Urban Creeks Monitoring Report

Water Quality Monitoring

Water Year 2015 (October 2014 – September 2015)

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, 2016

CREDITS

This report is submitted by the participating agencies in the

SAN MATEO COUNTYWIDE
Water Pollution Prevention Program
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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 2009 Municipal Regional Stormwater National Pollutant Discharge Elimination System (NPDES) Permit in this document the 2009 permit is referred to as "MRP 1.0")[1]. The RMC includes the following participants:

- Clean Water Program of Alameda County (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 Sanitation and Flood Control District (Vallejo)

In 2015, the San Francisco Bay Regional Water Quality Control Board (SFRWQCB or Regional Water Board) revised and reissued the MRP (the 2015 permit is referred to as "MRP 2.0"). This Urban Creeks Monitoring Report complies with MRP 2.0 Provision C.8.h.iii for reporting of all data in Water Year 2015 (October 1, 2014 through September 30, 2015). Data were collected pursuant to Provision C.8 of MRP 1.0. Data presented in this report were produced under the direction of the RMC and the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP) using probabilistic and targeted monitoring designs as described herein.

Consistent with the BASMAA RMC Multi-Year Work Plan (Work Plan; BASMAA 2012) and the Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2011), monitoring data were collected in accordance with the BASMAA RMC Quality Assurance Program Plan (QAPP; BASMAA, 2014a) and the BASMAA RMC Standard Operating Procedures (SOPs; BASMAA, 2014b). Where applicable, monitoring data were derived using methods comparable with methods specified by the California Surface Water Ambient Monitoring Program (SWAMP) QAPP[2]. Data presented in this report were also submitted in electronic SWAMP-comparable formats by SMCWPPP to the Regional Water Board on behalf of SMCWPPP Permittees and pursuant to Provision C.8.h.ii of MRP 2.0.

[1] The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) adopted MRP 1.0 on October 14, 2009 (SFRWQCB 2009). 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area are permitted under the MRP. 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 QAPP is available at:
http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/swamp_qapp_master090108a.pdf

List of Acronyms

ACCWP	Alameda County Clean Water Program
ASBS	Area of Special Biological Significance
BASMAA	Bay Area Stormwater Management Agency Association
BMP	Best Management Practice
C/CAG	San Mateo City/County Association of Governments
CCCWP	Contra Costa Clean Water Program
CDO	Cease and Desist Order
CEDEN	California Environmental Data Exchange Network
CRAM	California Rapid Assessment Method
CSCI	California Stream Condition Index
CW4CB	Clean Watersheds for a Clean Bay
DO	Dissolved Oxygen
FIB	Fecal Indicator Bacteria
FSURMP	Fairfield Suisun Urban Runoff Management Program
GIS	Geographic Information system
IBI	Benthic Macroinvertebrate Index of Biological Integrity
IPM	Integrated Pest Management
LID	Low Impact Development
MBNMS	Monterey Bay National Marine Sanctuary
MPC	Monitoring and Pollutants of Concern Committee
MRP	Municipal Regional Permit
MS4	Municipal Separate Storm Water Sewer System
MST	Microbial Source Tracking
MWAT	Maximum Weekly Average Temperature
MYP	Multi-Year Plan
NPDES	National Pollution Discharge Elimination System
PAHs	Polycyclic Aromatic Hydrocarbons
PBDEs	Polybrominated Diphenyl Ethers
PCBs	Polychlorinated Biphenyls
PEC	Probably Effect Concentration
PHAB	Physical Habitat
POC	Pollutant of Concern

QAPP	Quality Assurance Project Plan
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program
RWSM	Regional Watershed Spreadsheet Model
S&T	Status and Trends
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFEI	San Francisco Estuary Institute
SFRWQCB	San Francisco Regional Water Quality Control Board
SMCRCD	San Mateo County Resource Conservation District
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SOP	Standard Operating Procedures
SPLWG	Sources, Pathways, and Loadings Work Group
SPoT	Statewide Stream Pollutant Trend Monitoring
SSID	Stressor/Source Identification
STLS	Small Tributaries Loading Strategy
SWAMP	Surface Water Ambient Monitoring Program
TEC	Threshold Effect Concentration
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TRC	Technical Review Committee
TU	Toxic Unit (equivalent)
UCMR	Urban Creeks Monitoring Report
USEPA	US Environmental Protection Agency
WLA	Waste Load Allocation
WQO	Water Quality Objective

Table of Contents

List of Figures

List of Tables

Appendices

Table E.1. Water Year 2016 Creek Status Monitoring Stations

In compliance with Provision C.8.h.iii.(1), this table of all Creek Status Monitoring stations sampled in Water Year 2015 is provided immediately following the Table of Contents. See Section 3.0 for additional information on Creek Status Monitoring.

Map ID	Station Number	Bayside or Coastside	Watershed	Creek Name	Land Use	Latitude	Longitude	Probabilistic		Targeted			
								Bioassessment, Nutrients, General WQ	Toxicity, Sediment Chemistry	CRAM	Temp	Cont. WQ	Pathogen Indicators
378	202R00378	Bayside	Pescadero Creek	Pescadero Creek	NU	37.21994	-122.16385	X		X			
440	202R00440	Coastside	Purisima Creek	Purisima Creek	NU	37.43417	-122.34959	X		X			
1356	202R01356	Coastside	San Pedro Creek	Middle Fork San Pedro Creek	U	37.57524	-122.46105	X		X			
1612	202R01612	Coastside	San Pedro Creek	Middle Fork San Pedro Creek	U	37.57810	-122.47139	X		X			
1448	204R01448	Bayside	San Francisquito Creek	Atherton Creek	U	37.43459	-122.21776	X	X	X			
1972	204R01972	Bayside	Cordilleras Creek	Cordilleras Creek	U	37.48375	-122.25730	X		X			
2056	204R02056	Bayside	Laurel Creek	Laurel Creek	U	37.53342	-122.30243	X	X	X			
2248	204R02248	Bayside	Laurel Creek	Laurel Creek	U	37.52659	-122.32843	X		X			
1704	205R01704	Bayside	Atherton Creek	Dry Creek	U	37.43389	-122.26094	X		X			
1816	205R01816	Bayside	San Francisquito Creek	Corte Madera Creek	U	37.36615	-122.21570	X		X			
58	204SMA058	Bayside	San Mateo Creek	San Mateo Creek	U	37.56249	-122.32843					X	
59	204SMA059	Bayside	San Mateo Creek	San Mateo Creek	U	37.56331	-122.32707					X	
60	204SMA060	Bayside	San Mateo Creek	San Mateo Creek	U	37.56244	-122.32828						X
80	204SMA080	Bayside	San Mateo Creek	San Mateo Creek	U	37.55731	-122.34204						X
100	204SMA100	Bayside	San Mateo Creek	San Mateo Creek	U	37.53719	-122.35001						X
110	204SMA110	Bayside	San Mateo Creek	Polhemus Creek	U	37.53235	-122.3508						X
120	204SMA119	Bayside	San Mateo Creek	San Mateo Creek	U	37.53312	-122.35073						X
68	205ALA015	Bayside	San Francisquito Creek	Alambique Creek	U	37.40443	-122.25430				X		
71	205BCR010	Bayside	San Francisquito Creek	Bear Creek	U	37.41179	-122.24106				X		
69	205BCR050	Bayside	San Francisquito Creek	Bear Creek	U	37.427017	-122.25378				X		
72	205BCR060	Bayside	San Francisquito Creek	Bear Creek	U	37.42550	-122.26243				X		
70	205WUN150	Bayside	San Francisquito Creek	West Union Creek	U	37.431117	-122.27622				X		

U = Urban, NU = Non-urban

1.0 Introduction

This Urban Creeks Monitoring Report (UCMR), was prepared by the San Mateo Countywide Water Pollution Prevention Program (SMCWPPP), on behalf of its 22 member agencies (20 cities/towns, the County of San Mateo, and the San Mateo County Flood Control District) subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities referred to as the Municipal Regional Permit (MRP).

The MRP was 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 (referred to as MRP 1.0). On November 19, 2015, the SFRWQCB updated and reissued the MRP as Order R2-2015-0049 (referred to as MRP 2.0). This report fulfills the requirements of Provision C.8.g.iii of MRP 2.0 for comprehensively interpreting and reporting all monitoring data collected during the foregoing October 1 – September 30 (i.e., Water Year 2015). Data were collected pursuant to water quality monitoring requirements in Provision C.8 of MRP 1.0[3]. Monitoring data presented in this report were submitted electronically to the SFRWQCB by SMCWPPP and may be obtained via the San Francisco Bay Area Regional Data Center of the California Environmental Data Exchange Network (CEDEN) (http://water100.waterboards.ca.gov/ceden/sfei.shtml).

Chapters in this report are organized according to the following topics and MRP 1.0 provisions. Some topics are summarized briefly in this report but described more fully in appendices.

