event is not sufficient to confirm geographic sources of bacteria, it does suggest that the Shamrock Watershed should be evaluated as part of the TMDL characterization monitoring program.

It is important to recognize that pathogen indicators do not directly represent actual pathogen concentrations and do not distinguish among sources of bacteria. Sources of pathogen indicator bacteria in the San Pedro Creek watershed include homeless encampments, wildlife, livestock, pets, leaking septic systems/sanitary sewers, and regrowth of bacteria in the environment. Bacteria from human sources are more likely to be associated with human health risks during water contact recreation. As a result, the comparison of pathogen indicator results to WQOs may not always be meaningful and should be interpreted cautiously.

7.1.4 Chlorine Monitoring

In compliance with Provision C.8.c.ii., free chlorine and total chlorine residual were measured at ten sites concurrent with bioassessment surveys. While chlorine residual has generally not been a concern in San Mateo County creeks, prior monitoring results suggest there are occasional trigger exceedances of free chlorine and total chlorine residual in the County. In WY 2020, the total chlorine residual concentration in the sample collected at Stulsaft Park on Arroyo Ojo de Agua exceeded the MRP trigger. The exceedance was immediately reported to the Redwood City illicit discharge contact. Trigger exceedances may be the result of one-time potable water discharges, and it is generally challenging to determine the source of elevated chlorine from such episodic discharges. Furthermore, chlorine in surface waters can dissipate from volatilization and reaction with dirt and organic matter. SMCWPPP will continue to monitor chlorine in compliance with the MRP and, as in the past, will follow-up with municipal illicit discharge staff as needed.

7.1.5 Pesticides and Toxicity Monitoring

Toxicity testing, sediment chemistry monitoring, and water column pesticides monitoring, collectively referred to as pesticides and toxicity monitoring, was conducted during WY 2014 through WY 2020 in compliance with Provisions C.8.c. of MRP 1.0 and C.8.g. of MRP 2.0. There were slight differences between the two permit terms regarding the required number of samples, toxicity test organisms, chemical constituents, and MRP triggers.

<u>Data Evaluation Summary</u>

There are five toxicity test species analyzed in water samples and two test species in sediment samples. The test organism *H. azteca*, required for water and sediment samples is known to be sensitive to pyrethroid pesticides. The test organism *C. dilutus*, added in MRP 2.0, is known to be sensitive to neonicotinoids and fipronil. A two-tiered approach is applied to assess toxicity. First, organism responses from ambient samples are compared to responses from appropriate laboratory control samples using a statistical comparison. This is followed by a comparison to a “threshold value” or “Percent Effect” that indicates the magnitude of the difference in response.

Sediment chemistry data for metals, PAHs, and legacy pesticides (MRP 1.0 only) are compared to Threshold Effect Concentrations (TECs) and Probable Effect Concentrations (PECs) published by MacDonald et al. (2000). Most samples in San Mateo County have chromium and nickel concentrations that exceed the TEC and PEC. These metals are naturally occurring in the serpentine formations that underly mountains and hills in the region. Sediment chemistry data for pyrethroid and fipronil (MRP 2.0 only) pesticides are compared to TOC-normalized LC50s, calculated as Toxicity Unit equivalents. There are no WQOs for the suite of monitored constituents for comparison to water chemistry data.

Under MRP 1.0 (WY 2014 and WY 2015), pesticides and toxicity monitoring stations were selected from the list of bioassessment stations surveyed those years. Under MRP 2.0 (WY 2016 – WY 2020), bottom-of-the-watershed stations in different creeks were monitored each year with the goal of eventually developing a geographically diverse dataset.

WY 2020 Results

In WY 2020, SMCWPPP conducted dry weather pesticides and toxicity monitoring at one station on Bear Creek in the Town of Woodside. Statistically significant toxicity was not observed in the water and sediment samples. Pesticide concentrations in the WY 2020 Bear Creek sediment sample were all very low, most below the MDL. The exceptions were bifenthrin and permethrin. When normalized to TOC, the TU equivalents calculated for bifenthrin and permethrin were 0.1 and 0.02, respectively. These results suggest that pesticides are not causing impairments to aquatic life in Bear Creek.

WY 2014 – WY 2020 Data Summary

Toxicity and chemistry data from WY 2014 through WY 2020 were reviewed for overall findings and evidence of trends. Overall, there were 18 test results that had significant toxicity, but with a Percent Effect that did not exceed the MRP trigger thresholds. A majority of these toxicity results were found in water samples and were associated with either *C. dubia* reproduction (six samples), a chronic toxicity endpoint, or *H. azteca* survival (six samples), an acute toxicity endpoint. Five of the six water samples with toxicity to *H. azteca* were collected during wet season sampling events, suggesting that stormwater runoff is affecting *H. azteca*. The water samples with toxicity to *C. dubia* were more evenly dispersed between wet and dry season sampling events. It is possible that the chronic *C. dubia* toxicity observed in San Mateo water samples are false positives resulting from inconsistencies in QA procedures used by the laboratory. Statewide, there have been other reports of unexplained chronic *C. dubia* toxicity, and the State Water Board is currently carrying out a Special Study to examine the issue.

Between WY 2014 and WY 2020, there were no PEC quotients calculated for the SMCWPPP sediment chemistry dataset that were ≥ 1.0 for analytes other than chromium and nickel. Excluding these naturally occurring metals, there were four samples with TEC quotients ≥ 1.0, the more conservative of the two evaluation criteria. These included legacy insecticide DDT compounds in Laurel Creek and Atherton Creek, individual PAHs in Laurel Creek and Atherton Creek, and copper and zinc in Pulgas Creek in WY 2019. Overall, detection frequencies for bifenthrin and fipronil were on par with results from the DPR Northern California study (Ensminger 2019) and *H. azteca* toxicity responses were similar to SPoT monitoring in San Mateo Creek (Phillips et al. 2020).

The pesticides and toxicity data collected from WYs 2014 through 2020 provide a reference to inform management decisions regarding water quality improvement in San Mateo County watersheds and guide the planning of future monitoring in the area.

7.2 WY 2020 Trigger Assessment

The MRP requires analysis of the monitoring data to identify candidate sites for SSID projects. Trigger thresholds against which to compare the data are provided for most monitoring parameters in the MRP and are described in the foregoing sections of this report. Stream condition was assessed based on CSCI scores that were calculated using BMI data. Nutrient data were evaluated using applicable water quality standards from the Basin Plan (SFRWQCB 2017). Water and sediment chemistry and toxicity data were evaluated using numeric trigger thresholds specified in the MRP. In compliance with Provision C.8.e.i. of the MRP, all monitoring results exceeding trigger thresholds are added to a list of candidate SSID projects that will be maintained throughout the permit term. Follow-up SSID projects can be selected from this list. Table 7.1 lists candidate SSID projects based on WY 2020 Creek Status and Pesticides & Toxicity monitoring data. Trigger and WQO exceedances from WY 2014 through WY 2019 were reported in the IMR (SMCWPPP 2020) and prior UCMRs (SMCWPPP 2015, 2016, 2017, 2018, and 2019a).

Additional analysis of the data is provided in the previous sections of this report and should be considered prior to selecting and defining SSID projects. The analyses include review of physical habitat and water chemistry data to identify potential stressors that may be contributing to degraded or diminished biological conditions. Analyses in this report also include historical and spatial perspectives that help provide context and deeper understanding of the trigger exceedances.

Table 7.1. Summary of SMCWPPP MRP trigger threshold exceedance analysis, WY 2020. "No" indicates samples were collected but did not exceed the MRP trigger; "Yes" indicates an exceedance of the MRP trigger.

Station Number	Creek Name	Bioassessment [1]	Nutrients [2]	Chlorine [3]	Water Toxicity [4]	Sediment Toxicity [4]	Sediment Chemistry [5]	Continuous Temperature [6]	Dissolved Oxygen [7]	pH [8]	Specific Conductance [9]	Pathogen Indicators [10]
202R01308	Pilarcitos Creek	Yes	No	No	--	--	--	--	--	--	--	--
202R04568	San Pedro Creek	Yes	No	No	--	--	--	--	--	--	--	--
202R05464	San Pedro Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R00680	Redwood Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R01256	Arroyo Ojo de Agua	Yes	No	Yes	--	--	--	--	--	--	--	--
204R02228	San Mateo Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R03272	San Mateo Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R03528	San Mateo Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R04884	San Mateo Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R05176	Laurel Creek	Yes	No	No	--	--	--	--	--	--	--	--
ADMS	San Pedro Creek	--	--	--				--	--	--	--	No
USSH	San Pedro Creek	--	--	--	--	--	--	--	--	--	--	No
PRLT	San Pedro Creek	--	--	--	--	--	--	--	--	--	--	Yes
SHAO	Shamrock Creek	--	--	--	--	--	--	--	--	--	--	Yes
SPCM	San Pedro Creek	--	--	--	--	--	--	--	--	--	--	Yes
204SMA070	San Mateo Creek	--	--	--	--	--	--	Yes	--	--	--	--
204SMA080	San Mateo Creek	--	--	--	--	--	--	No	No	No	No	--
204SMA090	San Mateo Creek	--	--	--	--	--	--	No	--	--	--	--
204SMA108	Polhemus Creek	--	--	--	--	--	--	Yes	--	--	--	--
204SMA110	San Mateo Creek	--	--	--	--	--	--	No	No	No	No	--
205BCR008	Bear Creek	--	--	--	No	No	No	--	--	--	--	--

Notes:
1. CSCI score ≤ 0.795.
2. Unionized ammonia (as N) ≥ 0.025 mg/L, nitrate (as N) ≥ 10 mg/L, chloride > 250 mg/L.
3. Free chlorine or total chlorine residual ≥ 0.1 mg/L.
4. Test of Significant Toxicity = Fail and Percent Effect ≥ 50 % in initial and follow-up samples.
5. TEC or PEC quotient ≥ 1.0 for any constituent.
6. Two or more weekly average temperatures exceed the MWAT of 17.0°C or 20% of results ≥ 24°C.
7. Twenty percent of results = DO < 7.0 mg/L in COLD streams or DO < 5.0 mg/L in WARM streams.
8. Twenty percent of results = pH < 6.5 or pH > 8.5.
9. Twenty percent of results = specific conductance > 2000 uS.
10. Enterococcus ≥ 130 cfu/100ml or *E. coli* ≥ 410 cfu/100ml.

7.3 Recommendations

The recommendations presented in this section are directed towards the implementation of monitoring requirements in Provisions C.8.d. and C.8.g. through the remainder of term during which MRP 2.0 remains in effect. At this time, it is anticipated that MRP 2.0 will be replaced with MRP 3.0 beginning in July 2022. Thus, the current monitoring requirements will likely be in effect throughout the entirety of WY 2021 and most of WY 2022. SMCWPPP is currently working with other members of the RMC and Regional Water Board staff through the MRP 3.0 Steering Committee and the Provision C.8 Water Quality Monitoring Workgroup to develop future monitoring requirements.

The following recommendations are based on findings from nine years (WY 2012 through WY 2020) of Creek Status and Pesticides/Toxicity monitoring conducted by SMCWPPP, as well as reflections on other monitoring, data analysis, and policy development projects being conducted in the region and statewide.

- **Biological Condition Assessment.** The probabilistic sample draw for urban sites in San Mateo County has been exhausted. Therefore, SMCWPPP will select all ten WY 2021 bioassessment sites on a targeted basis. Regional Water Board staff approved this approach in a letter dated January 26, 2021, and provided the following guidance on site selection:

  > *The first and preferred option is to select targeted sites at reaches or watersheds of interest to Permittees and stakeholders in order to 1) fill in spatial data gaps or 2) undertake a watershed or sub-watershed study. Such sites may or may no include sites previously sampled during the probabilistic draw.*
  >
  > *The second option is to resample sites where land use changes or other factors may have resulted in a change in bioassessment results over time. For this option, Permittees are advised to focus on sites where monitoring began prior to adoption of MPR 1, for which the County stormwater program has multiple years of samples and data available.*
  >
  > *The third option is to implement a combination of the first and second options.*

  SMCWPPP staff will work with San Mateo County Permittees and stakeholders to identify WY 2021 bioassessment sites according to the options presented by Regional Water Board staff.

- **Continuous Monitoring for Temperature and General Water Quality** has been an effective tool in supporting SSID studies and evaluating the condition of cold water habitat (COLD) and warm water habitat (WARM) Beneficial Uses. For example, in WY 2020, continuous monitoring data were used to evaluate support of COLD Beneficial Uses in San Mateo Creek, one of the few Bayside salmonid streams in San Mateo County. SMCWPPP staff will work with San Mateo County Permittees and stakeholders to identify WY 2021 continuous monitoring sites.

- **Pathogen Indicator Monitoring.** SMCWPPP will continue to comply with Provision C.8.d.v. requirements by collecting five samples for pathogen indicator analysis.

- **Chlorine Monitoring**. SMCWPPP will continue to comply with Provision C.8.d.ii. requirements by measuring free and total chlorine in ten samples. Measurements will be made synoptic with bioassessment monitoring.

- **Pesticides and Toxicity Monitoring** will be conducted during the dry season at a bottom-of-the-watershed station. In order to continue expanding the geographic extent of these data, a new station will be selected.

8.0 Summary of Stormwater Management Programs by San Mateo County Permittees

The Creek Status and Pesticides and Toxicity Monitoring program (consistent with MRP Provisions C.8.d and C.8.g of the MRP) implemented by SMCWPPP focuses on assessing the water quality condition of urban creeks in San Mateo County and identifying stressors and sources of impacts observed.

This *Urban Creeks Monitoring Report Part A: Creek Status and Pesticides & Toxicity Monitoring* presents bioassessment and stressor data collected in WY 2020, and builds on the findings of SMCWPPP's *Integrated Monitoring Report* (SMCWPPP 2020) which presented a comprehensive review of data collected in WY 2012 through WY 2019. Bioassessment data suggest that most urban streams in San Mateo County have *likely altered* or *very likely altered* populations of aquatic life indicators (e.g., benthic macroinvertebrates, algae). These poor stream conditions are likely the result of long-term changes in stream hydrology, channel geomorphology, in-stream habitat complexity, and other modifications to the watershed and riparian areas associated with the urban development that has occurred over the past 50 plus years. Additionally, episodic or site-specific increases in temperature (particularly in lower creek reaches or reaches directly below reservoirs) may not be optimal for aquatic life in some local creeks.

SMCWPPP Permittees are actively implementing many stormwater management programs to address these and other stressors and associated sources of water quality conditions observed in local creeks, with the goal of protecting these natural resources. For example:

- In compliance with Provision C.3 of the MRP, new and redevelopment projects in the Bay Area are now designed to more effectively reduce water quality and hydromodification impacts associated with urban development. Low impact development (LID) and Green Stormwater Infrastructure (GSI), such as rainwater harvesting and use, infiltration and biotreatment are required as part of development and redevelopment projects. In addition, Green Infrastructure planning is now part of all municipal projects. These LID and GSI measures are expected to reduce the impacts of urban runoff and associated impervious surfaces on stream health. SMCWPPP maintains a GSI Database that tracks these projects and illustrates their geographic scope.
- In compliance with Provision C.7 of the MRP, SMCWPPP and the San Mateo County Permittees are implementing stormwater outreach activities. Some of SMCWPPP's recent accomplishments include a County campaign to reduce littering of cigarette butts, Coastal Cleanup Day events, increased social media presence, participation in the Our Water Our World (OWOW) program, publication of newsletters, launching of a countywide school outreach program that asked students to submit proposals to green up their school campus, a K-12 teacher fellowship program for developing units related to stormwater pollution prevention, and a countywide rain barrel rebate program. The overarching goal of these actions is to reduce stormwater pollution by educating and motivating residents.
- In compliance with MRP Provision C.9, Permittees are implementing pesticide toxicity control programs that focus on source control and pollution prevention measures. The control measures include the implementation of integrated pest management (IPM) policies/ordinances, public education and outreach programs, pesticide disposal

programs, supporting the adoption of formal State pesticide registration procedures, and sustainable landscaping requirements for new and redevelopment projects. These efforts will eventually be supplemented by the statewide Urban Pesticides Amendments which will seek to manage pesticide usage via state and federal pesticide regulatory authorities such as DPR and USEPA. The anticipated result is a reduction in pyrethroids and other pesticides in urban stormwater runoff and a reduction in the magnitude and extent of toxicity in local creeks. The Urban Pesticides Amendments team is also proposing a statewide monitoring program that will substitute for pesticides and toxicity monitoring requirements in MS4 permits, such as the MRP. The goal is to generate useful data at minimal cost and standardize information at the statewide level. The Draft Amendments will likely be released for public review in early 2021 with adoption anticipated in mid-2021 or 2022. At this time, the mechanism for implementing the statewide monitoring program is uncertain.

- Trash loadings to local creeks have been reduced through implementation of new control measures in compliance with Provision C.10 of the MRP and other efforts by Permittees to reduce the impacts of illegal dumping directly into waterways. These actions include the installation and maintenance of trash capture systems, the adoption of ordinances to reduce the impacts of litter prone items, enhanced institutional controls such as street sweeping, and the on-going removal and control of direct dumping. The MRP establishes a mandatory trash load reduction schedule, minimum areas to be treated by full trash capture systems, and requires development and implementation of receiving water monitoring programs for trash.
- In compliance with Provisions C.2 (Municipal Operations), C.4 (Industrial and Commercial Site Controls), C.5 (Illicit Discharge Detection and Elimination), and C.6 (Construction Site Controls) of the MRP, Permittees continue to implement Best Management Practices (BMPs) that are designed to prevent non-stormwater discharges during dry weather and reduce the exposure of stormwater runoff to contaminants during rainfall events.
- In compliance with Provision C.13 of the MRP, copper in stormwater runoff is reduced through implementation of controls such as architectural and site design requirements, prohibition of discharges from water features treated with copper, and industrial facility inspections.
- Mercury and polychlorinated biphenyls (PCBs) in stormwater runoff are being reduced through implementation of the respective TMDL water quality restoration plans. In compliance with Provisions C.11 (mercury) and C.12 (PCBs) of the MRP, the Countywide Program will continue to identify sources of these pollutants and will implement control actions designed to achieve load reduction goals. In WY 2020, SMCWPPP documented all existing and planned mercury and PCBs control measures to demonstrate attainment of the goals. Most control measures have multiple stormwater treatment benefits such as peak flow reduction and removal many potential pollutants. Monitoring activities conducted in WY 2020 that specifically target mercury and PCBs are described in the Pollutants of Concern Monitoring Data Report that is included as Part D of this UCMR.

In addition to controls implemented in compliance with the MRP, numerous other efforts and programs designed to improve the biological, physical and chemical condition of local creeks are underway. For example, in 2017 C/CAG developed the San Mateo Countywide Stormwater Resource Plan (SRP) to satisfy state requirements and guidelines to ensure C/CAG and San

Mateo county MRP Permittees are eligible to compete for future voter-approved bond funds for stormwater or dry weather capture projects. The SRP identifies and prioritizes opportunities to better utilize stormwater as a resource in San Mateo County through a detailed analysis of watershed processes, surface and groundwater resources, input from stakeholders and the public, and analysis of multiple benefits that can be achieved through strategically planned stormwater management projects. These projects aim to capture and manage stormwater more sustainably, reduce flooding and pollution associated with runoff, improve biological functioning of plants, soils, and other natural infrastructure, and provide many community benefits, including cleaner air and water and enhanced aesthetic value of local streets and neighborhoods.

Through the continued implementation of MRP-associated and other watershed stewardship programs, SMCWPPP anticipates that stream conditions and water quality in local creeks will continue to improve over time. In the near term, toxicity observed in creeks should decrease as pesticide regulations better incorporate water quality concerns during the pesticide registration process. In the longer term, control measures implemented to “green” the “grey” infrastructure and disconnect impervious areas constructed over the course of the past 50 plus years will take time to implement. Consequently, it may take several decades to observe the benefits of these important, large-scale improvements to our watersheds in our local creeks. Long-term creek status monitoring programs designed to detect these changes over time are therefore beneficial to our collective understanding of the condition and health of our local waterways.

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ATTACHMENTS

Attachment 1

QA/QC Report

Urban Creeks Monitoring Report - Creek Status and Pesticides & Toxicity Monitoring

Quality Assurance/Quality Control Report

Water Year 2020

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Prepared for:

San Mateo Countywide Water Pollution Prevention Program

March 31, 2021

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LIST OF ACRONYMS

BASMAA	Bay Area Stormwater Management Agencies Association
BMI	Benthic Macroinvertebrates
CDFW	California Department of Fish and Wildlife
DPD	Diethyl-p-phenylene Diamine
DQO	Data Quality Objective
EDDs	Electronic data deliverables
EV	Expected Value
KLI	Kinnetic Laboratories, Inc.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MPN	Most Probably Number
MQO	Measurement Quality Objective
MRP	Municipal Regional Permit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MV	Measured Value
ND	Non-detect
NIST	National Institute of Standards and Technology
NPDES	National Pollution Discharge Elimination System
NV	Native Value
PAH	Polycyclic Aromatic Hydrocarbon
PR	Percent Recovery
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RMC	Regional Monitoring Coalition
RPD	Relative Percent Difference
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SFRWQCB	San Francisco Regional Water Quality Control Board
SMCWPPP	San Mateo County Urban Pollution Prevention Program
SOP	Standard Operating Procedures
STE	Standard Taxonomic Effort
SV	Spike Value
SWAMP	Surface Water Ambient Monitoring Program
TKN	Total Kjeldahl Nitrogen
WY	Water Year

1. INTRODUCTION

In Water Year 2020 (WY 2020; October 1, 2019 through September 30, 2020), the San Mateo County Water Pollution Prevention Program (SMCWPPP or Program) conducted Creek Status Monitoring in compliance with Provision C.8.d and Pesticide & Toxicity Monitoring in compliance with Provision C.8.g of the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities, referred to as the Municipal Regional Permit (MRP). The monitoring strategy includes regional ambient/probabilistic monitoring and local "targeted" monitoring as described in the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). The Program implemented a comprehensive data quality assurance and quality control (QA/QC) program, covering all aspects of Creek Status and Pesticides & Toxicity monitoring. QA/QC for data collected was performed according to procedures detailed in the BASMAA RMC Quality Assurance Project Plan (QAPP) (BASMAA 2020) and the BASMAA RMC Standard Operating Procedures (SOP; BASMAA 2016), SOP FS-13 (Standard Operating Procedures for QA/QC Data Review). The BASMAA RMC QAPP and SOP are based on the QA program developed by the California Surface Water Ambient Monitoring Program (SWAMP 2017).

Based on the QA/QC review, WY 2020 data met overall QA/QC objectives. However, two continuous water quality monitoring parameters were rejected and some additional data were flagged. Details are provided in the sections below.

1.1. DATA TYPES EVALUATED

During creek status monitoring (MRP Provision C.8.d), several data types were collected and evaluated for quality assurance and quality control. These data types include the following:

1. Bioassessment data
    a. Benthic Macroinvertebrates (BMI)
    b. Algae
2. Physical Habitat Assessment
3. Field Measurements
4. Water Chemistry
5. Pathogen Indicators
6. Continuous Water Quality (two 1-2 week deployments; 15-minute interval)
    a. Temperature
    b. Dissolved Oxygen
    c. Conductivity
    d. pH
7. Continuous Temperature Measurements (5-month deployment; 1-hour interval)

During pesticide & toxicity monitoring the following data types were collected and evaluated for quality assurance and quality control:

1. Water Toxicity (dry weather; MRP Provision C.8.g.i)
2. Sediment Toxicity (dry weather; MRP Provision C.8.g.ii)
3. Sediment Chemistry (dry weather; MRP Provision C.8.g.ii)

1.2. LABORATORIES

Laboratories that provided analytical and taxonomic identification support to SMCWPPP and the RMC were selected based on demonstrated capability to adhere to specified protocols. Laboratories are certified and are as follows:

- Caltest Analytical Laboratory (nutrients, chlorophyll a, ash free dry mass, sediment chemistry)
- Pacific EcoRisk, Inc. (water and sediment toxicity)

- Alpha Analytical Laboratories, Inc. (pathogen indicators)
- BioAsessment Services (benthic macroinvertebrate (BMI) identification)
- Jon Lee Consulting (BMI identification Quality Control)
- EcoAnalysts, Inc. (algae identification)

1.3. QA/QC Attributes

The RMC SOP and QAPP identify seven data quality attributes that are used to assess data QA/QC. They include (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Precision, (6) Accuracy, and (7) Contamination. 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. Chemical analysis relies on repeatable physical and chemical properties of target constituents to assess accuracy and precision. Biological data are quantified by experienced taxonomists relying on organism morphological features.

1.3.1. Representativeness

Data representativeness assesses whether the data were collected so as to represent actual conditions at each monitoring location. For this project, all samples and field measurements are assumed to be representative if they are performed according to protocols specified in the RMC QAPP and SOPs.

1.3.2. Comparability

The QA/QC officer ensures that the data may be reasonably compared to data from other programs producing similar types of data. For RMC Creek Status monitoring, individual stormwater programs try to maintain comparability within the RMC. The key measure of comparability for all RMC data is the California Surface Water Ambient Monitoring Program.

1.3.3. Completeness

Completeness is the degree to which all data were produced as planned; this covers both sample collection and analysis. For chemical data and field measurements an overall completeness of greater than 90% is considered acceptable for RMC chemical data and field measurements. For bioassessment-related parameters – including BMI and algae taxonomy samples/analysis and associated field measurement – a completeness of 95% is considered acceptable.

1.3.4. Sensitivity

Sensitivity analysis determines whether the methods can identify and/or quantify results at low enough levels. For the chemical analyses in this project, sensitivity is considered to be adequate if the reporting limits (RLs) comply with the specifications in RMC QAPP Appendix E: RMC Target Method Reporting Limits. For benthic macroinvertebrate data, taxonomic identification sensitivity is acceptable provided taxonomists use standard taxonomic effort (STE) Level I as established by the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT). There is no established level of sensitivity for algae taxonomic identification.

1.3.5. Accuracy

Accuracy is assessed as the percent recovery of samples spiked with a known amount of a specific chemical constituent. Chemistry laboratories routinely analyze a series of spiked samples; the results of these analyses are reported by the laboratories and evaluated using the RMC Database QA/QC Testing Tool. Acceptable levels of accuracy are specified for chemical analytes and toxicity test parameters in

RMC QAPP Appendix A: Measurement Quality Objectives for RMC Analytes, and for biological measurements in Appendix B: Benthic Macroinvertebrate MQOs and Data Production Process.

1.3.6. Precision

Precision is nominally assessed as the degree to which replicate measurements agree, nominally determined by calculation of the relative percent difference (RPD) between duplicate measurements. Chemistry laboratories routinely analyze a series of duplicate samples that are generated internally. The RMC QAPP also requires collection and analysis of field duplicate samples at a rate of 5% of all samples for all parameters[1]. The results of the duplicate analyses are reported by the laboratories and evaluated using RMC Database QA/QC Testing Tool. Results of the Tool are confirmed manually. Acceptable levels of precision are specified for chemical analytes and toxicity test parameters in RMC QAPP Appendix A: Measurement Quality Objectives for RMC Analytes, and for biological measurements in Appendix B: Benthic Macroinvertebrate MQOs and Data Production Process.

1.3.7. Contamination

For chemical data, contamination is assessed as the presence of analytical constituents in blank samples, including laboratory, field, and equipment blanks. The RMC QAPP requires collection and analysis of field blank samples at a rate of 5% for orthophosphate. Field blanks are not required for other constituents.

[1] The QAPP also requires the collection of field duplicate samples for 10% of biological samples (BMI and algae). However, there are no prescribed methods for assessing the precision of these duplicate samples.

2. METHODS

2.1. REPRESENTATIVENESS

To ensure representativeness, each member of the SMCWPPP field crew received and reviewed all applicable SOPs and the QAPP. Most field crew members also attended a two-day bioassessment and field sampling training session from the California Water Boards Training Academy. The course was taught by California Department of Fish and Wildlife, Aquatic Bioassessment Laboratory staff and covered procedures for sampling benthic macroinvertebrates, algae, and measuring physical habitat characteristics using the applicable SWAMP SOPs. As a result, each field crew member was knowledgeable of, and performed data collection according to the protocols in the RMC QAPP and SOPs, ensuring that all samples and field measurements are representative of conditions in San Mateo County urban creeks.

2.2. COMPARABILITY

In addition to the bioassessment and field sampling training, SMCWPPP field crew members participated in an inter-calibration exercise with other stormwater programs prior to field assessments at least once during the permit term. During the inter-calibration exercise, the field crews also reviewed water chemistry (nutrient) sample collection and water quality field measurement methods. Close communication throughout the field season with other stormwater program field crews also ensured comparability.

Sub-contractors collecting samples and the laboratories performing analyses received copies of the RMC SOP and QAPP and have acknowledged reviewing the documents. Data collection and analysis by these parties adhered to the RMC protocols and was included in their operating contracts.

Following completion of the field and laboratory work, the field data sheets and laboratory reports were reviewed by the SMCWPPP Program Quality Assurance staff, and were compared against the methods and protocols specified in the SOPs and QAPP. Specifically, staff checked for conformance with field and laboratory methods as specified in SOPs and QAPP, including sample collection and analytical methods, sample preservation, sample holding times, etc.

Electronic data deliverables (EDDs) were submitted to the San Francisco Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by SWAMP, to ensure data comparability with the SWAMP program. In addition, data entry followed SWAMP documentation specific to each data type, including the exclusion of qualitative values that do not appear on SWAMP's look up lists[2] such as field crew member names and site IDs. Completed templates were reviewed using SWAMP's online data checker[3], further ensuring SWAMP-comparability.

2.3. COMPLETENESS

2.3.1. Data Collection

All efforts were made to collect 100% of planned samples. Upon completion of all data collection, the number of samples collected for each data type was compared to the number of samples planned and the number required by the MRP, and reasons for any missed samples were identified. When possible, SMCWPPP staff resampled sites if missing data were identified prior to the close of the monitoring period. Specifically, continuous water quality data were reviewed immediately following deployment for adherence to MQOs. If data were rejected, samplers were redeployed immediately.

[2] Look up lists available online at https://swamp.waterboards.ca.gov/swamp_checker/LookUpLists.aspx
[3] Checker available online at https://swamp.waterboards.ca.gov/swamp_checker/SWAMPUpload.aspx

For bioassessments, the SMCWPPP field crew made all efforts to collect the required number of BMI and algae subsamples per site; in the event of a dry transect, the samples were slid to the closest sampleable location to ensure 11 total subsamples in each station's composite sample.

2.3.2. Field Sheets

Following the completion of each sampling event, the field crew leader/local monitoring coordinator reviewed any field generated documents for completion, and any missing values were entered. Once field sheets were returned to the office or shared electronically, a SMCWPPP QA staff member reviewed the field sheets again and noted any missing data.

2.3.3. Laboratory Results

SMCWPPP QA staff assessed laboratory reports and EDDs for the number and type of analysis performed to ensure all sites and samples were included in the laboratory results.

2.4. SENSITIVITY

2.4.1. Biological Data

Benthic macroinvertebrates were identified to SAFIT STE Level I, with the additional effort of identifying chironomids (midges) to subfamily/tribe instead of family (Chironomidae).

2.4.2. Chemical Analysis

The reporting limits for analytical results were compared to the target reporting limits in Appendix E (RMC Target Method Reporting Limits) of the RMC QAPP. Results with reporting limits that exceeded the target reporting limit were flagged.

2.5. ACCURACY

2.5.1. Biological Data

Ten percent of the total number of BMI samples collected was submitted to a separate taxonomic laboratory, Jon Lee Consulting, for independent assessment of taxonomic accuracy, enumeration of organisms, and conformance to standard taxonomic level. For SMCWPPP, one sample was evaluated for QC purposes. Results were compared to MQOs in Appendix B (Benthic macroinvertebrate MQOs and Data Production Process).

2.5.2. Chemical Analysis

Caltest evaluated and reported the percent recovery (PR) of laboratory control samples (LCS; in lieu of reference materials) and matrix spikes (MS), which were recalculated and compared to the applicable MQOs set by Appendix A (Measurement Quality Objectives for RMC Analytes) of the RMC QAPP MQOs. If a QA sample did not meet MQOs, all samples in that batch for that particular analyte were flagged.

For reference materials, percent recovery was calculated as:

$$PR = MV / EV \times 100\%$$

Where: MV = the measured value
EV = the expected (reference) value

For matrix spikes, percent recovery was calculated as:

$$PR = [(MV - NV) / SV] \times 100\%$$

Where: MV = the measured value of the spiked sample
NV = the native, unspiked result
SV = the spike concentration added

2.5.3. Water Quality Data Collection

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

Temperature data were checked for accuracy by comparing measurements taken by HOBO temperature loggers with NIST thermometer readings in room temperature water and ice water prior to deployment. The mean difference and standard deviation for each HOBO was calculated, and if a logger had a mean difference exceeding 0.2 ^{o}C, it was replaced.

2.6. PRECISION

2.6.1. Field Duplicates

For creek status monitoring, duplicate biological samples were collected at 10% (one) of the 10 sites and duplicate water chemistry samples were collected at 10% (one) of the sites sampled to evaluate precision of field sampling methods. The RPD for water chemistry field duplicates was calculated and compared to the MQO (RPD < 25%) set by Table A-1 and A-2 in Appendix A of the RMC QAPP. If the RPD of the two field duplicates did not meet the MQO, the results were flagged.

The RMC QAPP requires collection and analysis of duplicate sediment chemistry and toxicity samples at a rate of 5% of total samples collected for the project. Responsibility for the collection of the field duplicate rotates each year amongst Alameda County Clean Water Program (ACCWP), Contra Costa Clean Water Program (CCCWP), Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP), and SMCWPPP.

The sediment sample and field duplicate were collected together using the Sediment Scoop Method described in the RMC SOP, homogenized, and then distributed to two separate containers. For sediment chemistry field duplicates, the RPD was calculated for each analyte and compared to the MQOs (RPD < 25%) set by Tables 26-7 through 26-11 in Appendix A of the RMC QAPP. For sediment and water toxicity field duplicates, the RPD of the batch mean was calculated and compared to the recommended acceptable RPD (< 20%) set by Tables 26-12 and 26-13 in Appendix A. If the RPD of the field duplicates did not meet the MQO, the results were flagged.

The RPD is calculated as:

RPD = ABS ([X1-X2] / [(X1+X2) / 2])

Where: X1 = the first sample result
X2 = the duplicate sample result

No field duplicate is required for pathogen indicators.

2.6.2. Chemical Analysis

Caltest evaluated and reported the RPD for laboratory duplicates, laboratory control sample duplicates (LCSD), and matrix spike duplicates (MSD). The RPDs for all duplicate samples were recalculated and compared to the applicable MQO set by Appendix A of the RMC QAPP. If a laboratory duplicate sample did not meet MQOs, all samples in that batch for that particular analyte were flagged.

2.7. CONTAMINATION

Blank samples were analyzed for contamination, and results were compared to MQOs set by Appendix A of the RMC QAPP. For creek status monitoring, the RMC QAPP requires all blanks (laboratory, equipment, and field) to be less than the analyte reporting limits. If a blank sample did not meet this MQO, all samples in that batch for that particular analyte were flagged.

3. RESULTS

3.1. Overall Project Representativeness

The SMCWPPP staff and field crew members were trained in SWAMP and RMC protocols, and received significant supervision from the local monitoring coordinator and QA officer. As a result, creek status monitoring data are considered to be representative of conditions in San Mateo County Creeks.

3.2. Overall Project Comparability

SMCWPPP creek status monitoring data are considered to be comparable to other agencies in the RMC and to SWAMP due to a shared QAPP and SOP, trainings, use of the same electronic data templates, and close communication.

3.3. Bioassessments and Physical Habitat Assessments

In addition to algae and BMI taxonomic samples, the SMCWPPP field crew collected chlorophyll a and ash free dry mass samples during bioassessments. The BMI taxonomic laboratory, BioAssessment Services, confirmed that the laboratory QA/QC procedures aligned with the procedures in Appendices B through D of the RMC QAPP and met the BMI MQOs in Appendix B.

3.3.1. Completeness

SMCWPPP completed bioassessments and physical habitat assessments for 10 of 10 planned/required sites for a 100% sampling completion rate.

3.3.2. Sensitivity

The BMI taxonomic identification met sensitivity objectives; the taxonomy laboratory, BioAssessment Services, and QC laboratory, Jon Lee Consulting, confirmed that organisms were identified to SAFIT STE Level I, with the exception of Chironomidae which was analyzed to SAFIT level 1a.

The analytical RL for ash free dry mass analysis (8 mg/L) and chlorophyll a (50 mg/L) were higher than the RMC QAPP target RLs of 2 mg/L and 5 mg/L, respectively. The elevated RLs were due to high concentrations that required large dilutions. The results were several orders of magnitude higher than the actual and target reporting limit and were not affected by the higher RL. Reporting limits in the RMC QAPP are meant to reflect current laboratory capabilities. At lower analyte concentrations where a dilution would not be necessary, the analytical RLs would have met the target RLs.

3.3.3. Accuracy

The BMI sample that was submitted to an independent QC taxonomic laboratory had three taxonomic discrepancies and no enumeration discrepancies. The QC laboratory calculated sorting and taxonomic identification metrics, which were compared to the measurement quality objectives in Table D-1 in Appendix D of the RMC QAPP. A comparison of the metrics with the MQOs is shown in Table 1. In WY 2020, all MQOs were met and no samples were flagged. A copy of the QC laboratory report is available upon request.

Table 1. Quality control metrics for taxonomic identification of benthic macroinvertebrates collected in San Mateo County in WY 2020 compared to measurement quality objectives.

Quality Control Metric	MQO	Error Rate	Exceeds MQO?
Absolute Recount		0%	No
High Taxonomic Resolution Count	≤10%	0%	No
High Taxonomic Resolution Individual	≤10%	0%	No
Individual ID	≤10%	0.49%	No
Low Taxonomic Resolution Count	≤10%	0%	No
Low Taxonomic Resolution Individual	≤10%	0%	No
Recount Accuracy	≥95%	100%	No
Taxa Count	≤10%	0%	No
Taxa Identification	≤10%	8.82%	No
Taxonomic Resolution Count	≤10%	0%	No
Taxonomic Resolution Individual	≤10%	0%	No

The analytical lab analyzed laboratory control samples and laboratory control sample duplicates for ash free dry mass and chlorophyll a. The PRs for all LCS and LCSD samples were within the MQO listed in the RMC QAPP (Table A-1), and no samples were flagged for accuracy exceedances.

There is currently no protocol for evaluating the accuracy of algae taxonomic identification.

3.3.4. Precision

Field blind duplicate chlorophyll a and ash free dry mass samples were collected at one site in WY 2020 and were sent to the laboratory for analysis. Due to the method used to collect duplicate algae field samples, these samples do not provide a valid estimate of precision in the sampling and are of little use to assessing precision, because there is no reasonable expectation that duplicates will produce identical data. Nonetheless, the RPD of the chlorophyll a and ash free dry mass duplicate results were calculated and compared to the MQO (< 25%) for conventional analytes in water (Table A-1 in Appendix A of the RMC QAPP). Due to the nature of chlorophyll a and ash free dry mass collection, the RPDs for both parameters are expected to exceed the MQO. The field duplicate results and their RPDs are shown in Table 2. As expected, chlorophyll a exceeded the MQO, while ash free dry mass did not. Chlorophyll a samples were flagged as necessary.

Discrepancies were expected due to the potential natural variability in algae production within the reach and the collection of field duplicates at different locations along each transect (as specified in the protocol). As a result, both parameters have frequently exceeded the field duplicate RPD MQOs during past years' monitoring efforts.

Table 2. Field duplicate water chemistry results for sites 204R04884, collected on May 21, 2020.

Analyte	Units	204R04884 May 21, 2020			
		Original Result	Duplicate Result	RPD	Exceeds MQO (>25%)[a]
Chlorophyll a	**mg/m²**	14.1	20.6	38%	Yes
Ash Free Dry Mass	**g/m²**	341.6	316.6	8%	No

[a]In accordance with the RMC QAPP, if the native concentration of either sample is less than the reporting limit, the RPD is not applicable

Laboratory duplicates were also collected for chlorophyll a and ash free dry mass samples. The RPDs for all ash free dry mass and chlorophyll a laboratory duplicates were found to be below the MQO limit, and no samples were flagged for precision.

3.3.5. Contamination

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

Additionally, the analytical laboratory ran several method blanks during ash free dry mass and chlorophyll a analysis and no contamination was detected in any of the blank samples.

3.4. Field Measurements

Field measurements of temperature, dissolved oxygen, pH, specific conductivity, and chlorine residual were collected concurrently with bioassessments and water chemistry samples. Chlorine residual was measured using a HACH Pocket Colorimeter™ II, which uses the Diethyl-p-phenylene Diamine (DPD) method. All other parameters were measured with a YSI Professional Plus or YSI 600XLM-V2-S multi-parameter instrument. All data collection was performed according to RMC SOP FS-3 (Performing Manual Field Measurements).

3.4.1. Completeness

Temperature, dissolved oxygen, pH, specific conductivity, free and total chlorine residual were measured at all 10 bioassessment sites for a 100% completeness rate.

3.4.2. Sensitivity

Free and total chlorine residual were measured using a HACH Pocket Colorimeter™ II, which uses the DPD method. For this method, the estimated detection limit for the low range measurements (0.02-2.00 mg/L) was 0.02 mg/L. There is, however, no established reporting limit. Colorimetric field instruments are generally not considered capable of providing accurate measurements of free chlorine and total chlorine residual below 0.13 mg/L (Missouri Department of Natural Resources 2004), due to analytical noise, regardless of the method detection limit provided by the manufacturer. For this reason, the Statewide General Permit for drinking Water Discharges (SWRCB 2014) and other recently issued NPDES permits, use 0.1 mg/L as a reporting limit for field measurements of total chlorine residual.

The Program also uses this threshold as a reporting limit for MRP chlorine residual monitoring. All measurements between 0.02 and 0.1 mg/L have been flagged as “detected, not quantified”. The adopted SMCWPPP reporting limit is still much lower than the target reporting limit of 0.5 mg/L listed in the RMC QAPP for free and total chlorine residual.

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

3.4.3. Accuracy

Data collection occurred Monday through Thursday, and the multi-parameter instrument was calibrated within 12 hours prior to the first sample on Monday, with the dissolved oxygen sensor calibrated every morning to ensure accurate measurements. Calibration solutions are certified standards, whose expiration dates were noted prior to use. The chlorine kit is factory-calibrated and is sent into the manufacturer every other year to be calibrated.

Free chlorine was measured to be higher than total chlorine at two of the ten sites sampled in WY 2020. In past years, free chlorine has also occasionally been measured as higher than total chlorine. Theoretically, the free chlorine measurement should always be less than or equal to the total chlorine measurement, as the total chlorine concentration in water encompasses the free chlorine concentration in addition to any other chlorine species. The reason for free chlorine concentrations exceeding total chlorine concentrations at a sample site has not been definitively established. Potential causes for these inverted results include matrix interferences, colorimeter user error, and uncertainty associated with low concentrations below the reporting limit. According to Hach, the manufacturer of the equipment and reagents, the free chlorine could have false positive results due to a pH exceedance of 7.6 and/or an alkalinity exceedance of 250 mg/L. It is unlikely that the higher free chlorine readings were caused by user error. The field crew is well trained and aware of potential problems with this testing method, such as wait times between adding reagents and taking the readings and separating the free chlorine and total residual chlorine samples. When free chlorine was observed to be higher than total chlorine at a sample site, the free chlorine measurement was retaken with a new water sample and recorded on the field form. It was deemed unnecessary to flag free chlorine measurements that were higher than total chlorine measurements.

3.4.4. Precision

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

3.5. Water Chemistry

Water chemistry samples were collected by SMCWPPP staff concurrently with bioassessment samples and analyzed by Caltest Analytical Laboratory within their respective holding times. Caltest performed all internal QA/QC requirements as specified in the QAPP and reported their findings to the RMC. Key water chemistry MQOs are listed in RMC QAPP Tables A-1 and A-2.

3.5.1. Comparability

Water chemistry data collected in WY 2020 in San Mateo County are comparable to data collected by SWAMP and other RMC agencies, but WY 2020 ammonia data are potentially *not* comparable to past years' results. Program staff noted that the total Kjeldahl nitrogen (TKN) concentrations were greater than ammonia concentrations for seven of the ten San Mateo creek sites sampled in WY 2020. Given that TKN is the sum of ammonia and organic nitrogen, this scenario is theoretically impossible. Since TKN and ammonia samples are collected in the same sample bottle, sampler error was excluded as a cause of the discrepancy. High nitrate concentrations may bias TKN low, but this explanation did not sufficiently explain the incongruity for all sites. Additionally, TKN concentrations for WY 2020 were comparable to historic TKN concentrations in San Mateo creeks measured during MRP-compliance monitoring. It was concluded that instead, ammonia concentrations were biased high during WY 2020. Nothing in the QA/QC process would suggest that concentrations are suspect, but WY 2020 ammonia concentrations were demonstrably higher than historic ammonia concentrations measured in the region. A review of all historic ammonia measurements found that concentrations in WY 2019 and two samples in WY 2018 were also noticeably higher than concentrations measured in WYs 2012-2017.

In WY 2016, the RMC QAPP was revised and the target RL was lowered for ammonia to reflect changes made to the SWAMPP QAPrP. Caltest was asked to switch to a low-level ammonia analytical method to meet this lower target RL. However, in WY 2018, the laboratory encountered technical problems with the lower-level analytical method and 8 of the 10 SMCWPPP samples were analyzed with the higher RL. Once the equipment was fixed, the remaining samples were analyzed via the low-level method. The two samples analyzed via the low-level analysis were noticeably higher than the samples analyzed earlier in the year. The Program hypothesizes that the samples analyzed via the low-level method post-2018 are biased high.

A simple Student's T-test[4] was run to determine if ammonia concentrations in WY 2019 and WY 2020 were significantly higher than samples run prior to the laboratory equipment malfunction. The results of this analysis are shown in Table 3. First combined results via the regular ammonia analytical method (WYs 2012-2015) were compared against combined results via the low-level analytical method used prior to the equipment issues (WY 2016 & 2017). There was no statistically significant difference between these two groups. However, there was a significant difference between ammonia concentrations from WYs 2019 and 2020 and ammonia concentrations from WYs 2012-2017. The same is true for a comparison of years where the low-level analysis was run (WYs 2016 & 2017 versus WYs 2019-2020).

Table 3. Two sample T-test (α = 0.05) comparison of ammonia concentrations from before and after a 2018 laboratory equipment malfunction.

Grouping 1	Grouping 2	Statistically Significant?
WYs 2012-2015	WYs 2016 & 2017	No
WYs 2012-2017	WYs 2019 & 2020	Yes
WYs 2016 & 2017	WYs 2019 & 2020	Yes

Though it appears WY 2019 and 2020 ammonia concentrations are biased high, there is no evidence of laboratory error since there were no significant QA issues during either year. As a result, the ammonia data were not flagged or rejected for being biased high. Caltest and the RMC have proposed two techniques to confirm and determine the source of the ammonia discrepancies including 1) analyzing ammonia samples collected in WY 2021 via both analytical methods; and 2) having Caltest and an unrelated analytical laboratory analyze duplicates samples via the low-level method.

3.5.2. Completeness

The Program collected 100% of planned/required water chemistry samples at the 10 bioassessment sites including one field duplicate sample. Samples were analyzed for all requested analytes, and 100% of results were reported.

3.5.3. Sensitivity

Laboratory RLs met or were lower than target RLs for all nutrients except chloride and nitrate. The RL for all chloride samples exceeded the target RL, but concentrations were much higher than RLs, and the elevated RLs do not decrease confidence in the measurements.

For the nitrate samples, laboratory RLs (0.05-0.1 mg/L) were higher than the target RL (0.01 mg/L). As a result, the nitrate concentration at one site was reported as "detected, but not quantified" as it was between the MDL and RL. If the laboratory analytical method was able to achieve the lower, target RL, this sample would have been quantified and would not have needed to be flagged, The Program has discussed the RLs with Caltest, and due the methodology, lower limits cannot currently be achieved. Target and actual RLs are shown in Table 4.

[4] Two-sample T-test assuming inequal variance, with a significance level of 0.05.