- **San Francisco Estuary Receiving Water Monitoring** (MRP 1.0 Provision C.8.b)
- **Creek Status Monitoring** (MRP 1.0 Provision C.8.c), including local targeted monitoring and SMCWPPP's contribution to the regional probabilistic monitoring program (Appendix A)
- **Monitoring Projects** (MRP 1.0 Provision C.8.d), specifically two completed SSID projects (Appendices B and C) and the BMP Effectiveness Investigation (Appendix E):
- **Pollutants of Concern (POC) Monitoring** (MRP 1.0 Provision C.8.e.i) (Appendices F and G)
- **Long-Term Trends Monitoring** (MRP 1.0 Provision C.8.e.ii)
- **Citizen Monitoring and Participation** (MRP 1.0 Provision C.8.f)
- **Recommendations and Next Steps**

Figure 1.1 maps locations of monitoring stations associated with Provision C.8 compliance in Water Year 2015 (WY2015), including Creek Status Monitoring, the Monitoring Projects (Stressor/Source Identification, BMP Effectiveness Investigation), SMCWPPP and Small Tributaries Loading Strategy (STLS) POC Monitoring, and Long-Term Trends Monitoring conducted at Stream Pollution Trend (SPoT) stations. This figure illustrates the geographic extent of monitoring conducted in San Mateo County in WY2015.

[3] Water quality monitoring requirements in MRP 2.0 are generally similar to requirements in MRP 1.0. Differences in water quality monitoring requirements between MRP 1.0 and MRP 2.0 are briefly outlined in this report where applicable.

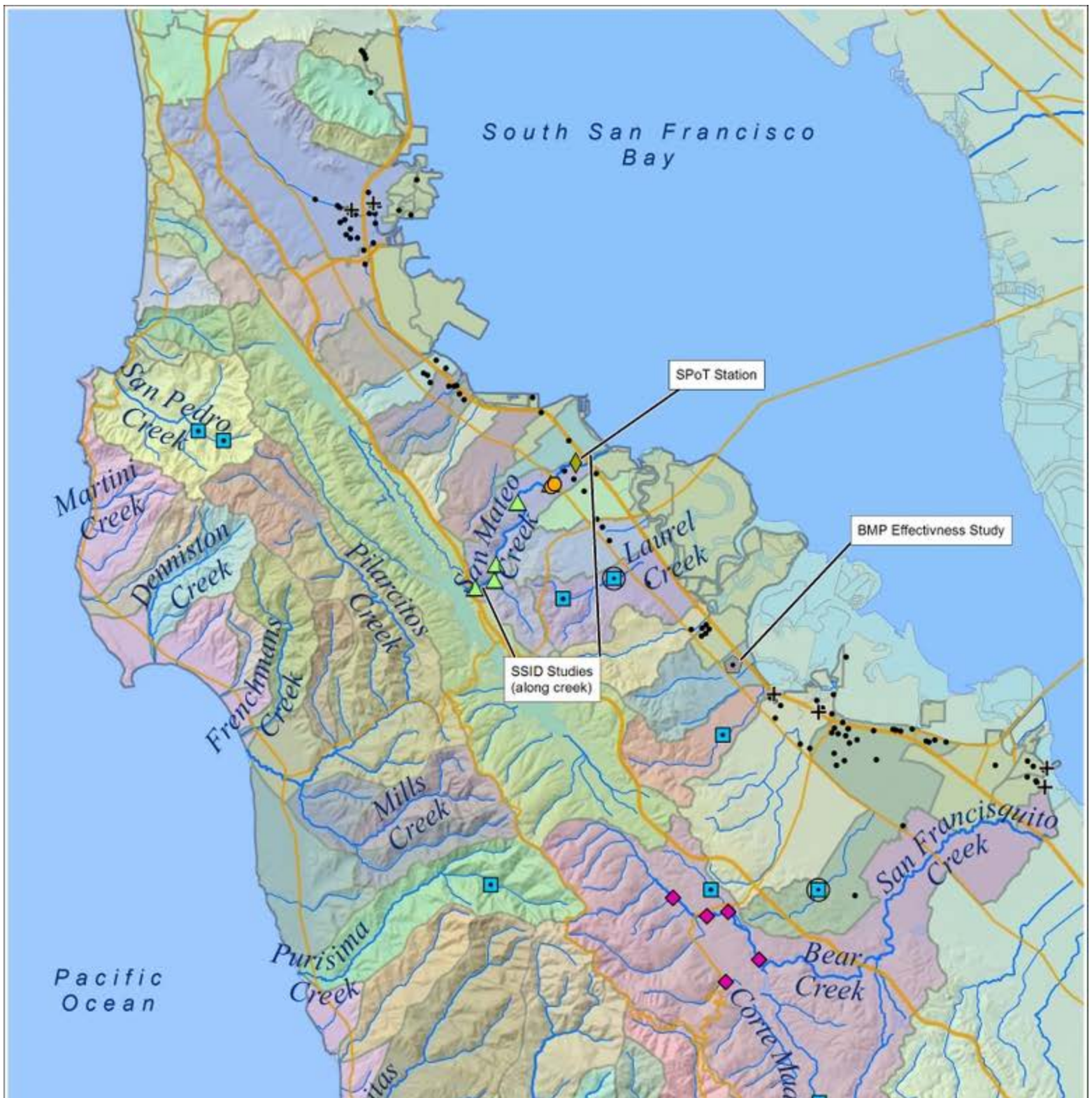

Figure. 1.1. San Mateo County MRP Provision C.8 monitoring locations: Creek Status Monitoring, Stressor/Source Identification (SSID) Studies, BMP Effectiveness Investigation, POC Monitoring, and Long-Term Trends (SPoT), WY2015.

1.1 RMC Overview

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. In June 2010, Permittees notified the Regional Water Board in writing of their agreement to participate in a regional monitoring collaborative to address requirements in Provision C.8. The regional monitoring collaborative is referred to as the Bay Area Stormwater Management Agency Association (BASMAA) Regional Monitoring Coalition (RMC). With notification of participation in the RMC, Permittees were required to commence water quality data collection by October 2011. In a November 2, 2010 letter to the Permittees, the Regional Water Board's Assistant Executive Officer (Dr. Thomas Mumley) acknowledged that all Permittees have opted to conduct monitoring required by the MRP through a regional monitoring collaborative, the BASMAA RMC. Participants in the RMC are listed in Table 1.1. SMCWPPP will continue its participation in the RMC during the permit term of MRP 2.0.

In February 2011, the RMC developed a Multi-Year Work Plan (RMC Work Plan; BASMAA 2011) to provide a framework for implementing regional monitoring and assessment activities required under MRP Provision C.8. The RMC Work Plan summarizes RMC projects planned for implementation between Fiscal Years 2009-10 and 2014-15 (BASMAA 2011). Projects were collectively developed by RMC representatives to the BASMAA Monitoring and Pollutants of Concern Committee (MPC), and were conceptually agreed to by the BASMAA Board of Directors (BASMAA BOD). A total of 27 regional projects are identified in the RMC Work Plan, based on the requirements described in Provision C.8 of the MRP 1.0[4].

Regionally implemented activities in the RMC Work Plan are conducted under the auspices of BASMAA, a 501(c)(3) non-profit organization comprised of the municipal stormwater programs in the San Francisco Bay Area. Scopes, budgets, and contracting or in-kind project implementation mechanisms for BASMAA regional projects follow BASMAA's Operational Policies and Procedures and are approved by the BASMAA BOD. MRP Permittees, through their stormwater program representatives on the BOD and its subcommittees, collaboratively authorize and participate in BASMAA regional projects or tasks[5]. Regional project costs are shared by either all BASMAA members or among those Phase I municipal stormwater programs that are subject to the MRP.

[4] Several regional projects have already been identified and will be conducted in compliance with MRP 2.0; however, the RMC will likely not compile the project descriptions in an updated Multi-Year Work Plan.

[5] Regional projects conducted in compliance with MRP 2.0 will continue to follow BASMAA Operational Policies and Procedures.

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
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 Countywide Water Pollution Prevention Program (SMCWPPP)	Cities of Belmont, Brisbane, Burlingame, Daly City, East Palo Alto, Foster City, Half Moon Bay, Menlo Park, Millbrae, Pacifica, Redwood City, San Bruno, San Carlos, San Mateo, South San Francisco, Atherton, Colma, Hillsborough, Portola Valley, and Woodside; San Mateo County Flood Control District; and, San Mateo County
Fairfield-Suisun Urban Runoff Management Program (FSURMP)	Cities of Fairfield and Suisun City
Vallejo Permittees	City of Vallejo and Vallejo Sanitation and Flood Control District

1.2 Coordination with Third-party Monitoring Programs

In WY2015, SMCWPPP continued to coordinate with water quality monitoring programs conducted by third parties, but that supplement Bay Area stormwater monitoring conducted via MRP 1.0. These programs include the San Francisco Bay Regional Monitoring Program (RMP) for Water Quality's Small Tributaries Load Strategy (STLS) and the Stream Pollutant Trends (SPoT) monitoring conducted by the State of California's Surface Water Ambient Monitoring Program (SWAMP). Water quality data from each of these programs are reported in this document and were utilized to comply with Provision C.8 of MRP 1.0, consistent with Provision C.8.a.[6] Data are specifically referenced in Sections 5.0 (POC Monitoring) and 6.0 (Trends Monitoring) of this report.

[6] Data reported by these programs are summarized in this report, however were not included in the SMCWPPP electronic data submittal.

2.0 San Francisco Estuary Receiving Water Monitoring

As described in MRP Provision C.8.b, Permittees are required to provide financial contributions towards implementing an Estuary receiving water monitoring program on an annual basis that at a minimum is equivalent to the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP). Since the adoption of the MRP 1.0, SMCWPPP has complied with this provision by making financial contributions to the RMP directly or through stormwater programs. Additionally, BASMAA and SMCWPPP staff actively participates in RMP committees, workgroups, and strategy teams as described in the following sections, which also provide a brief description of the RMP and associated monitoring activities conducted during WY2015. These contributions and participation will continue through MRP 2.0.