Table 4. Target and actual reporting limits for nutrients analyzed in SMCWPPP creek status monitoring. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

Analyte	Target RL mg/L	Actual RL mg/L
Ammonia	0.02	0.02
Chloride	0.25	1-10
Total Kjeldahl Nitrogen	0.5	0.1
Nitrate	0.01	0.05-0.1
Nitrite	0.01	0.005
Orthophosphate	0.01	0.01
Silica	1	0.1-0.2
Phosphorus	0.01	0.01

3.5.4. Accuracy

The RMC QAPP lists a target recovery range of 90-110% for nutrient laboratory control samples (LCS), and 80-120% for nutrient matrix spike and matrix spike duplicates (MS/MSD). For other conventional analytes (i.e., silica and chloride), both the LCS and MS/MSD MQO for recovery is 80-120%.

Recoveries on most LCS and MS/MSD samples were within the MQO target range. However, two silica MS/MSD pairs and one TKN MS/MSD pair exceeded the MQO range for percent recovery,. As a result, all silica samples and six TKN samples were assigned the appropriate SWAMP flag. Though the data were flagged, none of the analytical data were rejected due to accuracy.

3.5.5. Precision

Caltest ran several LCS/LCSD and MS/MSD pairs for all target analytes, and the RPD for all pairs were consistently below the MQO target of < 25%.

Water chemistry field duplicates were collected at one site in San Mateo County and were compared against the original samples. The field duplicate water chemistry results and their RPDs are shown in Table 5. Because of the variability in reporting limits, RPD was not calculated when either the original or duplicate sample concentration was less than the RL. For WY 2020, the ammonia duplicate sample slightly exceeded the RPD MQO; the MQO is 25% and the measured RPD was 29%. As a result of the exceedance, ammonia samples were flagged. Field crews will continue to make an effort in subsequent years to collect the original and duplicate samples in an identical fashion.

Table 5. Field duplicate water chemistry results for site 204R04884, collected on May 21, 2020. Data in highlighted rows exceed measurement quality objectives in RMC QAPP.

Analyte Name	Fraction Name	Unit	Original Result	Duplicate Result	RPD	Exceeds MQO (>25%)[a]
Ammonia as N	Total	mg/L	0.12	0.16	29%	Yes
Chloride	None	mg/L	13	13	0%	No
Nitrate as N	None	mg/L	0.13	0.13	0%	No
Nitrite as N	None	mg/L	J 0.001	J 0.001	N/A	N/A
Nitrogen, Total Kjeldahl	None	mg/L	ND	ND	N/A	NA
Orthophosphate as P	Dissolved	mg/L	ND	ND	N/A	N/A
Phosphorus as P	Total	mg/L	0.015	0.013	14%	No
Silica as SiO2	Total	mg/L	4.5	4.7	4%	No

[a]In accordance with the RMC QAPP, if the native concentration of either sample is less than the reporting limit, the RPD is not applicable

3.5.6. Contamination

During WY 2020, Caltest analyzed two equipment blanks (orthophosphate filter blanks) and several laboratory blanks. No contamination was detected in any of the laboratory or equipment blanks. The SMCWPPP field crew takes appropriate precautions to avoid contamination, including wearing gloves during sample collection and rinsing sample containers with stream water when preservatives are not needed.

3.6. Pathogen Indicators

Pathogen indicator samples were collected by SMCWPPP staff and were analyzed by Alpha Analytical Laboratories, Inc for *E. coli* and enterococcus. Samples were collected on July 20, 2020.

3.6.1. Completeness

The MRP requires that five pathogen indicator samples be collected in San Mateo County each year. In WY 2020, all five required/planned pathogen indicator samples were collected for a 100% completeness rate.

3.6.2. Sensitivity

The reporting limits for *E. coli* and enterococcus (1 MPN/100mL) met the target RL of 2 MPN/100mL listed in the project QAPP.

3.6.3. Accuracy

Negative and positive laboratory control samples were run for microbial media. A negative response was observed in the negative control and a positive response was observed in the positive control as required by the project QAPP Table A-4.

3.6.4. Precision

The RMC QAPP requires one laboratory duplicate to be run per 10 samples or per analytical batch, whichever is more frequent. However, determining precision for pathogen indicators requires 15 duplicate sets. Due to the small number of samples collected for this project, there were not enough laboratory duplicates to determine precision. In WY 2020, one laboratory duplicate was run for each microbial analyte, but these duplicates are not sufficient to determine precision. Nonetheless, the RPD was calculated for the duplicates - the RPD for *E.coli* was 5.3% and for the enterococcus the RPD was 24.5%.

The RMC QAPP does not require a field duplicate to be collected for pathogen indicators. However, one field duplicate was collected in WY 2020 by the field crew for a different project. The RPD was 0.5% for *E. coli* and 14% for enterococcus. Since there is no requirement for pathogen indicator field duplicates, there is no corresponding MQO, and the precision could not be assessed. See Table 6 for the field and lab duplicate results.

Table 6. Laboratory and field duplicate pathogen results collected on July 20, 2020.

Duplicate Type	Analyte	Original Result (MPN/100mL)	Duplicate Result (MPN/100mL)	RPD
Lab Duplicate	E. coli	198.9	209.8	5.3%
Lab Duplicate	Enterococcus	260.3	203.5	24.5%
Field Duplicate	E. coli	60.5	60.2	0.5%
Field Duplicate	Enterococcus	120.1	104.3	14%

3.6.5. Contamination

One method blank (sterility check) was run in the batch for *E. coli* and enterococcus. No growth was observed in the blank.

3.7. Continuous Water Quality

Continuous water quality measurements were recorded at two sites during the spring (May 2020), concurrent with bioassessments, and again in the fall (September 2020) in compliance with the MRP. Temperature, pH, dissolved oxygen, and specific conductivity were recorded once every 15 minutes for approximately two-weeks using a multi-parameter water quality sonde (Eureka Manta+30 or YSI 6600-V2).

3.7.1. Completeness

The MRP requires SMCWPPP to monitor dissolved oxygen, pH, specific conductance, and temperature at two sites using sondes that record at 15-minute intervals over 1-2 weeks in the spring concurrent with bioassessment sampling and 1-2 weeks in summer at the same sites. In WY 2020, both deployments lasted 15 days, exceeding the one week minimum. No data were rejected for the first deployment, but one parameter for each site was rejected during the second deployment in September; specific conductivity was rejected for site 204SMA080, and pH was rejected for site 204SMA110. See Section 3.7.3 for details. Consequently, the completion rate for continuous monitoring dropped below the 90% threshold to 87.5%. New training and calibration protocols have been developed to avoid these issues in the future..

3.7.2. Sensitivity

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

3.7.3. Accuracy

Program staff conduct pre- and post-deployment sonde calibrations for the two sondes used during monitoring events and calculate the drift during the deployments. A summary of the drift measurements is shown in Table 7. During the second monitoring event, the sonde deployed at 204SMA080 exceeded both the pH 7 and specific conductivity MQOs. Upon review of the data collected by the sonde, the QA officer decided to only reject the conductivity dataset and flag the pH data. While the sonde just barely failed the pH 10 drift check, there was no drift for pH 7. Furthermore, the pH data collected by the sonde followed expected diurnal patterns and did not appear to be biased low as the pH 10 drift would suggest.

Similarly, the sonde deployed at 204SMA110 for the second deployment exceeded the MQOs for both pH 7 and 10, as well specific conductivity. The pH results at this site were subsequently rejected for this deployment due to evident instrumentation errors noted in the dataset. Since the conductivity drift check was just outside the acceptable range, and the dataset did not appear to be affected by the failed drift check, these data were flagged, but not rejected.

Table 7. Drift measurements for two continuous water quality monitoring events in San Mateo County urban creeks during WY 2020. Highlighted values exceeded measurement quality objectives.

Parameter	Measurement Quality Objectives	204SMA080		204SMA110	
		Event 1	Event 2	Event 1	Event 2
Dissolved Oxygen (mg/L)	± 0.5 mg/L or 10%	-0.02	-0.17	-0.03	0.06
pH 7.0	± 0.2	-0.02	0.00	-0.04	0.78
pH 10.0	± 0.2	-0.07	-0.21	-0.07	-0.23
Specific Conductance (uS/cm)	± 10%	-1.8%	2083%	-1.1%	-10.33%

3.7.4. Precision

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

3.8. Continuous Temperature Monitoring

Continuous temperature monitoring was conducted from April through September 2020 at five sites in San Mateo County. Onset HOBO Water Temperature data loggers recorded one measurement per hour.

3.8.1. Completeness

The MRP requires SMCWPPP to monitor four stream reaches for temperature each year but anticipating the potential for a HOBO temperature logger to be lost during such a long deployment, SMCWPPP deployed one extra temperature logger for a total of five loggers. In the middle of the deployment, SMCWPPP staff checked the loggers to ensure that they were still present and recording. If a logger was missing during the mid-deployment field check, it would be replaced with a new logger. Similarly, a logger would be moved if necessary. During the field check, staff also downloaded the existing data and redeployed the other loggers. All temperature loggers were recovered at the end of the deployment, resulting in a completion rate of over 100%.

3.8.2. Sensitivity

There is no target reporting limit for temperature listed in the RMC QAPP, thus sensitivity could not be evaluated for continuous temperature measurements.

3.8.3. Accuracy

A pre-deployment accuracy check was run on the temperature loggers in March 2020. None of the loggers exceeded the 0.2 °C mean difference threshold for either the room temperature bath or the 0.2 °C mean difference for the ice bath.

3.8.4. Precision

There are no precision protocols for continuous temperature monitoring.

3.9. Sediment Chemistry

The dry season sediment chemistry sample was collected by Kinnetic Laboratories, Inc (KLI) concurrently with the dry season toxicity sample on July 22, 2020. Samples were analyzed by Caltest for inorganic compounds, synthetic organic compounds, and grain size distribution . Caltest conducted all QA/QC requirements as specified in the RMC QAPP and reported their findings to the RMC. Key sediment chemistry MQOs are listed in RMC QAPP Tables A-7 through A-11.

3.9.1. Completeness

The MRP requires a sediment chemistry sample to be collected at one location each year. In WY 2020, SMCWPPP collected the sediment chemistry sample at 205BRC008. The laboratory analyzed samples well within the one year holding time for analytes in sediment, set by the RMC SOP, and reported 100% of the required analytes.

3.9.2. Sensitivity

For sediment chemistry analysis conducted in WY 2020, laboratory RLs were higher than RMC QAPP target RLs for metals, pyrethroid pesticides, fipronil and its degradates, carbaryl, and total organic carbon. A comparison of target and actual reporting limits for these parameters is shown in Table 8. Since RLs for an individual sample are dependent on the percent solids of that sample, it is likely that the amount of solids in the sample caused these exceedances. Additionally, the pyrethroid and fipronil samples required a dilution. As a result of this dilution, the RL for these analytes (1.1 ng/g) was greater than the target RL (0.33 ng/g) listed in the RMC QAPP. If dilutions had not been necessary, the analytical RLs would have met the target RL.

Table 8. Comparison of target and actual reporting limits (RLs) for sediment analytes where analytical reporting limits exceeded target limits. Sediment samples were collected in San Mateo County creeks in WY 2020.

Analyte	Target RL	Actual RL	Unit
Arsenic	0.3	0.52	mg/Kg
Cadmium	0.01	0.08	mg/Kg
Chromium	0.1	1	mg/Kg
Copper	0.01	0.41	mg/Kg
Lead	0.01	0.08	mg/Kg
Nickel	0.02	0.08	mg/Kg
Zinc	0.1	0.8	mg/Kg
Bifenthrin	0.33[a]	1 [b]	ng/g
Cyfluthrin	0.33 [a]	1 [b]	ng/g
Total Lambda-cyhalothrin	0.33 [a]	1 [b]	ng/g
Total Cypermethrin	0.33 [a]	1 [b]	ng/g
Total Deltamethrin	0.33 [a]	1 [b]	ng/g
Total Esfenvalerate/Fenvalerate	0.33 [a]	1 [b]	ng/g
Permethrin	0.33 [a]	1 [b]	ng/g
Fipronil	0.33 [a]	1 [b]	ng/g
Fipronil Desulfinyl	0.33 [a]	1 [b]	ng/g
Fipronil Sulfide	0.33 [a]	1 [b]	ng/g
Fipronil Sulfone	0.33 [a]	1 [b]	ng/g
Carbaryl	30	31	ng/g
Total Organic Carbon	0.01	0.052	% dw

[a] There is no appropriate SWAMP targets for pyrethroids or for fipronil and its degredates. For these analytes, the RMC target RLs are based on current lab capabilities.
[b] These samples were diluted, which raised the RL. If dilutions had not been necessary, the samples' RL would have been less than the target RL.

3.9.3. Accuracy

Inorganic Analytes

In the RMC QAPP, the PR MQO for LCS and MS samples is 75-125% for inorganic analytes. None of the LCSs exceeded the RMC MQO, but one MSD sample analyzed for lead exceeded the PR MQO. Additionally, the zinc MS sample was non-calculable because the measured concentration was less than the native concentration. The zinc and lead samples were flagged for matrix spike samples exceeded their recovery MQOs, but the samples were not rejected.

Synthetic Organic Compounds

The MQO specified in the RMC QAPP for the recovery of synthetic organic compounds (excluding pyrethroid pesticides) in sediment is 50-150% for both LCS and MS samples. None of the LCS or MS PRs exceeded the RMC MQO range,

The RMC QAPP lists pyrethroid pesticides separately from other synthetic organic compounds, but they have the same MQO of 50-150% for both LCS and MS/MSD samples. All LCS samples analyzed for pyrethroid pesticides were within the prescribed MQO for recovery. However, one matrix spike analyzed for permethrin slightly exceeded the MQO. The permethrin sample was subsequently flagged, but not rejected.

3.9.4. Precision

Inorganic Analytes
The RMC QAPP lists the maximum RPD for inorganic analytes (metals) as 25%. All MS/MSD pairs for metals were below the RMC RPD MQO of 25%. The RMC QAPP does not require the analysis of LCS duplicates for inorganic compounds.

Synthetic Organic Compounds
The maximum RPD for synthetic organics listed in the sediment laboratory report ranges from 30 to 50% for most analytes. However, the RMC QAPP lists the MQO as < 25% RPD for most synthetic organics, < 35% for pyrethroids and fipronil, and < 40% for carbaryl. None of the MS/MSD pairs exceeded the RPD MQO.

Field Duplicates
A sediment sample field duplicate was collected in Santa Clara County on July 22, 2020 and evaluated for precision. The field duplicate sample and corresponding RPDs are shown in Table 9. Due to the variability in reporting limits, values less than the RL were not evaluated for RPD. The measured concentrations of a majority of analytes from the original and duplicate samples were below the method detection limit and therefore reported as “ND”. As a result, the RPDs were non-calculable. Analytes that exceeded their MQO and were flagged were small pebbles (4 to <8 mm), lead, and three polycyclic aromatic hydrocarbons (PAHs; fluoranthene, phenanthrene, and pyrene).

Given the inherent variability associated with sediment sample field duplicates, the number of analytes with RPDs outside of the MQO limits is acceptable. The method used to collect sediment field duplicates provides more insight to laboratory precision than precision of field methods; however, the results do suggest that field methods are precise.

Table 9. Sediment chemistry duplicate field results for site 205STQ010, collected on July 22, 2020 in Santa Clara County. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

	Analyte	Unit	Original	Duplicate	RPD	Exceeds MQO? (<25%)[a]
Grain Size Distribution	Clay: <0.0039 mm	%	9.02	8.82	2%	No
	Silt: 0.0039 to <0.0625 mm	%	16.96	17.05	1%	No
	Sand: V. Fine 0.0625 to <0.125 mm	%	10.41	11.31	8%	No
	Sand: Fine 0.125 to <0.25 mm	%	18.93	18.1	4%	No
	Sand: Medium 0.25 to <0.5 mm	%	25.7	25.49	1%	No
	Sand: Coarse 0.5 to <1.0 mm	%	11.04	10.97	1%	No
	Sand: V. Coarse 1.0 to <2.0 mm	%	7.94	8.27	4%	No
	Granule: 2.0 to <4.0 mm	%	5.23	4.74	10%	No
	Pebble: Small 4 to <8 mm	%	3.89	0.56	150%	Yes
	Pebble: Medium 8 to <16 mm	%	ND	ND	NA	NA
	Pebble: Large 16 to <32 mm	%	ND	ND	NA	NA
	Pebble: V. Large 32 to <64 mm	%	ND	ND	NA	NA
Metals	Arsenic	mg/Kg dw	2.8	2.7	4%	No
	Cadmium	mg/Kg dw	0.19	0.17	11%	No
	Chromium	mg/Kg dw	47	46	2%	No
	Copper	mg/Kg dw	35	34	3%	No
	Lead	mg/Kg dw	19	10	62%	Yes
	Nickel	mg/Kg dw	47	41	14%	No
	Zinc	mg/Kg dw	130	130	0%	No
	Total Organic Carbon	%	2.8	3.2	13%	No
Pyrethroids (MQO <35%)	Bifenthrin	ng/g dw	7.8	6.6	17%	No
	Cyfluthrin	ng/g dw	2.5	2.2	13%	No
	Lambda-Cyhalothrin	ng/g dw	J0.72	J0.7	NA	NA
	Cypermethrin	ng/g dw	J0.75	J0.78	NA	NA
	Deltamethrin/Tralomethrin	ng/g dw	ND	ND	NA	NA
	Esfenvalerate/Fenvalerate	ng/g dw	ND	ND	NA	NA
	Permethrin	ng/g dw	3.1	2.6	18%	No
	Carbaryl	mg/Kg dw	ND	ND	NA	NA
Fipronil	Fipronil	ng/g dw	ND	ND	NA	NA
	Fipronil Desulfinyl	ng/g dw	ND	ND	NA	NA
	Fipronil Sulfide	ng/g dw	ND	ND	NA	NA
	Fipronil Sulfone	ng/g dw	J0.53	J0.57	NA	NA
Polycyclic Aromatic Hydrocarbons	Acenaphthene	ng/g dw	ND	ND	NA	NA
	Acenaphthylene	ng/g dw	ND	ND	NA	NA
	Anthracene	ng/g dw	ND	ND	NA	NA
	Benz(a)anthracene	ng/g dw	ND	ND	NA	NA
	Benzo(a)pyrene	ng/g dw	ND	ND	NA	NA
	Benzo(b)fluoranthene	ng/g dw	ND	ND	NA	NA
	Benzo(e)pyrene	ng/g dw	ND	ND	NA	NA
	Benzo(g,h,i)perylene	ng/g dw	ND	ND	NA	NA
	Benzo(k)fluoranthene	ng/g dw	ND	ND	NA	NA
	Biphenyl	ng/g dw	ND	ND	NA	NA
	Chrysene	ng/g dw	ND	ND	NA	NA

Table 9. Sediment chemistry duplicate field results for site 205STQ010, collected on July 22, 2020 in Santa Clara County. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

	Analyte	Unit	Original	Duplicate	RPD	Exceeds MQO? (<25%)[a]
	Dibenz(a,h)anthracene	ng/g dw	ND	ND	NA	NA
	Dibenzothiophene	ng/g dw	ND	ND	NA	NA
	Dimethylnaphthalene, 2,6-	ng/g dw	55	65	17%	No
	Fluoranthene	ng/g dw	55	76	32%	Yes
	Fluorene	ng/g dw	ND	ND	NA	NA
	Indeno(1,2,3-c,d)pyrene	ng/g dw	ND	ND	NA	NA
	Methylnaphthalene, 1-	ng/g dw	ND	ND	NA	NA
	Methylnaphthalene, 2-	ng/g dw	ND	ND	NA	NA
	Methylphenanthrene, 1-	ng/g dw	ND	ND	NA	NA
	Naphthalene	ng/g dw	ND	ND	NA	NA
	Perylene	ng/g dw	ND	ND	NA	NA
	Phenanthrene	ng/g dw	33	43	26%	Yes
	Pyrene	ng/g dw	66	87	27%	Yes

[a] MQO for pyrethroids is <35%. In accordance with the RMC QAPP, if the native concentration of either sample is less than the reporting limit, the RPD is not applicable

J concentrations are below the RL that are "detected, not quantified"

<u>Laboratory Duplicates</u>

Laboratory duplicates were collected and analyzed for grain sizes and total organic carbon. All RPDs were below the MQO limits.

3.9.5. Contamination

The RMC QAPP requires all blanks (laboratory and field) to be less than the analyte reporting limits. All laboratory blanks were below their analytes' MDL except for the sample analyzed for lead. Since this QA sample was below the reporting limit, the lead sample was flagged, but no corrective action was necessary.

3.10. Toxicity Testing

Dry season water and sediment toxicity samples were collected by KLI concurrently with dry season sediment chemistry samples at one San Mateo County site on July 22, 2020. All toxicity tests were performed by Pacific EcoRisk. The water samples were analyzed for toxicity to five organisms (*Selenastrum capricornutum, Ceriodaphnia dubia, Pimephales promelas, Hyalella azteca, and Chironomus dilutus*) and the sediment samples were analyzed for toxicity to *Hyalella azteca* and *Chironomus dilutus.*

3.10.1. Completeness

The MRP requires the collection of dry season water and sediment toxicity samples at one site per year in San Mateo County. Pacific EcoRisk tested the required organisms for toxicity, and 100% of results were reported.

3.10.2. Sensitivity and Accuracy

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

3.10.3. Precision

Field duplicates for water and sediment toxicity are not required by the RMC QAPP. Subsequently, precision could not be evaluated.

3.10.4. Contamination

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

4. SUMMARY

In WY 2020, sample collection and analysis followed MRP and RMC QAPP requirements. A summary of the QA/QC analysis is provided below.

Data Discrepancies

- Ammonia concentrations are potentially biased high, but data were not flagged or rejected until this finding can be confirmed and the source identified.
- Free chlorine measurements were greater than total chlorine measurements at two sites.

Rejected data

- Continuous specific conductivity data were rejected for 204SMA080 for the second deployment.
- Continuous pH data were rejected for site 204SMA110 for the second deployment.

Flagged data

- Chlorine between 0.02 and 0.1 mg/L flagged as "detected, not quantified."
- All silica water samples and six TKN water samples were flagged due to their MS/MSDs exceeding the PR MQO.
- Chlorophyll a and ammonia data were flagged due to the field duplicates exceeding the RPD MQO.
- The zinc, lead, and permethrin sediment samples were flagged due to their MS/MSDs exceeding PR MQO.
- Small pebbles (4 to <8 mm), lead, fluoranthene, phenanthrene, and pyrene sediment samples were flagged due to the field duplicate exceeding the RPD MQO.
- Lead sediment samples were flagged for potential contamination.

5. REFERENCES

Bay Area Stormwater Management Agency Association (BASMAA). 2012. Regional Monitoring Coalition Final Creek Status and Long-Term Trends Monitoring Plan. Prepared By EOA, Inc. Oakland, CA. 23 pp.

Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2020. Creek Status Monitoring Program Quality Assurance Project Plan, Final Draft Version 4. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 129 pp.

Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition. 2016. Creek Status Monitoring Program Standard Operating Procedures Version 3. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 192 pp.

Missouri Department of Natural Resources. 2004. Water Pollution Control Permit Manual, Appendix T: Total Chlorine Residual Study. 2 pp.

State Water Resources Control Board (SWRCB). 2014. Statewide National Pollutant Discharge Elimination System (NPDES) Permit for Drinking Water System Discharges to Waters of the United States. Order WQ 2014-0194-DWQ. General Oder No. CAG140001. 111 pp.

Surface Water Ambient Monitoring Program (SWAMP). 2017. SWAMP Quality Assurance Program Plan. May. 140 pp.

Attachment 2

SMCWPPP Bioassessment Data, WY 2020

Site Information					Water Quality						Water Chemistry (nutrients)														Biological and Physical Habitat Indicator Scores					Physical Habitat									Land Use Variables		
Station Code	Creek Name	Latitude	Longitude	Sample Date	Dissolved Oxygen (mg/L)	Temperature (Deg C)	Spec Conductance (uS/cm)	pH	Chloride (mg/L)	Silica (mg/L)	Ash Free Dry Mass (g/m2)	Chlorophyll a (mg/m2)	Ammonia (mg/L)	UIA (ug/L)	Nitrate as N (mg/L)	QA Flag	Nitrite as N (mg/L)	QA Flag	TKN as N (mg/L)	QA Flag	Total Nitrogen(mg/L)	Ortho Phosphate as P (mg/L)	QA Flag	Total Phosphorus (mg/L)	CSCI	ASCI_Diatom	ASCI_Soft Algae	ASCI_Hybrid	IPI	Channel Alteration	Epifaunal Substrate	Sediment Deposition	Human Disturbance Index	Evenness Flow Habitat	% Substrate <2 mm	Shannon Diversity Habitat	Sum Riparian Cover	Shannon Diversity Substrate	% Impervious (wat)	% Urban (wat)	Road Density (wat)
202R01308	Pilarcitos Creek	37.4684	-122.4363	5/18/20	10.2	14.3	438	7.3	33	18	191	4	0.12	0.6	0.39	=	0.002	DNQ	0.11	=	0.50	0.074	=	0.091	0.65	0.79	-88	0.78	0.86	15	12	6	2.3	0.4	71	1.4	226	1.3	3%	3%	0.9
202R04568	San Pedro Creek	37.5808	-122.4798	5/27/20	9.6	13.7	430	7.6	24	18	210	14	0.11	1.0	0.25	=	0.005	=	-0.08	ND	0.30	0.017	=	0.027	0.50	0.71	0.60	0.70	1.17	17	14	10	1.9	0.9	37	1.8	208	1.6	12%	21%	2.6
202R05464	San Pedro Creek	37.5869	-122.4953	5/27/20	9.4	16.2	427	8.0	25	17	813	387	0.11	2.8	0.31	=	0.001	DNQ	-0.08	ND	0.35	0.039	=	0.039	0.51	0.63	1.13	0.58	1.09	17	12	8	1.6	0.7	34	2.0	188	1.4	13%	23%	3.1
204R00680	Redwood Creek	37.4379	-122.241	5/19/20	8.5	15	1111	8.0	57	36	204	131	0.12	2.6	0.06	DNQ	0.001	DNQ	0.3	=	0.36	0.073	=	0.083	0.44	0.52	1.09	0.45	0.9	7	12	13	2.1	0.5	61	1.7	177	1.5	23%	81%	8.4
204R01256	Arroyo Ojo de Agua	37.4545	-122.2505	5/19/20	8.3	14.9	988	7.8	37	66	101	82	0.09	1.2	0.31	=	0.003	DNQ	0.41	=	0.72	0.11	=	0.12	0.54	0.46	1.41	0.57	1.14	16	16	17	2.0	1.0	22	1.7	164	1.7	34%	79%	9.6
204R02228	San Mateo Creek	37.561	-122.3374	5/20/20	10.9	14.1	223	7.7	15	5.3	784	74	0.12	1.5	0.1	=	0.002	DNQ	-0.08	ND	0.14	0.019	=	0.021	0.60	0.76	0.70	0.68	1.06	12	9	7	2.4	0.8	35	1.7	172	1.6	9%	14%	2.8
204R03272	San Mateo Creek	37.5339	-122.3503	5/26/20	9.9	13.7	182	7.4	13	4.2	415	147	0.10	0.6	0.14	=	0.001	DNQ	-0.08	ND	0.18	0.009	DNQ	0.012	0.61	0.77	1.41	0.80	1.13	17	17	13	1.2	0.9	32	1.6	169	1.7	7%	8%	2.2
204R03528	San Mateo Creek	37.5483	-122.3463	5/26/20	10.2	15.6	196	7.6	14	4.6	39	19	0.11	1.2	0.13	=	0.001	DNQ	0.08	DNQ	0.21	0.01	=	0.01	0.58	0.74	0	0.56	1.11	17	16	9	0.8	0.8	37	1.6	207	1.7	7%	10%	2.4
204R04884	San Mateo Creek	37.5406	-122.3499	5/21/20	10.5	12.7	187	7.2	13	4.5	342	14	0.12	0.4	0.13	=	0.001	DNQ	-0.08	ND	0.17	-0.006	ND	0.015	0.67	0.75	1.41	0.73	1.12	18	17	7	1.1	1.0	46	1.8	209	1.5	7%	9%	2.3
204R05176	Laurel Creek	37.5333	-122.3045	5/20/20	7.6	14	671	7.5	54	11	208	470	0.15	1.2	0.13	=	0.003	DNQ	0.41	=	0.54	0.072	=	0.088	0.42	0.83	0.70	0.86	1	11	8	8	2.3	0.4	18	1.4	165	1.6	38%	72%	11.7

QA Flag: ND - Non-detect (used ½ value of the method detection limit), DNQ - Detected Not Quantifiable (used measured value)

NR - Not Recorded

UIA- Un-ionized Ammonia

TKN - Total Kjeldahl Nitrogen

CSCI - California Stream Index

ASCI_D - Algae Stream Condition Index (Diatoms)

ASCI_H - Algae Stream Condition Index (Hybrid)

ASCI_SA - Algae Stream Condition Index (Soft Algae)

IPI - Index Physical Habitat Integrity

URBAN CREEKS MONITORING REPORT

PART B: STRESSOR/SOURCE IDENTIFICATION PROJECTS

Water Year 2020



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

SAN MATEO COUNTYWIDE
Water Pollution
Prevention Program

A Program of the City/County Association of Governments

March 31, 2021

CREDITS

This report is submitted by the participating agencies in the

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
Clean Water. Healthy Community.
www.flowstobay.org

Town of Atherton
City of Belmont
City of Brisbane
City of Burlingame
Town of Colma
City of Daly City
City of East Palo Alto
City of Foster City
City of Half Moon Bay
Town of Hillsborough
City of Menlo Park
City of Millbrae
City of Pacifica
Town of Portola Valley
City of Redwood City
City of San Bruno
City of San Carlos
City of San Mateo
City of South San Francisco
Town of Woodside
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List of Acronyms

ACCWP	Alameda Countywide Clean Water Program
BASMAA	Bay Area Stormwater Management Agency Association
BMP	Best Management Practices
C/CAG	City/County Association of Governments
CCCWP	Contra Costa Clean Water Program
FIB	Fecal Indicator Bacteria
FSURMP	Fairfield Suisun Urban Runoff Management Program
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
MST	Microbial Source Tracking
NPDES	National Pollutant Discharge Elimination System
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
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
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
WQO	Water Quality Objective
WY	Water Year

1.0 Introduction

This *Urban Creeks Monitoring Report (UCMR) Part B: Stressor/Source Identification Projects, Water Year*[1] *(WY) 2020* was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP). SMCWPPP is a program of the City/County Association of Governments (C/CAG) of San Mateo County. Each incorporated city and town in the county and the County of San Mateo share a common 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). The next iteration of the MRP (i.e., MRP 3.0) is currently being drafted and is anticipated to become effective July 1, 2022.

This report fulfills the requirements of provision C.8.h.iii.(2) for providing a Stressor/Source Identification (SSID) Status Report pursuant to Provision C.8.e.iii.(3). As such, this report includes a running summary of all SSID projects undertaken by SMCWPPP and its regional partners.

Monitoring data collected by SMCWPPP in support of SSID projects are collected in accordance with the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) Quality Assurance Project Plan (QAPP; BASMAA 2020) and Standard Operating Procedures (SOPs; BASMAA 2016). Where applicable, monitoring data are derived using methods comparable with those specified by the California Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Program Plan (QAPrP)[2].

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 monitoring results may be considered as appropriate.

The MRP allows Permittees to comply with the SSID requirements of Provision C.8 through a regional collaborative effort, their countywide stormwater program, 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 BASMAA 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

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[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 2020 (WY 2020) began on October 1, 2019 and concluded on September 30, 2020.

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

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 1.1. BASMAA 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 and Sea Level Rise Resiliency 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 2.0, SMCWPPP and its RMC partners were required to collectively initiate a region-wide minimum of eight SSID projects, with a minimum of one project assessing toxicity. 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 project conducted regionally. Through these agreements, SMCWPPP initiated one San Mateo County-specific project and participated in one regional project. The Pillar Point Harbor Watershed Pathogen Indicator SSID Project is summarized in Section 2.0. The regional project addressing PCBs releases from electrical utility equipment is summarized in Section 3.0.

Provision C.8.e.ii. of the MRP requires that all SSID project reports initiated during the permit term are presented in a unified, regional-level report. As such, the BASMAA RMC Regional SSID Report is included as Attachment 1. Attachment 1 provides the start date, problem definition, schedule, and current status of all regional SSID projects.

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 the MRP 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.

2.0 Pillar Point Watershed Pathogen Indicator SSID Project

The Pillar Point Watershed Pathogen Indicator SSID Project was triggered by fecal indicator bacteria (FIB) densities exceeding WQOs that have been measured in receiving waters and tributaries to Pillar Point Harbor. A SSID work plan (SMCWPPP 2018) was submitted with the SMCWPPP WY 2017 UCMR dated March 31, 2018. The work plan describes steps to investigate urban sources of FIB in the Pillar Point Watershed. SMCWPPP implemented the work plan in WY 2018 and WY 2019 with assistance from and in close coordination with the San Mateo County Resource Conservation District (RCD). Consistent with Provision C.8.e.iii.(1)(g) of the MRP, the study generally follows the *California Microbial Source Identification Manual* (Griffith et al. 2013).

The objective of the SSID study was to build on a Proposition 50 Clean Beaches Initiative Grant-funded study that was conducted by the RCD and University of California, Davis (UCD) in 2008 and 2011-12 (RCD 2014). The Proposition 50 Pillar Point Harbor Source Identification Project consisted of extensive water quality and hydrologic monitoring in the Harbor and its watershed, including collection of water, sediment, and biofilm samples during wet and dry weather for analysis of FIB (*E. coli* and enterococci) and bacteroidales associated with human, bovine, dog, horse, and avian sources. The RCD/UCD study indicated that high FIB densities measured at Pillar Point beaches were likely due to influences from storm drains and creeks rather than from sources at the beaches and within the harbor itself.

The Pillar Point SSID project followed-up on the Proposition 50 Pillar Point Harbor Source Identification Project and focused on identifying spatial and temporal (seasonal) information about FIB sources from the MS4 through desktop and field investigations. Field investigations included grab samples collected at 14 stations located in five subwatersheds draining to Pillar Point Harbor (Figure 2.2). In most subwatersheds, the sample design included stations upstream of the MS4, within the MS4, and at the outlet to the Harbor. Sampling was conducted during two storm events and two dry season events in WY 2018. All samples were analyzed for FIB (*E. coli*) and human and dog bacteroidales genetic markers. Human and dog markers were selected to represent the most likely controllable anthropogenic sources. Desktop investigations conducted in WY 2018 and WY 2019 included development of a geodatabase to map potential bacteria sources and review of beach monitoring data collected by San Mateo County Environmental Health Services.

Results showed *E. coli* densities often exceed recommended WQOs for freshwaters designated as having water contact recreation (REC-1) Beneficial Uses (i.e., 320 cfu/100mL). However, FIB densities are highly variable and do not follow predictable seasonal patterns across all subwatersheds investigated. For example, two of the subwatersheds did not have higher wet weather FIB densities compared to dry season densities. A dearth of human and dog markers detected in this SSID study (particularly during the dry season) suggests that FIB conveyed by the MS4 may not be controllable. Uncontrollable sources, such as wildlife (i.e., raccoons, deer, rodents) that are present in the MS4 and watershed, may also contribute FIB to receiving waters. Regrowth of FIB in biofilms within the MS4, and subsequent shearing off of these materials is another possible source of FIB, though data limitations in this study preclude making evidence-based conclusions.

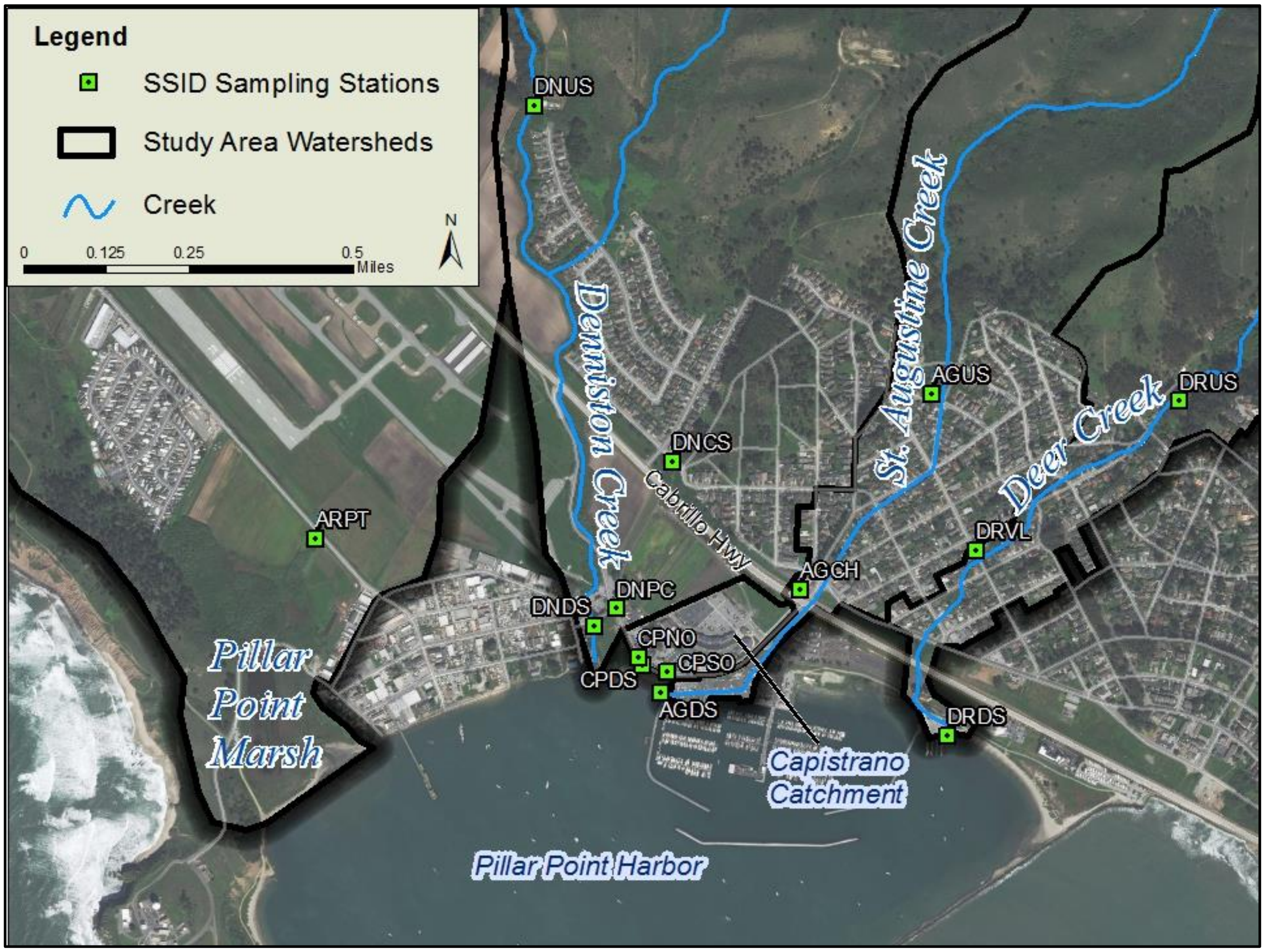

Figure 2.2. Pillar Point Watershed Pathogen Indicator SSID Project monitoring stations.

The Final Pillar Point Harbor Watershed Pathogen Indicator SSID Project Report was submitted to the Regional Water Board on October 28, 2019. Regional Water Board staff returned comments on February 7, 2020 requesting minor revisions as a condition for the SSID project to be deemed complete. The Revised Final Project Report was submitted to the Regional Water Board on June 30, 2020 (SMCWPPP 2020b).

The Revised Final Project Report documents management actions that are already being implemented along the coast and throughout the County that specifically or opportunistically reduce bacterial sources in stormwater runoff. These actions include stormwater and sewer infrastructure improvements, prohibition of non-stormwater runoff, trash controls, pet waste ordinances, pet waste cleanup stations, stormwater education and outreach, confined animal facility best management practices, and beach clean-ups.

Several additional bacterial control measures were recommended in the Revised Final Project Report. These include installation of additional pet waste cleanup stations; continued education and outreach; investigations to identify locations within the MS4 where groundwater infiltration may be occurring (and subsequent repair); outreach to the owner(s)/operator(s) of the sewage collection system to understand and potentially improve operations, monitoring, and maintenance; and continued technical assistance to farms and ranches to promote water quality protection.

It is important to acknowledge that a) WQOs for FIB do not distinguish among sources of FIB and b) FIB detections do not necessarily correlate well with the presence of pathogens. Animal fecal waste is much less likely to contain pathogens of concern to human health than human sources, and FIB associated with biofilms may not indicate the presence of pathogens. In most cases, human sources of fecal contamination are associated with REC-1 health risks rather than wildlife or domestic animal sources (USEPA 2012). Furthermore, even if controllable bacteria sources (i.e., human and dog sources) are eliminated, FIB densities in receiving waters could still exceed WQOs due to wildlife and natural FIB growth in biofilms, sediment, and organic matter. As a result, the comparison of pathogen indicator results to WQOs may not always be meaningful and should be interpreted cautiously.

2.1 Pillar Point Harbor and Venice Beach Bacteria TMDL

On February 10, 2021, the Regional Water Board approved a resolution (No. R2-2021-0002) to amend the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) to establish a Total Maximum Daily Load (TMDL) and implementation plan to control bacteria at the beaches in Pillar Point Harbor and at Venice Beach, which is located approximately two miles south of the Harbor. The TMDL and Basin Plan amendment will become effective upon approval by the State Water Board and the U.S. Environmental Protection Agency (USEPA), likely in late-2021.

This Basin Plan Amendment will establish the following:

- A bacteria TMDL with numeric targets for enterococci indicator bacteria to protect water contact recreational uses at the beaches in Pillar Point Harbor and Venice Beach.
- Load and wasteload allocations, expressed in terms of enterococci densities, for all controllable sources of bacteria to the beaches; and
- A plan to implement the TMDL and monitoring water quality to evaluate progress in meeting the numeric targets.
- The Basin Plan amendment will also incorporate statewide bacteria objectives for the protection of REC-1 Beneficial Uses.

It is anticipated that implementation actions specific to MS4 dischargers will be required via a provision in MRP 3.0.

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.

Prior to initiation of the SSID work plan, SCVURPPP prepared a report that summarizes Co-permittees' current state of knowledge about electrical utility applications and PCBs titled Potential Contributions of PCBs to Stormwater from Electrical Utilities in the San Francisco Bay Area. That report was submitted with the SCVURPPP's Fiscal Year (FY) 2017/18 Annual Report as Appendix 11-2 (SCVURPPP 2018). The report provides an overview of electrical utility applications in the Bay Area, summarizes existing information on the release of PCBs from utility equipment, identifies the information gaps, and recommends preliminary next steps. The report also recommends that because electrical utility equipment is widespread and distributed across multiple jurisdictions, addressing PCBs from this source should be done at the regional level, rather than on a site-by-site basis.

Following up on that recommendation, BASMAA developed the work plan for the regional SSID project to further evaluate the extent and magnitude of electrical utilities as a source of PCBs to urban stormwater runoff. In compliance with MRP provision C.8.e, the work plan for conducting the SSID project included in SMCWPPP's WY 2018 UCMR (SMCWPPP 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. As the first step in implementing the work plan, BASMAA submitted a letter to the Regional Water Board late in FY 2018/19 requesting assistance in obtaining information from PG&E. The letter specifically asked the Regional Water Board to use their regulatory authority under Section 13267 of the Clean Water Act to compel PG&E to provide the needed data. However, PG&E is currently in bankruptcy proceedings, and the outcomes of that process have not yet been determined. As such, the Regional Water Board has delayed sending a "13267 letter" to PG&E and is currently considering other options for moving forward with PG&E on this issue. In response, BASMAA developed a revised approach to the SSID project, which would implement the work plan but with a focus on municipally-owned electrical utilities in the San Francisco Bay Area (Bay Area), rather than

PG&E. The Regional Water Board staff agreed[3] to this revised approach at the BASMAA Monitoring and Pollutants of Concern Meeting held on March 4, 2020. BASMAA then implemented the work plan with the revised approach during the remainder of FY 2019/20. The project gathered data from municipally-owned electrical utilities on their current and past inventories of PCBs-containing electrical equipment and current spill response and reporting procedures. These data were used to develop a source control framework that identified improved management and reporting of PCBs-containing equipment removals and spill response. The data were also used to estimate the load reductions that can be achieved through implementing these measures. The final BASMAA project report PCBs from Electrical Utilities in San Francisco Bay Area Watersheds Stressor/Source Identification Project was included as Attachment 11-1 to SMCWPPP's FY 2019/20 Annual Report.

Consistent with MRP procedures, SMCWPPP and the RMC are seeking approval of the completion of the PCBs from Electrical Utilities in San Francisco Bay Area Watersheds SSID Study from the Water Board Executive Officer.

[3] Per Jan O'Hara at the BASMAA Monitoring and Pollutants of Concern Committee meeting held on March 4, 2020.

4.0 References

BASMAA (Bay Area Stormwater Management Agency Association) Regional Monitoring Coalition (RMC). 2020. Creek Status and Pesticides & Toxicity Monitoring Quality Assurance Project Plan, Final Version 4. Prepared for BASMAA by EOA, Inc. on behalf of the Santa Clara Urban Runoff Pollution Prevention Program and the San Mateo Countywide Water Pollution Prevention Program, Applied Marine Sciences on behalf of the Alameda Countywide Clean Water Program, and Armand Ruby Consulting on behalf of the Contra Costa Clean Water Program. 79 pp plus appendices.

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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	Bacteria	Other				
AL-1	2/4/21	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	2/4/21	ACCWP	Arroyo Las Positas		Arroyo Las Positas Stressor Source Identification Project	X	X							X	Creek Status Monitoring has identified multiple instances of benthic macroinvertebrate assemblages within the "Very Likely Altered" condition category, exceedances of the Basin Plan objective for pH, and multiple instances of nitrate concentrations above guidelines for nuisance algal growth and nitrate toxicity.	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 was included in ACCWP's March 2020 IMR. The planned second year's efforts were mostly precluded by the Covid-19 pandemic restrictions. ACCWP will investigate alternative monitoring techniques in WY 2021 to better understand causal factors.	
CC-1	2/4/21	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 recommended project completion. Flow augmentation appears to be a viable means of avoiding lethally low DO in portions of the creek downstream of the WWTP. Permittees are voluntarily implementing flow augmentation and monitoring during WY2021 and WY 2022.	

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	Bacteria	Other				
SC-1	2/17/21	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 was submitted with the WY 2019 IMR.	Final report submitted. Waiting for EO concurrence.
SC-2	2/4/21	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 and the WY 2019 IMR. A project report describing the results of the WY 2019 and WY 2020 monitoring and recommending project completion will be submitted by mid-2021.	
SM-1	2/4/21	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 were	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 Oct 28, 2019. On Feb 7, 2020, RWQCB staff requested minor report changes prior to Executive Officer concurrence regarding project completion. The Revised Final Report was submitted Jun 30, 2020. A TMDL addressing bacteria in Pillar Point Harbor is currently under development.	Yes (per letter dated 2/7/20)

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	Bacteria	Other				
																conducted in WY 2019 to understand hydrology and specific source areas.		
FSV-1	2/20/21	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.	A Project Outline was submitted with the IMR in March 2020. The project has been approved by RB staff. Fencing to exclude cattle from Rindler Creek will be installed in Fall 2021 and subsequent monitoring will commence in Spring 2022 to monitor project efficacy.	
RMC-1	2/17/21	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, with RWQCB staff concurrence, developed a revised approach to implement the work plan but with a focus on municipally-owned utilities. The SSID project was completed in June 2020.	Final report submitted. Waiting for EO concurrence.