The RMP is a long-term monitoring program that is discharger funded and shares direction and participation by regulatory agencies and the regulated community with the goal of assessing water quality in the San Francisco Bay. The regulated community includes Permittees, publicly owned treatment works (POTWs), dredgers, and industrial dischargers. The San Francisco Estuary Institute (SFEI) is the implementing entity for the RMP and the fiduciary agent for RMP stakeholder funds. SFEI does not provide direct oversight of the RMP but does help identify stakeholder information needs, develop workplans that address these needs, and implement the workplans.

The RMP is intended to help answer the following core management questions:

1. *Are chemical concentrations in the Estuary potentially at levels of concern and are associated impacts likely?*
2. *What are the concentrations and masses of contaminants in the Estuary and its segments?*
3. *What are the sources, pathways, loadings, and processes leading to contaminant related impacts in the Estuary?*
4. *Have the concentrations, masses, and associated impacts of contaminants in the Estuary increased or decreased?*
5. *What are the projected concentrations, masses, and associated impacts of contaminants in the Estuary?*

The RMP budget is generally broken into two major program elements: Status and Trends, and Pilot/Special Studies. The following sections provide a brief overview of these programs. The RMP 2015 Detailed Workplan provides more details and establishes deliverables for each component of the RMP budget (http://www.sfei.org/sites/default/files/biblio_files/2015%20RMP%20Detailed%20Workplan.pdf). More information, including monitoring results, is available in the 2015 *State of the Estuary Report*[7] (http://www.sfestuary.org/about-the-estuary/soter/) and its companion, the 2015 *Pulse of the Bay* (http://www.sfei.org/programs/pulse-bay).

[7] In 2015, the *State of the Estuary Report* was published as an online *Flipbook* with interactive charts and data stories, as well as in portable document format (pdf).

2.1 RMP Status and Trends Monitoring Program

The Status and Trends Monitoring Program (S&T Program) is the long-term contaminant-monitoring component of the RMP. The S&T Program was initiated as a pilot study in 1989, implemented thereafter, and then redesigned in 2007 based on a more rigorous statistical design that enables the detection of trends. The Technical Review Committee (TRC) continues to assess the efficacy and value of the various elements of the S&T Program and to recommend modifications to S&T Program activities based on ongoing findings. In 2015, the S&T Program was comprised of the following program elements that collect data to address the RMP management questions described above:

- Long-term water, sediment, and bivalve monitoring
- Episodic toxicity monitoring
- Sport fish monitoring on a five-year cycle
- USGS hydrographic and sediment transport studies
    - Factors controlling suspended sediment in San Francisco Bay
    - Hydrography and phytoplankton
- Triennial bird egg monitoring (cormorant and tern)
- Sediment sampling in Bay Margins

Additional information on the S&T Program and associated monitoring data are available for downloading via the RMP website at http://www.sfei.org/content/status-trends-monitoring.

2.2 RMP Pilot and Special Studies

The RMP also conducts Pilot and Special Studies on an annual basis. Studies are typically designed to investigate and develop new monitoring measures related to anthropogenic contamination or contaminant effects on biota in the Estuary. Special Studies address specific scientific issues that RMP committees, workgroups, and strategy teams identify as priority for further study. These studies are developed through an open selection process at the workgroup level and selected for funding through the TRC and the Steering Committee.

In 2015, Pilot and Special Studies focused on the following topics:

- Continuous monitoring of nutrients and dissolved oxygen at moored sensors
- Nutrients loads modeling
- Small tributary load monitoring (see Section 5.0 for more details)
- Chemicals of emerging concern (CEC) monitoring (perfluorochemicals, fipronil, and microplastics)
- Selection of priority margin areas for evaluation and development of conceptual PCB models
- Selenium in fish tissue monitoring

Results and summaries of the most pertinent Pilot and Special Studies can be found on the RMP website (http://www.sfei.org/rmp/rmp_pilot_specstudies).

In WY2015, a considerable amount of RMP and Stormwater Program staff time was spent overseeing and implementing Special Studies associated with the RMP's Small Tributary Loading Strategy (STLS) and the STLS Multi-Year Monitoring Plan (MYP). Pilot and Special Studies associated with the STLS are intended to fill data gaps associated with loadings of Pollutants of Concern (POC) from relatively small tributaries to the San Francisco Bay. Additional information on STLS-related studies is included in Section 5.0 (POC Loads Monitoring) of this report.

2.3 Participation in Committees, Workgroups and Strategy Teams

In WY2015, BASMAA and/or SMCWPPP staff actively participated in the following RMP Committees and workgroups:

- Steering Committee (SC)
- Technical Review Committee (TRC)
- Sources, Pathways and Loadings Workgroup (SPLWG)
- Contaminant Fate Workgroup (CFWG)
- Exposure and Effects Workgroup (EEWG)
- Emerging Contaminant Workgroup (ECWG)
- Sport Fish Monitoring Workgroup
- Nutrient Technical Workgroup
- Strategy Teams (e.g., PCBs, Mercury, Dioxins, Small Tributaries, Nutrients)

Committee and workgroup representation was provided by Permittee, stormwater program (including SMCWPPP) staff and/or individuals designated by RMC participants and the BASMAA BOD. Representation typically includes participating in meetings, reviewing technical reports and work products, co-authoring or reviewing articles included in the RMP's *Pulse of the Estuary*, and providing general program direction to RMP staff. Representatives of the RMC also provided timely summaries and updates to, and received input from Stormwater Program representatives (on behalf of Permittees) during BASMAA Monitoring and Pollutants of Concern Committee (MPC) and/or BASMAA BOD meetings to ensure Permittees' interests were represented.

3.0 Creek Status Monitoring

Provision C.8.c of MRP 1.0 and Provision C.8.d of MRP 2.0 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 waters supportive of or likely supportive of beneficial uses?*

Creek status monitoring parameters, methods, occurrences, durations and minimum number of sampling sites for each stormwater program are described in Table 8.1 of the MRP. Based on the implementation schedule described in MRP Provision C.8.a.ii, creek status monitoring coordinated through the RMC began in October 2011.

The RMC's regional monitoring strategy for complying with MRP Provision C.8.c - Creek Status Monitoring - is described in the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2011). The strategy includes a regional ambient/probabilistic monitoring component and a component based on local "targeted" monitoring. The combination of these monitoring designs allows each individual RMC participating program to assess the status of beneficial uses in local creeks within its Program (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).

Creek status monitoring data from WY2015 were submitted to the Regional Water Board by SMCWPPP. The analyses of results from creek status monitoring conducted by SMCWPPP in WY2014 are summarized below and presented in detail in Appendix A (SMCWPPP Creek Status Monitoring Report, WY2014).

The probabilistic monitoring design was developed to remove bias from site selection such that ecosystem conditions can be objectively assessed on local (i.e., SMCWPPP) and regional (i.e., RMC) scales. Probabilistic parameters consist of benthic macroinvertebrate and algae bioassessment, nutrients and conventional analytes. Riparian assessments, chlorine measurements, and collection of water and sediment toxicity and sediment chemistry are also conducted at probabilistic sites. Ten probabilistic sites were sampled by SMCWPPP in WY2015. A small number of additional non-urban sites were sampled by the SFRWQCB as part of the Surface Water Ambient Monitoring Program (SWAMP), in collaboration with SMCWPPP; however, the SWAMP data were not available at the time this report was completed.

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. Targeted monitoring parameters consist of water temperature, general water quality, pathogen indicators and riparian assessments. In WY2015, hourly water temperature measurements were recorded during the dry season using HOBO® temperature data loggers installed at five sites in the San Francisquito Creek watershed. General water quality monitoring (temperature, dissolved oxygen, pH and specific conductivity) was conducted using YSI continuous water quality equipment (sondes) for two 2-week periods (spring and late summer) at two sites in San Mateo Creek. Water samples were collected at five sites in San Mateo Creek for analysis of pathogen indicators (*E. coli* and fecal coliform).

Probabilistic and targeted Creek Status monitoring stations are listed in Table 3.1 and mapped in Figure 3.1 (and Figure 1.1, with other types of monitoring stations).

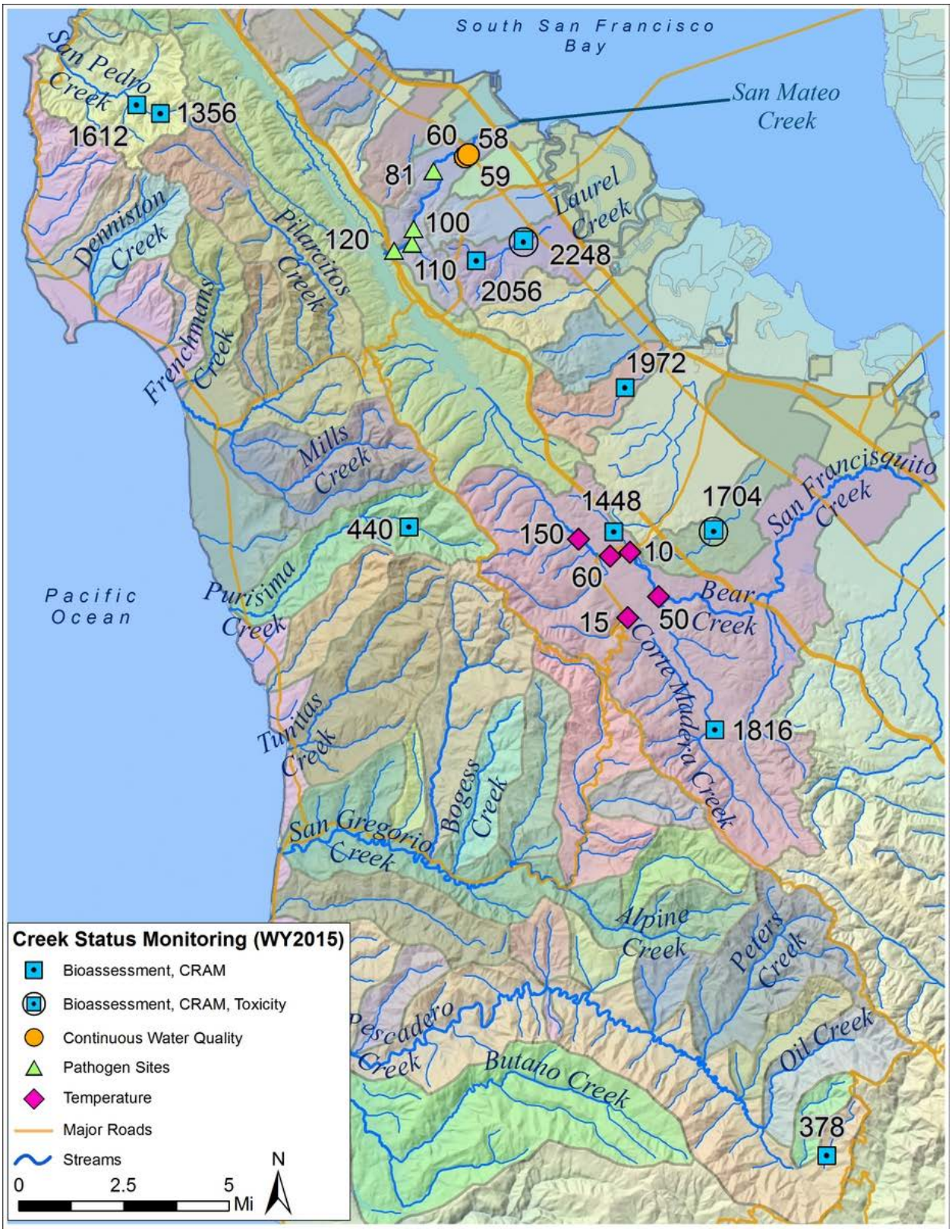

Figure 3.1. Map of major creeks and SMCWPPP stations monitored in WY2015 in compliance with MRP 1.0 Provision C.8.c.

Table 3.1. MRP 1.0 Provision C.8.c Creek Status monitoring stations in San Mateo County, WY2015.

Map ID	Station Number	Bayside or Coastside	Watershed	Creek Name	Land Use	Latitude	Longitude	Probabilistic		Targeted			
								Bioassessment, Nutrients, General WQ	Toxicity, Sediment Chemistry	CRAM	Temp	Cont. WQ	Pathogen Indicators
378	202R00378	Bayside	Pescadero Creek	Pescadero Creek	NU	37.21994	-122.16385	X		X			
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2248	204R02248	Bayside	Laurel Creek	Laurel Creek	U	37.52659	-122.32843	X		X			
1704	205R01704	Bayside	Atherton Creek	Dry Creek	U	37.43389	-122.26094	X		X			
1816	205R01816	Bayside	San Francisquito Creek	Corte Madera Creek	U	37.36615	-122.21570	X		X			
58	204SMA058	Bayside	San Mateo Creek	San Mateo Creek	U	37.56249	-122.32843					X	
59	204SMA059	Bayside	San Mateo Creek	San Mateo Creek	U	37.56331	-122.32707					X	
60	204SMA060	Bayside	San Mateo Creek	San Mateo Creek	U	37.56244	-122.32828						X
80	204SMA080	Bayside	San Mateo Creek	San Mateo Creek	U	37.55731	-122.34204						X
100	204SMA100	Bayside	San Mateo Creek	San Mateo Creek	U	37.53719	-122.35001						X
110	204SMA110	Bayside	San Mateo Creek	Polhemus Creek	U	37.53235	-122.3508						X
120	204SMA119	Bayside	San Mateo Creek	San Mateo Creek	U	37.53312	-122.35073						X
68	205ALA015	Bayside	San Francisquito Creek	Alambique Creek	U	37.40443	-122.25430				X		
71	205BCR010	Bayside	San Francisquito Creek	Bear Creek	U	37.41179	-122.24106				X		
69	205BCR050	Bayside	San Francisquito Creek	Bear Creek	U	37.427017	-122.25378				X		
72	205BCR060	Bayside	San Francisquito Creek	Bear Creek	U	37.42550	-122.26243				X		
70	205WUN150	Bayside	San Francisquito Creek	West Union Creek	U	37.431117	-122.27622				X		

3.1 Management Questions

The first management question (***Are water quality objectives, both numeric and narrative, being met in local receiving waters, including creeks, rivers and tributaries?***) is addressed primarily through the evaluation of probabilistic and targeted monitoring data with respect to the triggers defined in MRP 2.0. A summary of trigger exceedances observed for each site is presented below in Table 3.2. Sites where triggers are exceeded may indicate potential impacts to aquatic life or other beneficial uses and are considered for future evaluation of stressor source identification (SSID) projects (see Section 4.0 for a discussion of ongoing and completed SSID projects).

The second management question (***Are conditions in local receiving waters supportive of or likely supportive of beneficial uses?***) is addressed primarily by assessing indicators of aquatic biological health using benthic macroinvertebrate and algae data collected at probabilistic sites. Biological condition scores were compared to physical habitat and water quality data collected synoptically with bioassessments to evaluate whether any correlations exist that may explain the variation in biological condition scores.

3.2 Creek Status Results/Conclusions

Probabilistic Survey Design

- Between WY2012 and WY2015, a total of 50 probabilistic sites were sampled by SMCWPPP (n=40) and SWAMP (n=10) in San Mateo County, including 33 urban and 17 non-urban sites. There are now a sufficient number of samples from probabilistic sites to develop estimates of ambient biological condition and stressor assessment for urban streams in San Mateo County. A larger dataset is needed to estimate biological condition at more local scales (e.g., watershed and jurisdictional areas) and more than four years of data are required to assess trends.

Biological Condition Assessment

- The California Stream Condition Index (CSCI) tool was used to assess the biological condition for benthic macroinvertebrate data collected at probabilistic sites. Of the ten sites monitored in WY2015, five sites were rated in good condition (CSCI scores $\geq$ 0.795) and five sites rated as very likely altered condition ($\leq$ 0.635) (Figure 3.2).
- CSCI scores were relatively consistent across four years of sampling. The median CSCI score for all four years ranged from 0.45 to 0.58 for urban sites and 0.9 to 1.1 for non-urban sites.
- Benthic algae data was collected synoptically with BMIs at all probabilistic sites. Algae index scores for diatom taxa (D18) were calculated for all sites. Four of the ten sites were rated in good condition (D18 scores $\geq$ 63), five sites rated as likely altered, and one site rated as very likely altered (<49).
- There was insufficient number of soft algae taxa to calculate algae indices S2 or H20 at any of the sites. Only three soft algal taxa were identified for all ten samples. Site characteristics and flow conditions prior to sampling do not appear to explain the absence of soft algae consistently at all the sites.
- There was very little difference in CSCI or algae IBI (D18) scores between perennial (n=8) and non-perennial (n=2) sites. CSCI scores had good response to different levels

of urbanization (calculated as percent impervious area). CSCI was highly correlated with physical habitat (PHAB) and CRAM scores. D18 was poorly correlated with both PHAB and CRAM scores.

Stressor Assessment

- Nutrients, algal biomass indicators, and other conventional analytes were measured in samples collected concurrently with bioassessments which are conducted in the spring season.
- CSCI scores has significant negative correlation with both land use variables (percent impervious and urban), specific conductivity, unionized ammonia, and SSC and positive correlation with two PHAB parameters (epifaunal substrate score and channel alteration score).
- Thresholds for water quality objectives were not exceeded.