AC = Clean Water Program of Alameda County (ACCWP)
CC = Contra Costa Clean Water Program (CCCWP)
SC = Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP)
SM = San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
FSV = Solano County Permittees
RMC = Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC)

URBAN CREEKS MONITORING REPORT

PART C: MONITORING IN SAN MATEO COUNTY FOR POLLUTANTS OF CONCERN

Water Year 2020

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

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program

A Program of the City/County Association of Governments

March 31, 2021

CREDITS

This report is submitted by the participating agencies in the

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
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City of Brisbane
City of Burlingame
Town of Colma
City of Daly City
City of East Palo Alto
City of Foster City
City of Half Moon Bay
Town of Hillsborough
City of Menlo Park
City of Millbrae
City of Pacifica
Town of Portola Valley
City of Redwood City
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LIST OF ABBREVIATIONS

BASMAA	Bay Area Stormwater Management Agency Association
BMP	Best Management Practice
CEC	Contaminants of Emerging Concern
CEDEN	California Environmental Data Exchange Network
CSCI	California Stream Condition Index
CW4CB	Clean Watersheds for Clean Bay
DTSC	California Department of Toxic Substances Control
ECWG	Emerging Contaminants Work Group of the RMP
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollution Discharge Elimination System
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PFAS	Perfluoroalkyl Sulfonates
PFOS	Perfluorooctane Sulfonates
POC	Pollutant of Concern
RMC	Regional Monitoring Coalition
RMP	San Francisco Bay Regional Monitoring Program
RWSM	Regional Watershed Spreadsheet Model
SAP	Sampling and Analysis Plan
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program (SMCWPPP)
SFEI	San Francisco Estuary Institute
SPoT	Statewide Stream Pollutant Trend Monitoring
SSC	Suspended Sediment Concentration
SSID	Stressor/Source Identification
STLS	Small Tributary Loading Strategy
TOC	Total Organic Carbon
UCMR	Urban Creeks Monitoring Report
USEPA	US Environmental Protection Agency
WLA	Wasteload Allocation
WQO	Water Quality Objective
WY	Water Year

1.0 INTRODUCTION

This Pollutants of Concern (POC) monitoring report was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), as part of SMCWPPP's March 2020 Urban Creeks Monitoring Report (UCMR). SMCWPPP is a program of the San Mateo County City/County Association of Governments (C/CAG). SMCWPPP prepared this report on behalf of San Mateo County local municipal agencies subject to the regional stormwater National Pollutant Discharge Elimination System (NPDES) permit for Bay Area municipalities issued by the San Francisco Regional Water Quality Control Board (Regional Water Board). The stormwater permit is usually referred to as the Municipal Regional Permit (MRP). The version reissued on November 19, 2015 is referred to as MRP 2.0 (SFBRWQCB 2015). This report fulfills the requirements of MRP Provision C.8.h.iii. for reporting a summary of Provision C.8.f. POC Monitoring conducted during Water Year (WY) 2020.[1]

It is important to note that for polychlorinated biphenyls (PCBs), this report focuses on progress to-date towards identifying source areas and properties in San Mateo County. In this context, it evaluates all the relevant and readily available sediment and stormwater runoff chemistry data collected in San Mateo County, ranging back to the early 2000s.

This POC monitoring report is an appendix to SMCWPPP's WY 2020 Urban Creeks Monitoring Report (UCMR). In addition, consistent with MRP Provision C.8.h.ii., POC monitoring data generated by SMCWPPP's 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).[2]

Section 2.0 of this report describes the specific monitoring and reporting requirements in MRP Provision C.8.f. (POC Monitoring), along with third-party sources of San Mateo County monitoring data. Section 3.0 summarizes POC monitoring accomplishments relative to the requirements in the MRP. Section 4.0 summarizes the QA/QC program that was implemented by the SMCWPPP during WY 2020 POC monitoring activities. Section 5.0 focuses on PCBs and mercury monitoring activities and evaluates progress to-date towards identifying PCBs source areas and properties in San Mateo County. Section 6.0 discusses WY 2020 monitoring for copper, nutrients, and emerging contaminants. Compliance with applicable Water Quality Objectives (WQOs) is discussed in Section 7.0. Section 8.0 summarizes and discusses all of the POC monitoring data presented in this report.

[1] The water quality monitoring described in this report was conducted on a Water Year basis. A Water Year begins on October 1 and ends on September 30 of the named year. For example, Water Year 2020 (WY 2020) began on October 1, 2019 and concluded on September 30, 2020.

[2] 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, pending further clarification, SMCWPPP will continue to submit only receiving water data to CEDEN.

2.0 POC MONITORING AND REPORTING REQUIREMENTS

Provision C.8.f. of the MRP (POC Monitoring) includes specific monitoring and reporting requirements, as described in the following sections.

2.1. POC Monitoring Requirements

Provision C.8.f. of the MRP (POC Monitoring) requires monitoring of several POCs including PCBs, mercury, copper, emerging contaminants,[3] and nutrients. Provision C.8.f. specifies yearly (i.e., during each WY) and total (i.e., over the 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;
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 total of 80 PCBs samples must be collected and analyzed. At least eight PCB samples must be collected each year. By the end of year four[4] 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. The MRP's POC Monitoring requirements are summarized in Table 1.

[3] Emerging contaminant monitoring requirements are met through participation in the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP) special studies. The special studies account for relevant contaminants of emerging concern (CECs) in stormwater and address at least PFOS, PFAS, and alternative flame retardants being used to replace PBDEs.

[4] 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); however, 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 of Permit Term [d]	Yearly Minimum	Minimum Number of Samples That Must Be Collected for Each Information Need by the End of Year Four of Permit Term				
				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 [a]	Water	20	2	--	--	--	20	--
Emerging Contaminants [b]	--	--	--	--	--	--	--	--
Ancillary Parameters [c]	--	--	--	--	--	--	--	--

Notes:

[a] Ammonium,[5] nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, total phosphorus (analyzed concurrently in each nutrient sample).

[b] Must include perfluorooctane sulfonates (PFOS, in sediment), perfluoroalkyl sulfonates (PFAS, in sediment), alternative flame retardants. The MRP requires that Permittees 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 Contaminants of Emerging Concern (CECs) in stormwater and address at least PFOS, PFAS, and alternative flame retardants being used to replace PBDEs.

[c] 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 in water samples to evaluate compliance with water quality standards.

[d] Total samples that must be collected over the five-year Permit term.

[5] There are several challenges to collecting samples for "ammonium" analysis. Therefore, samples are analyzed for total ammonia which is the sum of un-ionized ammonia (NH_3) and ionized ammonia (ammonium, NH_{4+}). Ammonium concentrations are calculated by subtracting the calculated concentration of un-ionized ammonia from the measured concentration of total ammonia. Un-ionized ammonia concentrations are 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.

The requirements in MRP Provision C.8.f. (POC Monitoring) are met through a variety of water quality programs and studies:

- SMCWPPP collects POC samples as part of its overall water quality monitoring program.
- SMCWPPP works collaboratively with other organizations that monitor water quality to find mutually beneficial approaches (see Section 1.3 Third-Party Data below).
- Other MRP provisions require studies or have information needs that are consistent with Provision C.8.f. requirements. The associated POC monitoring is credited towards these other provisions and Provision C.8.f.:
    - MRP Provisions C.11/12.a. require that Permittees develop and maintain a list of management areas (referred to as Watershed Management Areas or WMAs) in which mercury and PCBs control measures will be implemented during the permit term, as well as the monitoring data and other information used to select the WMAs. Updated lists with identified control measures are provided with each of SMCWPPP's Annual Reports. Provision C.8.f. supports C.11/12.a. requirements by requiring monitoring directed towards mercury and PCBs source identification.
    - MRP Provision C.12.e. requires that Permittees sample caulk and other sealants used in storm drain or roadway infrastructure in the public right-of-way to investigate whether PCBs are present in such material and in what concentrations. SMCWPPP worked with other MRP Permittees through the Bay Area Stormwater Management Agencies Association (BASMAA) to complete a regional investigation that addressed this requirement. 54 samples of caulk and sealant materials from ten types of roadway and storm drain infrastructure were collected throughout the MRP area and combined into 20 composites that were tested for PCBs. Results of the investigation were documented by BASMAA (2018), a report submitted with SMCWPPP's FY 2017/18 Annual Report.
- To learn more about the effectiveness of selected stormwater treatment controls, SMCWPPP participated in two additional BASMAA regional projects. The studies were developed to satisfy Provision C.8.f. requirements for SMCWPPP and other Bay Area stormwater programs to each collect at least eight PCBs and mercury samples that address Management Question No. 3 (Management Action Effectiveness). The studies investigated the effectiveness of hydrodynamic separator (HDS) units and various types of biochar-amended bioretention soil media (BSM) at removing PCBs and mercury from stormwater runoff:
    - A regional study evaluated the effectiveness of biochar-amended bioretention soil media (BSM) to remove PCBs and mercury from stormwater runoff collected in the MRP region. Twenty-six samples consisting of influent/effluent pairs from bench scale column tests of BSM enhanced with biochar were analyzed. Stormwater runoff was run through six columns with five different biochar-enhanced BSM mixes and one standard BSM as a control to evaluate which mix was most effective at removing PCBs and mercury. All five biochar-BSM blends showed evidence of overall improved PCBs and mercury performance compared to the standard BSM; however, the increased benefit relative to increased cost was not analyzed. The study found that hydraulics was a critical factor in achieving good pollutant removal in the columns, suggesting that the use of outlet controls could enhance the performance of BMPs. Furthermore, this study suggested that an irreducible minimum concentration of PCBs may be approximately 1,000 pg/L (BASMAA 2019a).

- A regional study entailed collecting samples of the solids captured and removed from eight HDS unit sumps during cleanouts and analyzed for mercury and PCBs. Maintenance records and construction plans were reviewed to develop estimates of the average volume of solids removed per cleanout. This information was combined with the monitoring data to estimate the mass of pollutant removed. Across all eight units, the median percent PCBs removed ranged from 5% - 32% of the catchment pollutant load (BASMAA 2019b).

Finally, MRP Provision C.12.g. requires Permittees to conduct or cause to be conducted studies concerning the fate, transport, and biological uptake of PCBs discharged from urban runoff to San Francisco Bay margin areas. The provision states: "the specific information needs include understanding the in-Bay transport of PCBs discharged in urban runoff, the sediment and food web PCBs concentrations in margin areas receiving urban runoff, the influence of urban runoff on the patterns of food web PCBs accumulation, especially in Bay margins, and the identification of drainages where urban runoff PCBs are particularly important in food web accumulation." C.12.g. requires Permittees to report in this IMR "the findings and results of the studies completed, planned, or in progress as well as implications of studies on potential control measures to be investigated, piloted or implemented in future permit cycles." Attachment 1 provides a summary of a multi-year project by the RMP that is addressing the requirements of Provision C.12.g. by identifying, modeling, and investigating embayments along the San Francisco Bay shoreline designated "Priority Margin Units" (PMUs). The project:

- Identified four PMUs for initial study that are located downstream of urban watersheds where PCBs management actions are ongoing and/or planned;
- Is developing conceptual and PCBs mass budget models for each of the four PMUs; and
- Is conducting monitoring in the PMUs to evaluate trends in pollutant levels and track responses to pollutant load reductions.

2.2. Third-Party Data

SMCWPPP and other Bay Area countywide stormwater programs have a long history of working collaboratively with other organizations that monitor water quality to find mutually beneficial approaches. MRP Provision C.8.a.iii. allows Permittees to use data collected by third-party organizations to fulfill monitoring requirements, provided the data are demonstrated to meet the specified data quality objectives. PCBs and mercury monitoring data collected in San Mateo County through two ongoing programs help address Provision C.8.f. monitoring requirements: (1) the Small Tributary Loading Strategy (STLS) of the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP), and (2) the statewide Stream Pollution Trends (SPoT) Monitoring Program, which is a core component of the Surface Water Ambient Monitoring Program (SWAMP) administered by the State Water Resources Control Board (SWRCB).

In addition, Clean Watersheds for a Clean Bay (CW4CB), a BASMAA project that was funded by a grant from USEPA and implemented 2010 - 2017, provided data collected in WY 2012, WY 2013, and WY 2016. These third-party data also provide context for evaluation of SMCWPPP monitoring results.

As in previous years, this POC monitoring report evaluates certain PCBs and mercury data collected in San Mateo County by third parties, along with the data collected directly by SMCWPPP. The following sections provide additional details about the RMP STLS and the SPoT Monitoring Program.

2.2.1. RMP STLS

The RMP's STLS Team typically conducts annual monitoring for POCs on a region-wide basis. SMCWPPP 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 supplementing monitoring required by the municipal stormwater permit. POC monitoring activities conducted by the STLS beginning in WY 2012 focused on pollutant loading monitoring at six region-wide stations (WY 2012 – WY 2014) and wet weather reconnaissance monitoring in catchments of interest (WY 2015 – present). In WY 2020, the STLS Team continued wet weather reconnaissance sampling using a similar approach to the PCBs and mercury sampling that was implemented by SMCWPPP in WY 2016 – WY 2018. Regionally, eight storm composite PCBs/mercury samples were collected from catchments containing old industrial land uses; however, none was located in San Mateo County.

RMP STLS monitoring in WY 2021 will continue to focus on wet weather reconnaissance sampling regionwide. Additional stations may be monitored using un-manned remote samplers that capture suspended sediment from the water column throughout the duration of their deployment, which is typically during one storm event. The STLS has been pilot testing these devices since WY 2015 and recently concluded that they generate data adequate for evaluating whether a WMA should be prioritized for source property investigations. In WY 2021, the STLS anticipates monitoring up to four remote sampler stations in San Mateo County.

In future years, RMP STLS monitoring is expected to shift towards Management Questions No. 2 (Contributions to Bay Impairment), No. 4 (Loads and Status), and No. 5 (Trends) (see Section 2.1). The STLS is currently developing a new regional model to estimate POC loading and trends evaluation at watershed and regional scales. According to the Modeling Implementation Plan (Wu and McKee 2019), a hydrology model is being developed in calendar year 2020. In 2021, a suspended sediment model will be developed, and in 2022, the hydrology and sediment models will be used as the basis for PCBs and mercury modeling. The model will initially focus on PCBs and mercury but will be designed to address other POCs in subsequent years, such as CECs. New empirical data obtained through field monitoring will likely be needed to calibrate and validate the various model components. However, details of the monitoring approaches are still under development.

2.2.2. SPoT Monitoring Program

The SPoT Monitoring Program conducts annual dry season monitoring (subject to funding constraints) of sediments collected from a statewide network of creeks and rivers. The goal of the SPoT Program is to investigate long-term trends in sediment chemistry and toxicity (Management Question No. 5 – Trends) and to relate contaminant concentrations and toxicity to watershed land uses. Sites are targeted in bottom-of-the-watershed locations with slow water flow and appropriate micromorphology to allow deposition and accumulation of sediments, including a station (204SMA020) near the mouth of San Mateo Creek. In most years, sediments are analyzed for PCBs, mercury, metals (including copper) toxicity, pesticides, and organic pollutants (Phillips et al. 2014). In WY 2020, SPoT collected a sediment sample from San Mateo Creek on July 15, 2020. The sample was analyzed for mercury, copper, pesticides, and toxicity (but not PCBs). It is likely that SPoT monitoring in WY 2021 will include PCBs, copper, pesticides, and toxicity, but not mercury (K. Siegler personal communication, August 2019). The most recent technical report prepared by SPoT program staff was published in 2020 and describes ten-year trends from the initiation of the program in 2008 through 2017 (Phillips et al. 2020).

2.3. MRP Reporting Requirements

Per MRP requirements, SMCWPPP submits a comprehensive Urban Creeks Monitoring Report (UCMR) by March 31 of each year, reporting on all data collected during the foregoing October 1 – September 30 period. The UCMR includes summaries of Creek Status monitoring, Stressor/Source Identification (SSID) projects, and this report on POC monitoring. In March 2020, per MRP requirements for the fifth year of the permit term, San Mateo County MRP Permittees submitted an Integrated Monitoring Report (IMR) in lieu of the annual UCMR. The IMR focused on summarizing and evaluating data collected from WYs 2014 – 2019 and was part of the Report of Waste Discharge submitted by SMCWPPP to apply for coverage under the reissued MRP.

In accordance with MRP requirements, this POC monitoring report includes the following standard monitoring report content:

- The purpose of the monitoring and brief descriptions of study design rationale;
- Quality Assurance/Quality Control summaries for sample collection and analytical methods, including a discussion of any limitations of the data;
- Brief descriptions of sampling protocols and analytical methods;
- Sample location description, including water body name and segment and location coordinates;
- Sample ID, collection date (and time if relevant), and media;
- Concentrations detected, measurement units, and detection limits;
- Assessment, analysis, and interpretation of the data for each monitoring program component;
- A listing of non-Permittee entities whose data are included in the report; and
- Assessment of compliance with applicable water quality standards.

3.0 SUMMARY OF POC MONITORING ACCOMPLISHMENTS

In compliance with MRP Provision C.8.f. of the MRP, in WY 2020 SMCWPPP conducted POC monitoring for PCBs, mercury, copper, and nutrients. General methods employed for POC monitoring and quality assurance/quality control (QA/QC) procedures were similar to previous years (SMCWPPP 2015, 2017a, 2018a, 2019a). The MRP-required yearly minimum number of samples was met or exceeded for all POCs. The total number of samples collected for each POC in WY 2020, the agency conducting the monitoring, and the Management Questions addressed are summarized in Table 2 (PCBs), Table 3 (mercury), Table 4 (copper), and Table 5 (nutrients). These tables also include this information for WY 2016 through WY 2019 and show that the MRP-required minimum number of samples required for each POC by the end of year five of the permit (i.e., WY 2020) was met or exceeded. In addition, Tables 2 through 5 show that the MRP-required minimum number of samples addressing each Management Question by the end of year four of the Permit was met or exceeded for all POCs.

Specific monitoring stations sampled in WY 2020 are listed in Table 6 and mapped in Figure 1. Figure 2 is a more comprehensive map of POC monitoring stations in San Mateo County, showing WYs 2014 – 2020 nutrients and copper monitoring stations, and PCBs/mercury stations from the early 2000s through WY 2020. These PCBs stations are presented in the context of evaluating progress to-date towards identifying PCBs source areas and properties in San Mateo County (see Section 5.0).

Table 2. SMCWPPP/BASMAA and Third-Party PCBs Monitoring Accomplishments in San Mateo County, WYs 2016 - 2020.

WY/Organization	Number of PCBs Samples	Management Question Addressed [a]					Sample Type and Comments
		1. Source Identification	2. Contributions to Bay Impairment	3. Management Action Effectiveness	4. Loads and Status	5. Trends	
WY 2020							
SMCWPPP	8	8	--	--	--	--	Urban sediment samples to identify source areas
WY 2019							
SMCWPPP	25	25	--	--	--	--	Urban sediment samples to identify source areas
RMP STLS	2	2	2	--	2	2	Stormwater runoff samples to characterize WMAs
SPoT	1	--	--	--	--	1	Creek bed sediment sample to assess trends (PCBs only, no mercury)
WY 2018							
SMCWPPP	13	13	13	--	13	13	Stormwater runoff samples to characterize WMAs
SMCWPPP	57	57	--	--	--	--	Urban sediment samples to identify source areas
BASMAA	5	5	--	--	--	--	Regional public infrastructure caulk/sealant samples (1/4 of project total)
BASMAA	8	--	--	8	--	--	Regional HDS unit & biochar effectiveness study (1/4 of project total)
RMP STLS	2	2	2	--	2	2	Stormwater runoff samples to characterize WMAs
SPoT	--	--	--	--	--	--	Creek bed sediment sample to assess trends
WY 2017							
SMCWPPP	17	17	17	--	17	17	Stormwater runoff samples to characterize WMAs
SMCWPPP	67	67	--	--	--	--	Urban sediment samples to identify source areas
RMP STLS	4	4	4	--	4	4	Stormwater runoff samples to characterize WMAs
SPoT	1	--	--	--	--	1	Creek bed sediment sample to assess trends (PCBs only, no mercury)
WY 2016							
SMCWPPP	8	8	8	--	8	8	Stormwater runoff samples to characterize WMAs
RMP STLS	7	7	7	--	7	7	Stormwater runoff samples to characterize WMAs
CW4CB	--	--	--	3	--	--	BMP effectiveness samples at Bransten Road bioretention facilities
Total / MRP Minimum [b]	**225 / 80**	**215 / 8**	**53 / 8**	**11 / 8**	**53 / 8**	**55 / 8**	

[a] Individual samples can address more than one Management Question simultaneously.

[b] The MRP overall minimum number of POC samples must be met by the end of the five-year permit term. The MRP minimum number of samples for each Management Question must be met by the end of year four of the permit.

Table 3. SMCWPPP/BASMAA and Third-Party Mercury Monitoring Accomplishments in San Mateo County, WYs 2016 - 2020.

WY/Organization	Number of Mercury Samples	Management Question Addressed [a]					Sample Type and Comments
		1. Source Identification	2. Contributions to Bay Impairment	3. Management Action Effectiveness	4. Loads and Status	5. Trends	
WY 2020							
SMCWPPP	8	8	--	--	--	--	Urban sediment samples to identify source areas
SPoT	1	--	--	--	--	1	Creek bed sediment sample to assess trends
WY 2019							
SMCWPPP	25	25	--	--	--	--	Urban sediment samples to identify source areas
RMP STLS	2	2	2	--	2	2	Stormwater runoff samples to characterize WMAs
SPoT	--	--	--	--	--	--	Creek bed sediment sample to assess trends
WY 2018							
SMCWPPP	13	13	13	--	13	13	Stormwater runoff samples to characterize WMAs
SMCWPPP	57	57	--	--	--	--	Urban sediment samples to identify source areas
BASMAA	8	--	--	8	--	--	Regional HDS unit & biochar effectiveness study (1/4 of project total)
RMP STLS	2	2	2	--	2	2	Stormwater runoff samples to characterize WMAs
SPoT	1	--	--	--	--	1	Creek bed sediment sample to assess trends (mercury only, no PCBs)
WY 2017							
SMCWPPP	17	17	17	--	17	17	Stormwater runoff samples to characterize WMAs
SMCWPPP	67	67	--	--	--	--	Urban sediment samples to identify source areas
RMP STLS	4	4	4	--	4	4	Stormwater runoff samples to characterize WMAs
SPoT	--	--	--	--	--	--	Creek bed sediment sample to assess trends
WY 2016							
SMCWPPP	8	8	8	--	8	8	Stormwater runoff samples to characterize WMAs
RMP STLS	7	7	7	--	7	7	Stormwater runoff samples to characterize WMAs
CW4CB	--	--	--	3	--	--	BMP effectiveness samples at Bransten Road bioretention facilities
Total / MRP Minimum [b]	**220 / 80**	**210 / 8**	**53 / 8**	**11 / 8**	**53 / 8**	**55 / 8**	

[a] Individual samples can address more than one Management Question simultaneously.

[b] The MRP overall minimum number of POC samples must be met by the end of the five-year permit term. The MRP minimum number of samples for each Management Question must be met by the end of year four of the permit.

Table 4. SMCWPPP/BASMAA and Third-Party Copper Monitoring Accomplishments in San Mateo County, WYs 2016 - 2020.

WY/Organization	Number of Samples	Management Question Addressed [a]					Sample Type and Comments
		1. Source Identification	2. Contributions to Bay Impairment	3. Management Action Effectiveness	4. Loads and Status	5. Trends	
WY 2020							
SMCWPPP	2	--	--	--	2	--	Dry season creek water samples from mixed-use watersheds
SPoT	1	--	--	--	--	1	Creek bed sediment samples to assess trends
WY 2019							
SMCWPPP	2	--	--	--	2	--	Dry season creek water samples from mixed-use watersheds
WY 2018							
SMCWPPP	4	--	--	--	4	4	Creek water samples collected during storm event and spring base flows
SPoT	1	--	--	--	--	1	Creek bed sediment samples to assess trends
WY 2017							
SMCWPPP	1	--	--	--	1	--	Copper analyzed on a subset of PCBs/Hg stormwater runoff samples
SMCWPPP	5	--	--	--	5	2	Creek water samples collected during storm event and spring base flows [c]
SPoT	1	--	--	--	--	1	Creek bed sediment samples to assess trends
WY 2016							
SMCWPPP	3	--	--	--	3	--	Copper analyzed on a subset of PCBs/Hg stormwater runoff samples
Total / MRP Minimum [b]	**20 / 20**	**NA [d]**	**NA**	**NA**	**17 / 4**	**9 / 4**	

[a] Individual samples can address more than one Management Question simultaneously.

[b] The MRP overall minimum number of POC samples must be met by the end of the five-year permit term. The MRP minimum number of samples for each Management Question must be met by the end of year four of the permit.

[c] One of these five samples was a PCBs/Hg stormwater runoff sample that was also analyzed for copper.

[d] NA = Not Applicable, the MRP does not require sampling to address management question.

Table 5. SMCWPPP/BASMAA and Third-Party Nutrients Monitoring Accomplishments in San Mateo County, WYs 2016 - 2020.

WY/Organization	Number of Samples	Management Question Addressed [a]					Sample Type and Comments
		1. Source Identification	2. Contributions to Bay Impairment	3. Management Action Effectiveness	4. Loads and Status	5. Trends	
WY 2020							
SMCWPPP	2	--	--	--	2	--	Dry season creek samples at stations also sampled during spring base flows
WY 2019							
SMCWPPP	9	--	--	--	9	--	Dry season creek samples at stations also sampled during spring base flows
WY 2018							
SMCWPPP	4	--	--	--	4	--	Creek water samples collected during storm event and spring base flows
WY 2017							
SMCWPPP	5	--	--	--	5	--	Creek water samples collected during storm event and spring base flows
WY 2016							
SMCWPPP	2	--	--	--	2	--	Creek water samples collected from bottom-of-the-watershed stations
Total / MRP Minimum [b]	**22 / 20**	**NA [c]**	**NA**	**NA**	**22 / 20**	**NA**	

[a] Individual samples can address more than one Management Question simultaneously.

[b] The MRP overall minimum number of POC samples must be met by the end of the five-year permit term. The MRP minimum number of samples for each Management Question must be met by the end of year four of the permit.

[c] NA = Not Applicable, the MRP does not require sampling to address management question.

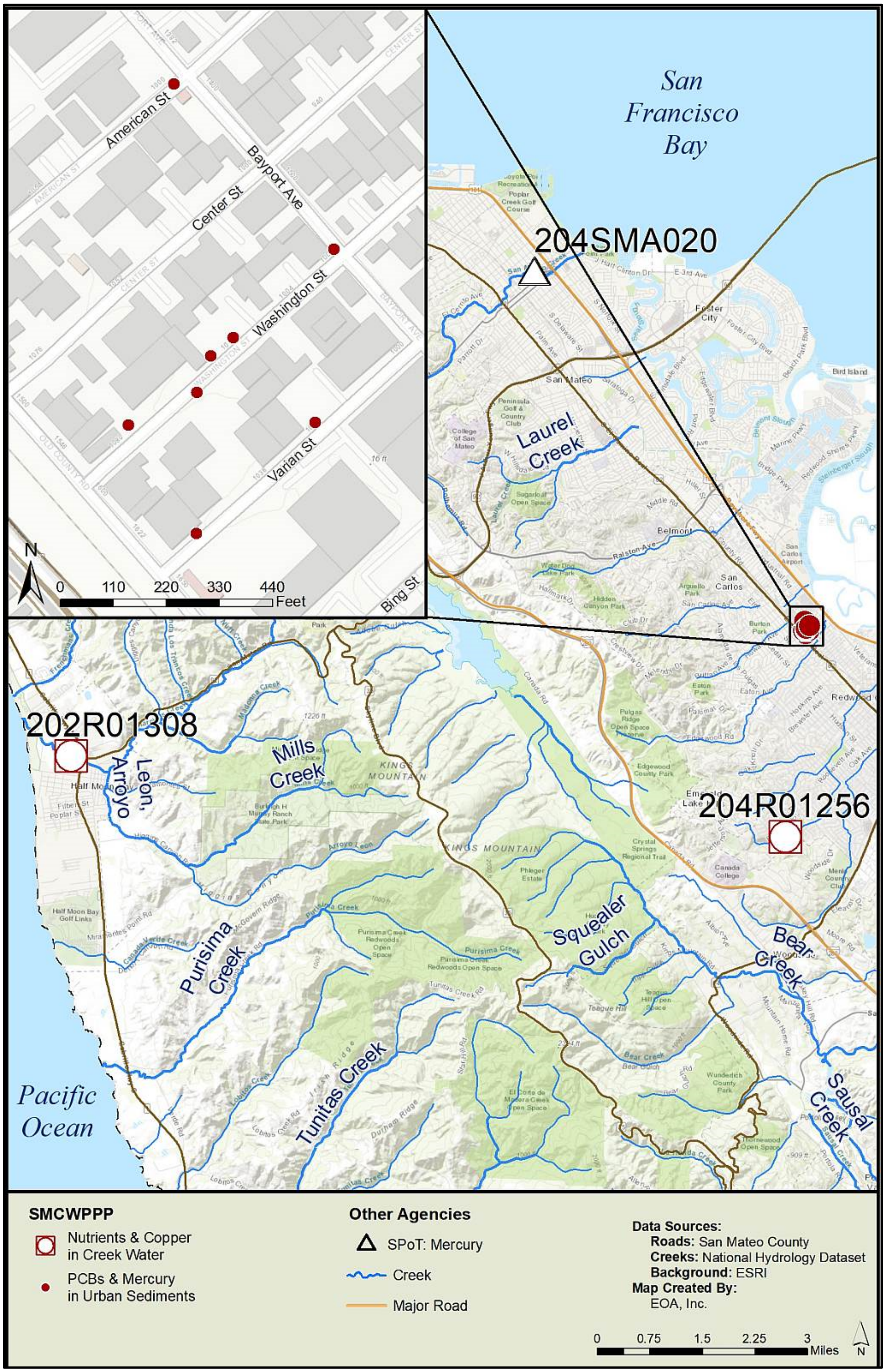

Figure 1. POC Monitoring Stations in San Mateo County, WY 2020. PCBs and mercury in urban sediments shown in inset.

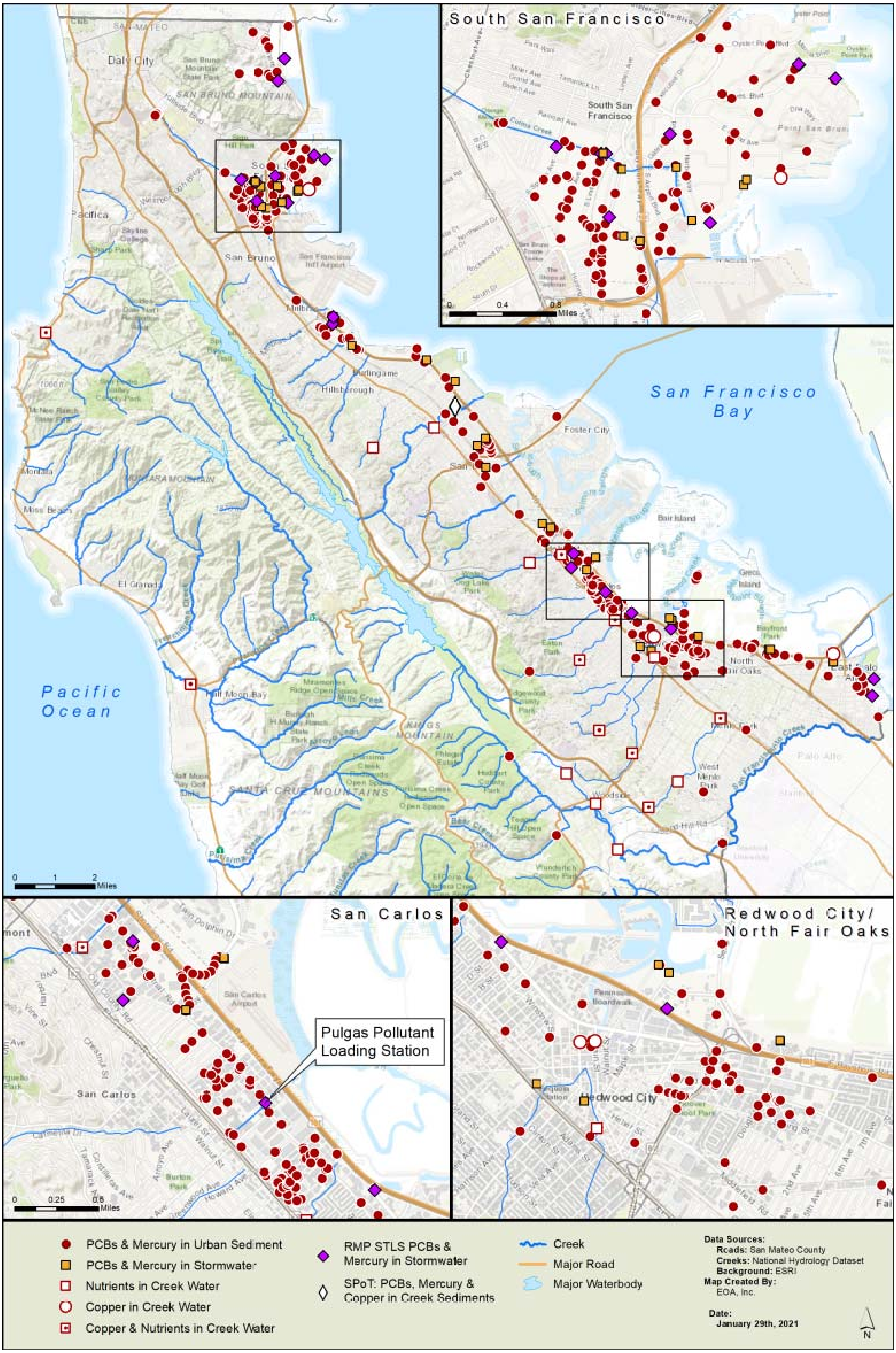

Figure 2. POC Monitoring Stations in San Mateo County: (1) nutrients and copper WYs 2014 – 2020 stations, and (2) PCBs/mercury early 2000s through WY 2020 stations.

Table 6. POC Monitoring Stations in San Mateo County, WY 2020.

Organization	Station Code	Sample Date	Latitude	Longitude	Matrix	PCBs	Mercury	Suspended Sediment	Total Copper	Dissolved Copper	Hardness as CaCO3	Nutrients [a]
SMCWPPP												
SMCWPPP	SM-SCS-20-A	9/17/2020	37.49666	-122.24639	sediment	X	X					
SMCWPPP	SM-SCS-20-B	9/17/2020	37.49727	-122.24689	sediment	X	X					
SMCWPPP	SM-SCS-20-C	9/17/2020	37.49921	-122.24661	sediment	X	X					
SMCWPPP	SM-SCS-20-D	9/17/2020	37.49730	-122.24555	sediment	X	X					
SMCWPPP	SM-SCS-20-E	9/17/2020	37.49746	-122.24640	sediment	X	X					
SMCWPPP	SM-SCS-20-F	9/17/2020	37.49767	-122.24631	sediment	X	X					
SMCWPPP	SM-SCS-20-G	9/17/2020	37.49778	-122.24615	sediment	X	X					
SMCWPPP	SM-SCS-20-H	9/17/2020	37.49829	-122.24544	sediment	X	X					
SMCWPPP	202R01308	7/9/2020	37.46834	-122.43634	water				X	X	X	X
SMCWPPP	204R01256	7/9/2020	37.45455	-122.25056	water				X	X	X	X
Third Party Organizations												
SPoT	204SMA020	7/15/2020	37.5703	-122.3186	sediment		X		X			

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

4.0 SUMMARY OF DATA QUALITY FOR WY 2020

In accordance with MRP requirements, a comprehensive QA/QC program was implemented by SMCWPPP covering all aspects of POC monitoring conducted during WY 2020. The QA/QC protocols have been described in previous SMCWPPP UCMRs (SMCWPPP 2017a, 2018a, 2019a) and continued to be based upon the Quality Assurance Project Plan (QAPP) developed for the CW4CB project (AMS 2012), supplemented by the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) QAPP (BASMAA 2020) and the Quality Assurance Program Plan (QAPrP) for the California Surface Water Ambient Monitoring Program (SWAMP).

Data were assessed for seven data quality attributes: (1) representativeness, (2) comparability, (3) completeness, (4) sensitivity, (5) contamination, (6) accuracy, and (7) precision. These seven attributes were 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, contamination, accuracy, and precision are quantitative assessments. Specific DQOs are based on Measurement Quality Objectives (MQOs) for each analyte.

Overall, the results of the QA/QC review suggest that the data generated during WY 2020 POC monitoring were of sufficient quality for the purposes of this program. While some data were flagged in the project database based on the MQOs and DQOs identified in the QAPPs, none of the data was rejected.

Attachment 2 contains a report summarizing the results of the WY 2020 data validation.

5.0 PROGRESS TO-DATE IDENTIFYING PCBS AND MERCURY SOURCES

The below sections summarize progress to-date using POC monitoring, informed by desktop screening/evaluation methods including site records reviews and aerial photograph analysis, to identify sources of PCBs and mercury in San Mateo County stormwater runoff. SMCWPPP's PCBs and mercury monitoring has been focused on catchments in San Mateo County (referred to as Watershed Management Areas or WMAs) containing high interest parcels with land uses potentially associated with PCBs (e.g., old industrial, electrical, and recycling) and/or other characteristics potentially associated with pollutant discharge (e.g., poor housekeeping, unpaved areas, and storage tanks). PCBs and mercury monitoring conducted by SMCWPPP has primarily focused on addressing Management Question No. 1 (Source Identification), while contributing to the regional dataset being used to address Management Questions No. 2 (Contributions to Bay Impairment) and No. 3 (Loads and Status) (see Section 2.1).

In addition to the efforts described in the below sections, during the past several years the RMP has conducted stormwater runoff monitoring in San Mateo County and other parts of the Bay Area through the STLS, with a focus on PCBs and mercury. As described earlier (Section 2.2.1), the STLS monitoring in San Mateo County was coordinated with SMCWPPP, with SMCWPPP staff assisting with selection of sampling stations and coordination with staff from local agencies. Monitoring objectives have included characterizing PCBs and mercury concentrations in stormwater runoff from the bottom of selected urban catchments with potential pollutant source areas. SMCWPPP (2017a, 2018a, 2019a, and 2020) include additional information on the STLS efforts in San Mateo County.

5.1. Sampling Summary and Chronology

The following sections summarize the general chronology of PCBs and mercury monitoring conducted in San Mateo County to characterize pollutant concentrations across the urban landscape and to identify source areas and properties. To-date, composite samples of stormwater runoff have been collected from the bottom of 49 San Mateo County WMAs and over 400 individual and composite grab samples of sediment have been collected within priority WMAs to help characterize the catchments and identify source areas and properties. Most samples were collected in the public ROW. The grab sediment samples were collected from a variety of types of locations, including manholes, storm drain inlets, driveways, streets, and sidewalks, often adjacent to or nearby high interest parcels with land uses associated with PCBs and/or other characteristics potentially associated with pollutant discharge. SMCWPPP's PCBs and mercury monitoring program has also included collecting sediment samples in the public ROW (e.g., from streets and the MS4) by every known PCBs remediation site in San Mateo County, to the extent applicable and feasible.

When a previously unknown potential source property was revealed via the PCBs and mercury monitoring program, SMCWPPP conducted a follow-up review of current and historical records regarding site occupants and uses, hazardous material/waste use, storage, and/or release, violation notices, and any remediation activities. In addition to databases such as EPA's Toxic Release Inventory (TRI) and Envirofacts, and the State of California's Geotracker and Envirostor, some of the most useful records were often found at the San Mateo County Department of Environmental Health.

Four previously unknown potential source properties have been identified in San Mateo County, all in WMA 210 (Pulgas Creek Pump Station South) in the City of San Carlos. SMCWPPP is working with the City of San Carlos to determine next steps for these properties, including additional monitoring and/or potential referral to the Regional Water Board (see Section 5.5.6 for more details). In addition, SMCWPPP's PCBs and mercury monitoring program has led to SMCWPPP referring four other properties (two sets of two adjacent properties, all in San Carlos) to the Regional Water Board for potential further PCBs investigation and abatement (see Section 5.5.6).

5.1.1. WY 2000 through WY 2014

From 2000 to 2015, SMCWPPP and other parties conducted periodic sediment sampling programs in San Mateo County to characterize the distribution of PCBs in various land uses throughout the urban landscape and identify catchments and properties that are potential sources of PCBs to the MS4. During this period, over 270 sediment samples were collected in San Mateo County, mainly from streets and MS4s in the public right-of-way (e.g., storm drain lines accessed via manholes, storm drain inlets, drainage channels, and pump station sumps). The samples were analyzed for PCBs congeners, total mercury, and ancillary analytes (KLI and EOA 2002, SMSTOPPP 2002, 2003, and 2004, Yee and McKee 2010, SMCWPPP 2015, and CW4CB 2017a).

The initial step in the sediment sampling programs was a 2000 and 2001 collaborative project among SMCWPPP and other Bay Area countywide stormwater programs referred to as the Joint Stormwater Agency Project (JSAP). The JSAP measured concentrations of PCBs, mercury and other pollutants in sediments collected from stormwater conveyance systems in San Mateo County and other parts of the Bay Area (KLI and EOA 2002). The primary goal was to characterize the distribution of pollutants among land uses in watersheds draining to the Bay.

In follow-up to the JSAP regional survey, SMCWPPP and other Bay Area countywide stormwater programs began performing "case studies" in some areas where relatively elevated PCBs were found during the JSAP. The primary goals were to develop methods to identify PCBs sources and begin to identify measures to address any controllable sources found. The techniques employed included collection and analysis of stormwater conveyance sediment samples and research on historical and current land use. In the early 2000s, SMCWPPP completed PCBs case study work in four San Mateo County areas where elevated levels of PCBs were found during the JSAP survey. The case studies investigated the Bradford and Broadway pump station drainages in Redwood City, the South Maple pump station drainage in South San Francisco, an area in the vicinity of Colma Creek, and the Pulgas Creek pump station drainage in San Carlos (SMSTOPPP 2002, 2003, and 2004).

In 2007, a State of California Proposition 13 grant-funded study by the San Francisco Estuary Institute (SFEI) collected street dirt and MS4 sediment samples in the City of San Carlos in San Mateo County and other parts of the Bay Area (Yee and McKee 2010). In addition, beginning in 2010 SMCWPPP partnered with the Bay Area Stormwater Management Agencies Association (BASMAA) to implement the USEPA grant-funded Clean Watersheds for a Clean Bay (CW4CB) project. CW4CB conducted additional investigation of PCBs sources to the MS4 in several old industrial areas in the Bay Area, including the Pulgas Creek pump station drainage in San Carlos (CW4CB 2017a).

In WY 2014, SMCWPPP worked with San Mateo County MRP Permittees to conduct a process to screen for "high interest parcels" for PCBs in the county. The process was generally consistent with a framework developed through a collaboration of SMCWPPP and the other Bay Area countywide stormwater programs in consultation with Regional Water Board staff. The screening covered all land areas in the county that drain to the Bay, focusing on about 160,000 urban parcels. Parcels were identified that were industrialized in 1980 or earlier (i.e., old industrial parcels) or have other land uses associated with PCBs (i.e., electrical, recycling, and military). SMCWPPP then worked with municipal staff to prioritize these parcels based on the evaluation of existing information on land uses and practices (e.g., redevelopment status, extent and quality of pavement, level of current housekeeping, any history of stormwater violations, and presence of electrical or heavy equipment, storage tanks, or stormwater treatment), local institutional/historical knowledge, and surveys of site conditions (walking/windshield surveys, Google Street View, and/or aerial photography). The prioritization resulted in a list of about 1,600 high interest parcels for PCBs in San Mateo County (SMCWPPP 2015).

5.1.2. WY 2015

In January and February 2015, SMCWPPP designed a monitoring plan based on the results of the 2014 screening for high interest parcels. SMCWPPP then collected 101 sediment samples from the urban storm drainage system (e.g., manholes, storm drain inlets) and public right-of-way surfaces (e.g., street gutters). The general goal was to continue attempting to identify potential PCBs source areas. Samples were distributed among the nine municipalities that collectively encompass 93% of the old industrial land use in San Mateo County that drains to San Francisco Bay (SMCWPPP 2015).

5.1.3. WY 2016

MRP Provisions C.11.a.iii. and C.12.a.iii. require that Permittees provide a list of management areas in which new PCBs and mercury control measures will be implemented during the permit term. These management areas were designated Watershed Management Areas (WMAs). In FY 2016, SMCWPPP began implementing a process to identify WMAs and prioritize them based on the potential for identifying PCBs sources and controls (especially source property referrals) to reduce PCBs loads. Progress toward developing the list was initially submitted in a report dated April 1, 2016 (SMCWPPP 2016a) and the initial list was submitted with SMCWPPP's FY 2015/16 Annual Report (SMCWPPP 2016b).

The 1,600 high interest parcels described above are almost entirely located within 105 "catchments of interest" with high interest parcels comprising at least 1% of their area (and usually with existing pollutant controls). WMAs were defined as the sum of the 105 catchments of interest and an additional 25 catchments with existing or planned stormwater pollutant controls (e.g., GI implemented on parcels per Provision C.3 requirements, built on public lands such as parks, or retrofitted into the public ROW), for a total of about 130 catchments designated as WMAs (SMCWPPP 2016a and b). It should be noted that WMA catchments are stormwater runoff hydrologic catchments in San Mateo County that drain to 24-inch or larger diameter outfalls. These urban catchments were originally delineated at this geographical scale as part of SMCWPPP's program to help local agencies develop trash controls in San Mateo County (SMCWPPP 2014).[6]

Finally, during the WY 2016 rainy season SMCWPPP collected eight composite samples of stormwater runoff. The samples were collected from outfalls at the bottom of WMAs that contain high interest parcels (i.e., with land uses associated with PCBs such as old industrial, electrical, and recycling, as

[6] The WMA numbering system starts with the numerical designations (ranging from 0 to 408) used by SMCWPPP (2014). Additional WMAs were delineated for areas that contain parcels of interest but were not delineated in 2014, with numerical designations ranging from 1000 to 1017. These 18 WMAs are not necessarily hydrologic catchments. They combine areas that drain to outfalls ≥ 24-inches, drain directly to natural waterways including the Bay, and/or private drainages. Finally, additional WMAs were delineated that lack parcels of interest but include pollutant controls (mainly GI in old urban parcels that were redeveloped). These WMAs are not hydrologic catchments and were delineated for each Permittee that drains to the Bay. They were designated "Other –" followed by three letters representing the jurisdiction (e.g., Other – SSF for South San Francisco).

described above). The RMP STLS collected an additional seven stormwater runoff composite samples in San Mateo County in coordination with SMCWPPP. Composite samples consisting of four to eight aliquots collected during the rising limb and peak of the storm hydrograph (as determined through field observations) were analyzed for PCBs congeners, total mercury, and other analytes (SMCWPPP 2017a).

5.1.4. WY 2017

SMCWPPP's major WY 2017 POC monitoring efforts included the following:

- Collected 17 composite samples of stormwater runoff from outfalls at the bottom of WMAs that contain high interest parcels with land uses associated with PCBs. The RMP STLS collected an additional four stormwater runoff composite samples in San Mateo County in coordination with SMCWPPP. Composite samples consisting of four to eight aliquots collected during the rising limb and peak of the storm hydrograph (as determined through field observations) were analyzed for PCBs congeners, total mercury, and other analytes (SMCWPPP 2018a).
- Collected 61 sediment samples as part of the program to attempt to identify source properties within WMAs. These samples were collected in the public ROW, including locations adjacent to high interest parcels. Individual and composite sediment samples collected from manholes, storm drain inlets, driveways, and sidewalks were analyzed for PCBs congeners, total mercury, and other analytes (SMCWPPP 2018a).
- Continued updating and prioritizing the list of WMAs in San Mateo County (SMCWPPP 2018b).

5.1.5. WY 2018

SMCWPPP's major WY 2018 POC monitoring efforts included the following:

- Collected 13 composite samples of stormwater runoff from outfalls at the bottom of WMAs that contain high interest parcels with land uses associated with PCBs. The RMP STLS collected an additional two stormwater runoff composite samples in San Mateo County in coordination with SMCWPPP. Composite samples consisting of four to eight aliquots collected during the rising limb and peak of the storm hydrograph (as determined through field observations) were analyzed for PCBs congeners, total mercury, and other analytes (SMCWPPP 2019a).
- Collected 50 sediment samples as part of the program to attempt to identify source properties within WMAs. These samples were collected in the public ROW, including locations adjacent to high interest parcels. Individual and composite sediment samples collected from manholes, storm drain inlets, driveways, and sidewalks were analyzed for PCBs congeners, total mercury, and other analytes (SMCWPPP 2019a).
- Continued updating and prioritizing the list of WMAs in San Mateo County (SMCWPPP 2019b).