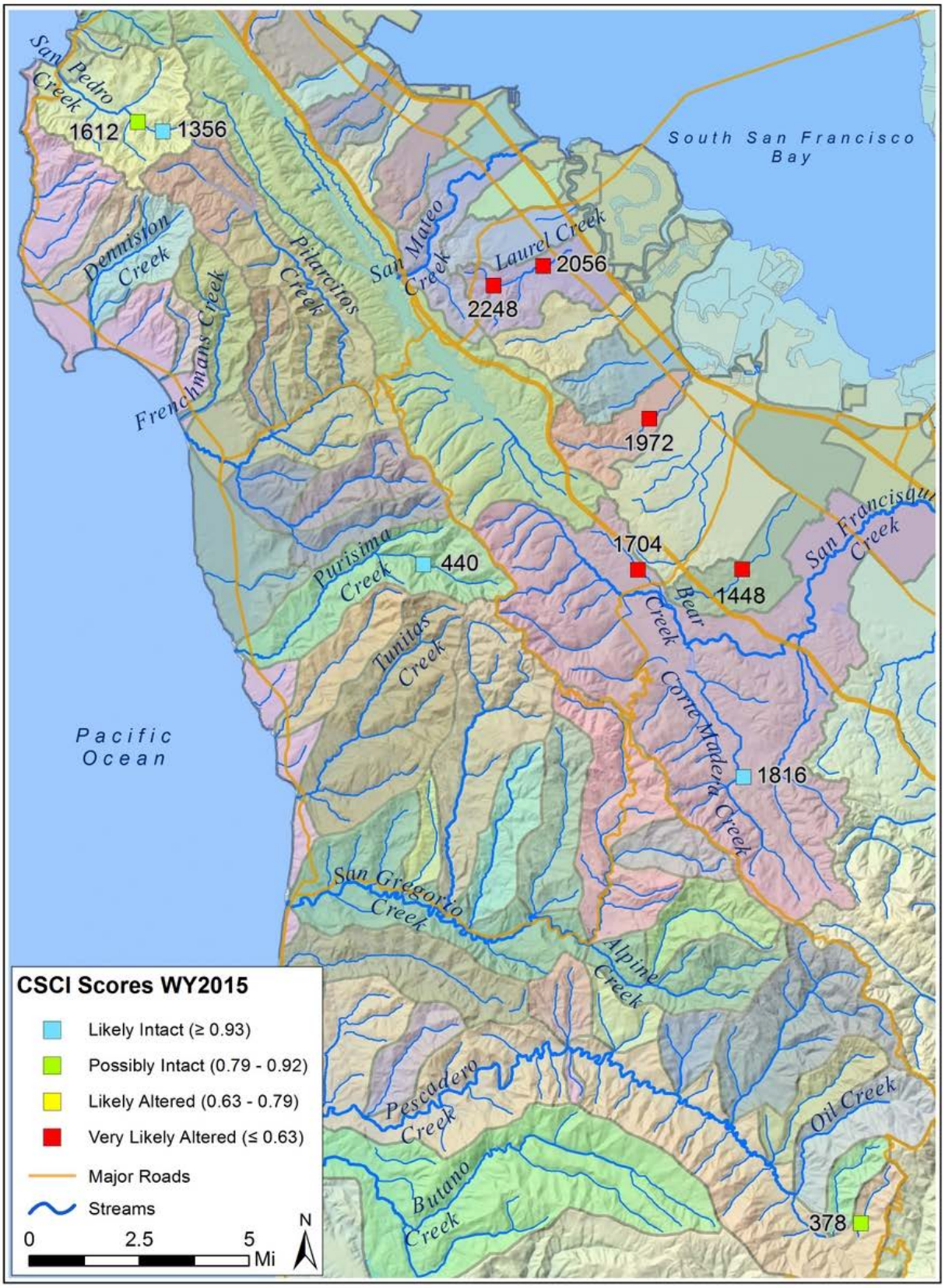

Figure 3.2. CSCI condition category for sites sampled in WY2015, San Mateo County.

Spatial and Temporal Variability of Water Quality Conditions

- There was minimal spatial variability in water temperature across the five sites in Bear Creek watershed.

- Dissolved oxygen concentrations were similar between the two San Mateo Creek sites, but were slightly lower during Event 2 compared to Event 1, possibly a result of warmer conditions late in the summer.

Potential Impacts to Aquatic Life

- Potential impacts to aquatic life were assessed through analysis of continuous temperature data collected at five targeted stations and continuous general water quality data (pH, dissolved oxygen, specific conductance, temperature) collected at two targeted stations. Stations were selected using the Directed Monitoring Design Principle.
- **Temperature**: The three temperature stations in Bear Creek exceeded the MRP 2.0 trigger threshold of having two or more weeks where the maximum weekly average temperature (MWAT) exceeded 17°C. Furthermore, both of the general water quality stations in San Mateo Creek exceeded the MWAT trigger during the second sampling event. None of the stations exceeded the maximum instantaneous trigger threshold of 24°C.
- All stations with MWAT trigger exceedances will be added to the list of candidate SSID projects; however, review of the monitoring data in the context of the ongoing drought and locally-derived temperature thresholds developed by NMFS suggests that temperature is not likely a limiting factor for salmonid habitat (i.e., summer rearing juveniles) in the study reaches.
- **Dissolved Oxygen**: The WQO for DO in waters designated as having cold freshwater habitat (COLD) beneficial uses (i.e., 7.0 mg/L) was met in all measurements recorded at the water quality stations in San Mateo Creek. As described in the Low DO SSID Project Report, previous low DO concerns in the study reach appear to have been mitigated by increased dry season releases from Crystal Springs Reservoir (see Appendix B).
- **pH**: Values for pH measured at the San Mateo Creek sites in WY2015 were within WQOs (6.5 to 8.5).
- **Specific Conductivity**: Specific conductivity concentrations recorded at the San Mateo Creek sites in WY2015 were below the trigger threshold of 2000 us/cm.
- **Chlorine**: Field testing for free chlorine and total chlorine residual was conducted at all ten probabilistic sites concurrent with spring bioassessment sampling (April-May), and at a subset (two) of the sites concurrent with dry season toxicity sampling (July). The MRP 1.0 trigger threshold of 0.08 mg/L was exceeded at one site on Atherton Creek. This site will be added to the list of candidate SSID projects.

Potential Impacts to Water Contact Recreation

- In WY2015, pathogen indicator sites were located in the San Mateo Creek watershed where a bacteria SSID study is in progress. Pathogen indicator triggers were exceeded at two of the five sites. Microbial source tracking (MST) techniques conducted as part of

the SSID study suggest year-round human bacterial sources and wet-weather dog sources (Appendix C).

- It is important to recognize that pathogen indicator thresholds are based on human recreation at beaches receiving bacteriological contamination from human wastewater, and may not be applicable to conditions found in urban creeks. As a result, the comparison of pathogen indicator results to body contact recreation water quality objectives may not be appropriate and should be interpreted cautiously.

Water/Sediment Toxicity and Sediment Chemistry

- Water toxicity samples were collected from two sites during two sample events (winter storm event and summer). Although both wet weather samples were toxic relative to the Lab Control treatment, no water toxicity samples exceeded MRP 1.0 trigger thresholds.
- Sediment toxicity and chemistry samples were collected concurrently with the summer water toxicity samples. Chronic toxicity to *Hyalella azteca* in the Laurel Creek samples exceeded the MRP 1.0 trigger threshold. This site will be added to the list of candidate SSID projects.
- All sediment samples exceeded the trigger threshold from MRP 2.0 with at least one Threshold Effect Concentration (TEC) quotient or Probable Effect Concentration (PEC) quotient greater than or equal to 1.0. Therefore, both sites will be added to the list of candidate SSID projects. However, these findings were not unexpected in San Mateo County where naturally occurring chromium and nickel from serpentinite geology often results in high concentrations of these metals in receiving water sediments.

3.3 Trigger Assessment

The MRP requires analysis of the monitoring data to identify candidate sites for SSID projects. Creek Status Monitoring data were collected pursuant to MRP 1.0 but were evaluated and reported pursuant to MRP 2.0 which became effective January 1, 2016. Trigger thresholds against which to compare the data are provided for most monitoring parameters in MRP 2.0 and are described in the foregoing sections of this report. Stream condition was determined based on CSCI scores that were calculated using BMI data. 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 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 will be selected from this list. Table 3.2 lists of candidate SSID projects based on WY2015 Creek Status monitoring data.

Additional analysis of the data is provided in the foregoing 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 3.2. Summary of SMCWPPP trigger threshold exceedance analysis, WY2015. "No" indicates samples were collected but did not exceed the MRP trigger; "Yes" indicates an exceedance of an MRP trigger.

Station Number	Creek Name	Bioassessment	Nutrients	Chlorine	Water Toxicity	Sediment Toxicity	Sediment Chemistry	Continuous Temperature	Dissolved Oxygen	pH	Specific Conductance	Pathogen Indicators
202R00378	Pescadero Creek	No	No	No	--	--	--	--	--	--	--	--
202R00440	Purisima Creek	No	No	No	--	--	--	--	--	--	--	--
202R01356	Middle Fork San Pedro Creek	No	No	No	--	--	--	--	--	--	--	--
202R01612	Middle Fork San Pedro Creek	No	No	No	--	--	--	--	--	--	--	--
204R01448	Atherton Creek	Yes	No	Yes	No	No	Yes	--	--	--	--	--
204R01972	Cordilleras Creek	Yes	No	No	--	--	--	--	--	--	--	--
204R02056	Laurel Creek	Yes	No	No	No	Yes	Yes	--	--	--	--	--
204R02248	Laurel Creek	Yes	No	Yes	--	--	--	--	--	--	--	--
205R01704	Dry Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R01816	Corte Madera Creek	No	No	No	--	--	--	--	--	--	--	--
204SMA058	San Mateo Creek	--	--	--	--	--	--	Yes	No	No	No	--
204SMA059	San Mateo Creek	--	--	--	--	--	--	Yes	No	No	No	--
204SMA060	San Mateo Creek	--	--	--	--	--	--	--	--	--	--	Yes
204SMA080	San Mateo Creek	--	--	--	--	--	--	--	--	--	--	Yes
204SMA100	San Mateo Creek	--	--	--	--	--	--	--	--	--	--	No
204SMA110	Polhemus Creek	--	--	--	--	--	--	--	--	--	--	No
204SMA119	San Mateo Creek	--	--	--	--	--	--	--	--	--	--	No
205ALA015	Alambique Creek	--	--	--	--	--	--	No	--	--	--	--
205BCR010	Bear Creek	--	--	--	--	--	--	Yes	--	--	--	--
205BCR050	Bear Creek	--	--	--	--	--	--	Yes	--	--	--	--
205BCR060	Bear Creek	--	--	--	--	--	--	Yes	--	--	--	--
205WUN150	West Union Creek	--	--	--	--	--	--	No	--	--	--	--