5.1.6. WY 2019

During WY 2019, SMCWPPP collected 25 sediment samples as part of the program to attempt to identify source properties within WMAs. These samples were collected in the public ROW, including locations adjacent to high interest parcels. Individual and composite sediment samples collected from manholes, storm drain inlets, driveways, and sidewalks were analyzed for PCBs congeners, total mercury, and other analytes. In addition, the RMP STLS collected two stormwater runoff composite samples in San Mateo County in coordination with SMCWPPP. The results of the WY 2019 and prior PCBs and mercury monitoring are summarized in the following sections.

5.1.7. WY 2020

During WY 2020, SMCWPPP collected eight sediment samples and analyzed each for PCBs and mercury. As in previous years, the primary goal of PCBs and mercury monitoring conducted by SMCWPPP in WY 2020 was to attempt to identify PCBs source properties or areas and thus to help address Management Question No. 1 (Source Identification). Sampling stations were located in a City of San Carlos old industrial catchment (WMA 210) where previous samples had some of the most elevated PCBs concentrations observed in the Bay Area. The sampling was designed to provide additional information relative to three suspected source properties in this WMA (see Section 5.5.6). Samples were collected from the public right-of-way using methods similar to those implemented previously (SMCWPPP 2015, 2016a, 2016b, 2017a, 2017b, 2018, 2019, 2020). Individual and composite sediment samples collected from manholes, storm drain inlets, driveways, and sidewalks were analyzed for the 40 PCBs congeners analyzed by the RMP for Bay samples[7] (EPA method 1668C), total mercury (method EPA 7471A), and moisture/total solids[8] (method ASTM D2216). The results are summarized and discussed in the following sections, in the context of data gathered during previous years.

Third-party organizations did not collect samples for PCBs analysis in San Mateo County during WY 2020.[9] In addition, during WY 2020 the RMP STLS did not collect any stormwater runoff samples in San Mateo County.

As part of continuing to develop strategies for reducing PCBs and mercury loads in stormwater runoff, SMCWPPP evaluated its WY 2020 PCBs and mercury sediment data and additional similar data from previous water years collected by SMCWPPP and through the STLS. Objectives included attempting to identify source areas and properties within WMAs, identifying which WMAs provide the greatest opportunities for implementing cost-effective PCBs controls, and prioritizing WMAs for potential future investigations. The results of the evaluation are described in the following sections.

5.2. San Mateo County Stormwater Runoff Monitoring for PCBs and Mercury

To prioritize WMAs for stormwater sampling, SMCWPPP has evaluated several types of data, including land use, PCBs and mercury concentrations from prior sediment and stormwater runoff sampling efforts, municipal storm drain maps showing pipelines and access points (e.g., manholes, outfalls, pump stations), and logistical/safety considerations. Composite samples, consisting of four to eight aliquots collected during the rising limb and peak of the storm hydrograph (as determined through field observations), have been analyzed for the RMP 40 PCBs congeners (EPA method 1668C), total mercury (EPA method 1631E), and suspended sediment concentration (SSC; method ASTM D3977-97).

During WYs 2016 – 2018, SMCWPPP collected 38 composite samples of stormwater runoff from outfalls at the bottom of WMAs that contain high interest parcels (SMCWPPP did not collect stormwater runoff samples in WYs 2019 and 2020). From WYs 2015 – 2019, an additional 14 composite stormwater

[7] The “RMP 40” congeners include: congeners PCB-8, PCB-18, PCB-28, PCB-31, PCB-33, PCB-44, PCB-49, PCB-52, PCB-56, PCB-60, PCB-66, PCB-70, PCB-74, PCB-87, PCB-95, PCB-97, PCB-99, PCB-101, PCB-105, PCB-110, PCB-118, PCB-128, PCB-132, PCB-138, PCB-141, PCB-149, PCB-151, PCB-153, PCB-156, PCB-158, PCB-170, PCB-174, PCB-177, PCB-180, PCB-183, PCB-187, PCB-194, PCB-195, PCB-201, PCB-203.

[8] Samples were analyzed for total solids to allow for calculation of dry weight concentrations.

[9] However, one sediment sample was collected in San Mateo County by the SPoT program and analyzed for mercury to address Management Question No. 5 (Trends) (see Section 2.2.2).

samples were collected through the RMP's STLS, with four of the RMP's STLS samples being at previously sampled sites. Prior to that, from WYs 2011 – 2014, the RMP STLS collected 43 grab samples at four sites, with the majority being at the Pulgas Creek Pump Station south catchment loading station. The total of 95 samples (at 49 stations) primarily helps address Management Questions No. 1 (Source Identification) and Management Question No. 4 (Loads and Status). These data have also been used by the RMP STLS 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. San Mateo County PCBs and mercury stormwater runoff sampling results are summarized in Attachment 3.

Table 7 summarizes PCBs, mercury, and SSC monitoring results for stormwater runoff samples collected in San Mateo County (by SMCWPPP and RMP STLS) through WY 2020. "Total PCBs" was calculated as the sum of the RMP 40 congeners. Particle ratio is calculated by dividing the total pollutant (PCBs or mercury) concentration by SSC. Assuming a pollutant is entirely bound to suspended sediments in the water sample, particle ratios estimate the average concentration of pollutant on the suspended sediment and are sometimes referred to as particle concentration. Since PCBs and mercury are hypothesized to primarily be bound to sediment in aquatic environments, particle ratios are often used to normalize pollutant concentrations in samples with varying levels of suspended sediment.

Table 7. Descriptive Statistics – PCBs and Mercury Concentrations in San Mateo County Stormwater Runoff and Natural Waterway Water Samples through WY 2020[a]

	PCBs (ng/L)[b]	Hg (ng/L)	SSC (mg/L)	PCBs Particle Ratio (mg/kg)[c]	Hg Particle Ratio (ng/mg)[c]
Min	0.01	ND[d]	3.0	0.0	ND[d]
10th Percentile	1.10	1.80	10.40	0.03	0.04
25th Percentile	2.92	4.00	21.70	0.08	0.12
50th Percentile	6.47	6.90	42.00	0.17	0.23
75th Percentile	31.43	15.00	74.08	0.70	0.45
90th Percentile	70.86	29.78	108	1.51	0.68
Max	2,988	71.10	719	22.75	2.33
Mean	59	13	68	0.8	0.35

[a] Results were averaged for storm events with more than one sample collected during the storm.

[b] Total PCBs calculated as sum of RMP 40 congeners.

[c] PCBs and Hg particle ratios calculated by dividing total PCBs and Hg concentrations by SSC, respectively.

[d] Not Detected.

For storms with more than one sample, total PCBs concentrations were averaged in Table 7. In addition, for sites with multiple samples, particle ratios in Table 7 were calculated by dividing the sum of PCBs concentrations by the sum of suspended sediment concentrations. This averaging is essentially equivalent to "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., in review).

Low PCBs concentrations in composite stormwater runoff samples from the bottom of WMA catchments have suggested that either PCBs sources are not prevalent in the catchment or the samples are "false negatives." False negatives could be the result of low rainfall/runoff rates failing to mobilize sediments from source areas and/or other factors. Only a few stormwater runoff sampling stations in San Mateo County have been resampled, but the results from two such stations in South San Francisco, as described by SMCWPPP (2018), suggested small storm sizes may have resulted in false negatives. SMCWPPP, in collaboration with the SCVURPPP, has recently preliminarily developed a method to normalize results from this type of stormwater runoff monitoring based upon storm intensity. However, the high variability in many of the parameters involved led to a high degree of uncertainty in the evaluation results. SMCWPPP and the SCVURPPP will continue to evaluate normalization methods and results as more data become available in future years, in coordination with related efforts by the RMP (referred to as the RMP's "Advanced Data Analysis").

5.3. Regional Stormwater Runoff Monitoring for PCBs and Mercury

This section evaluates data collected by SMCWPPP to-date on PCBs concentrations in stormwater runoff and natural waterways in the context of similar data collected throughout the Bay Area. The analysis included data from other Bay Area countywide stormwater programs and the RMP STLS (Gilbreath et al., in review). The dataset includes water samples collected during 303 storm events at 151 municipal separate storm sewer system (MS4) bottom of catchment stations and 28 natural waterways (usually creeks with natural channels) throughout the Bay Area. The MS4 catchment sites included storm drain manholes, outfalls, pump stations, and artificial channels.[10] Many of the sites have been sampled more than once and/or have multiple sample results reported for individual storm events. Twenty-seven of the 151 MS4 sites have multiple sample results (sample counts of 2 to 80) and 18 of the 28 natural waterway sites have multiple sample results (sample counts of 2 to 126). The majority of the regional samples were collected as single storm event composite samples at each site. However, for sites with multiple grab samples collected throughout a storm event, the PCBs concentration for that storm event is reported as the average of all individual grab samples collected during that storm event.

The average or composite storm event PCBs concentrations in Bay Area stormwater runoff and natural waterway samples (n=303) are shown in Figure 3. PCBs particle ratios are shown in Figure 4. Figures 3 and 4 compare PCBs results for samples collected in San Mateo County to samples collected outside of the County. Four of the ten highest storm event PCBs concentrations in the overall stormwater runoff sample dataset are for samples collected in San Mateo County. The highest average PCBs concentration measured during a storm event in the Bay Area was from the Pulgas Creek Pump Station South in San Carlos (2,988 ng/L). Average PCBs concentrations measured during 2 other storm events at the Pulgas Creek Pump Station South were also in the top ten of all Bay Area storm events collected regionally. The 8th highest storm event PCBs concentration in the Bay Area was measured at the Industrial Road Ditch sample site, also in San Carlos (160 ng/L). Of the samples collected regionally, storm event samples collected in San Mateo County also included four of the five highest average PCBs particle ratios.

The average or composite storm event mercury concentrations in Bay Area stormwater runoff and natural waterway samples (n=160) are shown in Figure 5. Mercury particle ratios are shown in Figure 6. Similar to Figures 3 and 4 for PCBs, Figures 5 and 6 compare mercury results for samples collected in San Mateo County to samples collected outside of the County.

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[10] Stormwater runoff samples have also been collected from inlets and/or treatment systems (e.g., bioretention) during special studies. However, those are not included in this analysis.

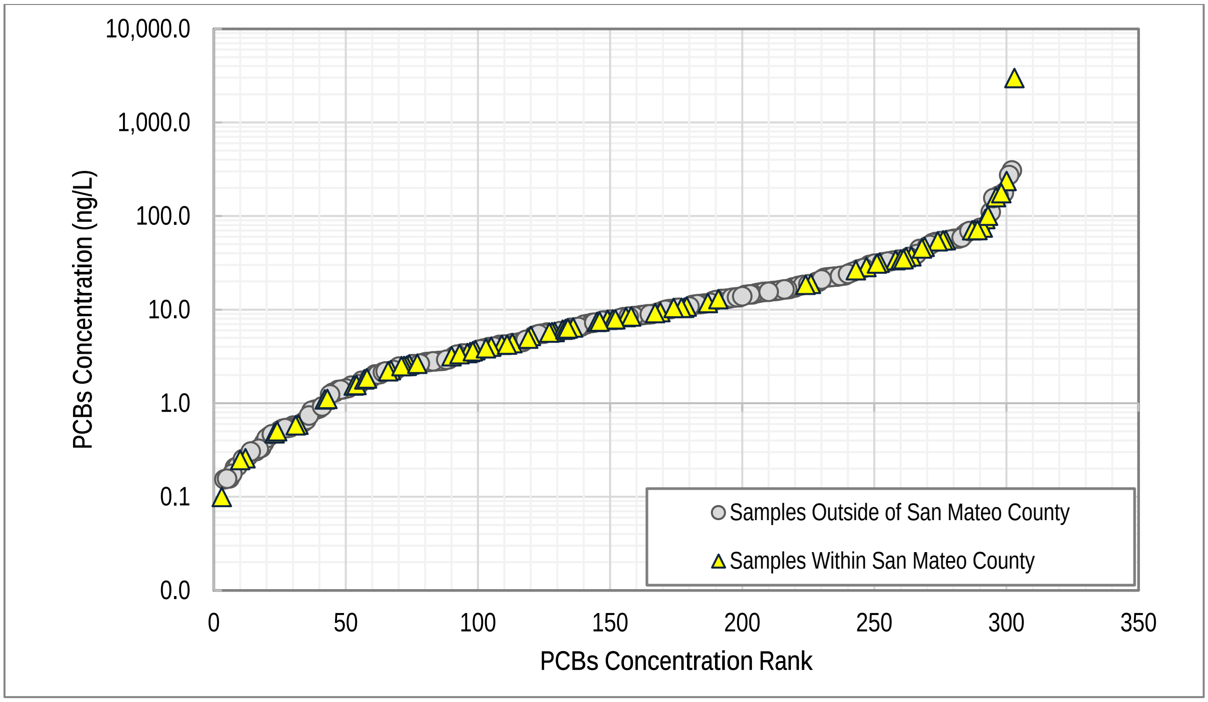

Figure 3. PCBs Concentrations in Storm Event Samples Collected in MS4s and Natural Waterways in the Bay Area.

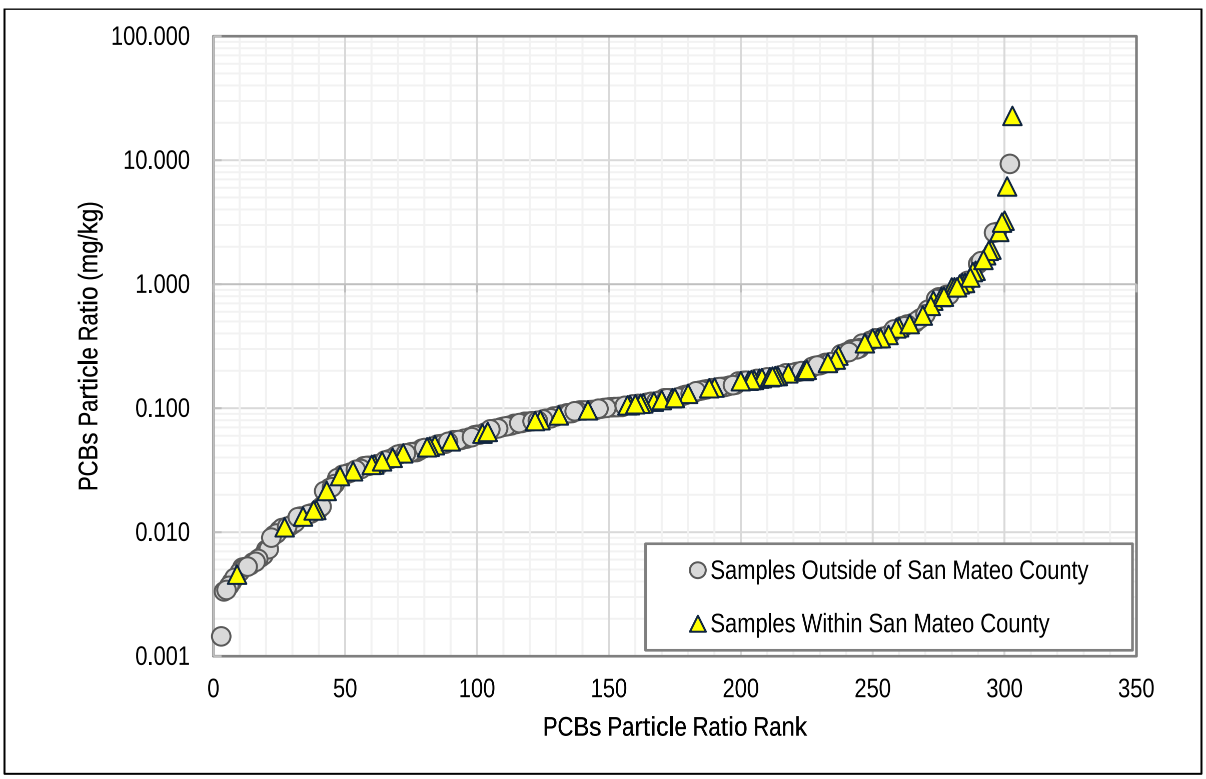

Figure 4. PCBs Particle Ratio in Storm Event Samples Collected in Large MS4s and Natural Waterways in the Bay Area.

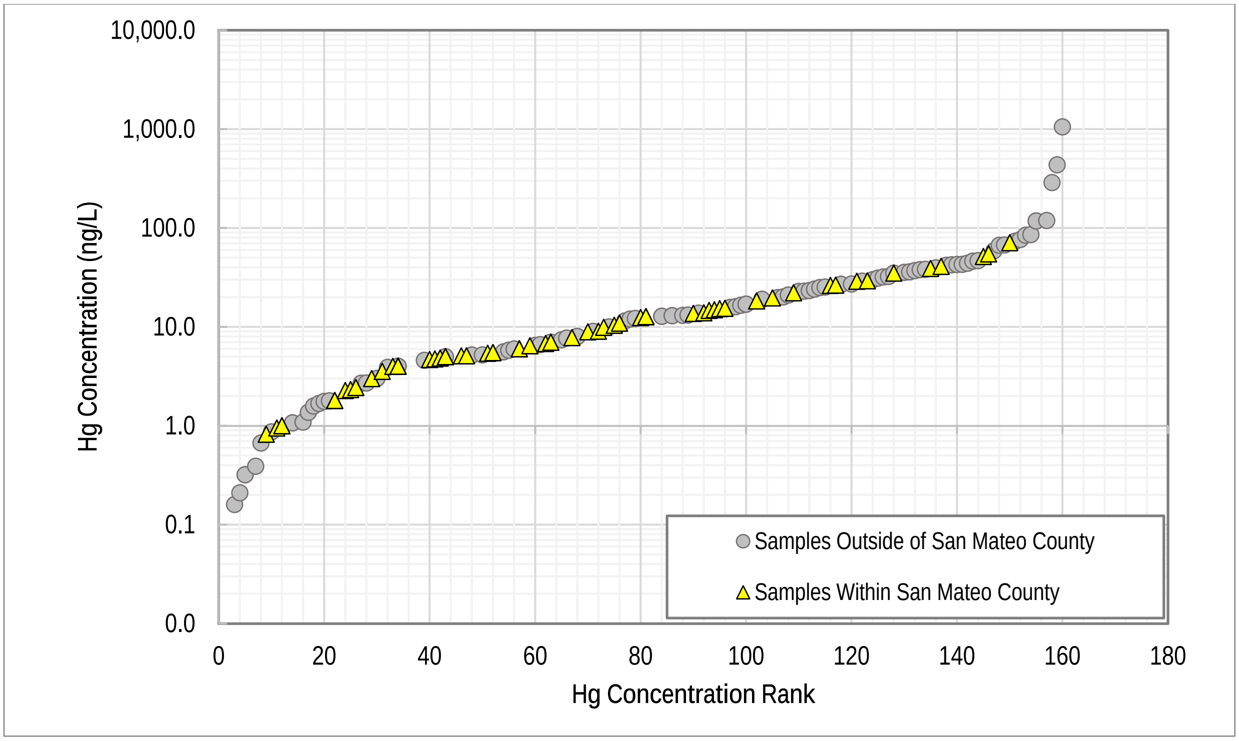

Figure 5. Mercury Concentrations in Storm Event Samples Collected in MS4s and Natural Waterways in the Bay Area.

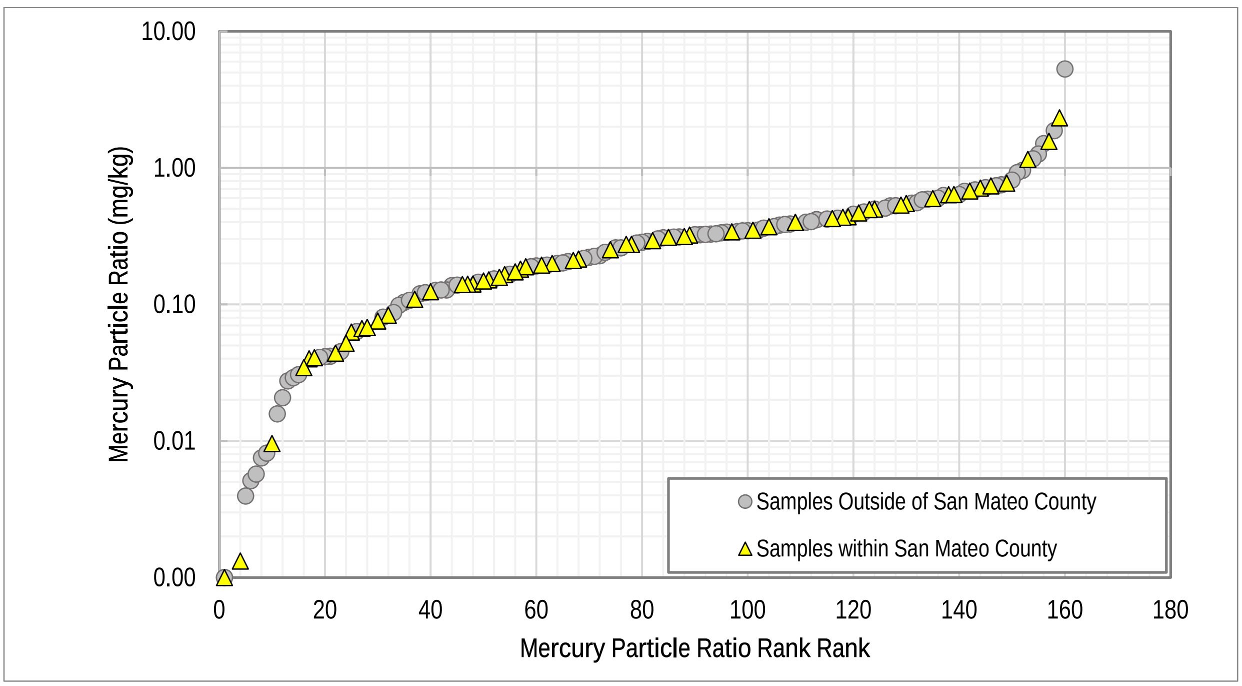

Figure 6. Mercury Particle Ratio in Storm Event Samples Collected in Large MS4s and Natural Waterways in the Bay Area.

Table 8 provides descriptive statistics for PCBs (n=303) and mercury (n=160) concentrations in the Bay Area stormwater runoff and natural waterway dataset. The median PCBs concentration is 7.9 ng/L and the mean is 29 ng/L. The median PCBs particle ratio is 0.10 mg/kg and the mean is 0.37 mg/kg. As shown in Figures 3 and 4, which are plotted on a log scale, there are a few catchments with highly elevated PCBs concentrations (such as the Pulgas Creek Pump Station catchments) that greatly influence the mean concentration relative to the median (i.e., 50th percentile).

Table 8. Descriptive Statistics – Storm Event PCBs and Mercury Concentrations in Bay Area Stormwater Runoff and Natural Waterway Water Samples through WY 2020[a]

Statistic	PCBs (ng/L)[b]	HgT (ng/L)	SSC (mg/L)	PCBs Particle Ratio (mg/kg)[c]	HgT Particle Ratio (mg/kg)[c]
N	303	160	303	303	160
Min	0.00	ND[d]	3.0	0.00	ND
10th percentile	0.58	1.3	16.	0.01	0.04
25th percentile	2.6	4.7	32	0.04	0.13
50th percentile	7.9	13	65	0.10	0.29
75th percentile	19	28	145	0.22	0.46
85th percentile	34	40	231	0.43	0.61
90th percentile	52	47	305	0.72	0.71
Max	2,988	1,053	2,630	23	5.3
Mean	29	30	138	0.37	0.38

[a] Based upon storm event data collected at 179 PCBs sampling stations during 303 storm events, and 118 mercury sampling stations during 160 storm events. Results were averaged for storm events with more than one sample collected during the storm.

[b] Total PCBs calculated as sum of RMP 40 congeners.

[c] PCBs and Hg Particle Ratios calculated by dividing Total PCBs and Hg concentrations by SSC, respectively.

[d] Not Detected.

5.4. San Mateo County Sediment Monitoring for PCBs and Mercury

Since WY 2001, over 400 sediment samples have been collected in San Mateo County as part of investigations to characterize urban catchments of interest (i.e., WMAs) and identify source properties within WMAs, potentially for referral to the Regional Water Board for further investigation and potential abatement. These samples were collected in the public right-of-way (ROW), including locations adjacent to high interest parcels. Individual and composite sediment samples were collected from manholes, storm drain inlets, driveways, streets, and sidewalks.

Each sample was analyzed for the RMP 40 PCBs congeners and total mercury. Total PCBs was calculated as the sum of the RMP 40 congeners. The laboratory passed all samples through a 2 mm sieve before analysis to remove gravel and cobbles. Table 9 compares the descriptive statistics for POC sediment samples that have been collected in San Mateo County through WY 2019, WY 2020 samples, and all Bay Area wide samples. For the WY 2020 PCBs samples, two samples were above 1.0 mg/kg, two were between 0.5 and 1.0 mg/kg, one was between 0.2 and 0.5 mg/kg and three were below 0.2 mg/kg. The median was 0.48 mg/kg, and the mean was 0.82 mg/kg. For the WY 2020 mercury samples, none was above 1.0 mg/kg, one was between 0.3 and 1.0 mg/kg, and 7 were below 0.3 mg/kg. The median was 0.11 mg/kg, and the mean was 0.14 mg/kg.

Attachment 4 summarizes San Mateo County PCBs and mercury sediment monitoring locations and analytical results. The results are discussed by selected WMA in the following sections, along with sediment data from previous Water Years and the stormwater runoff data collected to-date.

Table 9. Descriptive Statistics –PCBs and Mercury Concentrations in Sediment Samples

	All Bay Area Samples To-date		San Mateo County Samples WYs 2001-2019		San Mateo County Samples WY 2020	
Number of Sediment Samples	**1,579**	**1,383**	**404[b]**	**352**	**8**	**8**
	PCBs (mg/kg)[a]	**Hg (mg/kg)**	**PCBs (mg/kg)[a]**	**Hg (mg/kg)**	**PCBs (mg/kg)[a]**	**Hg (mg/kg)**
Min	ND[c]	ND[c]	ND[c]	0.006	0.039	0.058
10th Percentile	ND[c]	0.054	0.002	0.046	0.058	0.068
25th Percentile	0.010	0.086	0.014	0.064	0.086	0.075
50th Percentile	0.041	0.149	0.043	0.101	0.475	0.112
75th Percentile	0.161	0.291	0.131	0.176	0.853	0.142
90th Percentile	0.771	0.726	0.481	0.331	1.828	0.237
Max	192.9	20.6	192.9	3.930	3.509	0.341
Mean	0.652	0.406	0.940	0.207	0.817	0.136

[a] Total PCBs calculated as sum of RMP 40 congeners.
[b] Includes 26 samples from reports on three PCBs site cleanups in San Carlos and Redwood City.
[C] Not Detected.

5.5. Watershed Management Area Status

SMCWPPP evaluated the monitoring data available to-date to help categorize WMAs by level of PCBs in existing stormwater runoff and sediment samples.[11] Based upon the data collected in San Mateo County to-date by SMCWPPP and other parties (e.g., the RMP's STLS), catchments of interest were categorized into the following five groups:

1. One or more sediment and/or stormwater runoff samples with PCBs concentrations (particle ratios for stormwater runoff) greater than 0.5 mg/kg (500 ng/g) and source properties have been identified within the catchment.

[11] This section focuses on "catchments of interest," which as described earlier (Section 5.1) are a subset of the list of San Mateo County WMAs. The list of 130 WMAs includes 105 "catchments of interest" with high interest parcels for PCBs comprising at least 1% of their area. The remaining 25 WMAs include PCBs and mercury controls such as green infrastructure on parcels but generally lack high interest parcels.

2. One or more sediment and/or stormwater runoff samples with PCBs concentrations (particle ratios for stormwater runoff) greater than 0.5 mg/kg (500 ng/g) and source properties have not been identified within the catchment.
3. One or more sediment and/or stormwater runoff samples with PCBs concentrations (particle ratios for stormwater runoff) between 0.2 – 0.5 mg/kg (200 – 500 ng/g), any other samples not in this range have PCBs concentrations (particle ratios for stormwater runoff) less than 0.2 mg/kg (200 ng/g).
4. All sediment and/or stormwater runoff samples have PCBs concentrations (particle ratios for stormwater runoff) less than 0.2 mg/kg (200 ng/g).
5. No samples collected to-date.

Figure 7 is a map illustrating the current status of WMAs in San Mateo County, based on the sediment and stormwater runoff monitoring results to-date. Only WMAs with high interest parcels were included in Figure 7.

Attachment 5 provides a summary of PCBs and mercury monitoring results for San Mateo county WMAs. For each WMA, Attachment 5 includes:

- The WMA area, the area of high interest parcels in the WMA, and the percent of the total WMA area that is comprised of high interest parcels;
- A summary of the number of stormwater runoff and sediment samples collected to-date in the WMA; and
- The median and range of PCBs concentrations in the samples collected to-date in the WMA (median and range of PCBs particle ratio for stormwater runoff samples).

Attachments 3, 4 and 5 summarize PCBs and mercury monitoring results for stormwater runoff and sediment samples collected in San Mateo County to -date.[12] Based on the available data to-date (e.g., sediment and stormwater runoff monitoring and land use research through WY 2020), WMAs with stormwater runoff sample PCBs particle ratios and/or sediment sample PCBs concentrations ≥0.2 mg/kg, and/or other features relevant to PCBs investigations, are described in the following sections, which are organized by the applicable municipalities.

[12] The WMA IDs in San Mateo County are numerical (1 – 1017). Sample names consist of a prefix for the county (SM), followed by a three-letter prefix for the Permittee where the sample was collected (e.g., SSF for South San Francisco, SCS for San Carlos), followed by the WMA ID, and followed by a letter (e.g., A, B, C) to distinguish the sampling site from the WMA in which that sample was collected. Samples collected previously may have a different sample naming convention.

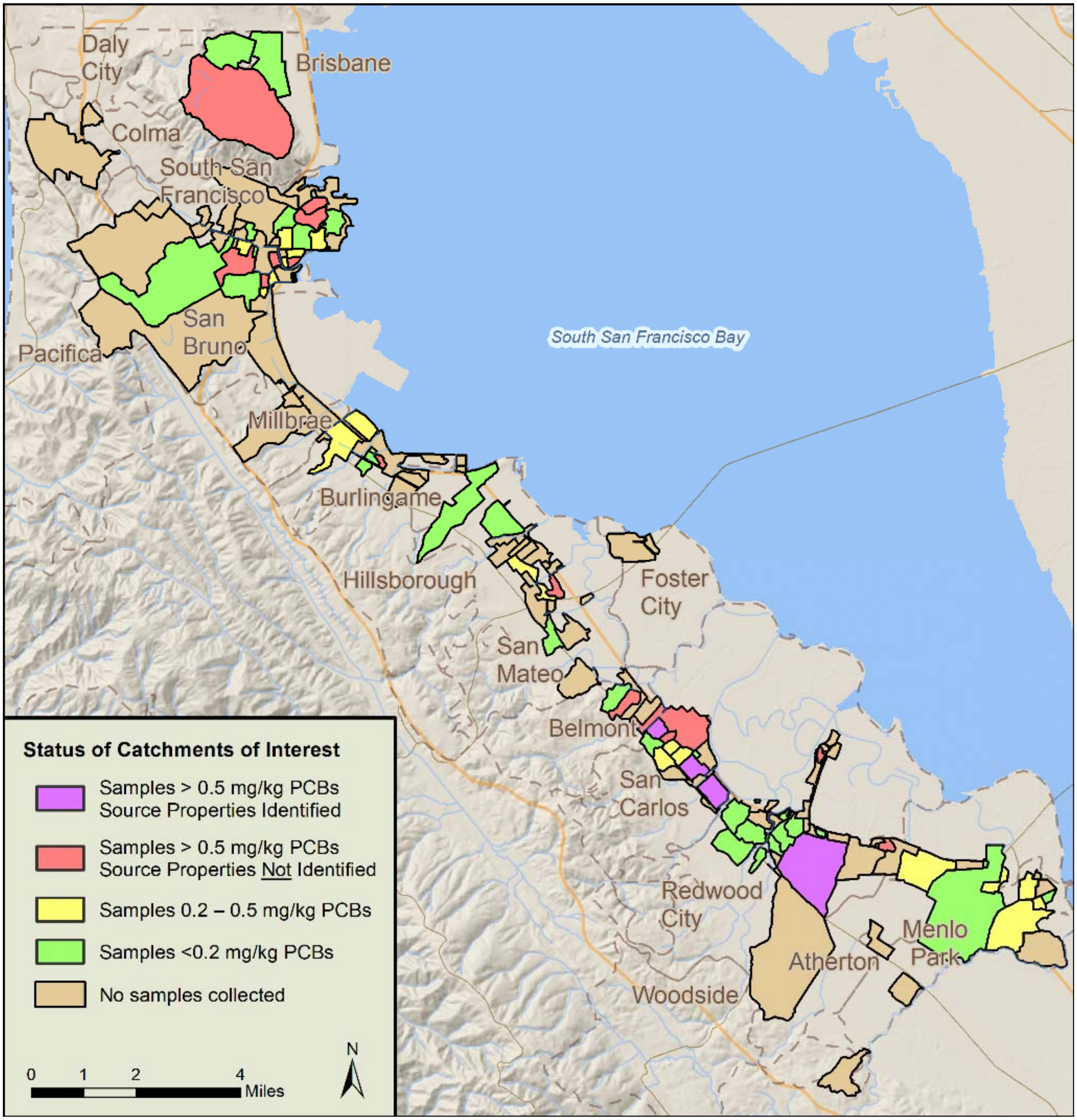

Figure 7. San Mateo County WMA Status Based upon Total PCBs Concentration in Sediment and/or PCBs Particle Ratio in Stormwater Runoff Samples Collected through WY 2020.

5.5.1. City of Brisbane

WMAs in the City of Brisbane with PCBs particle ratios over 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figure 8 and briefly described below. It should be noted that the industrial area in the northeast corner of Figure 8 drains to San Francisco's combined sewer and is therefore not included in this evaluation.

WMA 17

WMA 17 is a large catchment that corresponds to the watershed of the now underground Guadalupe Creek. It contains a large industrial area developed mostly in the 1960s and buildings of the type that could potentially have PCBs in building materials. Several old railroad lines used to support the industries. A sediment sample collected during WY 2015 in one of the two main lines under Valley Drive had elevated levels of PCBs (1.22 mg/kg) despite potential dilution due to the large size of the watershed. A stormwater runoff sample collected by the RMP in WY 2016 (SM-BRI-17A or Valley Dr SD) had a relatively low PCBs particle ratio of 0.11 mg/kg. Six additional sediment samples were collected in WY 2018, with one of the samples having elevated PCBs (1.02 mg/kg), and the remaining samples all under 0.2 mg/kg. The elevated sample was collected from an inlet that drains a portion of one of the old railroad lines. Another four sediment samples were collected in WY 2019 along the old railroad line with one of the samples having an elevated PCBs concentration (0.56 mg/kg), and the other three being below 0.2 mg/kg PCBs. Despite the above attempts to iteratively hone in on a source area in this WMA, none of the sediment samples collected to-date with elevated PCBs appears appear to be associated with a specific parcel. However, it is possible that additional sediment sampling could lead to identifying specific source property(ies) (e.g., within the railroad ROW).

WMA 1004

WMA 1004 is located along Tunnel Avenue in the Brisbane Baylands area. Stormwater runoff sample SM-BRI-1004A (Tunnel Avenue Ditch) was collected by the RMP in WY 2016 and had a relatively low PCBs particle ratio of 0.11 mg/kg. The catchment has a high proportion of high interest properties, including containing all of the Brisbane Baylands old railyard and a large PG&E property on Geneva Avenue. The Baylands area is an active cleanup site (although not for PCBs) and will eventually be redeveloped. Several sediment samples collected in past years in the vicinity of the PG&E property and historical railroad lines had relatively low PCBs concentrations (<0.2 mg/kg PCBs).

WMA 350

WMA 350 is upstream of WMA 1004 and is partly located in Daly City. It contains a PCBs cleanup site (Bayshore Elementary in Daly City) that was redeveloped in 2017. The PCBs were associated with the original building materials and it therefore appears unlikely that there is an ongoing source of PCBs to the MS4. One sediment sample collected downstream of the school in WY 2018 had a relatively low concentration of PCBs.

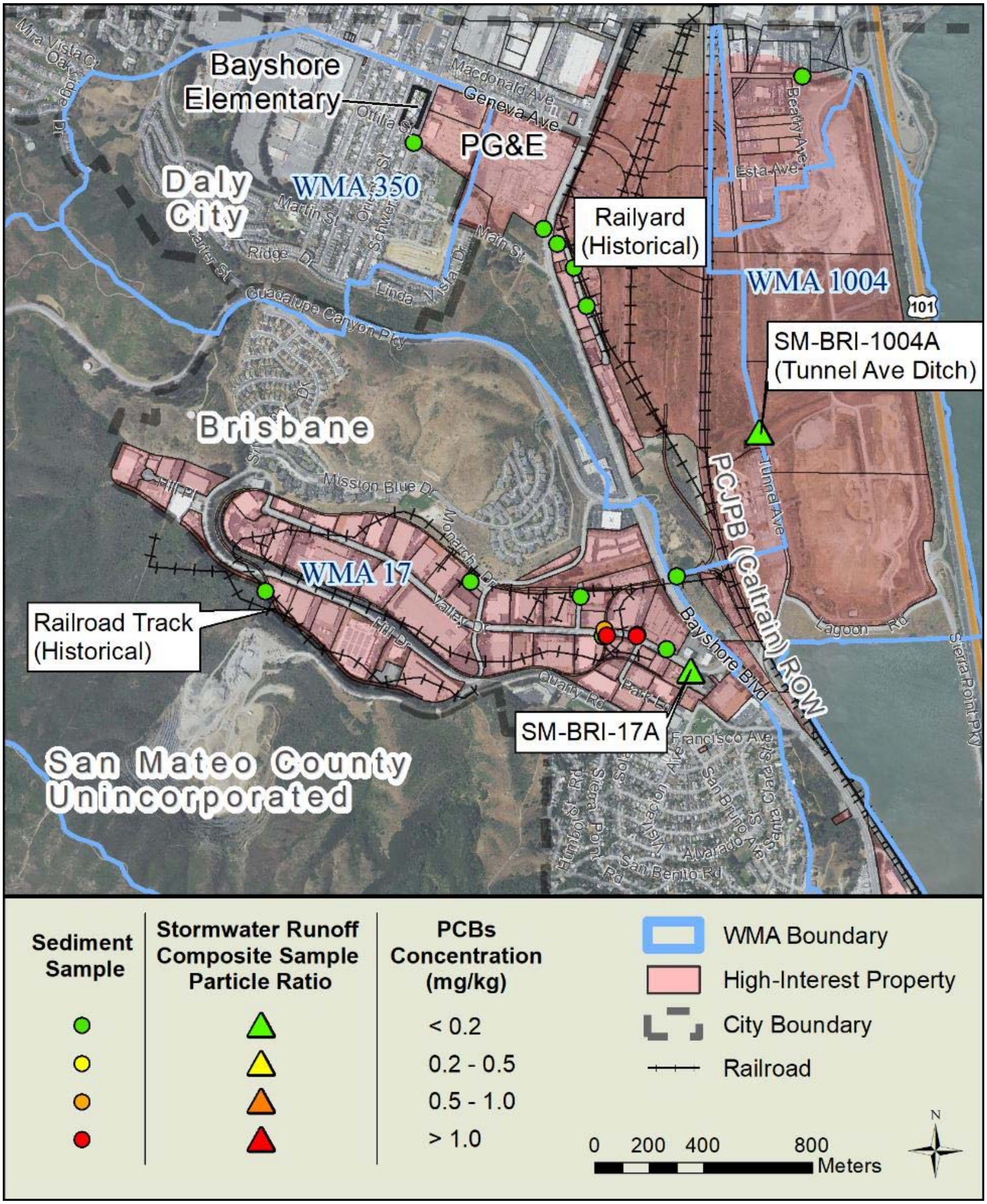

Figure 8. WMAs 17, 350, and 1004.

5.5.2. City of South San Francisco

WMAs in the City of South San Francisco with PCBs particle ratios over 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figures 9 through 13 and briefly described below.

WMA 291

WMA 291 is a relatively large catchment that is comprised almost entirely of old industrial land uses. A stormwater runoff sample collected by the RMP in WY 2017 had an elevated PCB particle ratio (0.74 mg/kg). A 2002 sediment sample at 245 S. Spruce Avenue had an elevated PCBs concentration of 2.72 mg/kg and this property was referred to the Regional Water Board in June 2003. However, since that time, investigations have not shown further evidence that this property is a source of PCBs to the MS4. Sediment samples in WY 2015 and WY 2017 on Linden Avenue near Dollar Avenue were also moderately elevated for PCBs (0.48 and 0.44 mg/kg). Two sediment samples were collected near 245 S. Spruce Avenue in WY 2018, one of which was moderately elevated for PCBs (0.21 mg/kg). The moderately elevated sample was collected from the boundary of the property and a historical railroad, which now is part of the current BART right-of-way. Investigations in this WMA have iteratively collected a total of 19 sediment samples, but except for the tentative identification of 245 S. Spruce Avenue, source properties have not been identified.

WMA 294

WMA 294 is a 67-acre catchment that drains into Colma Creek at Mitchell Avenue. Within the WMA is 166 Harbor Way, designated in the Department of Toxic Substances Control (DTSC) Envirostor database as "Caltrans/SSF Maintenance Station." This property was purchased by Caltrans which tested the soil and found several contaminants including PCBs. The contaminated soil has been capped since at least 2005 and the property is currently mostly vacant with a small portion devoted to k-rail storage. A sediment sample was collected in the driveway of this property in WY 2017 had a moderately elevated PCBs concentration of 0.28 mg/kg. A stormwater runoff sample collected in WY 2017 also had a moderately elevated PCBs particle ratio (0.37 mg/kg).

WMA 314

WMA 314 is a 66-acre catchment located near Oyster Point that is comprised of light industrial land uses along with an old railroad right-of-way. Site SM-SSF-314A (Gull Dr. SD) was sampled by the RMP STLS in WY 2015 and resampled in WY 2018 and had an elevated PCBs particle ratio in both samples (0.95 and 0.86 mg/kg, respectively). The WY 2018 sample had a total PCBs concentration (71 ng/L) that was about an order of magnitude higher than the WY 2015 sample (8.6 ng/L). Two sediment samples collected in WY 2017 both had relatively low (urban background) concentrations of PCBs, with the highest concentration being 0.15 mg/kg. Another sediment sample taken in WY 2019 also had a low PCBs concentration of 0.02 mg/kg. Thus, the efforts to-date have not identified any source area(s) associated with the elevated PCBs particle ratios in the stormwater runoff samples. However, it is possible that additional sediment sampling could lead to identifying specific source property(ies) (i.e., within the railroad ROW).

WMA 315

WMA 315 is a 108-acre catchment with an outfall very close to the outfall for WMA 314. WMA 315 is comprised almost entirely of light industrial land uses. The RMP STLS collected a stormwater runoff sample at the bottom of this catchment in WY 2016 and then resampled the same station in WY 2018 (Gull Drive station). Total PCBs (5.8 ng/L) and PCBs particle ratio (0.18 mg/kg) were relatively low in the WY 2016 sample, but roughly an order of magnitude higher in the WY 2018 sample (total PCBs = 93.2 ng/L and PCBs particle ratio = 1.02 mg/kg). Five sediment samples were collected in this catchment in WY 2019, with two of the samples having moderately elevated PCBs concentration (0.27 and 0.43 mg/kg). Both samples were along railroads, one active and one historic. Thus, the efforts to-date have not identified any source area(s) associated with the elevated PCBs particle ratios in the stormwater runoff sample. However, it is possible that additional sediment sampling could lead to identifying specific source property(ies) (e.g., within the railroad ROW).

WMA 319

WMA 319 is also located near Oyster Point. Sample SM-SSF-319A (Forbes Blvd Outfall) was collected by the RMP STLS in WY 2016 and had a relatively low PCBs particle ratio of 0.08 mg/kg. Although the catchment was historically industrial, it is now mostly redeveloped and composed of biotechnology corporations. A sediment sample in WY 2017 also had a relatively low (0.06 mg/kg) PCBs concentration.

WMA 358

WMA 358 is a small 32 acre catchment that drains into Colma Creek at Utah Avenue. A sediment sample collected in WY 2015 had an elevated PCBs concentration (1.46 mg/kg). Three follow-up sediment samples collected in WY 2017 all had relatively low (urban background) levels of PCBs, with the highest concentration being 0.09 mg/kg. Another follow-up sediment sample collected in WY 2019 also had a low concentration (0.03 mg/kg). Stormwater runoff samples have not been collected from this catchment and would be challenging to collect because of tidal inundation. The attempts to-date to identify a source area in this WMA have not succeeded. However, it is possible that additional sediment sampling could be more fruitful.

WMA 359

WMA 359 is a small 23 acre catchment that drains into Colma Creek behind 222 Littlefield Avenue. In WY 2017 the RMP STLS collected a stormwater runoff sample with a somewhat elevated PCBs particle ratio of 0.79 mg/kg. The catchment is composed of all old industrial land uses including old railroad tracks. In WY 2018, three follow-up sediment samples collected in the catchment all had relatively low PCBs concentrations (less than 0.2 mg/kg). Another follow-up sediment sample collected in WY 2019 also had a low PCBs concentration (0.13 mg/kg). Based on the work conducted to-date, it appears that identifying any source areas via additional sediment sampling in this WMA's public ROW would be challenging.

WMA 1001

WMA 1001 is a large 345-acre catchment that is composed of all the non-contiguous small catchments along Colma Creek that have outfall diameters of 18-inches and smaller. In WY 2018, a stormwater runoff sample collected from this catchment had a relatively low total PCBs concentration of 1,100 ng/L, but a moderately elevated PCBs particle ratio of 0.35 mg/kg. Six sediment samples collected in 2015 and 2018 had relatively low concentrations (≤ 0.09 mg/kg).

WMA 1001B

In WY 2017, a stormwater runoff sample (SM-SSF-1001B) collected on Shaw Road near this catchment's outall to Colma Creek had an elevated PCBs particle ratio (1.7 mg/kg). This catchment is very small and only drains about five light industrial properties along Shaw Road including historical rail lines. A sediment sample collected in this catchment in WY 2015 had a concentration of 0.46 mg/kg. Five additional sediment samples were collected in this catchment in WY 2018, with one having a moderately elevated PCBs concentration of 0.35 mg/kg, and the other five all having relatively low concentrations (≤ 0.06 mg/kg). During WY 2019, two sediment samples were also collected along Shaw Road in WMA 362 (just south of WMA 1001) to investigate an electrical property and another property that straddles both WMAs. Both had low concentrations of PCBs (≤ 0.07 mg/kg).

WMA 1001D

Between 2000 and 2015, seven samples were collected in this catchment with two of the samples (from 2000 and 2007) having a moderately elevated PCBs concentration (0.23 and 0.43 mg/kg). The remaining five samples all had low concentrations of PCBs (< 0.04 mg/kg). During an attempt in WY 2017 to sample stormwater runoff near the outfall of this catchment, field workers observed that this catchment likey drains to the south to WMA 291.