3.4 Management Implications

The Program's Creek Status Monitoring program (consistent with MRP 1.0 Provision C.8.c) focuses on assessing the water quality condition of urban creeks in San Mateo County and identifying stressors and sources of impacts observed. Although the sample size from WY2015 (overall n=10; urban n=9) is not sufficient to develop statistically representative conclusions regarding the overall condition of all creeks, it builds on data collected in WY2012 through WY2014 and could be used in a regional analysis of biological indicator and stressor data collected in San Mateo County. Even considering WY2015 data alone, it is clear that most urban streams have likely or very likely altered populations of aquatic life indicators (e.g., aquatic macroinvertebrates). These 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 many decades. Furthermore, episodic or site specific increases temperature may not be optimal for aquatic life in 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 MRP 1.0 Provision C.3, 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 develop (LID) methods, such as rainwater harvesting and use, infiltration and biotreatment are required as part of development and redevelopment projects. These LID measures are expected to reduce the impacts of urban runoff and associated impervious surfaces on stream health. MRP 2.0 expands these requirements to include Green Infrastructure planning for all municipal projects.
- In compliance with MRP 1.0 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, the adoption of formal State pesticide registration procedures, and sustainable landscaping requirements for new and redevelopment projects. Through these efforts, the amount of pyrethroids observed in urban stormwater runoff should decrease significantly over time, and in turn significantly reduce the magnitude and extent of toxicity in local creeks. This work will continue under MRP 2.0.
- Trash loadings to local creeks have been reduced through implementation of new control measures in compliance with MRP 1.0 Provision C.10 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. MRP 2.0 establishes a mandatory trash load reduction schedule, minimum areas to be treated by full trash capture systems, and requires development of receiving water monitoring programs for trash.
- In compliance with MRP 1.0 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) Permittees continue to implement programs that are designed to prevent non-stormwater discharges during dry weather and reduce the exposure of contaminants to stormwater and sediment in runoff during rainfall events. These programs will continue under MRP 2.0.
- In compliance with MRP 1.0 Provision C.13, copper in stormwater runoff is reduced through implementation of controls such as architectural and site design requirements, street sweeping, and participation in statewide efforts to significantly reduce the level of copper vehicle brake pads. These measures will be continued during the MRP 2.0 permit term.
- Mercury and polychlorinated biphenyls (PCBs) in stormwater runoff are being reduced through implementation of the respective TMDL water quality restoration plans. Under

MPR 2.0, the Program will continue to identify sources of these pollutants and will implement control actions designed to achieve new minimum load reduction goals.

Through the continued implementation of the above and other MRP-associated efforts 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 in the past will take time to implement. Consequently, it may take several decades to observe the outcomes 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.

4.0 Monitoring Projects (C.8.d)

Three types of monitoring projects are required by Provision C.8.d of MRP 1.0:

1. Stressor/Source Identification Projects (C.8.d.i);
2. BMP Effectiveness Investigations (C.8.d.ii); and,
3. Geomorphic Projects (C.8.d.iii).

The overall scopes of these projects are generally described in MRP 1.0 and the RMC Work Plan (BASMAA 2011). The status of projects that SMCWPPP is conducting are described in the sections below and Figure 1.1 maps where these studies were (or are being) conducted.

4.1 Stressor/Source Identification Projects

As a participant in the RMC, SMCWPPP agreed to initiate two Stressor/Source Identification (SSID) Projects toward the region wide minimum of ten SSID Projects required by MRP 1.0. The SSID Projects must identify and isolate potential sources and/or stressors associated with observed water quality impacts. Creeks considered for SSID Projects are those with creek status monitoring results that exceed the triggers identified in Table 8.1 of MRP 1.0.

Based on creek status monitoring data collected by SMCWPPP, two SSID projects were completed in WY2015. Both projects are in San Mateo Creek.

4.1.1 San Mateo Creek Low Dissolved Oxygen SSID Project

Historical and recent (WY2013) monitoring data collected in the vicinity of De Anza Park in the San Mateo Creek watershed showed dissolved oxygen (DO) concentrations below the water quality objective (WQO) of 7 mg/L for waters designated as cold water habitat. During WY2014 SMCWPPP conducted a SSID project to address this potential water quality concern. Results of the SSID investigation suggest that low DO conditions are no longer present or expected in this reach of San Mateo Creek due to a recently implemented ongoing schedule of increased dry season releases of water from the upstream Crystal Springs Reservoir. These findings were confirmed through Creek Status Monitoring conducted in WY2015 per MRP 1.0 Provision C.8.c. No additional management measures are recommended and the SSID project is considered complete.

The Final Project Report was submitted to the Regional Water Board on July 9, 2015 and is included with this UCMR as Appendix B.

4.1.2 San Mateo Creek Pathogen Indicator SSID Project

Monitoring data collected in 2003 and 2012 at stations in San Mateo Creek showed fecal indicator bacteria (FIB) at densities exceeding WQOs for waters designated as having water contact recreation (REC-1) Beneficial Uses. During water years 2014 and 2015 SMCWPPP conducted a SSID project to address this potential water quality concern. Results of the SSID investigation suggest that FIB are present at densities exceeding REC-1 WQOs in San Mateo Creek reaches downstream of Sierra Drive. However, noncontact recreation (REC-2) Beneficial Use WQOs are not exceeded. Microbial source tracking (MST) techniques suggest that human sources are present year-round and dog sources are present during and shortly after wet weather. Many other potential sources of FIB are present in the watershed and likely contribute

to the FIB densities measured at sampling stations. These include uncontrollable sources such as wildlife and natural bacterial growth in the creek bed and conveyance system.

A number of management actions designed specifically or opportunistically to control bacterial sources are currently planned or are being implemented by municipalities in the San Mateo Creek watershed. These include control measures for pet waste (signage and public education), trash reduction efforts that may reduce nuisance wildlife, programs to address homeless encampments, and several improvements to the sanitary sewer conveyance system in response to a Cease and Desist Order (CDO).

The City of San Mateo, Town of Hillsborough, San Mateo County, and SMCWPPP may wish to consider working together to increase public education and outreach targeting pet waste in the San Mateo Creek watershed. Potential examples include installation of additional cleanup signs, dog bag dispensers, and trash receptacles at creekside parks. Local municipalities should also continue the homeless elimination efforts begun through the HOPE strategy and HOT program. In addition, to help evaluate the effectiveness of current and planned control actions, SMCWPPP may wish to consider continuing to monitor FIB in San Mateo Creek via its MRP Creek Status monitoring program. However, even if human and dog sources are better controlled, results could still exceed WQOs due to uncontrollable sources such as wildlife and natural bacterial growth

The Final Project Report is included with this UCMR as Appendix C.

4.1.1 SSID Project Requirements under MRP 2.0

Provision C.8.e of MRP 2.0 requires that Permittees initiate a minimum number of SSID projects during the permit term. SMCWPPP intends to continue its participation in the RMC for which there is a region-wide minimum of eight new SSID Projects during the permit term. SMCWPPP has not yet initiated any SSID projects during MRP 2.0. Provision C.8.e requires that creek status, toxicity, and pesticide monitoring results (Provisions C.8.d and C.8.g) are reviewed annually and that a list is developed of all results exceeding the C.8.d trigger thresholds. Pollutant of Concern Monitoring (C.8.f) results may be included on the list as appropriate. See Table 3.2 for the list of WY2015 trigger exceedances. These sites will be considered as candidates for future SSID projects.

SSID projects conducted by RMC partners under MRP 1.0 are summarized in the Regional SSID Project Summary Table (Appendix D).

4.2 BMP Effectiveness Investigation

Provision C.8.d.ii of the MRP (BMP Effectiveness Investigation) requires that Permittees investigate the effectiveness of one Best Management Practice (BMP) in San Mateo County for stormwater treatment or hydrograph modification control measure[8]. The MRP encourages fulfillment of the requirement via investigation of BMP(s) used to fulfill requirements of Provisions C.3.b.iii, C.11.e, and C.12.e, provided the BMP Effectiveness Investigation includes the range of pollutants generally found in urban runoff.

[8] MRP 2.0 does not require a BMP Effectiveness Investigation under Provision C.8 but does require monitoring to provide information on the effectiveness of future or existing management actions under Provision C.8.f (Pollutants of Concern Monitoring). SMCWPPP is developing a monitoring approach to comply with this requirement.

The Clean Watersheds for a Clean Bay (CW4CB) project was initiated to evaluate pilot BMPs installed for the control of polychlorinated biphenyls (PCBs) and mercury in stormwater runoff from urban areas pursuant to MRP Provisions C.11 and C.12. In San Mateo County, CW4CB includes monitoring curb extension bioretention/biotreatment facilities located along Bransten Road in the City of San Carlos. The CW4CB monitoring design at Bransten Road includes paired influent and effluent sampling and volume/flow measurements to calculate PCB and mercury load reductions. CW4CB analytical constituents include suspended sediments, total organic carbon, lead, mercury, and PCBs. Additional constituents generally found in stormwater runoff (e.g., nutrients, cadmium, chromium, copper, nickel, zinc) were added by the Program to supplement the CW4CB investigation. Samples were collected and flow volumes were measured during three storm events in WY2014 and one event in WY2015.