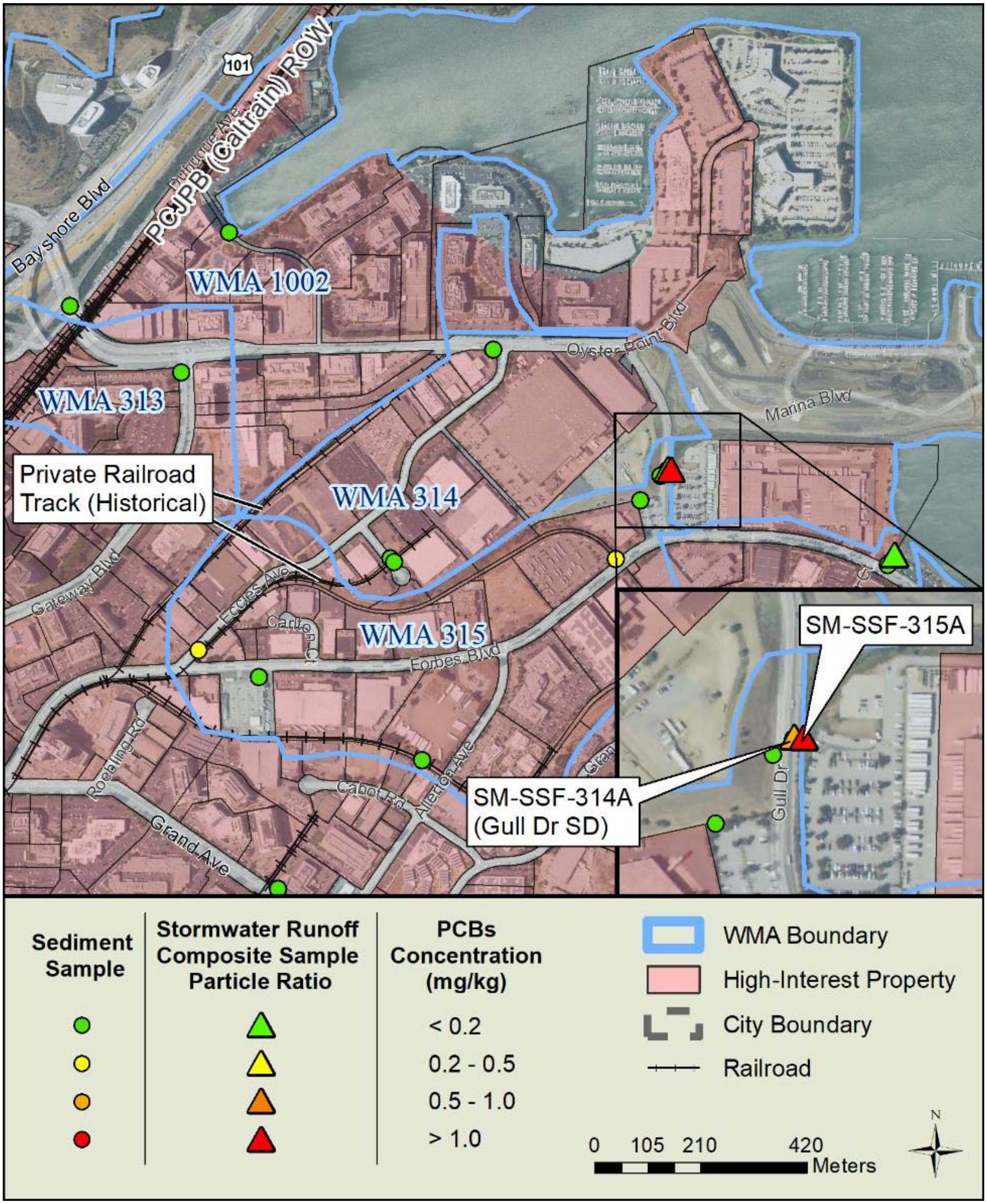

Figure 9. WMAs 313, 314, 315, and 1002

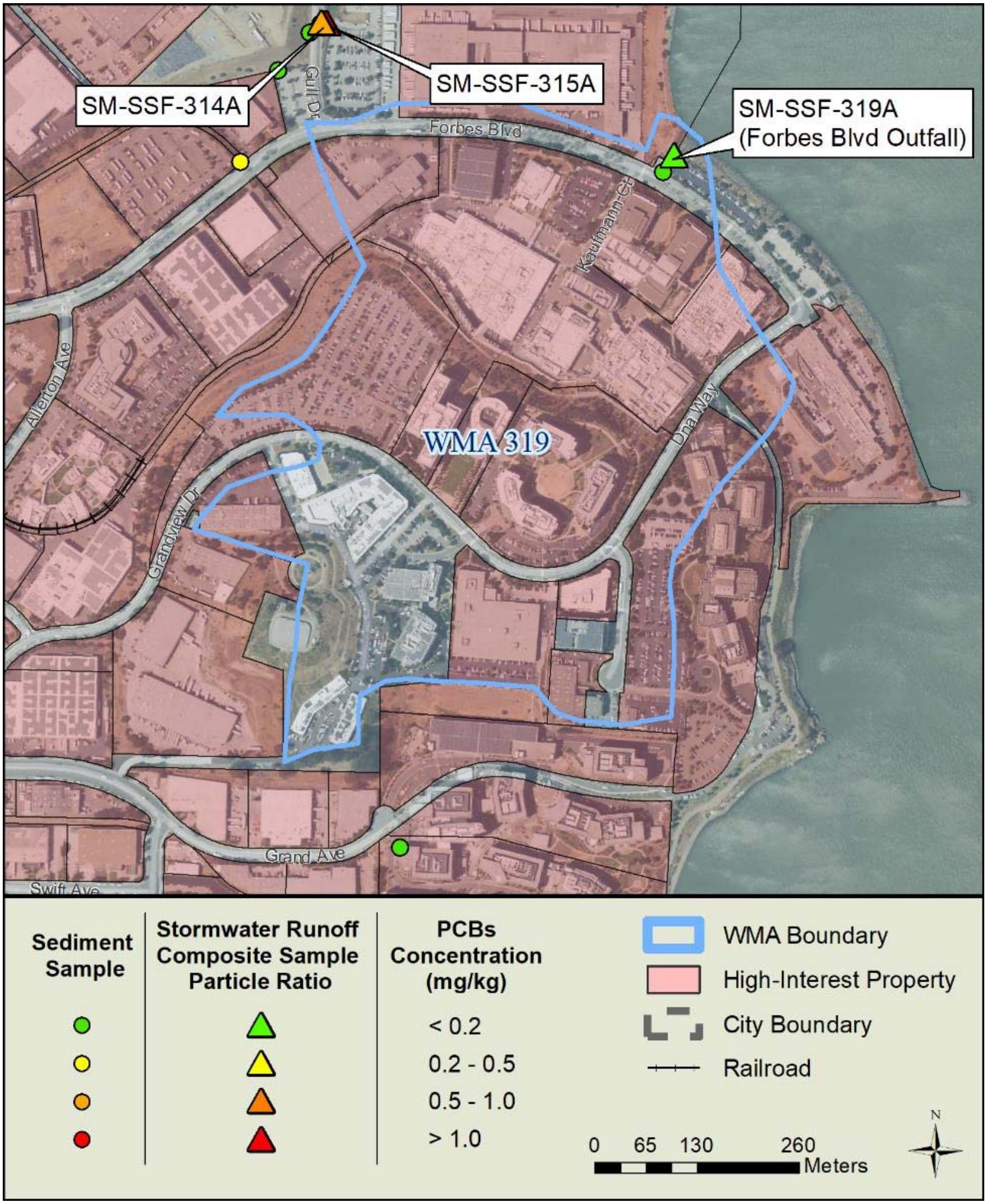

Figure 10. WMA 319

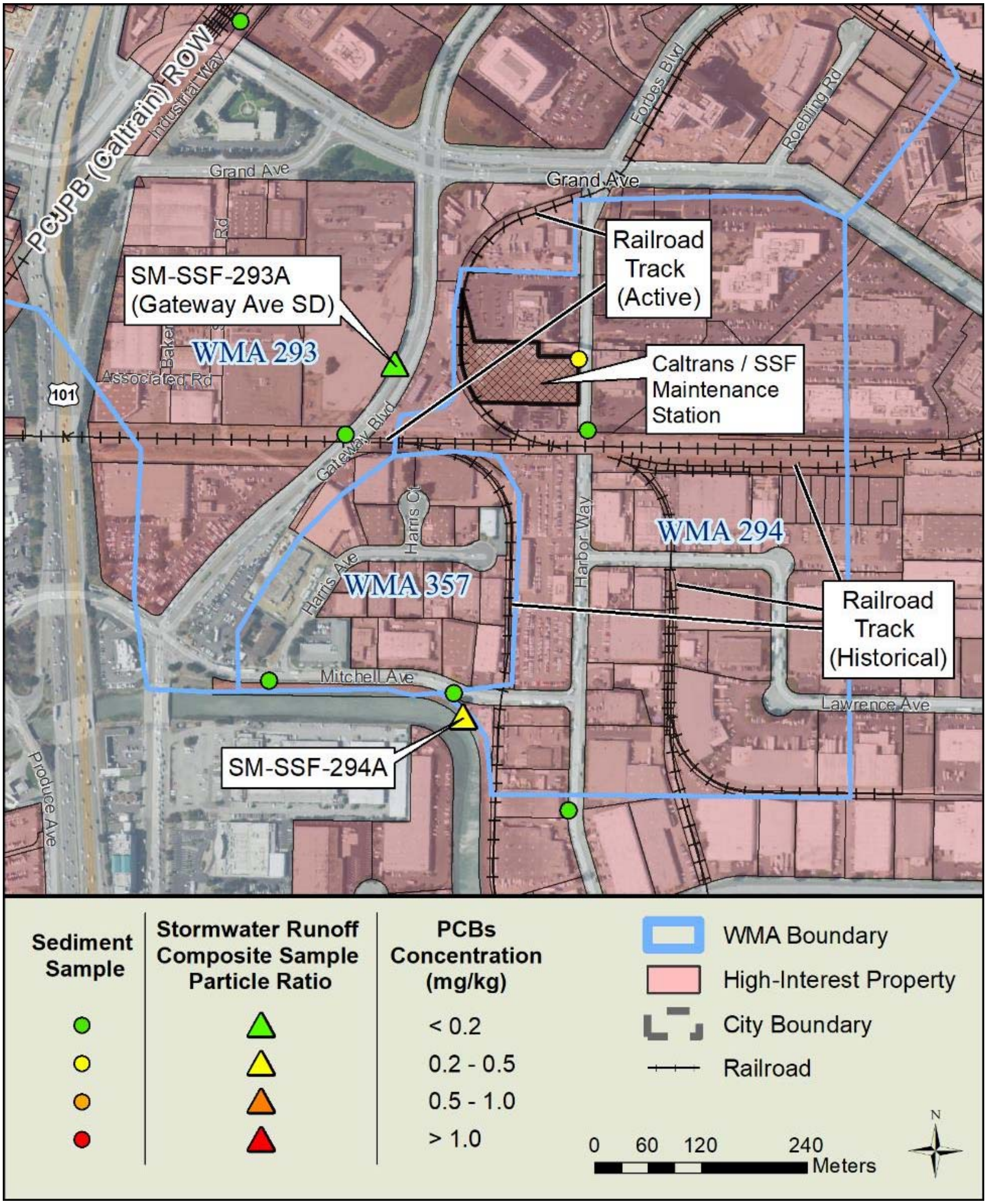

Figure 11. WMAs 293, 294, and 357

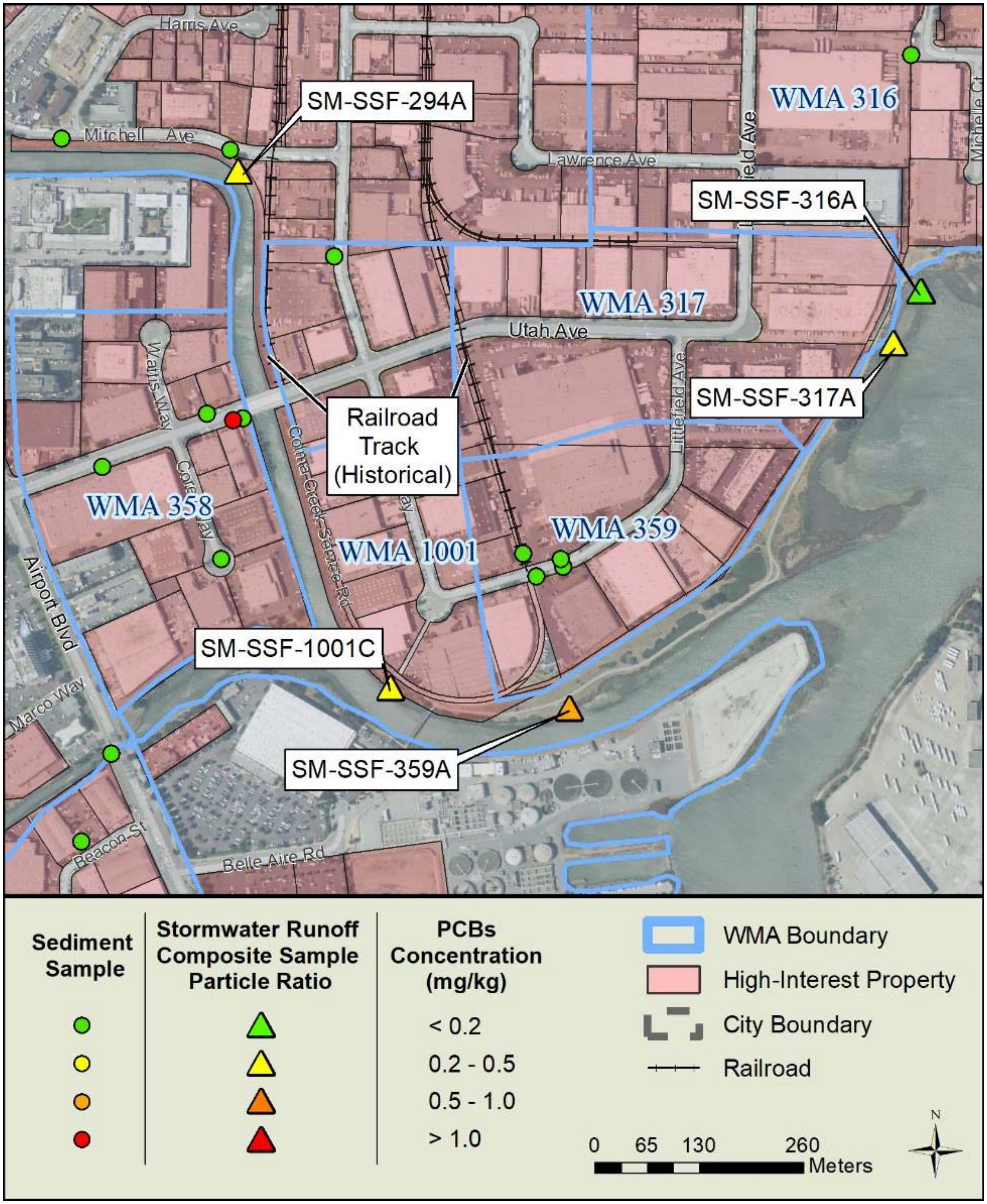

Figure 12. WMAs 316, 317, 358, 359, and 1001

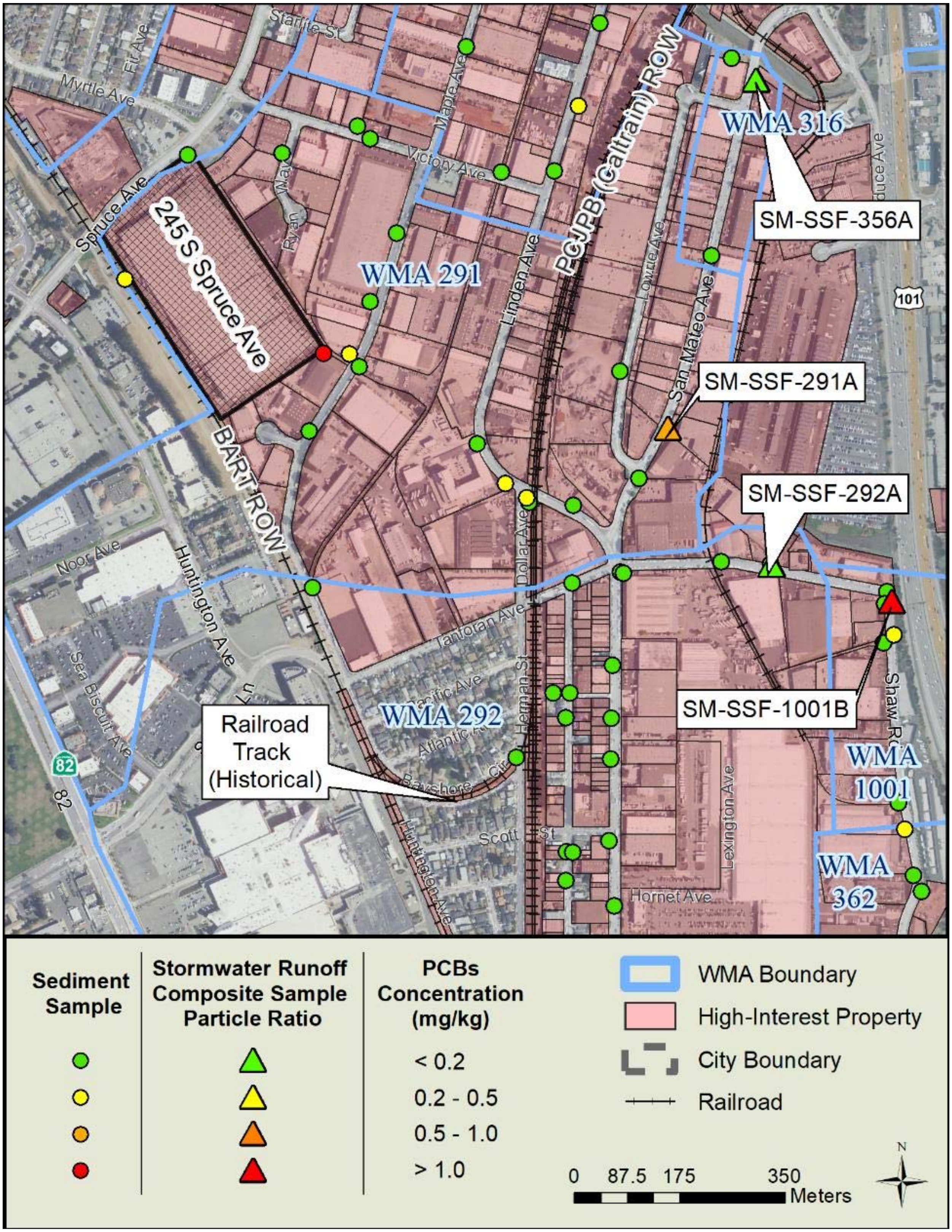

Figure 13. WMAs 291, 292, 316, and 1001

5.5.3. City of Burlingame

WMAs in the City of Burlingame with PCBs particle ratio over 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figures 14 and 15 and briefly described below.

WMA 85

WMA 85 is a 121-acre catchment northwest of Highway 101 in Burlingame that is comprised mostly of light industrial land uses. A stormwater sample collected in WY 2018 had a slightly elevated PCBs particle ratio of 0.24 mg/kg, and a repeat sample of the same location by the RMP in WY 2019 had a PCBs particle ratio of 0.33 mg/kg and a relatively high total PCBs concentration of 31.1 ng/l. Two previous sediment samples collected in this WMA had relatively low concentrations (less than 0.2 mg/kg), including one at a pump station.

WMA 142

WMA 142 is a small 20-acre catchment that is comprised mostly of industrial land uses. Sample SM-BUR-142A was part of a trio of stormwater runoff samples collected at the forebay of the Marsten Road pump station. It had an elevated PCBs particle ratio (0.67 mg/kg). SM-BUR-1006A, which was collected at the same location but drains adjacent WMA 1006, had a moderately elevated PCBs particle ratio (0.37 mg/kg). Seven sediment samples collected in or very close to WMA 142 in WY 2018 all had low PCBs concentrations (less than 0.2 mg/kg).

WMA 164

WMA 164 is a 241-acre catchment. The lower half of this catchment has mostly light industrial land uses and the upper half has mostly residential and commercial land uses. A stormwater runoff sample collected in WY 2018 had a moderately elevated PCBs particle ratio of 0.45 mg/kg, although another sample collected by the RMP in WY 2019 had a low PCBs particle ratio of 0.05 mg/kg. This site is downstream of a pump station where sediments may settle out of the stormwater runoff flows. Four sediment samples collected in this catchment in WYs 2002 and 2015 had relatively low PCBs concentrations (less than 0.2 mg/kg).

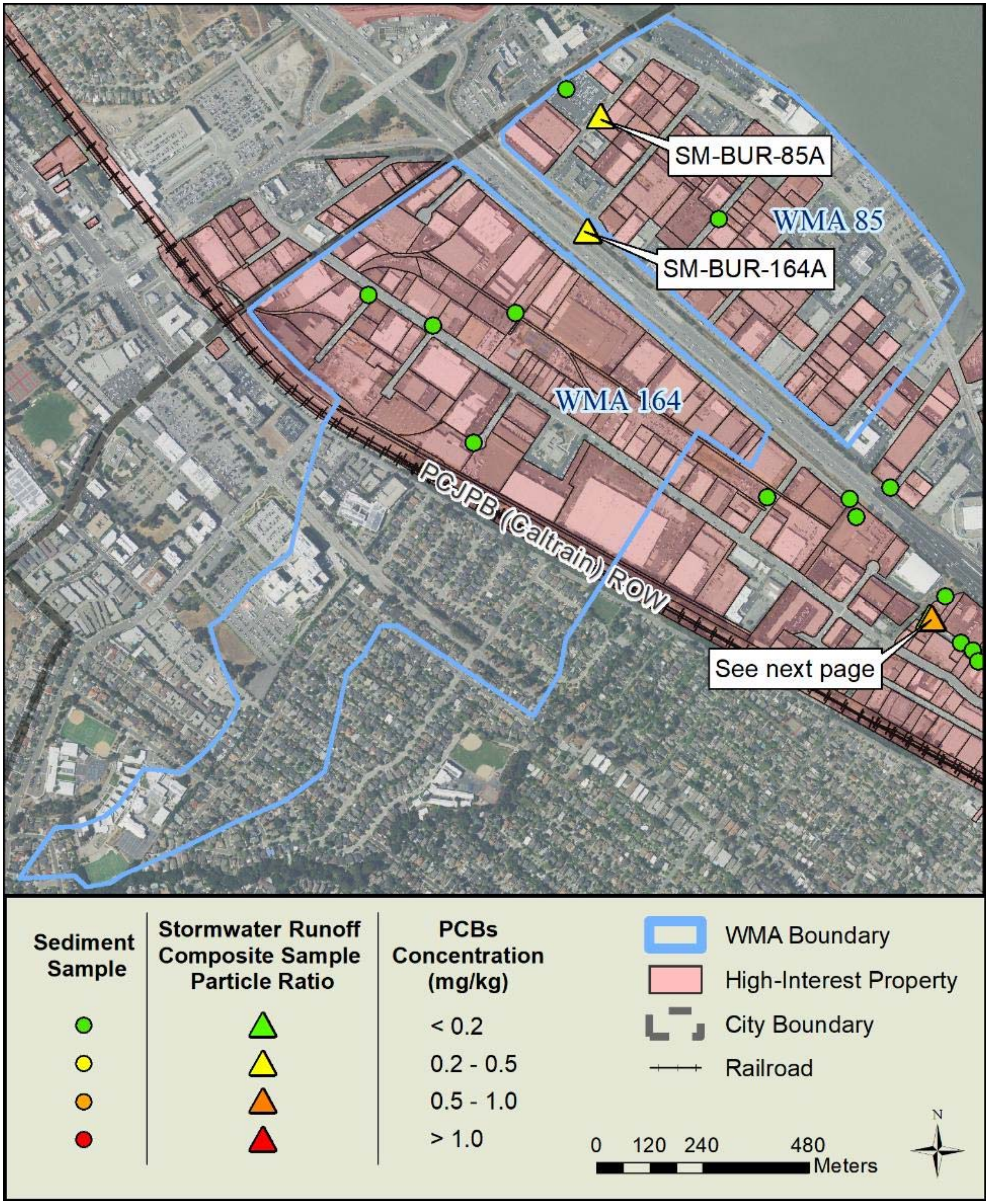

Figure 14. WMAs 85 and 164

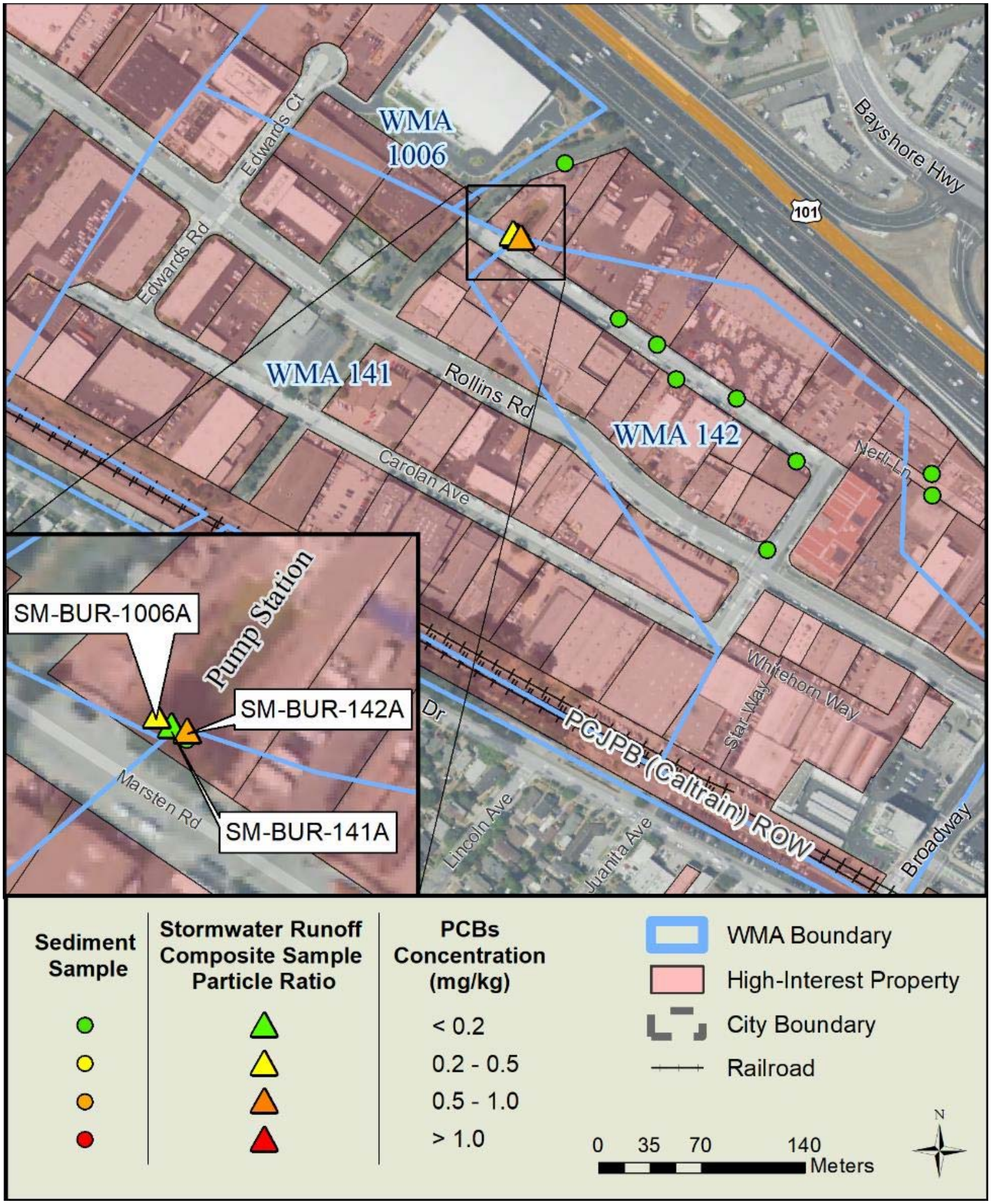

Figure 15. WMAs 141, 142, and 1006

5.5.4. City of San Mateo

WMAs in the City of San Mateo with PCBs particle ratio greater than 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figure 16 and briefly described below.

WMA 156

WMA 156 is a 40-acre catchment that flows north into the 16th Street Channel at Delaware Street. Historically it contained old industrial land uses. It drains Caltrain property including the Hayward Park Station. There is a major retail redevelopment project currently underway in this WMA. A stormwater runoff sample collected in WY 2017 near the catchment outfall had a slightly elevated PCB particle ratio (0.2 mg/kg) but a sediment sample collected upstream did not have an elevated PCBs concentration.

WMA 408

WMA 408 is a 43-acre catchment next to WMA 156. It is comprised of a mix of retail, commercial and residential land uses, with a relatively low proportion (16%) of high interest parcels (see Attachment 5). A stormwater runoff sample collected in WY 2017 had a relatively high PCBs particle ratio (1.9 mg/kg). This result was notable given the lack of industrial land uses and low percentage of high interest parcels. Seven follow-up sediment samples collected from this WMA in WY 2018 all had relatively low PCBs concentrations (less than 0.2 mg/kg). Given the high previous result and low concentrations in multiple sediment samples, it may be advisable to resample the stormwater runoff station.

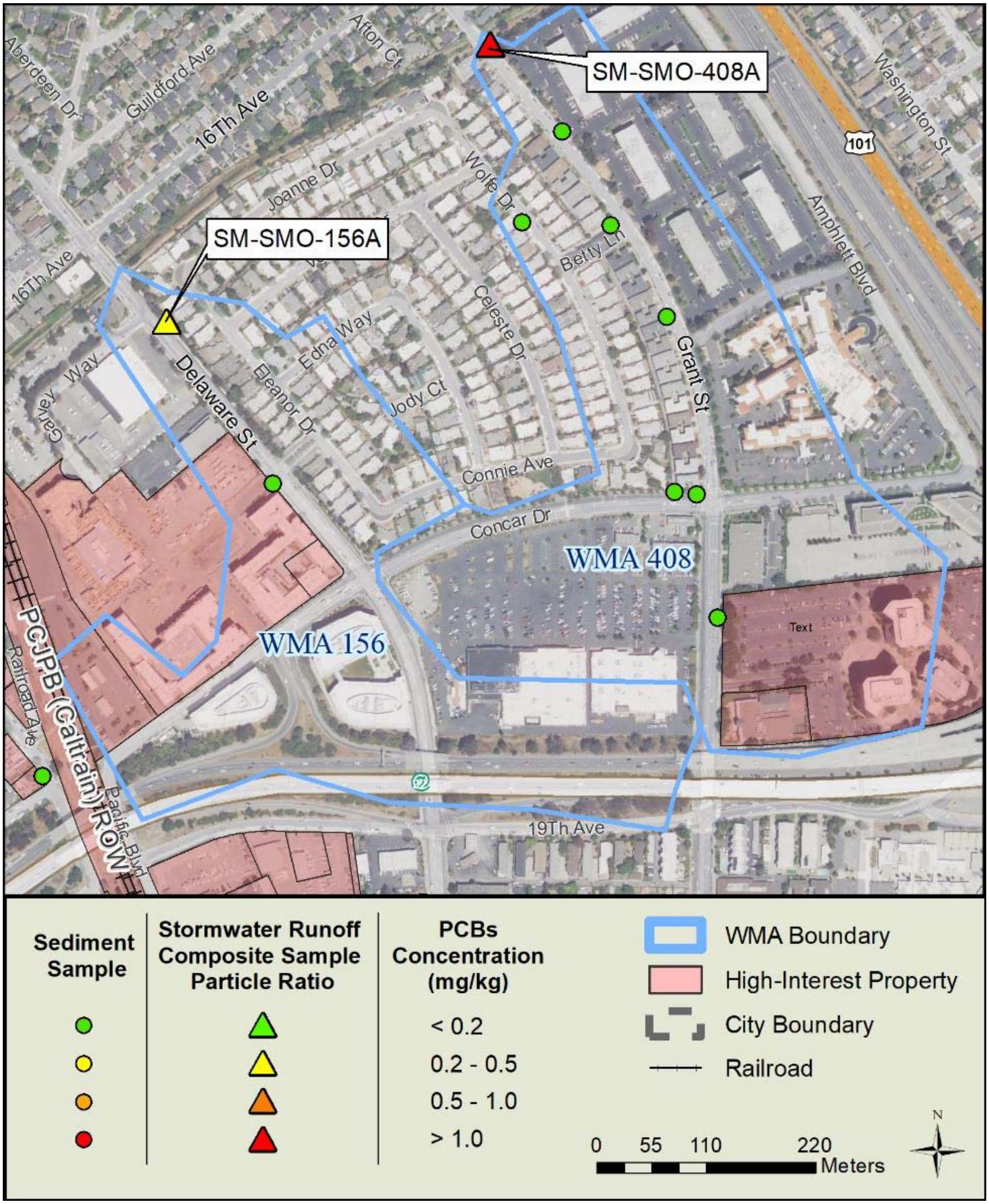

Figure 16. WMAs 156 and 408

5.5.5. City of Belmont

WMAs in the City of Belmont with PCBs particle ratio greater than 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figure 17 and briefly described below.

WMA 60

WMA 60 is a 298-acre catchment that drains north into Laurel Creek. Two stormwater runoff samples were collected in the catchment in WY 2017 (SM-BEL-60A and SM-BEL-60B). Sample SM-BEL-60A was not elevated but SM-BEL-60B had a relatively high PCBs particle ratio (1.0 mg/kg). This result was noteworthy since the sample catchment is mostly residential with few high interest parcels. In WY 2018, seven sediment samples were collected in this catchment, all of which had relatively low PCBs concentrations (less than 0.2 mg/kg). In WY 2019 an additional sediment sample was collected that also had a very low PCBs concentration (0.002 mg/kg). Given the previous elevated stormwater runoff sample result and the low concentrations in the sediment samples, it may be advisable to resample the stormwater runoff station.

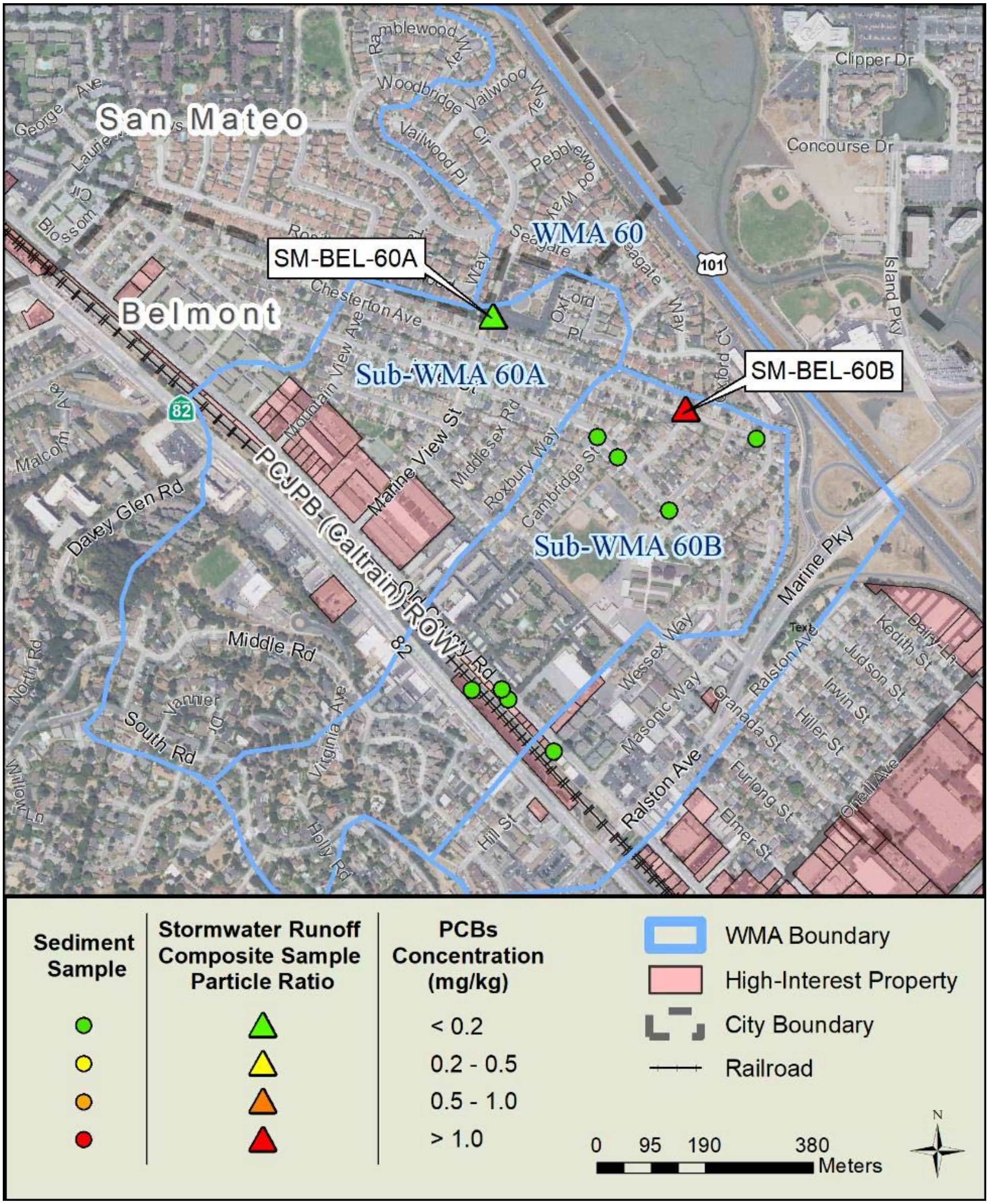

Figure 17. WMA 60

5.5.6. City of San Carlos

WMAs in the City of San Carlos with PCBs particle ratios greater than 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figure 18 – 21 and briefly described below.

WMA 75

WMA 75 is a 66-acre catchment comprised entirely of old industrial land uses. Sample SM-SCS-75A (Industrial Road Ditch) was collected by the RMP in WY 2016 and had a PCBs particle ratio of 6,140 ng/g, which is among the highest levels found in Bay Area stormwater samples collected to-date. The sample station is located where the MS4 daylights into a ditch on the east side of Industrial Road downstream of the adjacent Delta Star and Tiegel Manufacturing properties. SMCWPPP collected seven sediment samples in WY 2017 in the area. Two of these samples were collected near the Delta Star and Tiegel properties. One was collected in the storm drain line directly downstream of both properties and had a very elevated PCBs concentration (49.4 mg/kg). The other was also elevated, with a PCBs concentration of 1.20 mg/kg, and was collected from surface sediments at the location where the Tiegel property drains into the public right-of-way. In WY 2018, SMCWPPP collected a sample across the street from Delta Star in front of the PG&E property. The sample had a PCBs concentration of 0.76 mg/kg. It is not believed that the PCBs in this sample originated from the PG&E property given that the sample only drained a portion of the front parking lot. Rather, the PCBs were more likely present at this location due to a halo effect around Delta Star. For example, groundwater has been observed in the MS4 in this area due to a high-water table, tidal effects, and infiltration. PCBs-containing sediments potentially could have been conveyed upstream in the storm drain line by groundwater that infiltrated into the pipe. The remainder of the PG&E property drains toward the east. The remaining samples were not elevated, suggesting that there are no other sources of PCBs in this WMA other than Delta Star and Tiegel properties (Figure 18).

Delta Star manufactures transformers, including transformers with PCBs historically (from 1961 to 1974). This is a cleanup site with elevated PCBs found in on-site soil and groundwater samples. PCBs migrated to the adjacent Tiegel property at 495 Bragato Road, a roughly three-acre site that is largely unpaved. A “Removal Action” under DTSC oversight was implemented between June 1989 and January 1991 to remove soil impacted with PCBs exceeding 25 ppm. The Delta Star and Tiegel properties currently meet public health, safety, and the environmental cleanup goals based on human exposure at the site. However, based on the PCBs concentrations in the sediment and stormwater runoff samples, the site appears to be a source of PCBs to the MS4 and San Francisco Bay at levels that are a concern from the standpoint of the Bay PCBs TMDL (i.e., contribute to bioaccumulation in Bay fish and other wildlife). SMCWPPP worked with the City of San Carlos to refer these properties to the Regional Water Board for potential additional investigation and abatement.

WMA 31 (Pulgas Creek Pump Station North)

WMA 31 is a 99-acre catchment that drains to the Pulgas Creek pump station from the north. In addition to elevated sediment samples collected by SMCWPPP from the pump station sump, the RMP collected four stormwater runoff samples from the bottom of catchment (i.e., where flows enter the pump station from the north) during two storms in WY 2011. The samples were all elevated, with an average PCBs particle ratio of 893 ng/g. In addition, street dirt and sediment samples with elevated PCBs have been collected in front of and in the vicinity of 977 Bransten Road, a property within WMA 31 (Figure 19). The current occupant of this property is GC Lubricants. 977 Bransten Road is a DTSC cleanup site due to soil and groundwater contamination with PCBs and other pollutants associated with activities at GC Lubricants and California Oil Recyclers, Inc., a previous tenant at the site. 1007/1011 Bransten Road is the property located adjacent to and immediately north of 977 Bransten Road and designated the "Estate of Robert E. Frank." A DTSC "Site Screening Form" describes PCBs in the subsurface on both sides of border between the two properties and states there may have been a historic source on both sides of the property line. Abatement measures have been implemented to reduce movement of contaminated soils from the properties, including a concrete cap over contaminated areas. However, the available information suggests that soils/sediments with PCBs are migrating from these properties into the public ROW, including the street and the MS4. SMCWPPP worked with the City of San Carlos to refer these properties to the Regional Water Board for potential additional investigation and abatement.

WMA 210 (Pulgas Creek Pump Station South)

WMA 210 is a 141-acre catchment that drains to the Pulgas Creek pump station from the south (Figures 20 and 21). In addition to elevated sediment samples collected by SMCWPPP from the pump station sump, the RMP's STLS has collected 33 storm samples at the bottom of this catchment (i.e., where flows enter the pump station from the south):

- WY 2011 – four samples collected in February and March 2011.
- WY 2013 – four samples collected in March 2013.
- WY 2014 – 25 samples collected from November 2013 through March 2014.

The 33 samples had an average PCBs particle ratio of 8,220 ng/g, the highest of any stormwater runoff sampling location in the Bay Area. There appear to be several sources of PCBs within this WMA.

The best documented of these sites is the property at 1411 Industrial Road. A sediment sample with a very elevated PCBs concentration (193 mg/kg) was previously collected from a storm drain inlet located in the parking lot of this 1.3-acre property. The property drains to the MS4 at a manhole at the sidewalk along the edge of Industrial Road where other elevated sediment samples have been collected. Since 2012 the occupant of this property has been a Habitat for Humanity Re-Store. Based upon records from the San Mateo County Department of Environmental Health, before that the property was occupied by an auto body shop and an automotive paint company. Between 1958 and 1994, Adhesive Engineering / Master Builders, Inc. was the occupant and conducted manufacturing, research and development of construction grade epoxy resin and products. Adhesive Engineering / Master Builders, Inc. had a history of violations for leaky wastewater drums and improper storage of hazardous wastes in the late 1980s and early 1990s, and PCBs were reportedly used on the site in the past. An environmental assessment report conducted as part of a business closure in 1994 revealed that 93 mg/kg PCBs was found in a soil sample collected in 1987. The soil sample was collected beneath an aboveground tank that was heated by oil-containing PCBs circulating in coils around the tank. The report also described the removal in 1987 of 44 cubic yards of contaminated soil from the area where the tank was located. As part of the 1994 environmental assessment, a soil sample was collected from the same area and PCBs were not detected at that time, but soil samples from other areas on the property were not collected and tested for PCBs. The above information suggests that the 1411 Industrial Road property is a source of PCBs to the MS4. Regional Water Board staff is currently working with the property owner to investigate and clean up the site. SMCWPPP is currently working with the City of San Carlos to explore the possibility of referring this property to the Regional Water Board for potential additional investigation and abatement.

In WY 2017, SMCWPPP collected ten sediment samples from the WMA 210 to better delineate the sources of PCBs in this catchment. Three samples were collected in the vicinity of 1411 Industrial Road to help rule out that neighboring properties are PCBs sources. All three of these samples had relatively low PCBs concentrations, with the highest having a PCBs concentration of 0.07 mg/kg, which helps to verify that the properties to the east and south are not also sources. Multiple sediment samples previously collected around the PG&E substation across the street also had relatively low levels of PCBs, suggesting that this property is not a source.

PCBs were previously found in inlets and manholes in the vicinity of Center, Washington and Varian Streets and Bayport Avenue (Figure 21). The PCBs in these samples could have originated from any of about 20 small industries on these streets. During WY 2017, seven additional samples were collected in this area. The results suggest that three small properties may be PCBs sources. Two samples collected from the driveways of 1030 Washington Street, a construction business, had elevated PCBs (1.29 and 3.73 mg/kg). A sample from the driveway of 1029 Washington Street was also elevated with a concentration of 5.64 mg/kg. In addition, samples from the driveway of 1030 Varian Street, an unpaved lot used for storage, had an elevated PCBs concentration of 1.84 mg/kg. It should be noted that all the buildings in this area appear to be of the type and age that could potentially have PCBs in building materials.

In WY 2018, SMCWPPP collected two sediment samples along Washington Street. The first sample was from the gutter upstream of 1030 Washington Street and had a PCBs concentration of 0.25 mg/kg. The second sample was from the gutter upstream of 1029 Washington Street and had a PCBs concentration of 0.06 mg/kg. These relatively low concentrations suggest that the sources of PCBs are not upstream of the two properties of interest along Washington Street.

When a previously unknown potential source property is revealed via the PCBs and mercury monitoring program, SMCWPPP conducts a follow-up review of current and historical records regarding site occupants and uses, hazardous material/waste use, storage, and/or release, violation notices, and any remediation activities. Apart from databases such as EPA's Toxic Release Inventory (TRI) and Envirofacts, and the State of California's Geotracker and Envirostor, the most useful records were often kept by San Mateo County Department of Environmental Health. In contrast to 1411 Industrial Road (see above), the review of records for 1030 Washington Street, 1029 Washington Street, and 1030 Varian Street did not reveal any obvious use or release of PCBs in the past.

In WY 2020, SMCWPPP collected eight additional sediment samples in the area where the above three small properties (1030 Washington Street, 1029 Washington Street, and 1030 Varian Street) are located, including upstream and downstream samples. Accounting for the normal variability in this type of sampling, the results were very consistent with the past results, and continue to suggest that three small properties may be PCBs sources. SMCWPPP is currently working with the City of San Carlos to determine next steps for these properties.

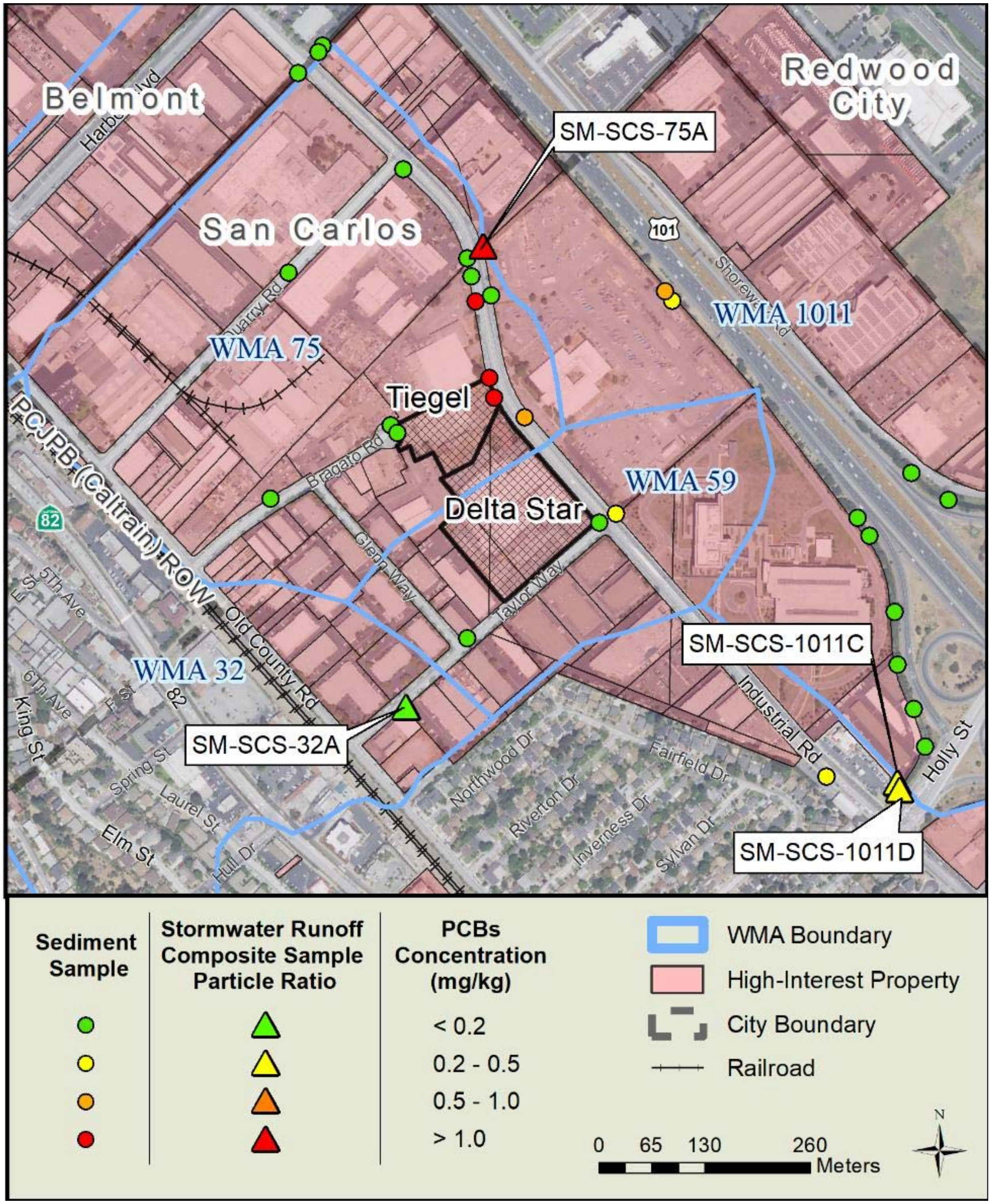

Figure 18. WMAs 59, 75, and 1011

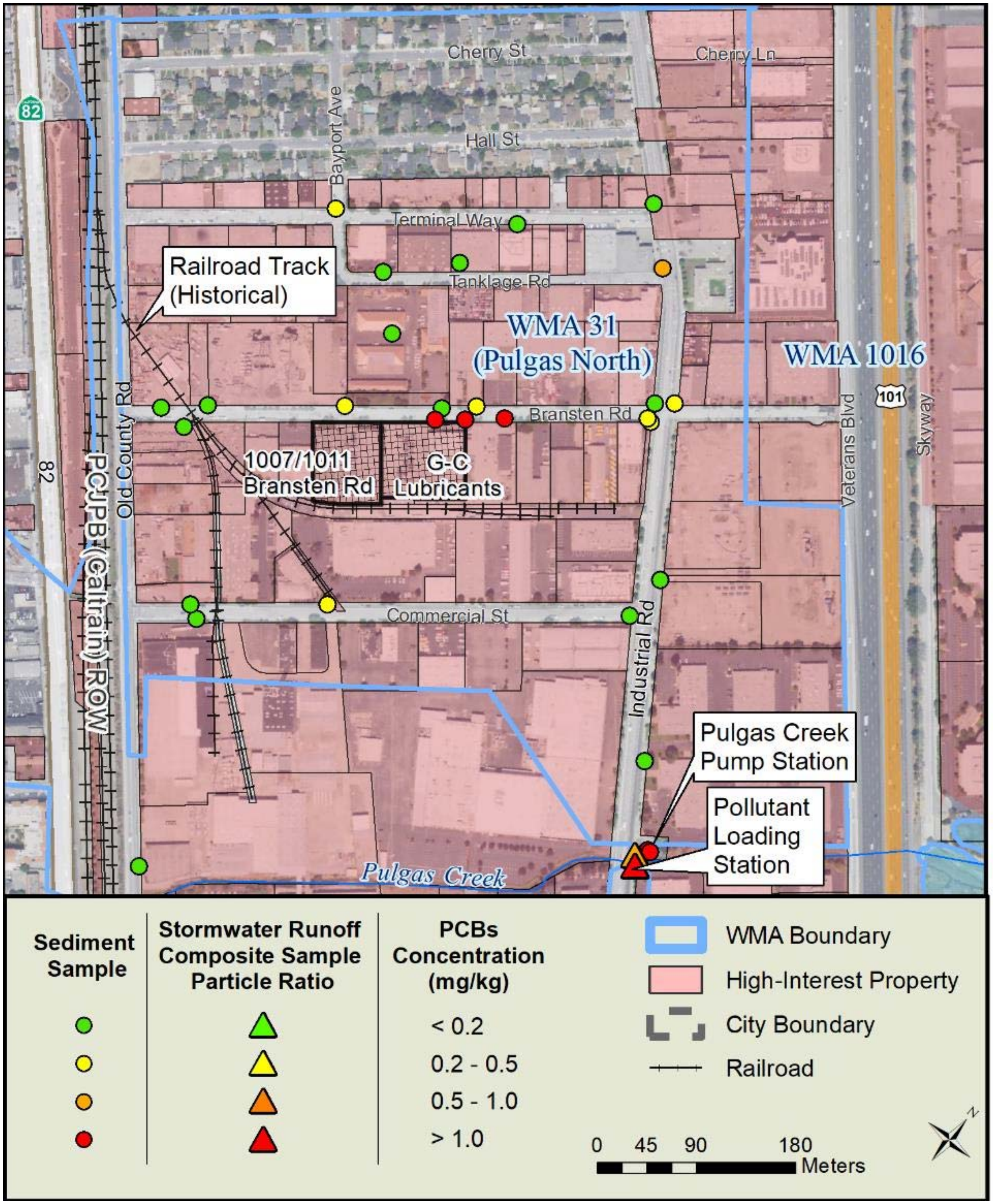

Figure 19. WMA 31

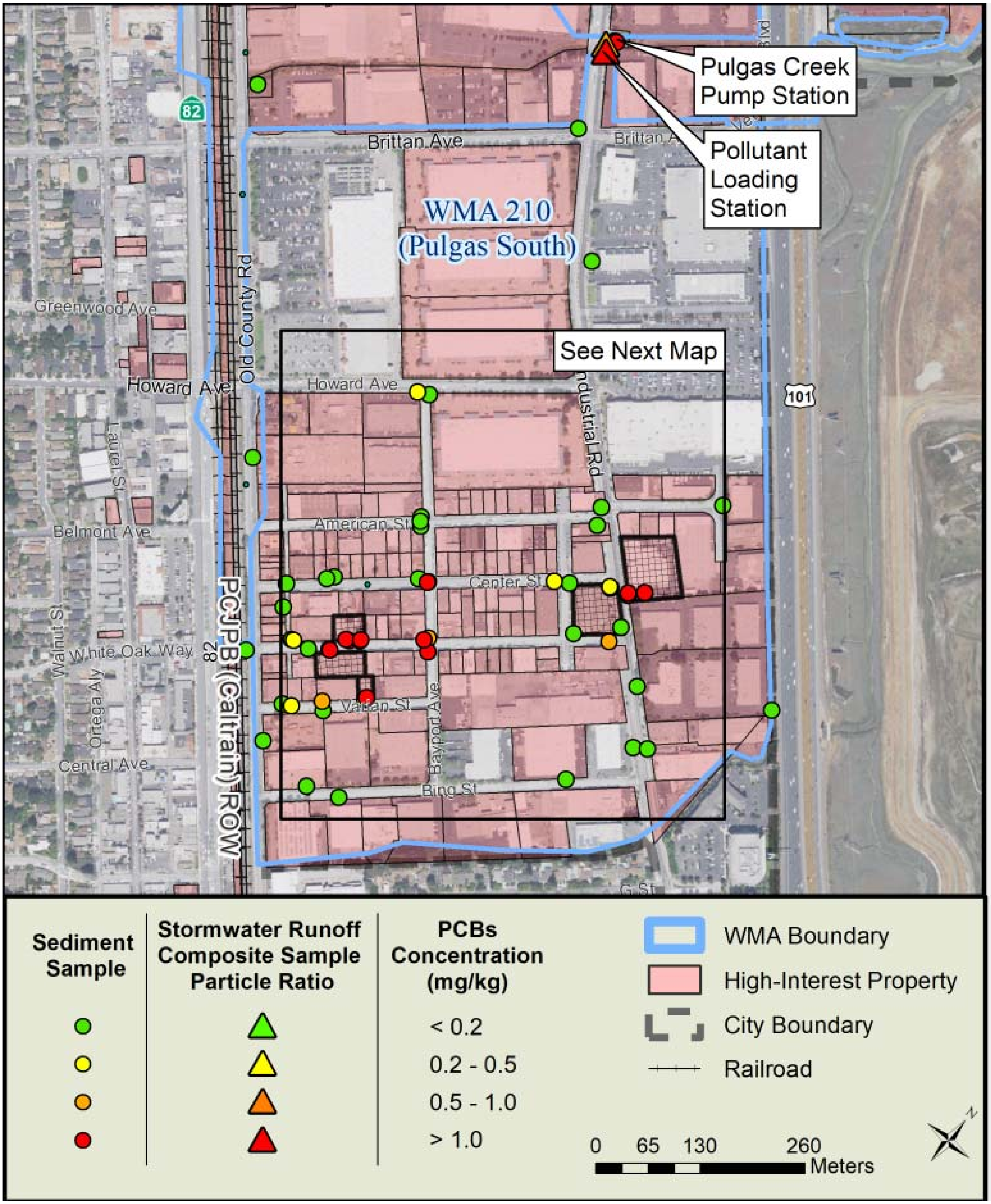

Figure 20. WMA 210

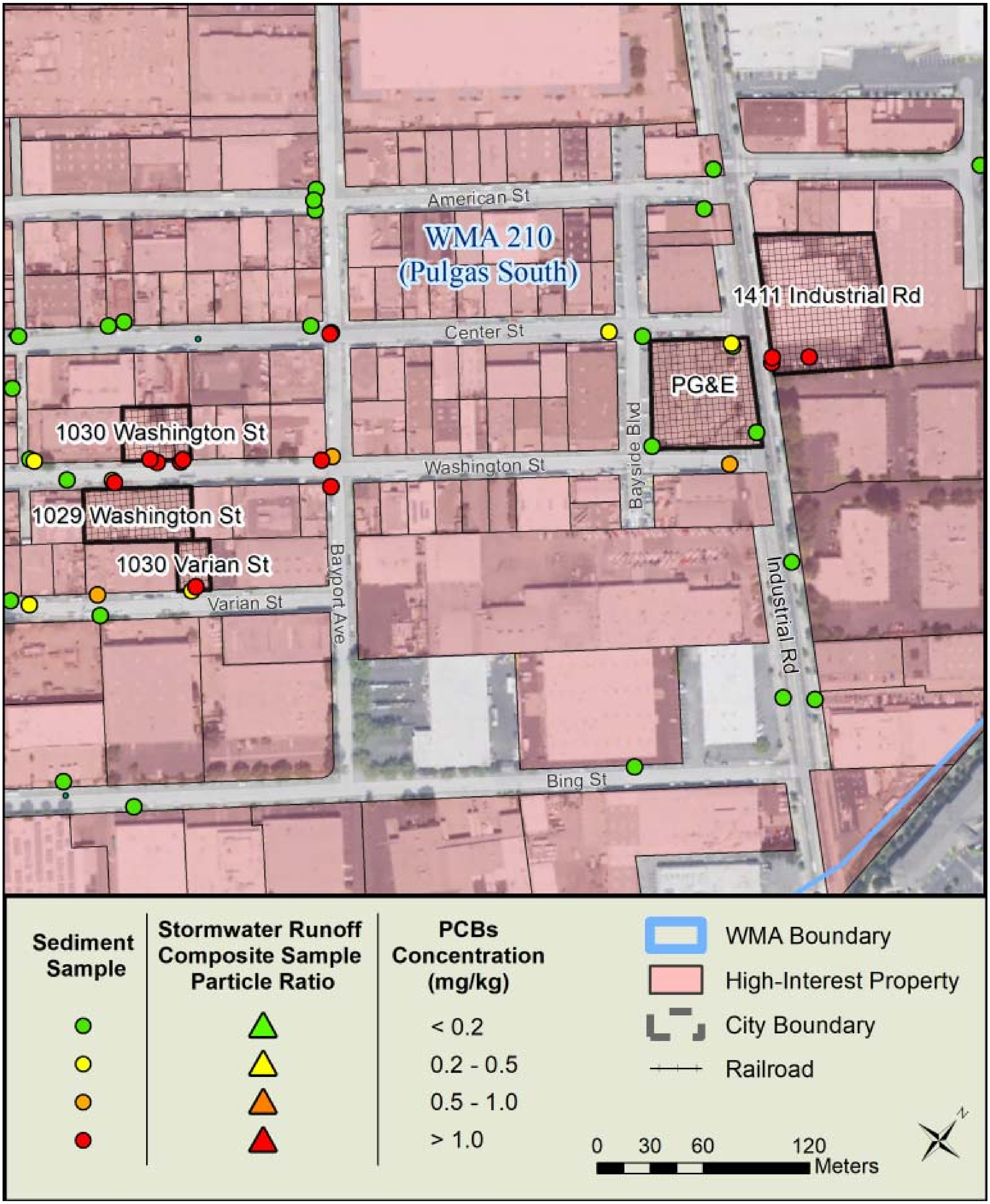

Figure 21. WMA 210 – Enlargement of Sampled Area

5.5.7. City of Redwood City

WMAs in the City of Redwood City with PCBs particle ratio greater than 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figure 22 – 25 and briefly described below.

WMA 379

WMA 379 (Figures 22 and 23) is an 802-acre catchment located in Redwood City and the unincorporated North Fair Oaks census-designated place (CDP). The catchment is divided into a northerly half (A) and a southerly half (B), each with a distinct MS4 outfall. Both outfalls were sampled by SMCWPPP in WY 2016. Sample SM-RCY-379A had a relatively low PCBs particle ratio (105 ng/g). Sample SM-RCY-379B also had a relatively low PCBs particle ratio (182 ng/g). In WY 2017, SMCWPPP collected fifteen samples in WMA 379 in an attempt to identify PCBs source along Bay Road and Spring Street, in follow-up to elevated sediment samples collected during previous years, including a sediment sample with an elevated PCBs concentration (6.93 mg/kg) collected in 2014 from a storm drain inlet on Spring Street (Amec 2015). None of nine samples collected in the Bay Road near Hurlingame Avenue area was elevated, with the highest PCBs concentration being 0.14 mg/kg. A single sample collected by SMCWPPP from an inlet at the back of the sidewalk in front of 2201 Bay Road had an elevated PCBs concentration of 1.97 mg/kg. This area includes two properties listed for PCBs on GeoTracker[13]: Tyco Engineering Products and an adjacent railroad spur. The Tyco site was remediated and redeveloped (MRP Provision C.3 compliant) and is currently a parking lot for Stanford Hospital. Four sediment samples were collected on Spring Street in WY 2017. None was elevated, with the highest PCBs concentration being 0.08 mg/kg. In WY 2018, two additional samples were collected to further verify the lower results along Spring Street, and to test for the presence of any PCBs sources along Charter Street on the south side of the old Tyco property. Both samples had low concentrations of PCBs (less than 0.2 mg/kg).

A total of 43 sediment samples and 2 composite stormwater runoff samples have been collected to-date in WMA 379 by SMCWPPP and others, but the only potential PCBs source area that has been identified is the former Tyco site and adjacent historical railroad spur. In April 2019, Regional Water Board staff informed SMCWPPP that they plan to include a conditional requirement to clean out the storm drain as part of the proposed cap modification and redevelopment of the property and may have the opportunity to request additional post-cleanout monitoring. SMCWPPP will continue to track these efforts and will request PCBs load reduction credit as appropriate.

WMA 405/1000

WMA 405 (Figure 24) consists almost entirely of SIMS Metal Management at the Port of Redwood City. Samples collected in WYs 2015 and 2017 from the driveway of SIMS and in close proximity to the site but another catchement (WMA 1000) had elevated PCBs concentrations of 0.57 and 0.75 mg/kg, respectively. Sims has implemented practices to prevent metal fluff potentially containing a variety of contaminants (including PCBs) from entering the Bay.

[13] GeoTracker is the State Water Resources Control Board's Internet-accessible database system used to track and archive compliance data from authorized or unauthorized discharges of waste to land, or unauthorized releases of hazardous substances from underground storage tanks.

WMA 239

WMA 239 (Figure 25) is a 36-acre mostly industrial catchment that is half in Redwood City and half in Menlo Park. In WY 2015, SMCWPPP collected a sediment sample in this catchment that had an elevated PCBs concentration of 0.57 mg/kg. Four additional sediment samples were collected in WY 2017, all of which had relatively low (urban background) PCBs concentrations, with the highest concentration being 0.16 mg/kg. Currently in this WMA there is a large housing redevelopment that is almost complete. One of the areas that was redeveloped (Haven Avenue Industrial Condominiums) at 3633 Haven Avenue was remediated for PCBs contamination in 2006. Stormwater runoff sampling has not been conducted in this catchment due to a lack of public access to the catchment outfall (which discharges to the Bay).

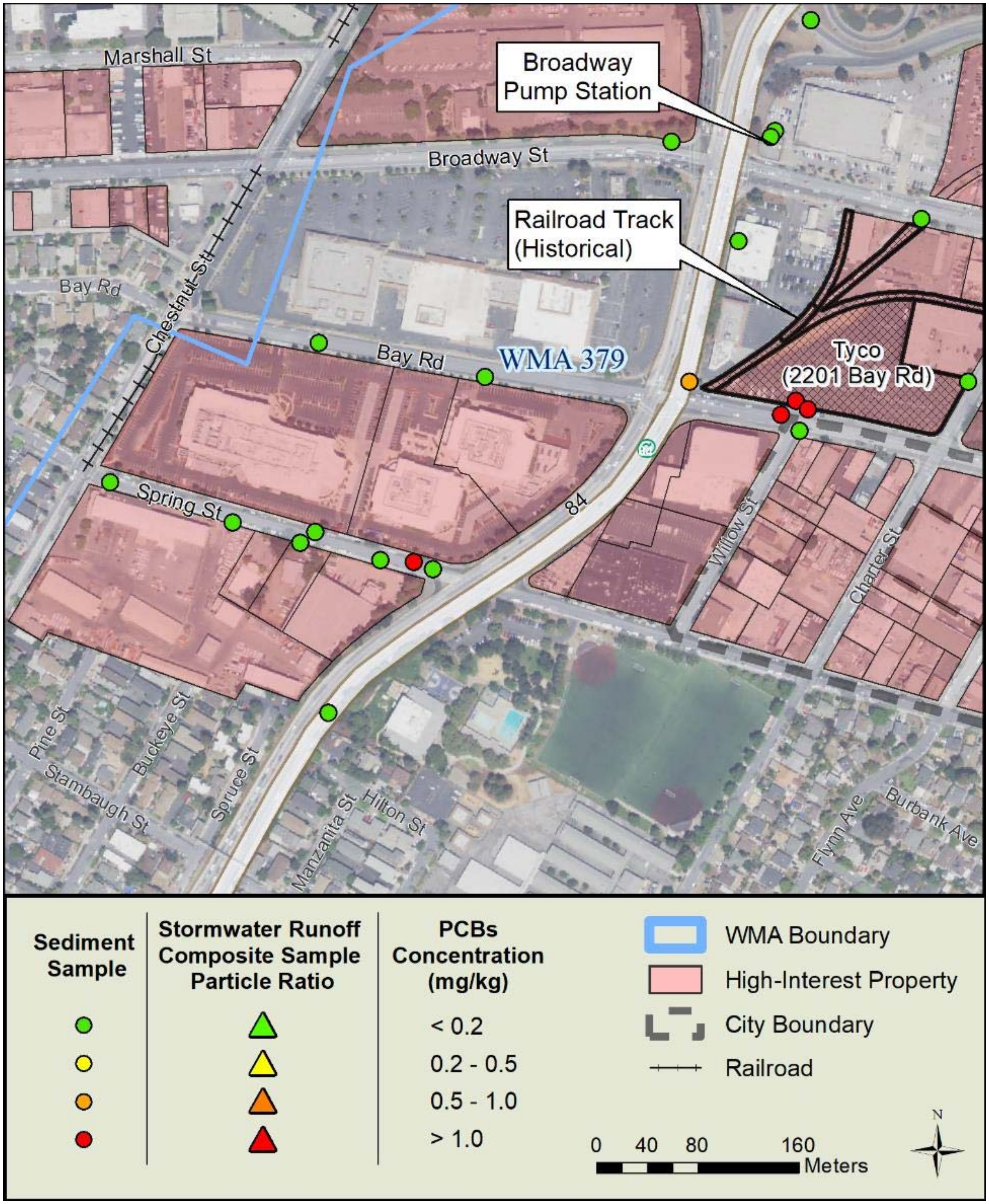

Figure 22. WMA 379 (northwest portion)

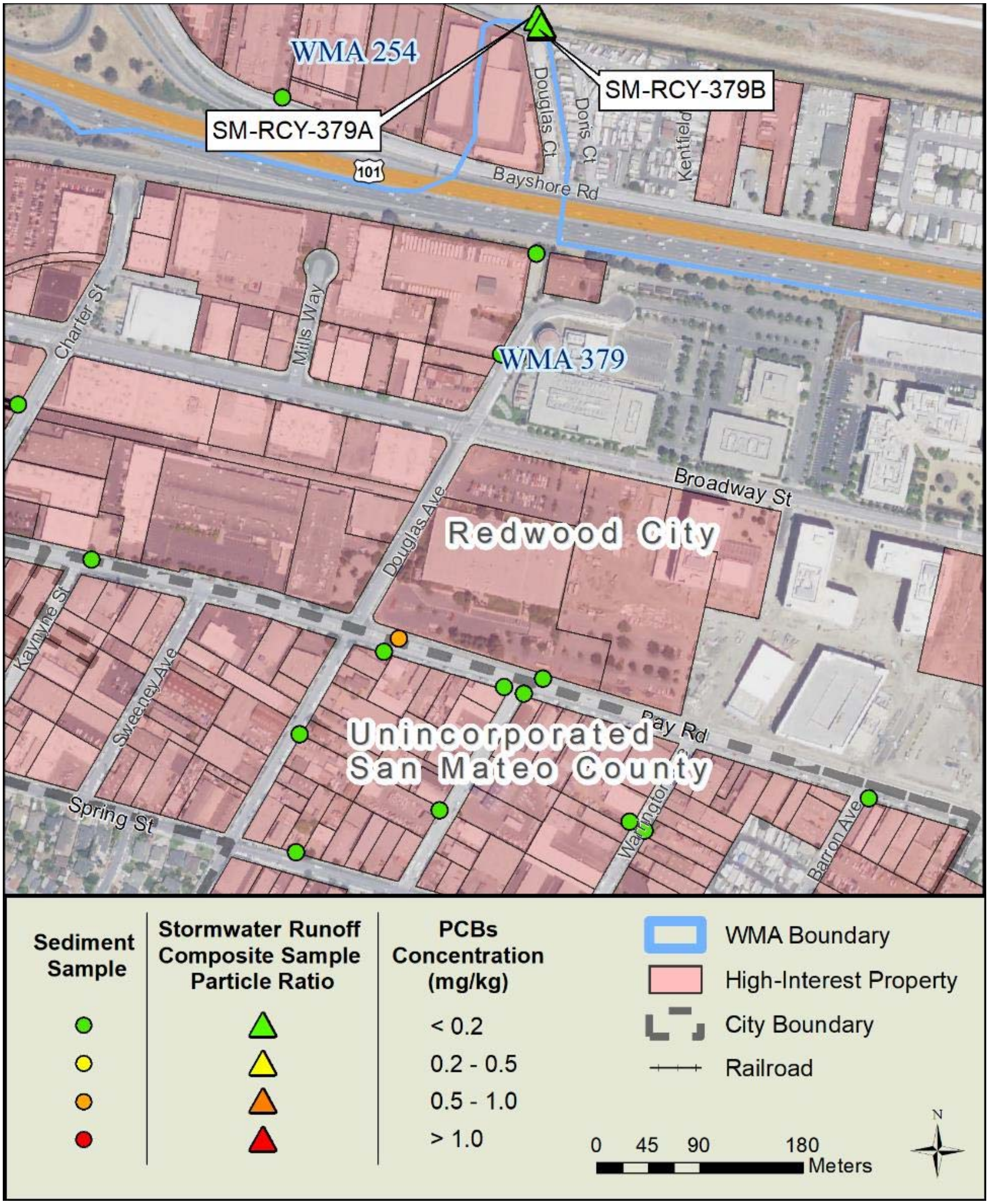

Figure 23. WMAs 254 and 379 (southeast portion)

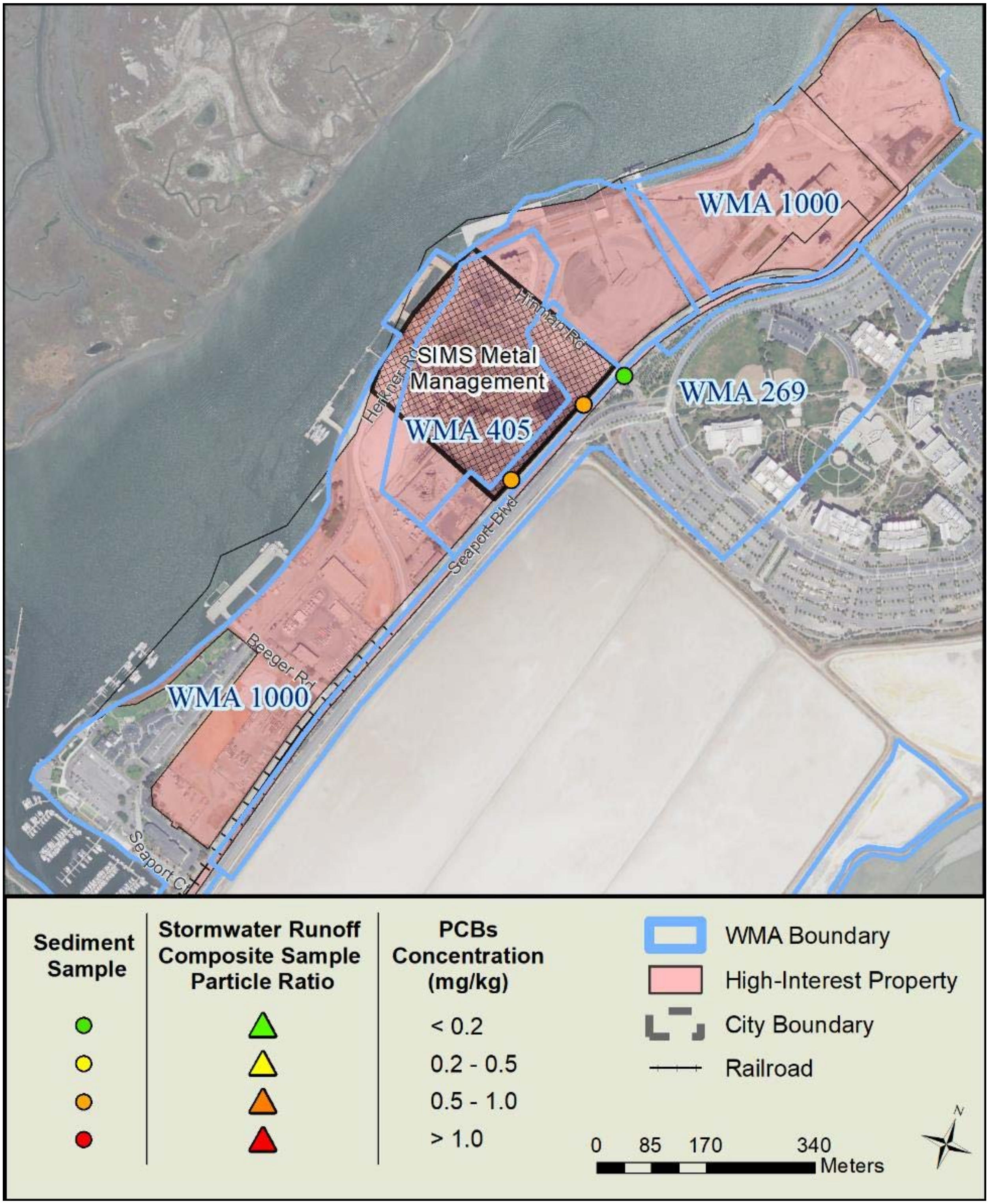

Figure 24. WMAs 269, 405, 1000

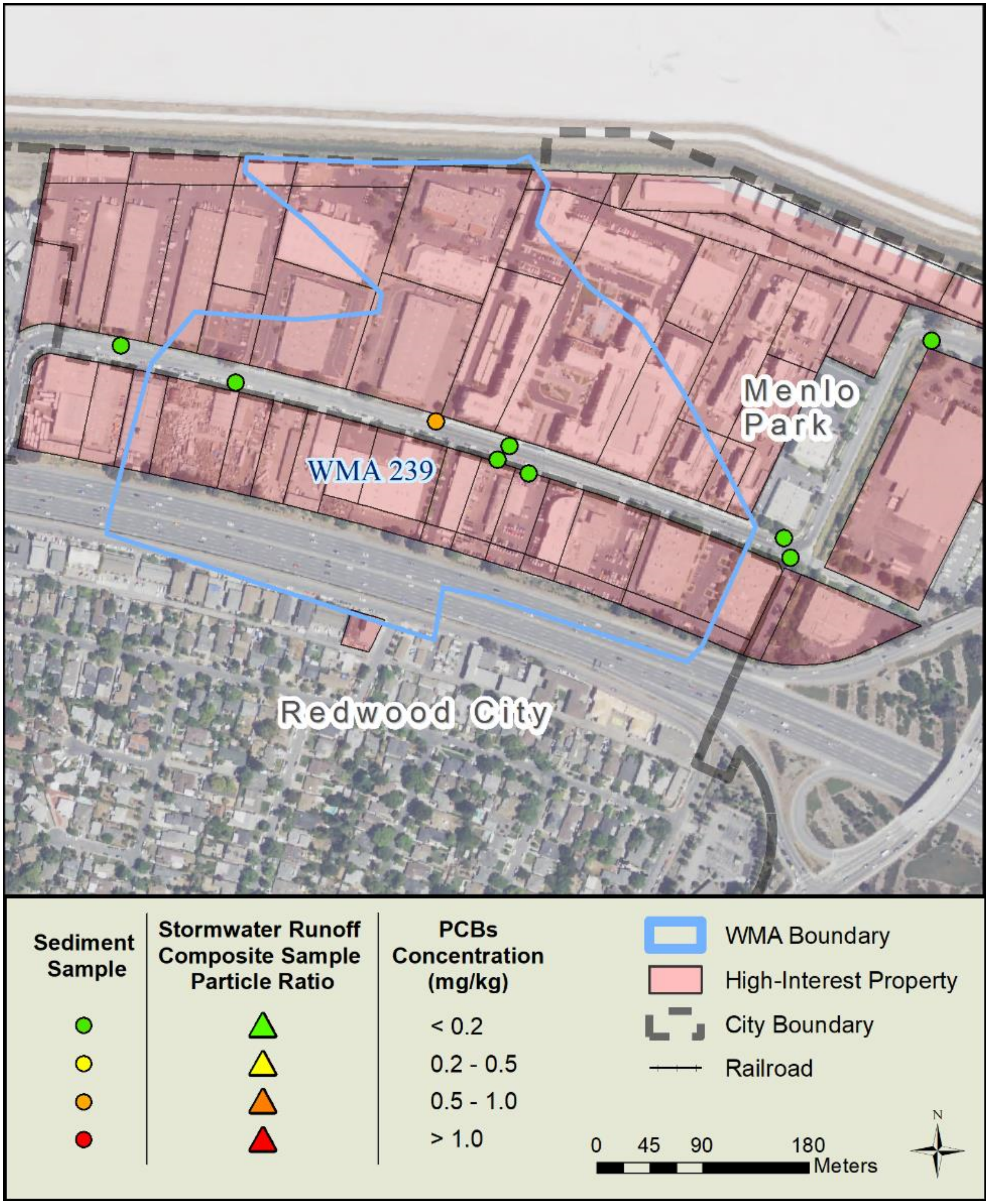

Figure 25. WMA 239

5.5.8. City of East Palo Alto

WMAs in the City of East Palo Alto with PCBs particle ratios greater than 0.2 mg/kg in stormwater runoff samples, elevated concentrations of PCBs in sediment samples, and/or other features relevant to investigating sources of PCBs are shown in Figure 26 and briefly described below.

WMA 70

WMA 70 is a 490-acre catchment. A stormwater runoff sample collected by the RMP in WY 2015 had an elevated total PCBs concentration (28.5 ng/L) but a relatively low PCBs particle ratio (108 ng/g). Three sediment samples collected by SMCWPPP in the area in WY 2017 had relatively low PCBs concentrations, with the highest having a concentration of 0.03 mg/kg.

WMA 1015/72

WMA 1015 consists of multiple catchments in the City of East Palo Alto. This WMA contains Romic Environmental Technologies Corporation, a property that is known to be contaminated with PCBs and has been vacant for many years. A stormwater runoff sample and two sediment samples in close proximity to the Romic driveway but in another catchement (WMA 72) all had relatively low concentrations of PCBs. WMA 1015 also contains 391 Demeter, a property that formerly was used to stockpile soils with PCBs that were removed from a separate remediation site. The site is expected to be redeveloped. This property drains directly to the Bay, and is all private property and inaccessible. A sediment sample from an inlet at the north end of Demeter Street (WMA 67) was moderately elevated in PCBs with a concentration of 0.21 mg/kg.

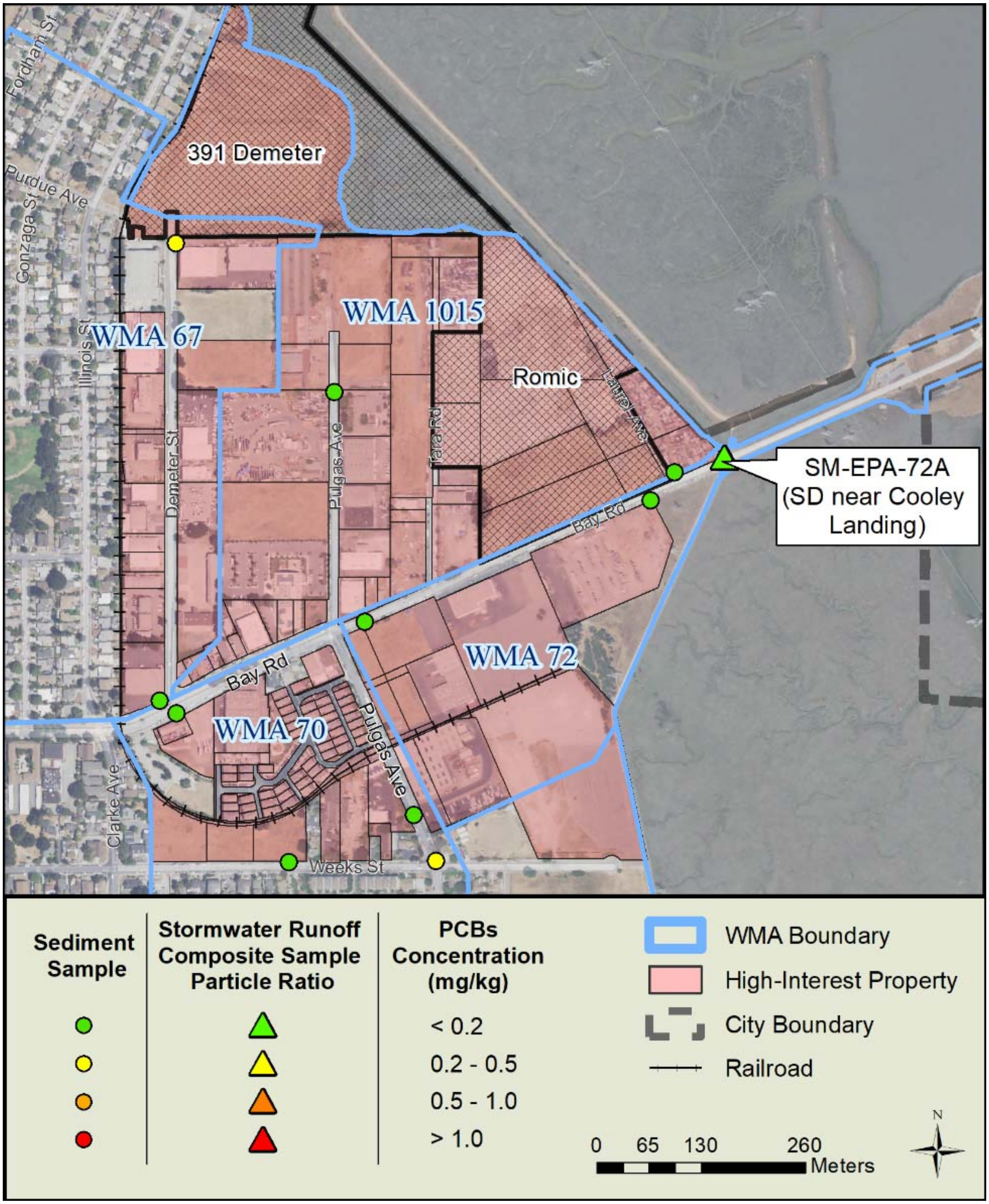

Figure 26. WMAs 70, 72, 1015

6.0 COPPER, NUTRIENTS, AND EMERGING CONTAMINANTS

The below sections summarize WY 2020 water quality monitoring and related activities conducted for copper, nutrients, and emerging contaminants. Copper and nutrient monitoring stations are shown in Figures 1 and 2 (see Section 3.0)

6.1. Copper

The Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan) includes a Water Quality Attainment Strategy (WQAS) to support copper site-specific objectives for San Francisco Bay (SFBRWQCB 2017). The WQAS for copper states that NPDES permits for urban runoff management agencies must require implementation of best management practices (BMPs) and control measures designed to prevent urban runoff discharges from causing or contributing to exceedances of copper Water Quality Objectives (WQOs). These measures are included in MRP Provision C.13. Additionally, the WQAS requires that NPDES permits contain requirements to conduct or cause to be conducted monitoring of copper loading to the Bay. The RMP Status and Trends Monitoring Program currently collects water and sediment samples from San Francisco Bay every two or three years for analysis of a large suite of toxic contaminants, including copper. In addition to the RMP studies, copper monitoring is required by MRP Provision C.8.f.

On July 9, 2020, SMCWPPP collected two grab creek water samples that were analyzed for copper, thus meeting the yearly minimum number of copper samples required by MRP Provision C.8.f. Samples for nutrient analysis were also collected at these same two stations (Figures 1 and 2, Section 3.0). Biological assessment monitoring was also conducted at these stations in the spring of 2020. The goal of SMCWPPP's WY 2020 copper monitoring was to address Management Question No. 4 (Loads and Status) by characterizing copper concentrations in mixed land use watersheds during the dry season.

These data are supplemented by one SPoT sediment sample collected July 15, 2020 from San Mateo Creek and analyzed for copper and other pollutants to assess long-term trends in large, mixed-use watersheds (Management Question No. 5). The SPoT analytical data are not available yet.

All SMCWPPP samples were analyzed for total and dissolved copper[14] (EPA Method EPA 200.8) and hardness (Standard Method SM 2340C). Results are summarized in Table 10. Comparisons to WQOs are included in Section 7.0.

Based on the laboratory results, the following findings were noted:

- As expected, dissolved copper concentrations were lower than total copper concentrations.
- Similar types of sites (streams draining mixed land uses) and flow conditions (baseflow) were sampled for copper by SMCWPPP during prior years (WYs 2017, 2018, and 2019; n=5) (SMCWPPP 2020). Total (0.43 and 0.68 µg/L) and dissolved (0.37 and 0.64 µg/L) copper concentrations measured in WY 2020 were within the ranges for these constituents measured in prior years (0.48 to 14 µg/L total copper and 0.41 to 12 µg/L dissolved copper).

[14] In order to simplify the field effort and reduce the risk of sample contamination, SMCWPPP requested that the analytical laboratory conduct the sample filtration required for dissolved copper analysis.

Table 10. Total and Dissolved Copper Concentrations in WY 2020 SMCWPPP Water Samples.

Station ID	Date Collected	Description	Total Copper (µg/L)	Dissolved Copper (µg/L)	Hardness as $CaCO_3$ (mg/L)
204R01256	July 9, 2020	Arroyo Ojo de Agua at Stulsaft Park (City of Redwood City)	0.68	0.64	560
202R01308		Pilarcitos Creek downstream of Highway 101 (City of Half Moon Bay)	0.43 J	0.37 J	160

Notes:

J = The reported result is an estimate. The value is less than the reporting limit but greater than the method detection limit.

6.2. Nutrients

Nutrients were included in the MRP POC monitoring requirements to support Regional Water Board efforts to develop nutrient numeric endpoints (NNE) for the San Francisco Bay Estuary. The "San Francisco Bay Nutrient Management Strategy" (NMS) is part of a statewide initiative to address nutrient over-enrichment in State waters (SFBRWQCB 2012). Its goal is to lay out a well-reasoned and cost-effective program to generate the scientific understanding needed to fully support major management decisions such as establishing/revising objectives for nutrients and dissolved oxygen, developing/implementing a nutrient monitoring program, and specifying nutrient limits in NPDES permits. The NMS monitoring program currently focuses on stations located within San Francisco Bay rather than freshwater tributaries.

MRP Provision C.8.f. requires monitoring for a suite of nutrients (i.e., ammonium, nitrate, nitrite, total Kjeldahl nitrogen (TKN), orthophosphate, and total phosphorus). This list is similar to the list of analytes measured by the RMP and BASMAA partners at the six regional loading stations (including the San Mateo County station in at the Pulgas Creek Pump Station in the City of San Carlos) monitored in WY 2012 - WY 2014. The prior data collected in freshwater tributaries to San Francisco Bay were used by the Nutrient Strategy Technical Team to develop and calibrate nutrient loading models.

On July 9, 2020, SMCWPPP collected two grab creek water samples that were analyzed for nutrients, thus meeting the yearly minimum number of nutrient samples required by MRP Provision C.8.f. Samples for copper analysis were also collected at these same two stations (Figures 1 and 2, Chapter 3.0). Biological assessment monitoring was also conducted at these stations in the spring of 2020. SMCWPPP's WY 2020 nutrient monitoring addresses Management Question No. 4 (Loads and Status).

The nutrient sample analytes and chemical analysis methods were ammonia (SM 4500 C), nitrate (EPA 300.0), nitrite (SM 4500 B), TKN (SM 4500 C), orthophosphate (SM 4500 E), and total phosphorus (SM 4500 E). Results are summarized in Table 11. For comparison, results from nutrient samples collected in the spring synoptic with biological assessment monitoring are also summarized in Table 11. Comparisons to freshwater WQOs are described in Section 7.0.

Based on the laboratory results, there was very little difference between the spring and summer concentrations of nitrate, nitrate, dissolved orthophosphate, and phosphorus. In contrast, the TKN concentrations were lower in the summer samples compared to the spring samples, and the ammonia concentrations were higher in the summer samples compared to the spring samples.

Table 11. Nutrient Concentrations in SMCWPPP WY 2020 Water Samples.

Station ID	Date Collected	Nitrate as N	Nitrite as N	Total Kjeldahl Nitrogen (TKN)	Ammonia as N	Un-ionized Ammonia as N [1]	Ammonium [2]	Total Nitrogen [3]	Dissolved Orthophosphate as P	Phosphorus as P
POC Monitoring (Provision C.8.f.)										
204R01256	7/9/2020	0.31	0.002 J	0.083 J	0.43	0.014	0.42	0.40	0.087	0.10
202R01308	7/9/2020	0.28	0.002 J	0.22	0.32	0.007	0.31	0.50	0.072	0.083
Biological Assessment Monitoring (Provision C.8.d.)										
204R01256	5/19/2020	0.31	0.003 J	0.11	0.091	0.0012	0.09	0.42	0.074	0.12
202R01308	5/18/2020	0.39	0.002 J	0.41	0.12	0.0006	0.12	0.80	0.11	0.091

Notes:

All constituents reported as mg/L.

J-flagged data are above the detection limit but less than the reporting limit and are therefore considered estimated.

ND = Not Detected

[1] Un-ionized ammonia calculated using formula provided by the American Fisheries Society Online Resources (https://fisheries.org/books-journals/online-resources/). Formula requires field measurements of temperature, pH, and specific conductance.

[2] Ammonium = ammonia – un-ionized ammonia.

[3] Total nitrogen = TKN + nitrate + nitrite.

6.3. Emerging Contaminants

Emerging contaminant monitoring is being addressed through the SMCWPPP's participation in the RMP. The RMP has investigated Contaminants of Emerging Concern (CECs) since 2001 and established the RMP Emerging Contaminants Work Group (ECWG) in 2006. The purpose of the ECWG is to identify CECs that might impact beneficial uses in the Bay and to develop cost-effective strategies to identify, monitor, and minimize impacts. In 2013, the RMP published the first version of the CEC Strategy, a "living" document that guides RMP special studies on CECs using a tiered risk-based and management action framework (Sutton et al. 2013). Over the intervening years, the CEC Strategy has been updated several times (Sutton and Sedlak 2015, Sutton et al. 2017, Lin et al. 2018). In 2020, a secondary factor was added to the tiered risk-based framework for CECs to address persistence of CECs in the environment. The 2020 update also outlines the strategy for integrating predictive toxicology to supplement the tiered risk-based framework (Miller et al. 2020).

Provision C.8.f. of the MRP identifies three emerging contaminants that must be addressed through POC monitoring: Perfluorooctane Sulfonate Substances (PFOS), Perfluoroalkyl and Polyfluoroalkyl Sulfonate Substances (PFAS), and Alternative Flame Retardants (AFRs). PFAS is a broad class of chemicals used in industrial applications and consumer goods primarily for their ability to repel oil and water. PFOS are a subgroup within the PFAS umbrella and are identified in the CEC Strategy as "moderate" concern due to Bay occurrence data suggesting a high probability of a low-level effect on Bay wildlife. Other PFAS are identified as "possible" concern due to uncertainties in measured or predicted Bay concentrations or in toxicity thresholds. RMP staff recently published reports summarizing PFOS and PFAS monitoring and modeling results (Houtz et al. 2016, Sedlak et al. 2017, Sedlak et al. 2018, Sanchez-Soberon et al. 2020).[15]

AFRs came into use following state bans and nationwide phase-outs of polybrominated diphenyl ether (PBDE) flame retardants in the early 2000's. They include many categories of compounds, including organophosphate esters (OPEs) which are a class of AFRs widely used in plastic and polymer additives for their flame-retardant properties. Most AFRs are identified as "possible" concern due to uncertainties in measured or predicted Bay concentrations or in toxicity thresholds; however, OPEs have recently been elevated to "moderate" concern by the ECWG due to their presence in the Bay at levels comparable or exceeding protective thresholds, the potential for cumulative endocrine disrupting effects, lack of understanding of fate and transport, and likelihood of increased use as replacement compounds (Shimabuku et al. 2020).

In 2018 the RMP STLS and ECWG worked together to conduct a special study to inform ECWG's planning activities related to AFRs. The special study compiled and reviewed available data and previously developed conceptual models for PBDE to support a stormwater related AFR conceptual model being developed by the ECWG. OPEs were prioritized for further investigation due to their increased use, persistent character, and ubiquitous detections at concentrations exceeding PBDE concentrations in the Bay. Limited stormwater data from two watersheds in Richmond and Sunnyvale suggest that urban runoff may be an important source of these compounds. Additional modeling and monitoring, including stormwater runoff monitoring, has been recommended. Results of the AFR special study were published in 2018 (Lin and Sutton 2018). In 2019, based on results from the 2017 RMP Status and Trends Water Cruise on OPE detections, and with the opportunity to advance monitoring of OPEs and other CECs via the multi-year non-targeted analysis of stormwater-related CECs initiated in 2018, the ECWG agreed to prioritize monitoring AFRs for future RMP special studies. In further consideration of the data gaps in CECs related to stormwater runoff, the RMP is also undergoing a review of the Status and Trends monitoring plan to include wet weather monitoring.

In 2018, the RMP's ECWG initiated a multi-year special study to analyze stormwater runoff samples collected from urban watersheds for a large suite of CECs. The list of CECs being analyzed is based on recent work conducted in Puget Sound streams and is intended to target urban runoff constituents rather than those found in wastewater (e.g., pharmaceuticals). In addition to vehicle tire chemicals and imidacloprid (a neonicotinoid insecticide), the list includes the CECs specifically identified in MRP Provision C.8.f. (PFOSs, PFASs, and AFRs). Pilot sampling began in 2019 in close coordination with the STLS. Year-two of this three-year study was approved in 2019, with the inclusion of additional CECs, including OPEs and bisphenol A and S. Based on recommendations from the ECWG in April 2020, the

[15] The Emerging Contaminants Workgroup is also conducting monitoring for other emerging contaminants that are not identified in the MRP. These include microplastics, ethoxylated surfactants, and fipronil.