Mean concentrations of all total metals were generally lower in the effluent compared to the influent; whereas, mean concentrations of dissolved metals and nutrients were sometimes higher and sometime lower in the effluent. One factor that may contribute to this result is that bioretention facilities are typically less efficient at removing dissolved constituents compared to those in the particulate phase. However, recent reports regarding installation that was inconsistent with the design, resulting in localized flooding and potential system performance issues at the Bransten Road facility, may have affected its pollutant removal performance. These concerns are currently under investigation. If appropriate, SMCWPPP will calculate loadings and removal efficiencies for the constituents after the concerns at the site are better understood and resolved and any CW4CB hydrologic data are published.

Results of the C.8 BMP effectiveness monitoring are described in Appendix E. Monitoring results from the CW4CB project are scheduled to be reported separately by April 2017.

4.3 Geomorphic Project

MRP Provision C.8.d.iii requires Permittees to conduct a geomorphic monitoring project intended to help answer the management question:

- *How and where can our creeks be restored or protected to cost-effectively reduce the impacts of pollutants, increased flow rates, and increased flow durations of urban runoff?*

The provision requires that Permittees select a waterbody/reach, preferably one that contains significant fish and wildlife resources, and conduct one of three types of projects. SMCWPPP elected to conduct a geomorphic study to help in the development of regional curves which help estimate equilibrium channel conditions for different sized drainages. As part of this Geomorphic Study, SMCWPPP surveyed bankfull geometries at two consecutive riffles in the Middle Fork of San Pedro Creek. Results of the Geomorphic Study were described in Part A of the Integrated Monitoring Report (SMCWPPP 2014).

5.0 POC Loads Monitoring (C.8.e)

Pollutants of Concern (POC) loads monitoring is required by Provision C.8.e.i of MRP 1.0[9]. Loads monitoring is intended to assess inputs of POCs to the Bay from local tributaries and urban runoff, assess progress toward achieving wasteload allocations (WLAs) for TMDLs, and help resolve uncertainties associated with loading estimates for these pollutants. In particular, there are four priority management questions that need to be addressed though POC loads monitoring:

1. Which Bay tributaries (including stormwater conveyances) contribute most to Bay impairment from POCs?
2. What are the annual loads or concentrations of POCs from tributaries to the Bay?
3. What are the decadal-scale loading or concentration trends of POCs from small tributaries to the Bay?
4. What are the projected impacts of management actions (including control measures) on tributaries and where should these management actions be implemented to have the greatest beneficial impact?

In WY2015, SMCWPPP complied with Provision C.8.e.i of MRP 1.0 through:

- Continued participation in the RMP Small Tributaries Loading Strategy (STLS) Team, and
- Implementation of a targeted reconnaissance sediment sampling program (i.e., the PCBs and Mercury Opportunity Area Analysis).

POC monitoring in WY2015 focused primarily on identification of source areas of PCBs and mercury to the municipal separate stormwater sewer system (MS4) and San Francisco Bay. This approach differed from prior years and addressed the reprioritization of near-term information needs that occurred during development of MRP 2.0. Both components of WY2015 POC monitoring are described below.

5.1 Small Tributaries Loading Strategy

The RMP STLS was developed in 2009 by the STLS Team, which included representatives from BASMAA, Regional Water Board staff, RMP staff, and technical advisors and is overseen by the Sources, Pathways, and Loadings Workgroup (SPLWG). The objective of the STLS is to develop a comprehensive planning framework to coordinate POC loads monitoring/modeling between the RMP and RMC participants. In 2011, with concurrence of participating Regional Water Board staff, a framework (i.e., the STLS Multi-Year Plan) was developed presenting an alternative approach to the POC loads monitoring requirements described in Provision C.8.e.i of MRP 1.0, as allowed by Provision C.8.e. The most recent published version (Version 2013a) of the STLS Multi-Year Plan (MYP) was submitted with the Regional Urban Creeks Monitoring Report in March 2013 (BASMAA 2013). The STLS MYP is integrated with other RMP-funded

[9] Provision C.8.f of MRP 2.0 requires POC Monitoring of PCBs, mercury, copper, emerging contaminants, and nutrients. MRP 2.0 defines yearly and total minimum number of samples for each POC. Five priority POC management information needs are identified including Source Identification, Contributions to Bay Impairment, Management Action Effectiveness, Loads and Status, and Trends. MRP 2.0 specifies minimum number of samples for each POC that must address each information need. SMCWPPP is in the process of developing a POC monitoring framework to comply with Provision C.8.f of MRP 2.0 over the next five years.

activities (see Section 2.0) and is a major component of the RMP MYP. Version 2013a of the STLS MYP includes two main elements that collectively address the four priority management questions for POC monitoring:

- Development and improvement of the Regional Watershed Spreadsheet Model (RWSM) as a tool for estimating regional loads of POCs to the Bay, and
- Watershed monitoring at six fixed stations.

Based on the lessons learned through the implementation of the STLS MYP in WY2012, WY2013, and WY2014, and the reprioritization of near-term information needs, SMCWPPP and its RMC partners implemented a revised approach to POC Loads monitoring in WY2015[10]. The revised monitoring approach was discussed at numerous STLS workgroup meetings during WY2014[11] and was agreed upon by STLS members, including Water Board staff, as the best approach to addressing near-term high priority information needs regarding PCB and mercury sources and loadings. The revised alternative approach initiated in WY2015 discontinues most POC loads monitoring stations sampled in previous Water Years, adds wet weather characterization monitoring, and maintains support of the RWSM. The sections below describe the tasks implemented by the RMP STLS in WY2015.

5.1.1 Wet Weather Characterization

With a goal of identifying watershed sources of PCBs and mercury, STLS field monitoring in WY2015 focused on collection of storm composite samples in the downstream reaches of approximately 20 catchments located throughout the region. The catchments range in size from 0.11 to 11.5 sq km and represent both natural creek watersheds and engineered MS4 drainage areas. The storm composite water samples were analyzed for concentrations of PCBs, total mercury, other metals (arsenic, cadmium, lead, copper, zinc), total organic carbon, dissolved organic carbon, suspended sediment concentration, and grain size distribution. In addition, a pilot study was conducted at a subset of 12 locations to collect fine sediments using specialized settling chambers. A full description of the methods and results is included in Appendix F (POC Reconnaissance Monitoring Progress Report, Water Year 2015).

Six catchments were targeted in San Mateo County based on recommendations by Program staff evaluating land uses in the County. (See Appendix G for a detailed description of the land use analysis approach.) All of the San Mateo County sampling stations were located at manholes accessing the MS4 or MS4 outlets to receiving waters.

Wet weather characterization monitoring will continue in WY2016 with support and sample station identification by SMCWPPP.

Compliance with Applicable Water Quality Standards

MRP Provision C.8.g.iii requires RMC participants to assess all data collected pursuant to Provision C.8 for compliance with applicable water quality standards. In compliance with this

[10] The BASMAA Phase I stormwater managers discussed the approach with the Assistant Executive Officer of the SF Bay Regional Water Quality Control Board at the August 28, 2014 monthly meeting and amended the RMC to reflect the modification.

[11] Discussions about revised POC loads monitoring approaches for FY 13-14 (Water Year 2015) were discussed and ultimately agreed upon by Water Board staff and other STLS and RMC partners at the following STLS meetings: October 13, 2013; March 19, 2014; April 1, 2014; April 16, 2014; May 15, 2014; and June 9, 2014.

requirement, comparisons of data collected at the wet weather characterization monitoring stations in WY2015 to applicable numeric WQO is provided below.

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

Discharge vs. Receiving Water – WQOs apply to receiving waters, not discharges. WQOs are designed to represent the maximum amount of pollutants that can remain in the water column without causing any adverse effect on organisms using the aquatic system as habitat, on people consuming those organisms or water, and on other current or potential beneficial uses. In WY2015, POC monitoring data were not collected in receiving waters; instead, they were collected within the engineered storm drain network. Dilution is likely to occur when the MS4 discharges urban stormwater (and non-stormwater) runoff into the local receiving water. Therefore, it is unknown whether or not discharges that exceed WQOs result in exceedances in the receiving water itself, the location where there is the potential for exposure by aquatic life.

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

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

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

Of the analytes monitoring at POC stations in WY2015, WQOs or criteria have only been promulgated for total mercury and total cadmium. WQOs for other metals analyzed are expressed in terms of the dissolved fraction of the metal in the water column for which data were not collected. Furthermore, the WQO for cadmium is are based on hardness which was not measured in the WY2015 samples. Therefore, the comparison of data collected in WY2015 to applicable numeric WQOs or criteria adopted by the Regional Water Board is limited to total mercury.

All of the samples collected in San Mateo County in WY2015 were well below the freshwater acute objective for mercury of 2.4 µg/L. Total mercury concentrations ranged from 0.014 µg/L to 0.055 µg/L. See Appendix F for tables listing the sampling results.

5.1.2 Regional Watershed Spreadsheet Model

The STLS Team and SPLWG continued to provide oversight in WY2015 to the development and refinement 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. The RWSM is being developed by SFEI on behalf of the RMP, with funding from both the RMP and BASMAA regional projects.