RMP has approved year three and an additional fourth year of monitoring to supplement the initial monitoring and provide more robust data across a better representation of watersheds, given limited monitoring in the first two years of the study. The final reports and manuscripts for this study are anticipated in fall 2022. The RMP has also approved a special study for 2020 that will focus on developing toxicity thresholds for new or "possible concern" CECs, per the updated CEC Strategy, which will support further improvements in the tiered risk-based framework for evaluating CECs in the Bay. Lastly, the RMP continues to develop a multi-pollutant modeling effort, which will be linked to a CECs stormwater monitoring strategy and will be designed to incorporate stormwater runoff related impacts to the Bay.

These RMP special studies satisfy the POC monitoring requirement for CECs within Provision C.8.f.

7.0 COMPARISON TO APPLICABLE WATER QUALITY OBJECTIVES

MRP provision C.8.h.i. requires Permittees 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 WY 2020 by SMCWPPP were compared to applicable numeric Water Quality Objectives (WQOs) included in the Basin Plan (SFBRWQCB 2017). None of the WY 2020 sample results exceeded applicable WQOs.

When conducting a comparison to applicable WQOs/criteria, certain factors should be considered to avoid the mischaracterization of water quality data:

- **Discharge vs. Receiving Water** – WQOs apply to receiving waters, not discharges such as stormwater runoff. A WQO generally represents the maximum concentration of a pollutant that can be present in the water column without adversely affecting organisms using the aquatic system as habitat, people consuming those organisms or water, and/or other current or potential beneficial uses. During WY 2020, nutrient and copper data were collected in receiving waters by SMCWPPP. PCBs and mercury samples were collected within the engineered storm drain network where WQOs do not apply. Dilution is likely to occur when the MS4 discharges urban stormwater (and non-stormwater) runoff into local receiving waters. 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 aquatic life to be exposed to a pollutant.
- **Freshwater vs. Saltwater** - POC monitoring samples were collected from freshwater (i.e., above tidal influence in creeks) and therefore comparisons were made to freshwater WQOs.
- **Aquatic Life vs. Human Health** - Comparisons were primarily made to WQOs for the protection of aquatic life, not WQOs for the protection of human health to support the consumption of water or organisms. This approach assumes that water and organisms are not likely consumed by humans at the locations of the monitoring stations.
- **Acute vs. Chronic Objectives/Criteria** – All monitoring of stormwater runoff for PCBs and mercury and several of the copper/nutrient creek sampling events were conducted during episodic storm events. Storm episode monitoring results likely do not represent long-term concentrations of the monitored constituents in receiving waters. Therefore, storm monitoring data (none in WY 2020) are compared to acute WQOs for aquatic life that represent the highest concentrations of a pollutant to which an aquatic community can be exposed for a short period of time (e.g., one hour) without resulting in an unacceptable effect. Spring and summer baseflow creek monitoring data are compared to chronic WQOs developed to assess longer-term exposure.

Of the analytes monitored by SMCWPPP at POC stations in WY 2020, WQOs or criteria for the protection of aquatic life have only been promulgated for total mercury, dissolved copper, and un-ionized ammonia. All mercury samples consisted of sediments collected from the MS4 where WQOs do not apply. Details of the dissolved copper and un-ionized ammonia WQO comparisons are provided below.

- **Dissolved Copper.** Acute (1-hour average) and chronic (4-day average) WQOs for copper are expressed in terms of the dissolved fraction of the metal in the water column and are hardness dependent[16]. The copper WQOs were calculated using the exponential functions described in the California Toxics Rule (40 CFR 131.38) which apply hardness values measured at the sample station. Dissolved copper concentrations measured at those stations were compared to the calculated WQOs. All dissolved copper concentrations measured in WY 2020 were well below calculated acute and chronic WQOs (Table 12).

- **Nutrients**. Ammonia, and specifically un-ionized ammonia, is toxic to aquatic life. Therefore, the Basin Plan states that discharge of wastes shall not cause receiving waters to contain annual median concentrations of un-ionized ammonia in excess of 0.025 mg/L or maximum concentrations above 0.4 mg/L in the Lower Bay, which includes bay side creeks in San Mateo County (SFBRWQCB 2017). Un-ionized ammonia concentrations were calculated based on measured concentrations of ammonia in the SMCWPPP samples (Table 11). None of the sample results exceeded the more stringent annual median WQO for un-ionized ammonia.

Table 12. Comparison of WY 2020 Monitoring Data to Copper Water Quality Objectives (WQO).

Station ID	Sample Date	Dissolved Copper (µg/L)	Hardness as $CaCO_3$ (mg/L)	Acute WQO for Dissolved Copper at Measured Hardness (µg/L)	Chronic WQO for Dissolved Copper at Measured Hardness (µg/L)
204R01256	7/9/2020	0.64	560	68.1	39.0
202R01308	7/9/2020	0.37 J	160	20.9	13.4

J = The reported result is an estimate. The value is less than the reporting limit but greater than the method detection limit.

[16] The current copper standards for freshwater in California do not account for the effects of pH or natural organic matter and can be overly stringent or under-protective (or both, at different times). Therefore, the California Stormwater Quality Association (CASQA) has asked the USEPA to considering updating the California Toxics Rule for copper using the Biotic Ligand Model (BLM) which accounts for the effect of water chemistry in addition to hardness (i.e., temperature, pH, dissolved organic carbon, major cations and anions).

8.0 SUMMARY

This POC monitoring report was prepared as part of SMCWPPP's March 2020 UCMR. SMCWPPP prepared this report on behalf of San Mateo County local municipal agencies subject to the MRP. This report fulfills the requirements of MRP Provision C.8.h.iii. for reporting a summary of Provision C.8.f. POC Monitoring conducted during WY 2020. In addition, consistent with MRP Provision C.8.h.ii., WY 2020 POC monitoring data generated by SMCWPPP's sampling of receiving waters (e.g., creeks) were submitted to the San Francisco Bay Area Regional Data Center for upload to CEDEN. Highlights from the POC monitoring program include the following:

- In WY 2020, SMCWPPP continued to collect and analyze POC samples in compliance with MRP Provision C.8.f. Yearly minimum sampling requirements specified in Provision C.8.f. were met for all POC monitoring parameters.
- SMCWPPP's PCBs and mercury monitoring has generally focused on San Mateo County WMAs containing high interest parcels with land uses potentially associated with PCBs. Consistent with MRP requirements, the focus has been on PCBs, with ancillary and secondary benefits assumed to be realized for mercury. This report summarized progress to-date towards identifying PCBs source areas and properties (see Section 5.0). In this context, it evaluated all the relevant and readily available sediment and stormwater runoff PCBs chemistry data collected in San Mateo County, ranging back to the early 2000s. This included POC monitoring data collected directly by SMCWPPP and appropriate data collected by third parties such as the RMP's STLS.
- To-date, composite samples of stormwater runoff have been collected from the bottom of 49 San Mateo County urban catchments of interest (Watershed Management Areas or WMAs) and over 400 individual and composite grab samples of sediment have been collected within priority WMAs. All of these samples were analyzed for PCBs and mercury to help characterize the catchments and identify source areas and properties. Most samples were collected in the public ROW. The grab sediment samples were collected from a variety of types of locations, including manholes, storm drain inlets, driveways, streets, and sidewalks, often adjacent to or nearby high interest parcels with land uses associated with PCBs and/or other characteristics potentially associated with pollutant discharge (e.g., poor housekeeping, unpaved areas). SMCWPPP's PCBs and mercury monitoring program has also included collecting sediment samples in the public ROW (e.g., from streets and the MS4) by every known PCBs remediation site in San Mateo County, to the extent applicable and feasible.
- Four previously unknown potential source properties have been identified in San Mateo County, all in WMA 210 (Pulgas Creek Pump Station South) in the City of San Carlos. The four properties are located at the following San Carlos addresses (see Section 5.5.6 for more details):
    1. 1411 Industrial Road
    2. 1030 Washington Street
    3. 1029 Washington Street
    4. 1030 Varian Street

- In WY 2020, SMCWPPP collected eight additional sediment samples in the area where three of the above small properties (1030 Washington Street, 1029 Washington Street, and 1030 Varian Street) are located, including upstream and downstream samples. Accounting for the normal variability in this type of sampling, the results were very consistent with past results, and continue to suggest that three small properties may be PCBs sources. Along with 1411 Industrial Road, SMCWPPP is working with the City of San Carlos to determine next steps for these properties, including potential referral to the Regional Water Board.
- Figure 7 is a map illustrating the current status of WMAs in San Mateo County, based upon the monitoring data collected through WY 2020. Based upon total PCBs concentration in sediment and/or PCBs particle ratio in stormwater runoff samples, each WMA is placed in one of the following categories, to help prioritize future efforts to conduct additional monitoring and implement PCBs controls:
    1. Samples > 0.5 mg/kg PCBs, source properties identified.
    2. Samples > 0.5 mg/kg PCBs, source properties not identified.
    3. Samples 0.2 – 0.5 mg/kg PCBs.
    4. Samples <0.2 mg/kg PCBs.
    5. No samples collected.
- Low PCBs concentrations in composite stormwater runoff samples from the bottom of some WMA catchments have suggested that either PCBs sources are not prevalent in the catchment or the samples are “false negatives.” False negatives could be the result of low rainfall/runoff rates failing to mobilize sediments from source areas and/or other factors. Only a few stormwater runoff sampling stations in San Mateo County have been resampled, but the results from two such stations in South San Francisco, as described by SMCWPPP (2018), suggested small storm sizes may have resulted in false negatives. SMCWPPP, in collaboration with the SCVURPPP, has preliminarily developed a method to normalize results from this type of stormwater runoff monitoring based upon storm intensity. However, the high variability in many of the parameters involved led to a high degree of uncertainty in the evaluation results. SMCWPPP and the SCVURPPP will continue to evaluate normalization methods and results as more data become available in future years, in coordination with related efforts by the RMP (referred to as the RMP’s “Advanced Data Analysis”).
- In WY 2020, SMCWPPP collected two grab creek water samples in July 2020 that were analyzed for copper, thus meeting the yearly minimum number of copper samples required by MRP Provision C.8.f. The samples were collected from Arroyo Ojo de Agua at Stulsaft Park (City of Redwood City) and Pilarcitos Creek downstream of Highway 101 (City of Half Moon Bay). Total and dissolved copper concentrations measured in WY 2020 were within the ranges measured in prior years. It should also be noted that the requirement to have a cumulative total of four samples addressing Management Question No. 4 (Loads and Status) and No. 5 (Trends) by year four of the Permit (i.e., WY 2019) has also been satisfied (SMCWPPP 2020).

- In WY 2020, SMCWPPP collected two grab creek water samples in July 2020 that were analyzed for nutrients, thus meeting the yearly minimum number of copper samples required by MRP Provision C.8.f. The samples were collected from the same stations as the above copper samples, Arroyo Ojo de Agua at Stulsaft Park (City of Redwood City) and Pilarcitos Creek downstream of Highway 101 (City of Half Moon Bay). The results of these summer sampling events were compared with results from nutrient samples collected in the spring synoptic with biological assessment monitoring. There was very little difference between the spring and summer concentrations of nitrate, nitrate, dissolved orthophosphate, and phosphorus. In contrast, TKN concentrations were lower in the summer samples compared to the spring samples, and the ammonia concentrations were higher in the summer samples compared to the spring samples. It should also be noted that the requirement to have a cumulative total of 20 nutrient samples addressing Management Question No. 4 (Loads and Status) by year four of the Permit (i.e., WY 2019) has also been satisfied (SMCWPPP 2020).
- In accordance with MRP requirements, a comprehensive QA/QC program was implemented by SMCWPPP covering all aspects of POC monitoring conducted during WY 2020. Overall, the results of the QA/QC review suggest that the data generated during WY 2020 POC monitoring were of sufficient quality for the purposes of this program. While some data were flagged in the project database based on the MQOs and DQOs identified in the QAPPs, none of the data was rejected.
- MRP provision C.8.h.i. requires Permittees 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 WY 2020 by SMCWPPP were compared to applicable numeric Water Quality Objectives (WQOs) included in the Basin Plan (SFBRWQCB 2017). Of the WY 2020 POC monitoring analytes, promulgated WQOs for the protection of aquatic life only exist for dissolved copper and unionized ammonia. None of the WY 2020 sample results exceeded the applicable WQOs.
- MRP Provision C.12.g. requires Permittees to conduct or cause to be conducted studies concerning the fate, transport, and biological uptake of PCBs discharged from urban runoff to San Francisco Bay margin areas. The provision states: "the specific information needs include understanding the in-Bay transport of PCBs discharged in urban runoff, the sediment and food web PCBs concentrations in margin areas receiving urban runoff, the influence of urban runoff on the patterns of food web PCBs accumulation, especially in Bay margins, and the identification of drainages where urban runoff PCBs are particularly important in food web accumulation." C.12.g. requires Permittees to report in this IMR "the findings and results of the studies completed, planned, or in progress as well as implications of studies on potential control measures to be investigated, piloted or implemented in future permit cycles." Attachment 1 provides a summary of a multi-year project by the San Francisco Bay (Bay) Regional Monitoring Program (RMP) that is addressing the requirements of Provision C.12.g. The project:
    - Identified four PMUs for initial study that are located downstream of urban watersheds where PCBs management actions are ongoing and/or planned;
    - Is developing conceptual and PCBs mass budget models for each of the four PMUs; and
    - Is conducting monitoring in the PMUs to evaluate trends in pollutant levels and track responses to pollutant load reductions.

- During WY 2020, SMCWPPP continued working with other Bay Area stormwater programs to help oversee RMP special studies that satisfy the POC monitoring requirement for CECs within Provision C.8.f.
- In WY 2021, the Program will continue to collect samples for PCBs, mercury, copper, and nutrients analysis in compliance with provision MRP C.8.f.
- In WY 2021, SMCWPPP will continue to participate in the RMP's STLS and the RMP's CEC Strategy.

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Attachment 1

Fate and Transport Study of PCBs: Urban Runoff Impact
On San Francisco Bay Margins

MRP PROVISION C.12.g. FATE AND TRANSPORT STUDY OF PCBS: URBAN RUNOFF IMPACT ON SAN FRANCISCO BAY MARGINS

Background

MRP Provision C.12.g requires Permittees to conduct or cause to be conducted studies concerning the fate, transport, and biological uptake of PCBs discharged from urban runoff to San Francisco Bay margin areas. The provision states: "the specific information needs include understanding the in-Bay transport of PCBs discharged in urban runoff, the sediment and food web PCBs concentrations in margin areas receiving urban runoff, the influence of urban runoff on the patterns of food web PCBs accumulation, especially in Bay margins, and the identification of drainages where urban runoff PCBs are particularly important in food web accumulation." Conceptually, advances in this type of knowledge could allow the Regional Water Board to explore revising the PCBs TMDL to incentivize implementing PCBs management actions in such drainages that drain to sensitive Bay margin areas. Prioritizing actions in these drainages could possibly facilitate reaching TMDL goals more efficiently, though establishing this type of prioritization process would involve many challenges.

Provision C.12.g. is being addressed through a multi-year project by the San Francisco Bay (Bay) Regional Monitoring Program (RMP) to identify, model, and investigate embayments along the Bay shoreline designated "Priority Margin Units" (PMUs). The project:

- Identified four PMUs for initial study that are located downstream of urban watersheds where PCBs management actions are ongoing and/or planned;
- Is developing conceptual and PCBs mass budget models for each of the four PMUs; and
- Is conducting monitoring in the PMUs to evaluate trends in pollutant levels and track responses to pollutant load reductions.

The objectives of this effort to model and investigate Bay PMUs include:

- Characterizing concentrations and the spatial distribution of PCBs in sediment and food web biota in PMUs, including establishing baseline data on PCBs concentration and loading;
- Evaluating the response of PMU receiving waters over time to load reduction efforts in the watershed, such as remediation of PCBs-contaminated properties, including tracking PCBs in sport fish as the ultimate indicator of progress in reduction of impairment; and
- Informing the review and possible revision of the PCBs TMDL and the reissuance of the MRP, both of which were initially tentatively scheduled to occur in 2020 (while the MRP reissuance process in underway and is anticipated to be completed in 2021, the status of evaluating and possibly revising the Bay PCBs TMDL remains uncertain at this time).

A general description and multi-year budget for this project is in the "PCBs" section of the RMP Multi-Year Plan, 2020 Annual Update, dated January 2020 (sfei.org/documents/2020-rmp-multi-year-plan).

The RMP PCBs Workgroup, which includes representative from BASMAA, the Regional Water Board, and other RMP stakeholders, provides oversight over the project, including reviewing and commenting on draft conceptual model reports and plans for PMU-related RMP Special Studies (e.g., PMU monitoring plans).

In accordance with MRP Provision C.12.g., Permittees submitted in their FY 2016/17 Annual Reports a workplan for meeting the above information needs, which included descriptions of studies proposed or underway and a preliminary schedule. Permittees then reported on the status of the studies in their FY 2017/18 Annual Reports. In their Integrated Monitoring Reports (IMRs), due by March 30, 2020, Permittees are required to report the findings and results of the studies completed, planned, or in progress as well as implications of the studies on potential control measures to be investigated, piloted, or implemented in future permit cycles.

The four PMUs initially selected were:

- Emeryville Crescent (Alameda County)
- San Leandro Bay (Alameda County)
- Steinberger Slough (San Mateo County)
- Richmond Harbor (Contra Costa County)

The PMU conceptual models are intended to provide a foundation for future monitoring to track responses to load reductions and may eventually help guide planning of management actions. Three of the selected embayments (all except San Leandro Bay) receive drainage from pilot watersheds that were included in BASMAA's Clean Watersheds for a Clean Bay project (basmaa.org/Clean-Watersheds-for-a-Clean-Bay-Project).

Status of PMU Conceptual Models

The following sections summarize the status of conceptual model development in each of the four PMUs.

Emeryville Crescent

A final conceptual model report (dated April 2017) is available on the San Francisco Estuary Institute (SFEI) website:

sfei.org/sites/default/files/biblio_files/Emeryville%20Crescent%20Draft%20Final%20Report%2005-02-17%20Final%20Clean_0.pdf.

The report's key finding, which was based on a simple one-box pollutant fate model and dependent on assumptions made for the model's input parameters, was that PCBs concentrations in sediment and the food web could potentially decline fairly quickly (within 10 years) in response to load reductions from the watershed.

San Leandro Bay

A conceptual model for San Leandro Bay was developed in three phases, with reports available on the SFEI website. The Phase 1 report (dated June 2017) presented analyses of watershed loading, initial retention, and long-term fate, including results of sediment sampling in 2016:

sfei.org/sites/default/files/biblio_files/Yee%20et%20al%202017%20Conceptual%20Model%20Report%20San%20Leandro%20Bay%20Phase%201.pdf.

The Phase 2 report (dated December 2017) is designated a data report and documented the methods, quality assurance, and all of the results of the 2016 field study:

sfei.org/sites/default/files/biblio_files/San%20Leandro%20Bay%20PCB%20Study%20Data%20Report%20Final.pdf

The Phase 3 report (dated November 2019) was recently completed and is available here:

sfei.org/sites/default/files/biblio_files/San%20Leandro%20Bay%20PCBs%20Phase%203%20Final%20Report%20_0.pdf

This final report incorporates all of the results of the 2016 field study and includes additional discussion of the potential influence of contaminated sites in the watershed and the results of passive sampling by Stanford researchers. It also includes a comparative analysis of long-term fate in San Leandro Bay and the Emeryville Crescent, a section on bioaccumulation, and a concluding section with answers to the management questions that were the impetus for the work.

The report included a discussion of the results of mass budget modeling that illustrated one type of challenge encountered during the PMU conceptual modeling effort. A wetland sediment core profile at Damon Slough indicated a substantial reduction in PCBs between the 1970s and the early 2000s. The simple mass budget model developed during this study suggested continued reductions in PCBs. However, a comparison of the results of extensive sampling of San Leandro Bay surface sediment in 1998 and in 2016 suggested minimal decline in PCBs over this more recent 18-year period. This finding may suggest that continuing PCBs inputs from the watershed are greater than estimated as part of the mass budget modeling and are slowing the recovery of San Leandro Bay. It is important to note that numerous uncertainties associated with the model and its parameters influence projected system response time.

Steinberger Slough / Redwood Creek

A conceptual model for Steinberger Slough / Redwood Creek is currently under development. SFEI staff released a draft report in February 2020. Like the other conceptual models, it includes results of existing monitoring efforts in the PMU and watershed, analyses of watershed loading, development of a mass budget, and long-term fate modeling, including projected PCBs concentrations in sediment and the food web in response to load reductions from the watershed.

Richmond Harbor

Due to budget limitations and because other RMP efforts were deemed higher priority, a conceptual model for the Richmond Harbor PMU is not yet under development.

RMP Special Studies Related to PMUs

In addition to ongoing conceptual model development (as described above), and continuing technical and logistical support for the RMP PCBs Workgroup, various types of RMP Special Studies[17] related to PMUs are ongoing, including the following:

- Shiner Surfperch PCBs Monitoring in PMUs – shiner surfperch is a crucial indicator of impairment, due to its explicit inclusion as an indicator species in the TMDL, importance as a sport fish species, tendency to accumulate high concentrations, site fidelity, and other factors. The conceptual site models recommend periodic monitoring of shiner surfperch to track trends in the PMUs, and as the ultimate indicator of progress in reduction of impairment. A coordinated sampling of PCBs in shiner surfperch in PMUs is being conducted as an add-on to RMP Status and Trends (S&T) sport fish sampling. A dataset for shiner surfperch will be developed that is directly comparable across the PMUs and the five locations that are sampled in S&T monitoring.
- Stormwater Runoff PCBs Monitoring in PMUs – this study is collecting information on PCBs concentrations and particle ratios in stormwater in watersheds draining to the PMUs to better estimate current PCBs loads into the PMUs (a critical component of the PMU mass budgets) and to help track the effectiveness of PCBs controls such as remediation of PCBs-contaminated properties.
- Assess Loading and Spatial Distribution of PCBs in Steinberger Slough / Redwood Creek PMU – this study will address information gaps in the conceptual model for this area and establish baseline data for evaluating the response of these receiving waters to load reduction efforts in the watershed. Passive sampling devices (PSDs) will be deployed to assess spatial patterns in dissolved PCBs in pore water and surface water, providing information on spatial patterns in an index of current biotic exposure. In addition, analysis of depth profiles of pore water with PSDs, accompanied by bulk sediment chemistry in cores, will provide information on the chronology of loading and exposure over the past 50 years. This study is being conducted in collaboration with Stanford researchers.

Discussion

As of the end of calendar year 2019, the PMU conceptual modeling and associated special studies are continuing to progress. Four PMUs for initial study, characterization, and tracking have been identified, and conceptual models have been completed for two of the PMUs, the Emeryville Crescent and San Leandro Bay. A draft conceptual model for a third PMU, Steinberger Slough / Redwood Creek, is under development. In conjunction with the modeling, RMP Special Studies are characterizing concentrations and the spatial distribution of PCBs in sediment and food web biota in PMUs and establishing baseline data on PCBs concentration and loading and will help evaluate the response of the PMUs to load reduction efforts in their watersheds.

The efforts to model and investigate the PMUs are generating valuable new data and knowledge that will inform future revisions of the PCBs TMDL. However, it would be premature to propose major changes to the TMDL at this time, such as revising the stormwater allocation (e.g., assigning allocations to watershed areas that vary depending upon the sensitivity of the Bay margin area to which they drain). Similarly, additional work should be completed before attempting to project any implications of the modeling and studies on potential control measures to be investigated, piloted, or implemented in

[17]These efforts are partly funded by Supplemental Environmental Projects (SEPs).

future stormwater permit cycles. BASMAA representatives will continue to participate in the RMP PCBs Workgroup to help oversee this work and guide it towards developing information that will inform implementing controls for PCBs in stormwater runoff and reducing the Bay's PCBs impairment.

Attachment 2

WY 2020 Quality Assurance / Quality Control Report

Pollutants of Concern Monitoring

Quality Assurance/Quality Control Report, WY 2020

1.0 Introduction

The San Mateo Countywide Pollution Prevention Program (SMCWPPP) conducted Pollutants of Concern (POC) Monitoring in Water Year (WY) 2020 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; Order No. R2-2015-0049). In WY 2020, POC monitoring included analysis for polychlorinated biphenyls (PCBs), total mercury, total and dissolved copper, and nutrients (i.e., ammonia, nitrate, nitrite, total Kjeldahl nitrogen, orthophosphate, and total phosphorus).

The POC monitoring program utilized the Clean Watersheds for Clean Bay Project (CW4CB) Quality Assurance Project Plan (QAPP; BASMAA 2013) as a basis for Quality Assurance and Quality Control (QA/QC) procedures. This was supplemented by the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) QAPP (BASMAA 2020) and the Quality Assurance Program Plan (QAPrP) for the California Surface Water Ambient Monitoring Program (SWAMP)[18], specifically for nutrient and copper samples, respectively. Data were assessed for seven data quality attributes: (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Contamination, (6) Accuracy, and (7) Precision. These seven attributes were 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 analytes are summarized in Table 1 for water and Table 2 for sediment. As there was no reporting limit listed in the QAPP for copper, results were compared to the SWAMP recommended reporting limits for inorganic analytes in freshwater.

Overall, the results of the QA/QC review suggest that the data generated during WY 2020 POC monitoring were of sufficient quality for the purposes of this program. While some data were flagged in the project database based on the MQOs and DQOs identified in the QAPPs, none of the data was rejected. Further details regarding the QA/QC review are provided in the sections below.

[18] The most recent SWAMP QAPrP is available here: https://www.waterboards.ca.gov/water_issues/programs/swamp/quality_assurance.html

Table 1. Measurement quality objectives for analytes in water from the CW4CB QAPP (BASMAA 2013) and BASMAA RMC QAPP (BASMAA 2020).

Sample	Nutrients[1]	Hardness[1]	SSC[2]	Copper[2]	Mercury[2]	PCBs[2]
Laboratory Blank	< RL	<RL	< RL	< RL	< RL	< RL
Reference Material (Laboratory Control Sample) Recovery	90-110%	80-120%	NA	75-125%	75-125%	50-150%
Matrix Spike Recovery	80-120%	80-120%	NA	75-125%	75-125%	50-150%
Duplicates (Matrix Spike, Field, and Laboratory)[3]	RPD < 25%	RPD < 25%	RPD < 25%	RPD < 25%	RPD < 25%	RPD < 25%
Reporting Limit	0.01mg/L except for: Ammonia (0.02mg/L) TKN[4] (0.5mg/L)	1 mg/L[5]	0.5 mg/L	0.10 µg/L[6]	0.0002 µg/L (0.2 ng/L)	0.002 µg/L (2000 pg/L)

RL = Reporting Limit; RPD = Relative Percent Difference

[1] From the BASMAA QAPP

[2] From the CW4CB QAPP

[3] NA if native concentration for either sample is less than the reporting limit

[4] TKN = Total Kjeldahl Nitrogen

[5] No hardness RL listed in either QAPP. Value is from SWAMP-recommended reporting limits for conventional analytes in freshwater. (https://www.waterboards.ca.gov/water_issues/programs/swamp/docs/tools/19_tables_fr_water/1_conv_fr_water.pdf)

[6] No copper RL listed in either QAPP. Value is 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)

Table 2. Measurement quality objectives for analytes in sediment from CW4CB QAPP (BASMAA 2013).

Sample	Total Solids	Mercury	PCBs
Laboratory Blank	< RL	< RL	< RL
Reference Material (Laboratory Control Sample) Recovery	N/A	75-125%	50-150%
Matrix Spike Recovery	N/A	75-125%	50-150%
Duplicates [1] (Matrix Spike, Field, and Laboratory)	RPD < 25%	RPD < 25%	RPD < 25%[2]
Reporting Limit	0.1%[3]	30 µg/kg 0.03 mg/kg 30,000 ng/kg	0.2 µg/kg 0.0002 mg/kg 200 ng/kg

RL = Reporting Limit; RPD = Relative Percent Difference

[1] NA if native concentration for either sample is less than the reporting limit

[2] Only applicable for matrix spike duplicates. Method specific for field and laboratory duplicates

[3] RL for total solids in water

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 were assumed to be representative if they were collected and analyzed according to protocols specified in the CW4CB QAPP and RMC QAPP. Field and laboratory personnel received and reviewed the QAPPs, and followed prescribed protocols including laboratory methods.

3.0 Comparability

The QA/QC officer ensures that the data may be reasonably compared to data from other programs producing similar types of data. For POC monitoring, individual stormwater programs strive to maintain comparability within the RMC. The key measure of comparability for all RMC data is the California Surface Water Ambient Monitoring Program.

Electronic data deliverables (EDDs) were submitted to the San Francisco Bay Regional Water Quality Control Board (SFRWQCB) in Microsoft Excel templates developed by SWAMP, to ensure data comparability with SWAMP. In addition, data entry followed SWAMP documentation specific to each data type, including the exclusion of qualitative values that do not appear on SWAMP's look up lists[19].

[19] Look up lists available online at https://swamp.waterboards.ca.gov/swamp_checker/LookUpLists.aspx

Completed templates were reviewed using SWAMP's online data checker[20], further ensuring SWAMP-comparability.

All WY 2020 data were considered comparable to SWAMP data and other RMC data.

4.0 Completeness

Completeness is the degree to which all data were produced as planned; this covers both sample collection and analysis. An overall completeness of greater than 90% is considered acceptable for RMC chemical data and field measurements.

During WY 2020, SMCWPPP collected 100% of planned samples. Two water samples were collected and analyzed for nutrients (ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), phosphorus, and orthophosphate), copper, and hardness. Eight sediment samples were also collected and analyzed for PCBs and mercury.

5.0 Sensitivity

5.1 Water

Sensitivity analysis determines whether the methods can identify and/or quantify results at low enough levels. For the water chemical analyses in this project, sensitivity is considered to be adequate if the reporting limits (RLs) comply with the specifications in RMC QAPP Appendix E (RMC Target Method Reporting Limits) and the CW4CB QAPP Appendix B (CW4CB Target Method Reporting Limits).

A summary of the target and actual RLs for each analyte is shown in Table 3. The RLs for nitrate, copper, and hardness samples exceeded their respective target RLs. Most of these samples were detected above the RL, and the lack of sensitivity did not affect the confidence in the concentrations, but one of the copper samples and its field blind duplicate was detected at a concentration between the method detection limit (MDL) and RL. If the laboratory were able to achieve a lower RL, this sample would have been quantified. SMCWPPP will discuss the copper RL with the analytical lab for future monitoring efforts.

5.2 Sediment Analysis

The RLs for 389 of the 576 sediment samples for individual PCB congeners exceeded the CW4CB RL requirement of 200 ng/kg, while 183 samples met the target RL. Most of the samples that exceeded the target RL were due to dilutions which were necessary for high concentrations of certain PCB congeners.

The target RL for mercury (0.03 mg/kg) was also exceeded for all samples. However, all mercury samples were detected at concentrations greater than the target RL and were not affected by the lack of sensitivity in the mercury analysis.

[20] Checker available online at https://swamp.waterboards.ca.gov/swamp_checker/SWAMPUpload.aspx

Table 3. Target and actual reporting limits for SMCWPPP pollutants of concern monitoring in water in WY 2020

Analyte	Unit	Target	Actual	Exceeds Target RL?
Ammonia	mg/L	0.02	0.02	No
Nitrate	mg/L	0.01	0.05	Yes
Nitrite	mg/L	0.01	0.005	No
Total Kjeldahl Nitrogen	mg/L	0.5	0.1	No
Phosphorus	mg/L	0.01	0.01	No
Orthophosphate	mg/L	0.01	0.01	No
Copper	µg/L	0.1	0.5	Yes
Hardness	mg/L	1	5-50	Yes

6.0 Contamination

For chemical data, contamination is assessed as the presence of analytical constituents in blank samples.

6.1 Water Analysis

Several laboratory and equipment (filter) blanks were run during the nutrient, copper, and hardness analyses. All associated blanks were non-detect.

6.2 Sediment Analysis

Several laboratory blanks were analyzed during sediment analysis for mercury and PCBs and all 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)/Matrix Spike Duplicates (MSD), which were recalculated and compared to the target ranges in the RMC and CW4CB QAPPs. If a QA sample did not meet MQOs, all samples in that batch for that analyte were flagged.

7.1 Water Analysis

All laboratory LCS and MS samples for nutrients, copper, and hardness were within their respective MQOs.

7.2 Sediment Analysis

All LCS and MS samples for sediment mercury and PCBs met their corresponding MQOs with the exception of two MS samples for PCB congeners 132/153 and 180, which had exceedances with respect to their upper threshold. The samples associated with these exceedances were flagged accordingly.

8.0 Precision

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

8.1 Water Analysis

All MSDs and LCS duplicates for nutrients, copper, and hardness were well below the targeted range of <25%. Additionally, one blind field duplicate was collected for nutrients, copper, and hardness during WY 2020 POC monitoring. The field duplicate met the RPD MQO for all analytes.

8.2 Sediment Analysis

Several MS/MSD pairs were analyzed for mercury and PCBs, and all but one (PCB 28) met the RPD MQO (< 25%). Two laboratory duplicates were also run for total solids, and their RPDs also met the corresponding MQO. One field duplicate was collected in WY 2020. The field duplicate exceeded the RPD MQO for six PCB congeners: PCBs 52, 87, 95, 99, 118, and 151. Given the inherent variability associated with sediment sample field duplicates, the number of analytes with RPDs outside of the MQO limits is expected to be higher than what occurred in WY 2020. The method used to collect sediment field duplicates provides more insight to laboratory precision than precision of field methods; however, the WY 2020 results do suggest that field methods are precise.

9.0 References

Bay Area Stormwater Management Agency Association (BASMAA). 2013. Quality Assurance Project Plan. Clean Watersheds for a Clean Bay – Implementing the San Francisco Bay's PCB and Mercury TMDL with a Focus on Urban Runoff. Revision Number 1. EPA San Francisco Bay Water Quality Improvement Fund Grant # CFDA 66.202. Prepared for Bay Area Stormwater Management Agencies Association (BASMAA) by Applied Marine Sciences (AMS). August 2013.

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

Surface Water Ambient Monitoring Program (SWAMP). 2018. Quality Assurance Program Plan. May 2018. 140 pp.

Attachment 3

Results of Monitoring San Mateo County Stormwater Runoff for PCBs and Mercury

Site Name (RMP Site Name in Parentheses)	Permittee	Sample Type	Latitude	Longitude	Water Year	Sample Date	SSC (mg/L)	Total PCBs (ng/L)	Total PCBs (ng/g)	Total Hg (ng/L)	Total Hg (ng/g)
RMP STLS Stormwater Runoff Samples											
Borel Creek		Receiving Water			WY 2011	2/16/2011	239	3.41	14.3	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2011	2/17/2011	49.7	19.1	384	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2011	2/17/2011	42.3	53.9	1,273	--	--
SM-SCS-31A (Pulgas Creek PS N)	San Carlos	MS4	37.50462	-122.24905	WY 2011	2/17/2011	105	43.3	411	--	--
SM-SCS-31A (Pulgas Creek PS N)	San Carlos	MS4	37.50462	-122.24905	WY 2011	2/17/2011	83.6	46.9	561	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2011	3/18/2011	24.7	21.9	884	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2011	3/18/2011	17.4	31.0	1,782	--	--
SM-SCS-31A (Pulgas Creek PS N)	San Carlos	MS4	37.50462	-122.24905	WY 2011	3/18/2011	31.0	66.6	2,148	--	--
SM-SCS-31A (Pulgas Creek PS N)	San Carlos	MS4	37.50462	-122.24905	WY 2011	3/18/2011	50.3	84.5	1,681	--	--
Belmont Creek		Receiving Water			WY 2011	3/18/2011	148	2.83	19.1	--	--
Belmont Creek		Receiving Water			WY 2011	3/18/2011	209	3.06	14.6	--	--
Belmont Creek		Receiving Water			WY 2011	3/18/2011	448	4.91	10.9	--	--
Borel Creek		Receiving Water			WY 2011	3/18/2011	372	6.30	16.9	--	--
Borel Creek		Receiving Water			WY 2011	3/18/2011	628	8.67	13.8	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2013	3/6/2013	7.09	15.1	2,125	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2013	3/6/2013	30.8	28.5	925	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2013	3/6/2013	40.1	32.5	809	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2013	3/6/2013	61.2	62.7	1,025	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	11/19/2013	22.5	467	20,733	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	11/19/2013	47.3	731	15,447	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	11/19/2013	277	4,084	14,744	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	11/19/2013	179	6,669	37,363	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/6/2014	10.1	35.3	3,493	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/6/2014	33.0	50.1	1,519	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/6/2014	65.0	64.1	987	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/6/2014	32.0	143	4,481	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/6/2014	50.9	211	4,153	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/8/2014	27.0	25.1	931	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/8/2014	42.0	29.1	692	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/8/2014	29.0	35.4	1,221	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/8/2014	14.0	37.4	2,672	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/26/2014	43.6	48.3	1,108	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/26/2014	27.0	69.5	2,574	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/26/2014	91.4	172	1,886	--	--

Site Name (RMP Site Name in Parentheses)	Permittee	Sample Type	Latitude	Longitude	Water Year	Sample Date	SSC (mg/L)	Total PCBs (ng/L)	Total PCBs (ng/g)	Total Hg (ng/L)	Total Hg (ng/g)
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	2/26/2014	131	660	5,057	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/26/2014	42.0	61.6	1,467	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/26/2014	38.2	63.0	1,648	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/26/2014	23.7	74.2	3,125	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/26/2014	120	505	4,196	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/31/2014	84.8	16.9	200	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/31/2014	21.6	28.5	1,318	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/31/2014	31.2	85.5	2,741	--	--
SM-SCS-210A (Pulgas Creek PS S)	San Carlos	MS4	37.50456	-122.24898	WY 2014	3/31/2014	41.8	151	3,616	--	--
SM-RCY-267A (Oddstad PS)	Redwood City	MS4	37.49172	-122.21886	WY 2015	12/2/2014	148	9.20	62.4	54.8	372
SM-RCY-337A (Veterans PS)	Redwood City	MS4	37.49723	-122.23693	WY 2015	12/15/2014	29.2	3.52	121	13.7	469
SM-EPA-70A (Runnymede Ditch)	East Palo Alto	MS4	37.46883	-122.12701	WY 2015	2/6/2015	265	28.55	108	51.5	194
SM-EPA-72A (SD near Cooley Landing)	East Palo Alto	MS4	37.47492	-122.12640	WY 2015	2/6/2015	82.0	6.47	78.9	35.0	427
SM-SSF-306A (South Linden PS)	South San Francisco	MS4	37.65017	-122.41127	WY 2015	2/6/2015	43.0	7.81	182	29.2	679
SM-SSF-293A (Gateway Blvd SD)	South San Francisco	MS4	37.65244	-122.40257	WY 2015	2/6/2015	45.0	5.24	117	19.6	436
SM-SSF-319A (Forbes Blvd Outfall)	South San Francisco	MS4	37.65889	-122.37996	WY 2016	3/5/2016	23.0	1.84	80.0	14.7	639
SM-SSF-315A (Gull Dr Outfall)	South San Francisco	MS4	37.66033	-122.38502	WY 2016	3/5/2016	33.0	5.77	175	10.4	315
SM-SSF-314A (Gull Dr SD)	South San Francisco	MS4	37.66033	-122.38510	WY 2016	3/5/2016	10.0	8.59	859	5.62	562
SM-BRI-17A (Valley Dr SD)	Brisbane	MS4	37.68694	-122.40215	WY 2016	3/5/2016	96.0	10.4	109	26.5	276
SM-BRI-1004A (Tunnel Ave Ditch)	Brisbane	MS4	37.69490	-122.39946	WY 2016	3/5/2016	96.0	10.5	109	71.1	741
SM-SCS-32A (Taylor Way SD)	San Carlos	MS4	37.51320	-122.26466	WY 2016	3/11/2016	25.0	4.23	169	28.9	1156
SM-SCS-75A (Industrial Rd Ditch)	San Carlos	MS4	37.51831	-122.26371	WY 2016	3/11/2016	26.0	160	6,139	13.9	535
SM-SSF-291A (S Linden Ave SD (291))	South San Francisco	MS4	37.64327	-122.41066	WY 2017	1/8/2017	16.0	11.8	736	12.4	775
SM-SSF-296A (S Spruce Ave SD at Mayfair Ave (296))	South San Francisco	MS4	37.65084	-122.41811	WY 2017	1/8/2017	111	3.36	30.3	38.9	350
SM-SSF-359A (Outfall to Colma Ck on service road near Littlefield Ave. (359))	South San Francisco	MS4	37.64290	-122.39677	WY 2017	2/7/2017	43.0	33.9	788	9.05	210
Colma Ck at S. Linden Blvd (Colma Ck at S. Linden Blvd)	South San Francisco	Receiving Water	37.65017	-122.41189	WY 2017	2/7/2017	71.0	2.65	37.3	15.3	215
SM-SSF-315A (Gull Dr Outfall)	South San Francisco	MS4	37.66033	-122.38502	WY 2018	1/8/18	91.0	93	1,024	4.74	52.1
SM-SSF-314A (Gull Dr SD)	South San Francisco	MS4	37.66033	-122.38510	WY 2018	1/9/18	75.0	71.0	946	5.10	68.0
SM-BUR-164A	Burlingame	MS4	37.59960	-122.37526	WY 2019	11/28/2018	80.0	3.87	48.4	22.1	276
SM-BUR-85A	Burlingame	MS4	37.60194	-122.37499	WY 2019	11/28/2019	93.0	31.1	334	40.9	440
SMCWPPP Stormwater Runoff Samples											
SM-MPK-71A	Menlo Park	MS4	37.48361	-122.14507	WY 2016	2/17/2016	13.7	0.59	43.2	6.80	496

Site Name (RMP Site Name in Parentheses)	Permittee	Sample Type	Latitude	Longitude	Water Year	Sample Date	SSC (mg/L)	Total PCBs (ng/L)	Total PCBs (ng/g)	Total Hg (ng/L)	Total Hg (ng/g)
SM-RCY-327A	Redwood City	MS4	37.48868	-122.22823	WY 2016	2/17/2016	43.7	5.70	130	14.9	341
SM-RCY-388A	Redwood City	MS4	37.48877	-122.22665	WY 2016	2/17/2016	49.5	2.49	50.3	15.4	311
SM-MPK-238A	Menlo Park	MS4	37.48480	-122.17445	WY 2016	3/5/2016	80.1	3.19	39.8	12.7	159
SM-MPK-238B	Menlo Park	MS4	37.48489	-122.17380	WY 2016	3/5/2016	51.3	6.20	121	8.90	173
SM-RCY-379A	Redwood City	MS4	37.48908	-122.20648	WY 2016	3/5/2016	123	13.0	106	18.3	149
SM-RCY-379B	Redwood City	MS4	37.48910	-122.20647	WY 2016	3/5/2016	43.3	7.87	182	10.9	252
SM-RCY-254A	Redwood City	MS4	37.48916	-122.20651	WY 2016	3/5/2016	13.9	1.57	113	9.90	712
SM-SSF-317A	South San Francisco	MS4	37.64707	-122.39230	WY 2017	12/10/2016	5.80	2.61	450	0.82	141
SM-SSF-316A	South San Francisco	MS4	37.64767	-122.39192	WY 2017	12/10/2016	44.1	4.25	96.4	1.80	40.8
SM-SSF-318A	South San Francisco	MS4	37.64787	-122.38723	WY 2017	12/10/2016	8.50	2.26	266	5.42	638
SM-BUR-142A	Burlingame	MS4	37.59183	-122.36623	WY 2017	12/15/2016	51.5	34.5	670	2.27	44.1
SM-BUR-141A	Burlingame	MS4	37.59184	-122.36626	WY 2017	12/15/2016	51.3	8.48	165	7.79	152
SM-BUR-1006A	Burlingame	MS4	37.59185	-122.36629	WY 2017	12/15/2016	51.8	18.9	365	6.44	124
SM-SSF-1001B	South San Francisco	MS4	37.64076	-122.40637	WY 2017	12/15/2016	32.2	55.2	1,714	2.44	75.8
SM-SSF-292A	South San Francisco	MS4	37.64126	-122.40866	WY 2017	12/15/2016	719	7.89	11.0	0.95	1.32
SM-SSF-294A	South San Francisco	MS4	37.64886	-122.40160	WY 2017	12/15/2016	28.6	10.5	367	1.80	62.9
SM-RCY-324A	Redwood City	MS4	37.48358	-122.22763	WY 2017	1/8/2017	44.0	7.43	169	26.3	598
SM-RCY-323A	Redwood City	MS4	37.48500	-122.23281	WY 2017	1/8/2017	8.10	1.55	191	12.7	1568
SM-SMO-89A	San Mateo	MS4	37.54877	-122.30450	WY 2017	1/10/2017	27.8	4.03	145	2.32	83.5
SM-BEL-60B	Belmont	MS4	37.52746	-122.27434	WY 2017	2/9/2017	36.4	37.2	1,022	3.98	109
SM-BEL-60A	Belmont	MS4	37.52887	-122.27821	WY 2017	2/9/2017	34.3	6.11	178	4.83	141
SM-SMO-156A	San Mateo	MS4	37.55661	-122.30842	WY 2017	2/20/2017	90.6	19	204	12.7	140
SM-SMO-408A	San Mateo	MS4	37.55918	-122.30479	WY 2017	2/20/2017	29.1	55.3	1,900	5.5	189
SM-MPK-66A	Menlo Park	MS4	37.48079	-122.14498	WY 2017	3/24/2017	21.4	8.35	390	3.55	166
SM-SCS-1011B	San Carlos	MS4	37.51692	-122.25373	WY 2018	1/8/2018	15.0	2.50	167	6.12	408
SM-SCS-1011A	San Carlos	MS4	37.51701	-122.25379	WY 2018	1/8/2018	59.7	10.8	181	3.94	66.0
SM-SMO-25A	San Mateo	MS4	37.57970	-122.31911	WY 2018	1/8/2018	14.8	2.22	150	3.10	209
SM-SMO-149A	San Mateo	MS4	37.58710	-122.33222	WY 2018	1/8/2018	17.0	1.79	105	5.24	308
SM-BUR-164A	Burlingame	MS4	37.59960	-122.37526	WY 2018	1/8/2018	9.9	4.43	447	5.27	532
SM-BUR-85A	Burlingame	MS4	37.60194	-122.37499	WY 2018	1/8/2018	15.2	3.67	241	5.55	365
SM-SSF-356A	South San Francisco	MS4	37.64851	-122.40913	WY 2018	1/24/2018	55.8	4.89	88	0.44	7.89
SM-RCY-266A	Redwood City	MS4	37.49483	-122.21869	WY 2018	3/1/2018	21.6	0.11	4.91	4.06	188
SM-RCY-333A	Redwood City	MS4	37.49549	-122.21984	WY 2018	3/1/2018	417	6.30	15.1	4.43	10.6
SM-SCS-1011D	San Carlos	MS4	37.51238	-122.25777	WY 2018	3/1/2018	25.3	5.82	230	0.66	26.1
SM-SCS-1011C	San Carlos	MS4	37.51246	-122.25781	WY 2018	3/1/2018	28.5	5.80	204	0.72	25.3

Site Name (RMP Site Name in Parentheses)	Permittee	Sample Type	Latitude	Longitude	Water Year	Sample Date	SSC (mg/L)	Total PCBs (ng/L)	Total PCBs (ng/g)	Total Hg (ng/L)	Total Hg (ng/g)
SM-SSF-1001C	South San Francisco	MS4	37.64309	-122.39930	WY 2018	3/1/2018	3.20	1.13	353	7.31	2284
SM-SSF-306B (South Linden PS)	South San Francisco	MS4	37.65025	-122.41170	WY 2018	4/6/2018	14.5	2.51	173	4.68	323

Notes:
SSC – Suspended Sediment Concentration.
Total PCBs = sum of the 40 PCBs congeners analyzed by the RMP for Bay samples.
PCBs and mercury results with units of ng/g are particle ratios.

Attachment 4

Results of Monitoring San Mateo County Sediments for PCBs and Mercury

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
Belmont	60	SM-BEL-60-A	5/22/2018	37.52699	-122.27609	0.00	0.21
		SM-BEL-60-B	5/22/2018	37.52667	-122.27568	0.00	0.02
		SM-BEL-60-C	5/22/2018	37.52297	-122.27790	0.01	0.17
		SM-BEL-60-D	5/22/2018	37.52281	-122.27776	0.02	0.23
		SM-BEL-60-E	5/22/2018	37.52200	-122.27684	0.02	0.09
		SM-BEL-60-F	5/22/2018	37.52295	-122.27849	0.02	0.12
		SM-BEL-60-G	5/22/2018	37.52701	-122.27293	0.01	0.08
		SM-BEL-60-J	5/13/2019	37.52585	-122.27464	0.00	0.01
	77	SM-BEL-01-A	5/13/2019	37.52513	-122.26635	0.01	0.24
Brisbane	1004	SMC025	9/20/2001	37.70673	-122.39801	0.14	1.73
		SM-BRI-01-A	2/18/2015	37.70150	-122.40867	0.04	0.17
		SM-BRI-01-B	2/18/2015	37.70102	-122.40810	0.01	0.04
		SM-BRI-01-C	2/18/2015	37.69897	-122.40682	0.04	0.06
		SM-BRI-01-D	2/18/2015	37.70024	-122.40736	0.01	0.04
	17	SM-BRI-02-A	2/18/2015	37.68805	-122.40444	1.22	0.07
		SM-BRI-02-B	5/29/2018	37.68805	-122.40570	1.02	0.12
		SM-BRI-02-C	5/29/2018	37.68809	-122.40442	0.04	0.07
		SM-BRI-02-D	5/29/2018	37.68975	-122.41143	0.01	0.04
		SM-BRI-02-G	5/29/2018	37.68803	-122.40585	0.01	0.06
		SM-BRI-02-H	5/29/2018	37.68933	-122.40681	0.01	0.05
		SM-BRI-02-I	5/29/2018	37.68765	-122.40319	0.04	0.23
		SM-BRI-02-J	5/14/2019	37.68805	-122.40571	0.03	0.06
		SM-BRI-02-L	5/14/2019	37.68826	-122.40579	0.56	0.14
		SM-BRI-02-M	5/14/2019	37.68930	-122.41998	0.01	0.09
		SM-BRI-02-N	5/14/2019	37.69007	-122.40282	0.15	0.05
Burlingame	1006	SMC015	9/6/2001	37.59387	-122.36823	0.06	0.12
		SMC017	9/6/2001	37.59229	-122.36591	0.14	0.35
		SM-BUR-02-A	2/11/2015	37.59448	-122.36737	0.10	0.30
		SM-BUR-04-A	2/11/2015	37.59425	-122.37052	0.10	0.39
		SM-BUR-04-B	2/12/2015	37.59425	-122.36840	0.01	0.06
		SM-BUR-03-D	5/23/2018	37.59043	-122.36304	0.03	0.12
		SM-BUR-03-E	5/23/2018	37.59030	-122.36303	0.03	0.15
	138	SM-BUR-06-B	5/13/2019	37.58840	-122.33720	0.18	0.16
	142	SM-BUR-03-A	2/11/2015	37.58994	-122.36429	0.15	0.33
		SM-BUR-03-B	2/12/2015	37.59181	-122.36623	0.06	0.09
		SM-BUR-03-C	5/23/2018	37.59087	-122.36455	0.01	0.07
		SM-BUR-03-F	5/23/2018	37.59119	-122.36517	0.02	0.05
		SM-BUR-03-G	5/23/2018	37.59098	-122.36502	0.03	0.06
		SM-BUR-03-H	5/23/2018	37.59134	-122.36547	0.01	0.06
		SM-BUR-03-I	5/23/2018	37.59049	-122.36408	0.03	0.08
	16	SM-BUR-06-A	2/11/2015	37.59107	-122.33662	0.05	0.14

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
	164	SMC016	9/6/2001	37.59790	-122.37708	0.08	0.10
		SM-BUR-05-A	2/11/2015	37.59820	-122.38085	0.05	0.31
		SM-BUR-05-B	2/11/2015	37.59761	-122.37918	0.09	0.83
		SM-BUR-05-C	2/11/2015	37.59523	-122.37808	0.04	0.10
	85	SM-BUR-01-A	2/12/2015	37.60248	-122.37588	0.03	0.16
		SM-BUR-01-B	2/11/2015	37.59990	-122.37191	0.03	0.17
Colma	Other - COL	SMC024	9/6/2001	37.67407	-122.45691	16.81	1.31
		SMC024	10/16/2003	37.67407	-122.45691	0.00	0.02
		SMC048	10/16/2003	37.67407	-122.45728	0.00	0.02
		SMC049	10/16/2003	37.67352	-122.45770	0.05	0.24
Daly City	1004	SM-DCY-01-A	5/29/2018	37.70427	-122.41417	0.01	0.06
East Palo Alto	1015	SM-EPA-01-C	1/19/2015	37.47474	-122.12710	0.02	0.08
		SM-EPA-01-D	1/19/2015	37.47558	-122.13191	0.06	0.10
	67	SM-EPA-01-A	1/19/2015	37.47722	-122.13418	0.21	0.22
		SM-EPA-01-B	1/19/2015	37.47208	-122.13429	0.02	0.12
	70	SM-EPA-02-A	1/19/2015	37.47084	-122.13069	0.05	0.26
		SM-EPA-02-D	1/19/2015	37.47033	-122.13036	0.34	0.45
		SM-EPA-02-G	3/27/2017	37.47029	-122.13244	0.03	0.05
		SM-EPA-02-H	3/27/2017	37.47194	-122.13406	0.01	0.05
	72	SM-EPA-02-C	1/19/2015	37.47443	-122.12743	0.02	0.33
		SM-EPA-02-F	3/27/2017	37.47300	-122.13143	0.02	0.08
	Other - EPA	SMC019	9/20/2001	37.46112	-122.12421	0.07	0.13
Foster City	1010	SM-FCY-01-A	5/13/2019	37.56762	-122.27260	0.00	0.09
Menlo Park	1012	SM-MPK-05-A	3/27/2017	37.48209	-122.16096	0.06	0.10
	1014	SM-MPK-03-A	1/22/2015	37.48678	-122.18090	0.02	0.04
		SM-MPK-02-E	3/27/2017	37.48525	-122.18228	0.03	0.04
	238A	SM-MPK-04-A	1/20/2015	37.48307	-122.17529	0.03	0.21
		SM-MPK-04-C	1/20/2015	37.48270	-122.17420	0.01	0.12
		SM-MPK-04-D	1/19/2015	37.48342	-122.17178	0.25	0.03
	238B	SM-MPK-04-E	1/19/2015	37.48281	-122.16719	0.29	0.10
	239	SM-MPK-02-B	1/20/2015	37.48610	-122.18564	0.57	0.13
		SM-MPK-02-D	3/27/2017	37.48592	-122.18493	0.01	0.06
	332	SM-MPK-02-A	1/20/2015	37.48664	-122.18868	0.03	0.04
	66	SM-MPK-06-A	1/19/2015	37.47566	-122.14726	0.06	0.12
	71	SM-MPK-05-B	3/27/2017	37.47939	-122.15569	0.01	0.13
	Other - MPK	SM-MPK-01-A	1/20/2015	37.45565	-122.18395	0.02	0.07
Millbrae	401	SM-MIL-01-A	5/13/2019	37.60764	-122.39189	0.00	0.03
Redwood City	1000	SM-RCY-04-D	1/22/2015	37.49742	-122.21299	0.02	0.07
		SM-RCY-05-A	1/22/2015	37.50961	-122.20813	0.57	0.96
		SM-RCY-05-C	4/5/2017	37.51096	-122.20742	0.75	0.35
	1014	SM-RCY-10-E	3/27/2017	37.48510	-122.18221	0.01	0.05

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
	239	SM-RCY-10-A	1/20/2015	37.48636	-122.18757	0.04	0.06
		SM-RCY-10-C	3/27/2017	37.48581	-122.18504	0.16	0.05
		SM-RCY-10-D	3/27/2017	37.48571	-122.18474	0.02	0.04
	253	SM-RCY-09-A	1/22/2015	37.48606	-122.19643	0.05	0.06
	254	SM-RCY-06-A	1/22/2015	37.48850	-122.20902	0.09	0.07
	267	SM-RCY-04-B	1/22/2015	37.49303	-122.21726	0.01	0.10
	269	SM-RCY-05-D	5/13/2019	37.51154	-122.20694	0.02	0.01
	327	SMC-033	10/4/2001	37.48907	-122.23151	0.00	--
		SMC-034	10/4/2001	37.48889	-122.22821	0.08	--
		SM-RCY-15-A	2/10/2015	37.48952	-122.23632	0.05	0.08
	333	SM-RCY-04-A	1/22/2015	37.49547	-122.21968	0.02	0.07
	336	SM-RCY-03-B	5/13/2019	37.49198	-122.22804	0.01	0.03
	337	SMC004	10/24/2000	37.49731	-122.23700	0.08	0.11
		SM-RCY-01-A	2/10/2015	37.49504	-122.23654	0.03	0.33
		SM-RCY-01-B	2/10/2015	37.49607	-122.23841	0.05	0.09
		SM-RCY-03-A	2/10/2015	37.49366	-122.23425	0.02	0.13
	379	SMC002	10/24/2000	37.48730	-122.21368	0.12	--
		SMC-035	10/4/2001	37.48651	-122.21399	0.08	--
		SMC-036	10/4/2001	37.48810	-122.21338	0.07	--
		SMC-037	10/4/2001	37.48309	-122.21759	0.01	--
		SMC-038	10/4/2001	37.48413	-122.21667	0.09	--
		SMC001	10/24/2000	37.48730	-122.20648	0.07	0.17
		SM-RCY-07-A	1/21/2015	37.48669	-122.21235	0.10	0.08
		SM-RCY-07-B	1/21/2015	37.48650	-122.20665	0.35	0.21
		SM-RCY-07-C	1/21/2015	37.48650	-122.20681	0.13	0.08
		SM-RCY-11-A	1/22/2015	37.48006	-122.22206	0.03	0.16
		SM-RCY-07-D	3/28/2017	37.48532	-122.21334	1.97	0.14
		SM-RCY-12-A	3/28/2017	37.48444	-122.21848	0.02	0.07
		SM-RCY-12-B	3/28/2017	37.48430	-122.21787	0.08	0.09
		SM-RCY-12-C	3/30/2017	37.48438	-122.21774	0.00	0.01
		SM-RCY-12-E	3/28/2017	37.48471	-122.21958	0.01	0.05
		SM-RCY-12-F	3/28/2017	37.48551	-122.21624	0.01	0.08
		SM-RCY-07-E	5/29/2018	37.48604	-122.21158	0.04	0.07
		SM-RCY-07-F	5/29/2018	37.48554	-122.21191	0.04	0.06
		SM-RCY-12-G	5/22/2018	37.48419	-122.21715	0.01	0.10
		RCA-201409241050	9/24/2014	37.48538	-122.21345	2.37	--
		RCB-201409241015	9/24/2014	37.48528	-122.21358	1.25	--
		RCC-201409291115	9/29/2014	37.48550	-122.21441	0.57	--
		RCD-201409241200	9/24/2014	37.48418	-122.21685	6.93	--
		RCE-201409291030	9/29/2014	37.48573	-122.21774	0.04	--
		RCF-201409291230	9/29/2014	37.48721	-122.21461	0.02	--

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
		RCG-201409240945	9/24/2014	37.48726	-122.21372	0.07	--
	407	SM-RCY-04-C	1/22/2015	37.49129	-122.21345	0.01	0.23
		SM-RCY-04-E	5/13/2019	37.49309	-122.21312	0.00	0.12
	Other - RCY	SMC011	10/24/2000	37.48889	-122.22699	0.34	--
		SMC-032	10/4/2001	37.48828	-122.22699	0.02	--
		SMC030	10/4/2001	37.48090	-122.23450	0.01	0.66
		SMC031	10/4/2001	37.48053	-122.22693	0.14	0.18
		SM-RCY-13-A	1/22/2015	37.48136	-122.22602	0.01	0.10
San Bruno	292	SBO01	7/12/2007	37.63690	-122.41241	0.03	0.36
		SBO02	7/12/2007	37.63708	-122.41162	0.18	0.27
		SSO05	7/12/2007	37.63690	-122.41229	0.00	0.47
		SBO03	7/12/2007	37.63489	-122.41150	0.01	0.15
		SBO04	7/12/2007	37.63647	-122.41241	0.00	0.07
		SBO05	7/12/2007	37.63611	-122.41150	0.16	0.11
		SBO06	7/12/2007	37.63892	-122.41248	0.00	0.23
		SBO07	7/12/2007	37.63928	-122.41241	0.11	0.30
		SBO08	7/12/2007	37.63928	-122.41272	0.00	0.20
		SBO09	7/12/2007	37.63892	-122.41162	0.15	0.21
		SBO10	7/12/2007	37.63831	-122.41162	0.00	0.06
		SBO11	7/12/2007	37.63971	-122.41162	0.12	0.22
		SBO13	7/12/2007	37.63831	-122.41339	0.00	0.13
	362	SM-SBO-05-D	5/14/2019	37.63538	-122.40616	0.07	0.06
San Carlos	1011	S-1	7/10/2015	37.51538	-122.25843	0.02	--
		S-10	7/10/2015	37.51589	-122.25769	0.03	--
		S-11	7/10/2015	37.51560	-122.25717	0.05	--
		S-12	7/10/2015	37.51551	-122.25644	0.08	--
		S-13	7/10/2015	37.51549	-122.25581	0.10	--
		S-14	7/10/2015	37.51579	-122.25521	0.02	--
		S-15	7/10/2015	37.51632	-122.25485	0.01	--
		S-16	7/10/2015	37.51681	-122.25468	0.01	--
		S-17	7/10/2015	37.51711	-122.25429	0.01	--
		S-2	7/10/2015	37.51519	-122.25826	0.01	--
		S-3	7/10/2015	37.51435	-122.25789	0.02	--
		S-4	7/10/2015	37.51377	-122.25783	0.05	--
		S-5	7/10/2015	37.51328	-122.25760	0.04	--
		S-6	7/10/2015	37.51286	-122.25743	0.07	--
		S-7	7/10/2015	37.51232	-122.25783	0.01	--
		S-8	7/10/2015	37.52043	-122.26604	0.02	--
		S-9	7/10/2015	37.52019	-122.26633	0.01	--
		SMC028	9/20/2001	37.52051	-122.26599	0.00	0.05
		SMC029	9/20/2001	37.51251	-122.25879	0.42	0.63

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
		BG-1	10/17/2014	37.51785	-122.26117	0.72	0.09
		S-1	10/17/2014	37.51775	-122.26106	0.37	0.09
		SCA37	8/24/2007	37.50909	-122.25781	0.00	0.06
		SCA38	8/24/2007	37.50970	-122.25708	0.00	0.07
		SCA39	9/21/2007	37.51050	-122.25598	0.00	0.13
	1016	PUL27	5/14/2013	37.50470	-122.24899	0.96	0.15
		SMC023	9/25/2001	37.50472	-122.24899	2.26	0.32
		SCA11	8/23/2007	37.50189	-122.25281	0.00	0.28
		SMC-023	9/25/2001	37.50472	-122.24895	6.19	--
		SMC-045	10/3/2002	37.50171	-122.25238	0.00	--
	210	PUL12	9/25/2012	37.49697	-122.24599	0.84	0.07
		PUL13	9/25/2012	37.49748	-122.24727	0.02	0.36
		PUL14	9/25/2012	37.49804	-122.24707	0.11	0.18
		PUL18	5/14/2013	37.50006	-122.24399	0.22	0.10
		PUL19	5/14/2013	37.49980	-122.24349	0.09	0.21
		PUL20	5/14/2013	37.49959	-122.24349	0.55	0.10
		PUL21	5/14/2013	37.49897	-122.24209	0.02	0.05
		PUL22	5/14/2013	37.50027	-122.24356	192.91	0.07
		PUL23	5/14/2013	37.49852	-122.24898	0.11	0.06
		PUL24	5/14/2013	37.49770	-122.24746	0.07	0.12
		PUL25	5/14/2013	37.49620	-122.24625	0.02	0.07
		PUL28	5/14/2013	37.49824	-122.24547	1.19	0.14
		PUL4	9/25/2012	37.50014	-122.24373	2.45	0.13
		PUL7	9/24/2012	37.50029	-122.24783	0.40	0.13
		PUL8	9/25/2012	37.49979	-122.24445	0.05	0.22
		PUL9	9/25/2012	37.49940	-122.24394	0.05	1.10
		SMC021	9/20/2001	37.49876	-122.24596	1.22	0.92
		SCA01	8/23/2007	37.49811	-122.24268	0.13	0.17
		SCA02	8/23/2007	37.49609	-122.24530	0.00	0.13
		SCA03	8/23/2007	37.49670	-122.24628	0.41	0.30
		SCA04	8/23/2007	37.49817	-122.24532	2.22	0.24
		SCA05	8/23/2007	37.49872	-122.24609	0.07	0.27
		SCA06	8/23/2007	37.49829	-122.24658	0.00	0.13
		SCA07	8/23/2007	37.49811	-122.24701	0.10	0.19
		SCA08	8/23/2007	37.49768	-122.24750	0.00	0.09
		SCA09	8/23/2007	37.49824	-122.24880	0.00	0.11
		SCA10	8/23/2007	37.50067	-122.25153	0.00	0.12
		SCA16	8/23/2007	37.50371	-122.24857	0.04	0.10
		SCA17	8/23/2007	37.50067	-122.24481	0.10	0.18
		SCA18	8/23/2007	37.50049	-122.24469	0.06	0.29
		SCA19	8/23/2007	37.49918	-122.24656	0.13	0.24

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
		SCA20	8/23/2007	37.49926	-122.24664	0.17	0.15
		SCA21	8/23/2007	37.50035	-122.24769	0.10	0.16
		SCA22	8/23/2007	37.50005	-122.24397	0.12	0.11
		SCA25	8/23/2007	37.49887	-122.24225	0.01	0.07
		SCA36	8/24/2007	37.49969	-122.24463	0.30	0.77
		SMC-021	9/20/2001	37.49875	-122.24597	1.82	--
		SMC-046	10/3/2002	37.50269	-122.24719	0.18	--
		SMC-047	10/3/2002	37.50012	-122.24371	11.52	--
		SM-SCS-06-A	3/30/2017	37.49628	-122.24492	0.01	0.17
		SM-SCS-06-B	3/30/2017	37.49690	-122.24589	0.03	0.08
		SM-SCS-06-C	3/30/2017	37.49746	-122.24638	5.64	0.04
		SM-SCS-06-D	3/30/2017	37.49733	-122.24555	1.84	3.93
		SM-SCS-06-E	3/30/2017	37.49614	-122.24537	0.00	0.02
		SM-SCS-06-F	3/30/2017	37.49768	-122.24626	3.73	0.12
		SM-SCS-06-G	3/30/2017	37.49776	-122.24615	1.29	0.07
		SM-SCS-06-H	3/30/2017	37.49942	-122.24278	0.07	0.06
		SM-SCS-06-I	3/30/2017	37.50158	-122.24354	0.03	0.27
		SM-SCS-06-L	4/5/2017	37.50021	-122.24113	0.06	0.13
		SM-SCS-06-M	5/22/2018	37.49727	-122.24686	0.25	0.10
		SM-SCS-06-N	5/22/2018	37.49731	-122.24662	0.06	0.05
		SM-SCS-20-A	9/17/2020	37.496656	-122.246386	0.07	0.19
		SM-SCS-20-B	9/17/2020	37.497265	-122.246886	0.09	0.10
		SM-SCS-20-C	9/17/2020	37.499214	-122.246607	0.04	0.13
		SM-SCS-20-D	9/17/2020	37.497302	-122.245552	0.37	0.34
		SM-SCS-20-E	9/17/2020	37.49746	-122.2464	0.58	0.07
		SM-SCS-20-F	9/17/2020	37.497668	-122.246307	3.51	0.12
		SM-SCS-20-G	9/17/2020	37.497775	-122.246147	1.11	0.06
		SM-SCS-20-H	9/17/2020	37.498288	-122.24544	0.77	0.08
	31	PUL1	9/24/2012	37.50623	-122.25353	1.61	--
		PUL10	9/24/2012	37.50583	-122.25432	0.34	--
		PUL15	9/25/2012	37.50661	-122.25300	1.44	0.23
		PUL2	9/24/2012	37.50510	-122.25538	0.05	--
		PUL26	5/14/2013	37.50653	-122.25444	0.14	0.07
		PUL5	9/24/2012	37.50484	-122.25542	0.02	--
		SMC022	9/20/2001	37.50653	-122.25330	0.29	0.07
		SCA12	8/23/2007	37.50372	-122.25403	0.00	0.13
		SCA13	8/23/2007	37.50378	-122.25417	0.01	0.21
		SCA14	8/23/2007	37.50452	-122.25311	0.30	0.35
		SCA15	8/23/2007	37.50606	-122.25071	0.00	0.05
		SCA26	8/23/2007	37.50484	-122.25572	0.00	0.09
		SCA27	8/23/2007	37.50639	-122.25329	1.09	0.06

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
		SCA28	8/24/2007	37.50633	-122.25355	0.19	0.04
		SCA29	8/24/2007	37.50751	-122.25194	0.09	0.08
		SCA30	8/24/2007	37.50737	-122.25185	0.21	0.15
		SCA31	8/24/2007	37.50838	-122.25279	0.87	0.12
		SCA32	8/24/2007	37.50732	-122.25439	0.00	0.08
		SCA33	8/24/2007	37.50700	-122.25572	0.27	0.29
		SCA34	8/24/2007	37.50787	-122.25421	0.01	0.13
		SCA35	8/24/2007	37.50873	-122.25330	0.05	0.27
		SMC-042	10/3/2002	37.50738	-122.25189	0.31	--
		SMC-043	10/3/2002	37.50761	-122.25178	0.32	--
		SMC-044	10/3/2002	37.50525	-122.24961	0.03	--
		SM-SCS-05-A	4/3/2017	37.50645	-122.25071	0.12	0.06
		SM-SCS-05-B	4/3/2017	37.50686	-122.25492	0.14	0.07
	59	SM-SCS-01-L	3/30/2017	37.51528	-122.26202	0.18	0.17
		SM-SCS-01-M	3/30/2017	37.51397	-122.26382	0.04	2.36
		SM-SCS-01-O	5/22/2018	37.51538	-122.26179	0.31	0.16
	75	SMC020	9/20/2001	37.51770	-122.26379	20.29	1.84
		SM-SCS-01-A	2/10/2015	37.51798	-122.26640	0.10	0.05
		SM-SCS-01-B	2/10/2015	37.51915	-122.26483	0.09	0.05
		SM-SCS-01-C	2/10/2015	37.51631	-122.26494	0.04	0.17
		SM-SCS-01-D	2/10/2015	37.51778	-122.26358	0.02	0.08
		SM-SCS-01-E	2/10/2015	37.51548	-122.26660	0.03	0.09
		SM-SCS-01-G	3/30/2017	37.51664	-122.26351	1.20	0.11
		SM-SCS-01-H	4/3/2017	37.51623	-122.26485	0.06	0.14
		SM-SCS-01-I	4/3/2017	37.51798	-122.26386	0.02	0.05
		SM-SCS-01-J	4/3/2017	37.51818	-122.26392	0.09	0.09
		SM-SCS-01-N	3/30/2017	37.51686	-122.26358	49.40	0.80
		SM-SCS-01-P	5/22/2018	37.51643	-122.26308	0.76	0.06
	80	SM-SCS-07-A	5/13/2019	37.49684	-122.24727	0.14	0.17
San Mateo	1007	SMC012	10/25/2000	37.57013	-122.31860	0.01	0.05
	1009	SM-SMO-07-B	2/12/2015	37.55247	-122.30973	0.04	0.04
		SM-SMO-08-A	2/12/2015	37.54986	-122.30739	0.03	0.04
	101	SM-SMO-11-A	2/18/2015	37.53200	-122.28861	0.08	0.13
	111	SM-SMO-04-A	2/18/2015	37.56774	-122.32320	0.06	0.11
		SM-SMO-05-A	2/12/2015	37.56514	-122.31933	0.05	0.07
	114	SM-SMO-06-A	2/18/2015	37.56134	-122.31515	0.23	0.25
	149	SMC005	10/25/2000	37.58691	-122.33191	0.19	0.20
		SM-SMO-14-A	2/12/2015	37.58631	-122.33303	0.07	0.63
	156	SM-SMO-07-C	4/5/2017	37.55516	-122.30717	0.01	0.05
	25	SM-SMO-02-A	2/11/2015	37.57746	-122.32173	0.03	0.13
	403	SM-SMO-15-A	2/12/2015	37.56700	-122.31035	0.02	0.08

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
	408	SM-SMO-07-D	5/23/2018	37.55756	-122.30338	0.01	0.11
		SM-SMO-07-E	5/23/2018	37.55402	-122.30207	0.00	0.04
		SM-SMO-07-F	5/23/2018	37.55515	-122.30259	0.00	0.06
		SM-SMO-07-G	5/23/2018	37.55513	-122.30234	0.00	0.04
		SM-SMO-07-H	5/23/2018	37.55674	-122.30272	0.02	0.10
		SM-SMO-07-I	5/23/2018	37.55757	-122.30439	0.01	0.13
		SM-SMO-07-J	5/23/2018	37.55840	-122.30395	0.01	0.13
	89	SM-SMO-08-B	2/12/2015	37.54552	-122.30445	0.01	0.07
	92	SM-SMO-08-C	5/13/2019	37.54847	-122.29967	0.00	0.02
	Other - SMO	SMC013	10/25/2000	37.58087	-122.32343	0.09	0.11
		SM-SMO-09-A	5/23/2018	37.54157	-122.30636	0.04	0.07
South San Francisco	1001	SM-SSF-09-D	2/13/2015	37.65025	-122.41140	0.04	0.07
		SM-SSF-09-A	2/17/2015	37.65047	-122.41284	0.02	0.18
		SM-SSF-09-C	2/17/2015	37.65147	-122.41703	0.02	0.16
		SM-SSF-10-A	2/17/2015	37.65328	-122.42609	0.01	0.05
		SM-SSF-03-E	5/24/2018	37.64792	-122.40022	0.09	0.07
		SM-SSF-04-G	5/29/2018	37.64229	-122.40323	0.01	0.11
	1001B	SM-SSF-05-A	2/17/2015	37.63734	-122.40605	0.46	0.05
		SM-SSF-05-C	5/24/2018	37.64013	-122.40653	0.06	0.06
		SM-SSF-05-D	5/24/2018	37.63774	-122.40618	0.01	0.07
		SM-SSF-05-E	5/24/2018	37.64090	-122.40648	0.02	0.10
		SM-SSF-05-F	5/24/2018	37.64025	-122.40633	0.35	0.06
		SM-SSF-05-G	5/24/2018	37.64072	-122.40652	0.01	0.18
	1001D	SMC003	10/25/2000	37.65033	-122.41388	0.23	0.17
		SSO10	7/12/2007	37.64807	-122.41248	0.43	0.34
		SSO19	7/12/2007	37.64709	-122.41290	0.04	0.12
		SSO24	7/12/2007	37.64893	-122.41461	0.02	0.10
		SM-SSF-08-B	2/13/2015	37.65035	-122.41412	0.04	0.06
		SM-SSF-08-C	2/13/2015	37.64932	-122.41211	0.01	0.04
		SM-SSF-08-D	2/13/2015	37.64706	-122.41390	0.04	0.17
	1002	SMC026	9/6/2001	37.65088	-122.38373	0.12	0.35
		SM-SSF-02-C	4/5/2017	37.66440	-122.39508	0.02	0.05
		SM-SSF-02-D	4/5/2017	37.66303	-122.39861	0.08	0.15
	291	SMC009	10/25/2000	37.64429	-122.41669	0.48	--
		SMC-039	10/2/2001	37.64508	-122.41632	0.07	--
		SMC-040	10/2/2001	37.64429	-122.41718	2.72	--
		SMC-041	10/2/2001	37.64410	-122.41650	0.04	--
		SSO16	7/12/2007	37.64252	-122.41119	0.00	0.03
		SSO18	7/12/2007	37.64209	-122.41241	0.00	0.01
		SSO20	7/12/2007	37.64752	-122.41638	0.00	0.05
		SSO21	7/12/2007	37.64771	-122.41663	0.00	0.08

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
		SSO22	7/12/2007	37.64728	-122.41803	0.13	0.09
		SSO25	7/5/2007	37.64313	-122.41742	0.03	0.12
		SM-SSF-06-A	2/16/2015	37.64411	-122.41159	0.02	0.06
		SM-SSF-06-B	2/17/2015	37.64219	-122.41329	0.48	0.07
		SM-SSF-06-C	2/13/2015	37.64612	-122.41585	0.05	0.05
		SM-SSF-06-F	4/5/2017	37.64299	-122.41425	0.04	0.08
		SM-SSF-06-H	4/5/2017	37.64240	-122.41370	0.44	0.08
		SM-SSF-06-I	4/5/2017	37.64212	-122.41325	0.04	0.24
		SM-SSF-07-C	5/24/2018	37.64534	-122.42094	0.21	0.06
	292	SBO12	7/12/2007	37.64111	-122.41150	0.00	0.10
		SSO15	7/12/2007	37.64093	-122.41241	0.00	0.17
		SMC027	9/6/2001	37.64130	-122.40961	0.03	0.04
		SM-SSF-05-B	2/17/2015	37.64109	-122.41145	0.02	0.09
		SM-SSF-06-D	2/17/2015	37.64128	-122.40868	0.14	3.40
		SM-SSF-06-G	4/5/2017	37.64079	-122.41729	0.15	0.06
	293	SM-SSF-02-A	2/16/2015	37.65172	-122.40318	0.07	0.37
		SM-SSF-02-B	2/16/2015	37.65591	-122.40464	0.01	0.07
	294	SM-SSF-03-A	2/16/2015	37.64910	-122.40172	0.07	0.28
		SM-SSF-03-C	2/16/2015	37.65181	-122.40008	0.19	0.18
		SM-SSF-03-D	4/5/2017	37.65253	-122.40021	0.28	0.47
	295	SSO01	7/5/2007	37.63971	-122.40381	0.33	0.18
		SSO02	7/5/2007	37.64130	-122.40363	0.00	0.06
		SM-SSF-04-B	2/16/2015	37.63974	-122.40212	0.30	0.09
	296	SM-SSF-07-B	5/24/2018	37.64722	-122.41981	0.02	0.83
	313	SM-SSF-02-F	4/5/2017	37.66189	-122.39608	0.01	0.05
	314	SM-SSF-01-B	2/16/2015	37.66032	-122.38511	0.12	0.07
		SM-SSF-01-E	4/3/2017	37.65864	-122.39130	0.15	0.19
		SM-SSF-01-G	4/3/2017	37.66241	-122.38908	0.05	0.03
		SM-SSF-01-R	5/14/2019	37.65858	-122.39122	0.02	0.16
	315	SM-SSF-01-L	5/14/2019	37.65693	-122.39556	0.27	0.27
		SM-SSF-01-M	5/14/2019	37.66021	-122.38526	0.02	0.26
		SM-SSF-01-N	5/14/2019	37.65977	-122.38571	0.03	0.50
		SM-SSF-01-O	5/14/2019	37.65871	-122.38623	0.43	0.14
		SM-SSF-01-P	5/14/2019	37.65504	-122.39049	0.01	0.06
		SM-SSF-01-Q	5/14/2019	37.65647	-122.39420	0.07	0.56
	316	SSO03	7/12/2007	37.65192	-122.39429	0.00	1.24
		SM-SSF-01-D	2/16/2015	37.65031	-122.39213	0.02	0.14
		SM-SSF-01-J	5/24/2018	37.65270	-122.39367	0.03	0.05
	318	SM-SSF-01-C	2/16/2015	37.64896	-122.38728	0.01	0.24
	319	SM-SSF-01-I	4/3/2017	37.65870	-122.38012	0.06	0.22
	354	SM-SSF-08-A	2/13/2015	37.65088	-122.41622	0.02	0.23

Permittee	WMA	Sample ID	Sample Date	Latitude	Longitude	Total PCBs (mg/kg)	Mercury (mg/kg)
	356	SSO17	7/12/2007	37.64587	-122.40991	0.00	0.08
		SM-SSF-06-E	2/13/2015	37.64883	-122.40961	0.03	3.59
	357	SM-SSF-03-B	2/16/2015	37.64918	-122.40410	0.09	0.15
	358	SM-SSF-04-A	2/16/2015	37.64606	-122.40160	1.46	0.15
		SM-SSF-04-C	4/3/2017	37.64613	-122.40198	0.01	0.08
		SM-SSF-04-D	4/3/2017	37.64450	-122.40173	0.09	0.11
		SM-SSF-04-E	4/3/2017	37.64608	-122.40147	0.05	0.07
		SM-SSF-04-H	5/14/2019	37.64551	-122.40344	0.03	0.09
	359	SM-SSF-03-F	5/24/2018	37.64449	-122.39690	0.05	0.07
		SM-SSF-03-G	5/24/2018	37.64458	-122.39694	0.01	0.08
		SM-SSF-03-H	5/24/2018	37.64463	-122.39747	0.02	0.09
		SM-SSF-03-J	5/14/2019	37.64438	-122.39728	0.13	0.44
	362	SM-SSF-05-H	5/24/2018	37.63642	-122.40572	0.01	0.08
		SM-SSF-05-J	5/14/2019	37.63666	-122.40587	0.00	0.12
	Other - SSF	SMC010	10/25/2000	37.65332	-122.42548	0.19	0.06
Unincorporated	1005	SM-SMC-09-A	2/17/2015	37.63283	-122.40533	0.01	0.05
	1011	SM-SMC-08-A	2/10/2015	37.51758	-122.27088	0.02	0.10
	247	SM-SMC-01-A	3/27/2017	37.41451	-122.19379	0.00	0.04
	379	SM-SMC-04-A	1/21/2015	37.47622	-122.20808	0.09	0.11
		SM-SMC-04-C	1/21/2015	37.47851	-122.21224	0.06	0.13
		SM-SMC-05-A	1/21/2015	37.47476	-122.21126	0.03	0.10
		SM-SMC-06-A	1/21/2015	37.48194	-122.20616	0.02	0.05
		SM-SMC-06-B	1/21/2015	37.48307	-122.20310	0.02	0.06
		SM-SMC-06-C	1/21/2015	37.48426	-122.20777	0.93	0.39
		SM-SMC-07-A	1/21/2015	37.48484	-122.21082	0.06	0.20
		SM-SMC-07-B	1/21/2015	37.48516	-122.21341	0.07	0.14
		SM-SMC-06-D	3/28/2017	37.48389	-122.20673	0.05	0.06
		SM-SMC-06-E	3/28/2017	37.48384	-122.20653	0.01	0.07
		SM-SMC-06-F	3/28/2017	37.48291	-122.20734	0.02	0.07
		SM-SMC-06-G	3/28/2017	37.48285	-122.20546	0.05	0.30
		SM-SMC-06-H	3/28/2017	37.48278	-122.20531	0.03	0.07
		SM-SMC-06-I	3/28/2017	37.48415	-122.20792	0.14	3.15
		SM-SMC-06-J	3/28/2017	37.48349	-122.20874	0.08	0.09
		SM-SMC-06-K	3/28/2017	37.48396	-122.20634	0.02	0.04
		SM-SMC-06-L	3/28/2017	37.48256	-122.20875	0.03	0.10
	Other - RCY	SMC006	10/24/2000	37.47528	-122.28278	0.01	0.04
	Other - SMC	SM-SMC-03-A	1/21/2015	37.47682	-122.19520	0.00	0.03
	Other - SMC	SM-SMC-10-A	1/20/2015	37.43302	-122.20285	0.04	0.06
	Other - WDE	SMC007	10/25/2000	37.44452	-122.29108	0.00	0.03
Woodside	Other - WDE	SMC008	10/24/2000	37.41632	-122.26910	0.00	0.04

Note:
Total PCBs = sum of the 40 PCBs congeners analyzed by the RMP for Bay samples.

Attachment 5

Summary of PCBs and Mercury Monitoring Results in San Mateo County WMAs

WMA ID	Permittee	Area (acres)	Area High Interest Parcels (acres)	Percent High Interest Parcels	Sediment Samples			Stormwater Runoff Samples		
					n	PCBs Median (mg/kg)	PCBs Range (mg/kg)	n	PCBs Particle Ratio Median (mg/kg)	PCBs Particle Ratio Range (mg/kg)
210	San Carlos	141	33	23.2%	55	0.11	0 - 192.91	33	1.78	0.20 - 37
17	Brisbane	1,639	55	3.4%	7	0.04	0.01 - 1.22	1	--	0.11
142	Burlingame	20	9	44.3%	9	0.03	0.01 - 0.15	1	--	0.67
359	South San Francisco	23	12	51.2%	3	0.02	0.01 - 0.06	1	--	0.79
408	San Mateo	43	7	16.3%	7	0.01	0 - 0.02	1	--	1.90
60	Belmont	298	6	1.9%	7	0.01	0 - 0.02	2	0.60	0.18 - 1.02
379	Redwood City	802	110	13.7%	44	0.06	0 - 6.93	2	0.14	0.11 - 0.18
291	South San Francisco	194	64	33.1%	19	0.05	0 - 2.72	1	--	0.74
1000	Redwood City	148	108	73.0%	3	0.57	0.02 - 0.75	0	--	--
75	San Carlos	66	38	58.3%	12	0.09	0.02 - 49.4	1	--	6.14
31	San Carlos	99	27	27.2%	26	0.19	0 - 1.61	4	1.12	0.41 - 2.15
1016	San Carlos	142	27	19.0%	8	0.54	0 - 6.19	0	--	--
239	Menlo Park / EPA	36	11	29.1%	5	0.04	0.01 - 0.57	0	--	--
358	South San Francisco	32	7	21.8%	4	0.07	0.01 - 1.46	0	--	--
70	East Palo Alto	490	16	3.3%	4	0.04	0.01 - 0.34	1	--	0.11
314	South San Francisco	66	4	5.4%	2	0.10	0.05 - 0.15	2	0.91	0.86 - 0.95
294	South San Francisco	67	21	31.2%	3	0.19	0.07 - 0.28	1	--	0.37
1001	South San Francisco	413	107	26.0%	17	0.04	0.01 - 0.43	2	1.03	0.35 - 1.71
407	Redwood City	18	10	52.9%	1	0.01	0.01 - 0.01	0	--	--
85	Burlingame	121	13	10.4%	2	0.03	0.03 - 0.03	1	--	0.24
164	Burlingame	241	79	32.6%	4	0.07	0.04 - 0.09	1	--	0.45
336	Redwood City	66	4	6.6%	0	--	--	0	--	--
1011	Redwood City	507	63	12.3%	25	0.03	0 - 0.72	4	0.19	0.17 - 0.23
25	San Mateo	219	6	2.9%	1	--	0.03	1	--	0.15
149	Burlingame	480	5	1.1%	2	0.13	0.07 - 0.19	1	--	0.11

WMA ID	Permittee	Area (acres)	Area High Interest Parcels (acres)	Percent High Interest Parcels	Sediment Samples			Stormwater Runoff Samples		
					n	PCBs Median (mg/kg)	PCBs Range (mg/kg)	n	PCBs Particle Ratio Median (mg/kg)	PCBs Particle Ratio Range (mg/kg)
266	Redwood City	91	4	4.1%	0	--	--	1	--	0.00
77	Belmont	86	4	4.7%	0	--	--	0	--	--
59	San Carlos	28	9	32.1%	3	0.18	0.04 - 0.31	0	--	--
356	South San Francisco	10	2	18.0%	2	0.02	0 - 0.03	1	--	0.09
333	Redwood City	15	4	29.4%	1	--	0.02	1	--	0.02
111	San Mateo	95	5	4.8%	2	0.06	0.05 - 0.06	0	--	--
1008	San Mateo	111	1	0.5%	0	--	--	0	--	--
139	Burlingame	63	2	3.0%	0	--	--	0	--	--
181	Daly City	75	12	15.6%	0	--	--	0	--	--
298	South San Francisco	122	3	2.7%	0	--	--	0	--	--
307	Daly City	1,277	5	0.4%	0	--	--	0	--	--
401	Millbrae	52	7	12.6%	0	--	--	0	--	--
238	Menlo Park	345	84	24.2%	4	0.14	0.01 - 0.29	2	0.08	0.04 - 0.12
67	East Palo Alto	95	11	12.0%	2	0.12	0.02 - 0.21	0	--	--
114	San Mateo	85	8	9.3%	1	--	0.23	0	--	--
295	South San Francisco	25	3	11.7%	4	0.155	0 - 0.33	0	--	--
362	South San Francisco	18	9	51.6%	2	0.234	0.01 - 0.46	0	--	--
350	Daly City	317	15	4.8%	1	0.009	0.01	0	--	--
32	Belmont	67	2	3.3%	0	--	--	1	--	0.17
317	South San Francisco	32	9	27.1%	0	--	--	1	--	0.45
66	Menlo Park	64	19	29.8%	1	0.06	0.06	1	--	0.39
1006	Burlingame	306	49	15.9%	5	0.10	0.01 - 0.14	1	--	0.36
319	South San Francisco	99	31	31.2%	1	--	0.06	1	--	0.08
318	South San Francisco	70	32	45.4%	1	--	0.01	1	--	0.27
1004	Brisbane	804	507	63.0%	4	0.02	0.01 - 0.04	1	--	0.11

WMA ID	Permittee	Area (acres)	Area High Interest Parcels (acres)	Percent High Interest Parcels	Sediment Samples			Stormwater Runoff Samples		
					n	PCBs Median (mg/kg)	PCBs Range (mg/kg)	n	PCBs Particle Ratio Median (mg/kg)	PCBs Particle Ratio Range (mg/kg)
156	San Mateo	40	7	17.0%	1	--	0.01	1	--	0.20
323	Redwood City	185	2	0.9%	0	--	--	1	--	0.19
306	South San Francisco	37	7	18.4%	0	--	--	2	0.18	0.17 - 0.18
315	South San Francisco	108	34	31.8%	1	--	0.12	2	0.60	0.17 - 1.02
324	Redwood City	44	1	2.0%	0	--	--	1	--	0.17
141	Burlingame	62	4	6.9%	0	--	--	1	--	0.17
89	San Mateo	98	10	10.3%	2	0.02	0.01 - 0.04	1	--	0.14
327	Redwood City	126	7	5.1%	3	0.05	0 - 0.08	1	--	0.13
337	Redwood City	138	16	11.5%	4	0.04	0.02 - 0.08	1	--	0.12
293	South San Francisco	654	58	8.9%	2	0.04	0.01 - 0.07	1	--	0.12
254	Redwood City	39	4	9.9%	1	--	0.09	1	--	0.11
316	South San Francisco	117	26	21.9%	3	0.02	0 - 0.03	1	--	0.10
72	East Palo Alto	26	12	44.4%	2	0.02	0.02 - 0.02	1	--	0.08
267	Redwood City	75	16	20.9%	1	--	0.01	1	--	0.06
388	Redwood City	42	1	1.4%	0	--	--	1	--	0.05
71	Menlo Park	1,394	22	1.6%	1	--	0.01	1	--	0.04
296	South San Francisco	1,272	7	0.6%	0	--	--	1	--	0.03
292	San Bruno	220	37	16.9%	19	0.12	0 - 0.18	1	--	0.01
313	South San Francisco	77	11	14.3%	1	--	0.01	0	--	--
1005	Millbrae	791	59	7.4%	1	--	0.01	0	--	--
1007	San Mateo	87	7	8.4%	1	--	0.01	0	--	--
1014	Menlo Park	176	18	10.3%	3	0.02	0.01 - 0.03	0	--	--
354	South San Francisco	10	4	44.7%	1	--	0.02	0	--	--
403	San Mateo	48	1	1.4%	1	--	0.02	0	--	--
332	Menlo Park	17	1	5.1%	1	--	0.03	0	--	--

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1009	San Mateo	175	43	24.3%	2	0.03	0.03 - 0.04	0	--	--
1015	East Palo Alto	52	48	92.7%	2	0.04	0.02 - 0.06	0	--	--
253	Redwood City	280	16	5.8%	1	--	0.05	0	--	--
16	Burlingame	24	8	31.4%	1	--	0.05	0	--	--
1012	Menlo Park	54	42	79.4%	1	--	0.06	0	--	--
101	San Mateo	221	10	4.3%	1	--	0.08	0	--	--
1002	South San Francisco	316	66	20.9%	3	0.08	0.02 - 0.12	0	--	--
357	South San Francisco	17	3	18.5%	1	--	0.09	0	--	--
1010	Foster City	273	8	3.1%	0	--	--	0	--	--
1013	Redwood City	40	4	8.9%	0	--	--	0	--	--
1017	San Mateo	19	4	21.1%	0	--	--	0	--	--
120	San Mateo	10	1	4.9%	0	--	--	0	--	--
138	Burlingame	15	5	29.9%	0	--	--	0	--	--
207	San Carlos	82	7	8.2%	0	--	--	0	--	--
247	Menlo Park	239	20	8.5%	0	--	--	0	--	--
252	Menlo Park	108	5	4.9%	0	--	--	0	--	--
261	Atherton	1,679	3	0.2%	0	--	--	0	--	--
269	Redwood City	45	4	9.2%	0	--	--	0	--	--
290	San Bruno	2,017	9	0.4%	0	--	--	0	--	--
297	South San Francisco	30	2	6.7%	0	--	--	0	--	--
311	South San Francisco	111	3	2.8%	0	--	--	0	--	--
325	Redwood City	21	1	4.8%	0	--	--	0	--	--
329	Colma	806	4	0.5%	0	--	--	0	--	--
334	Redwood City	19	4	18.3%	0	--	--	0	--	--
335	Redwood City	24	0	0.0%	0	--	--	0	--	--

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352	South San Francisco	40	7	16.7%	0	--	--	0	--	--
378	Menlo Park	138	4	2.9%	0	--	--	0	--	--
395	Millbrae	480	8	1.6%	0	--	--	0	--	--
399	San Mateo	32	1	4.6%	0	--	--	0	--	--
405	Redwood City	22	22	100.0%	0	--	--	0	--	--
57	San Carlos	63	4	5.6%	0	--	--	0	--	--
68	East Palo Alto	317	0.5	0.2%	0	--	--	0	--	--
80	San Carlos	21	1	4.7%	0	--	--	0	--	--
90	San Mateo	21	0.3	1.4%	0	--	--	0	--	--
92	San Mateo	136	4	2.7%	0	--	--	0	--	--
Other -	Unincorporated	10,917	343	3.1%	3	0.00	0 - 0.04	0	--	--
Other -	Woodside	7,286	5	0.1%	1	--	0	0	--	--
Other -	Menlo Park	2,487	25	1.0%	1	--	0.02	0	--	--
Other -	Colma	1,139	5	0.4%	4	0.03	0 - 16.81	0	--	--
Other -	San Carlos	2,517	2	0.1%	1	--	0.06	0	--	--
Other -	East Palo Alto	274	4	1.4%	1	--	0.07	0	--	--
Other -	Redwood City	6,030	6	0.1%	6	0.07	0.01 - 0.34	0	--	--
Other -	San Mateo	5,800	55	0.9%	1	--	0.09	0	--	--
Other -	South San Francisco	1,554	3	0.2%	1	--	0.19	0	--	--
Other -	Atherton	2,315	1	0.0%	0	--	--	0	--	--
Other -	Belmont	2,511	5	0.2%	0	--	--	0	--	--
Other -	Brisbane	245	0.4	0.2%	0	--	--	0	--	--
Other -	Burlingame	1,827	9	0.5%	0	--	--	0	--	--
Other -	Daly City	1,131	11	1.0%	0	--	--	0	--	--
Other -	Foster City	2,065	0	0.0%	0	--	--	0	--	--

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Other -	Hillsborough	3,974	3	0.1%	0	--	--	0	--	--
Other -	Millbrae	1,309	3	0.2%	0	--	--	0	--	--
Other -	Portola Valley	5,790	0	0.0%	0	--	--	0	--	--
Other -	San Bruno	542	0	0.0%	0	--	--	0	--	--

Notes:

Total PCBs = sum of the 40 PCBs congeners analyzed by the RMP for Bay samples.