The RWSM is based on the idea that to accurately assess total contaminant loads entering San Francisco Bay, it is necessary to estimate loads from local watersheds. “Spreadsheet models”

of stormwater quality provide a useful and relatively cheap tool for estimating regional scale watershed loads. Spreadsheet models have advantages over mechanistic models because the data for many of the input parameters required by mechanistic models may not currently exist, and also require large calibration datasets which take money and time to collect.

Development of a spreadsheet model to estimate POC loads from small tributaries to the Bay has been underway since 2010 when a water-based copper model was completed. Because PCBs and mercury are more closely related to sediments, a draft model for suspended sediments was developed. However, resulting loads estimates for PCBs and mercury appeared to be too high leading to the conclusion that accuracy and precision at small (e.g., watershed) scales is challenged by the regional nature of the calibration process and the simplicity of the model. In WY2015, a water-based model was adopted for PCBs and mercury along with new approaches to calibration which reflect the log-normal distribution of the dataset. The improved RWSM can be used for estimating regional scale annual average loads and could be useful for determining relative loading between sub-regions and more polluted versus less polluted watersheds.

During WY2015, SMCWPPP reviewed and provided input on draft reports referencing the RWSM or its loadings estimates (e.g., DRAFT Sources, Pathways and Loadings: Multi-Year Synthesis with a focus on PCBs and Hg). SMCWPPP also participated in the SPLWG which is the main venue for soliciting input from interested parties and technical advisors. SMCWPPP also worked with SFEI to identify potential GIS land use data layer improvements.

In WY2016, additional calibration data from the WY2015 wet weather characterization monitoring and BASMAA studies will be incorporated into the model. Improvements to the land use GIS layer will also help refine the model. As the modeling team at SFEI becomes more proficient with alternative water-based platforms (i.e., SWMM, HEC-RAS) through development of the Green Plan-IT tool, a more sophisticated basis may be adopted in future years. Decisions will be made in consultation with the STLS and the SPLWG.

5.1.3 STLS Trends Strategy

In WY2015, a new STLS Trends Strategy team was developed based on recommendations from the SPLWG to define where and how trends may be most effectively measured in relation to management effort so that data collection methods deployed over the next several years support this future need. Initially comprised of SFEI staff, RMC participants, and Regional Water Board staff, the STLS Trends Strategy team met monthly between July and September 2015. Additional interested parties and advisors such as EPA and USGS will be invited to participate in subsequent meetings. In WY2015, the STLS Trends Strategy team developed a mission statement, a list of questions to be addressed by trends monitoring, and a draft document outline. Decisions were also made regarding which indicators (e.g., water concentration, water column particle ratio, load, bed sediment concentration) should be considered under various application scenarios (e.g., Bay Area, single watersheds, individual management measures). The Draft Trends Strategy document in anticipated for review in early 2016. It will summarize the background, management questions, and guiding principles, and will describe coordination between the RMP and BASMAA within the context of the MRP, proposed tasks to answer the management questions, deliverables, and the overall timeline. SMCWPPP will continue to participate in the STLS Trends Strategy team in WY2016.

5.2 PCBs and Mercury Opportunity Area Analysis

As part of the development of PCB and mercury loading estimates presented in Part C of the Program's Integrated Monitoring Report (SMCWPPP 2014), SMCWPPP (in collaboration with SFEI) developed preliminary GIS data layers illustrating potential PCB and mercury source areas. These data layers along with existing data on PCBs/mercury concentrations in sediment and stormwater represent the current state-of-knowledge of source areas for these pollutants in San Mateo County. These preliminary data layers, however, are based on limited and potentially outdated information on land uses and current activities at properties that may contribute or limit the level of pollutants transported to the Bay via stormwater. In an effort to collect additional information on current land uses, facility practices and contributions of PCBs and mercury from these properties, SMCWPPP conducted a *PCB and Mercury Opportunity Area Analysis* as part of the Program's revised POC loads monitoring approach in WY2015. The outcome of this activity will assist Permittees in identifying source areas in San Mateo County, which if managed may provide further load reduction opportunities during future NPDES permit terms.

Appendix G contains the PCBs and Mercury Source Area Identification, Water Year 2015 POC Monitoring Report (SMCWPPP 2015a) which describes results of the *PCB and Mercury Opportunity Area Analysis.*

In WY2015 SMCWPPP conducted a targeted reconnaissance sediment sampling program on behalf of its Permittees in compliance with Provision C.8.e.i of MRP 1.0. Over one hundred bedded sediment samples were collected for PCBs and mercury analysis (these pollutants are often found bound to sediments in the environment) to screen for areas in the urban environment with elevated POC concentrations. The general goal was to continue identifying potential source areas for further study. These areas are potential opportunity areas for implementing controls to reduce stormwater discharges of PCBs and mercury.

Samples were distributed among the nine municipalities that collectively encompass over 93% of the old industrial land use in San Mateo County. Sample stations, mapped in Figure 1.1, were sited in locations considered most likely to contain PCBs based on nearby current and historical land use (e.g., PCB-related activities, presence of heavy or electrical equipment, recycling operations) and housekeeping (e.g., pavement in poor condition, evidence of sediment track out) conditions. Areas with already confirmed PCBs contamination were specifically excluded from the program. Bedded sediment samples from the urban storm drainage system (e.g., beneath manholes, storm drain inlets) and public right-of-way surfaces (e.g., street gutters) were collected using methods detailed in the Sampling and Analysis Plan (SAP) for PCBs and Mercury Opportunity Area Analysis and Implementation Planning (SMCWPPP 2015b).

Total PCBs (i.e., sum of 40 PCB congeners) concentrations ranged from less than 0.01 mg/kg to 1.46 mg/kg with an average of 0.11 mg/kg and a median of 0.04 mg/kg. A total of five samples exceeded the 0.5 mg/kg threshold that was selected by the Bay Area Stormwater Management Agencies Association (BASMAA) Monitoring and Pollutants of Concern Committee as an approximate benchmark for identifying areas that should be considered for future investigation (e.g., additional sampling, records review). Total mercury concentrations ranged from 0.03 mg/kg to 3.59 mg/kg with an average of 0.22 mg/kg and a median of 0.10 mg/kg. There is currently no comparable BASMAA benchmark for mercury; however, two samples exceeded 1.0 mg/kg. The primary objective of this project was not to identify specific source properties, but to identify areas where further investigation is warranted. SMCWPPP anticipates further investigation of the five areas with elevated PCB concentrations during the next term of the MRP.

The sampling design specifically targeted sample stations within the old industrial landscape that are influenced by parcels that were classified and prioritized as having relatively higher potential to be sources of PCBs. However, a strong correlation between the land use analysis and sampling results was lacking, and only five percent of the samples had total PCBs concentrations exceeding the 0.5 mg/kg threshold. This suggests that continuing to identify additional source areas and properties in San Mateo County may be challenging. The remainder of the PCB load appears to be coming from sources that are less elevated and more diffuse and will likely be more challenging to control. Thus data collected to date suggests that the diffuse nature of PCB contamination within the urban landscape may require a rethinking of the approach and timeline needed to meet TMDL load reduction goals.

Identifying pollutant source areas is a challenging and often a multi-year process. The sediment samples collected during this project in combination with historical sediment and stormwater runoff samples are part of an ongoing effort to identify areas in San Mateo County of high interest for further study and the potential opportunity to implement pollutant controls. SMCWPPP staff has identified priority outfall catchments and associated potential wet weather sampling locations that contain High interest source areas where elevated levels of PCBs have not already been found. SMCWPPP began the process of sampling wet weather composite samples for POC analysis at priority outfall catchments in WY2015 through the RMP (described in Section 5.1.1). In WY2016, the RMP will collect additional wet weather samples at high priority catchments, and SMCWPPP will conduct similar sampling at up to eight locations. These wet weather samples will help identify catchments that contain source areas where further investigation will be required.

SMCWPPP plans to continue working with other Bay Area countywide stormwater programs (through the BASMAA MPC Committee) to evaluate the results of the ongoing efforts in the Bay Area to identify PCBs and mercury source areas and plan next steps in San Mateo County. Follow-up monitoring will be conducted in coordination with compliance with Provision C.8.f (Pollutants of Concern Monitoring) of MRP 2.0. Monitoring under Provision C.8.f is intended to address a number of management questions related to priority pollutants such as mercury and PCBs, including helping to identify pollutant source areas. The overall objectives of follow-up efforts to address PCBs and mercury under Provisions C.11, C.12 and C.8.f of the reissued MRP will include continuing to identify which pollutant source areas in San Mateo County provide the greatest opportunities for implementing controls to reduce discharges of these pollutants.

6.0 Long-Term Trends Monitoring (C.8.e)

In addition to POC loads monitoring, Provision C.8.e requires Permittees to conduct long-term trends monitoring to evaluate if stormwater discharges are causing or contributing to toxic impacts on aquatic life. Required long-term monitoring parameters, methods, intervals and occurrences are included as Category 3 parameters in Table 8.4 of MRP 1.0, and prescribed long-term monitoring locations are included in MRP Table 8.3. Similar to creek status and POC loads monitoring, long-term trends monitoring began in October 2011 for RMC participants.

As described in the RMC Creek Status and Trends Monitoring Plan (BASMAA 2011), the State of California's Surface Water Ambient Monitoring Program (SWAMP) through its Statewide Stream Pollutant Trend Monitoring (SPoT) Program currently monitors the seven long-term monitoring sites required by Provision C.8.e.ii. Sampling via the SPoT program is currently conducted at the sampling interval described in Provision C.8.e.iii in the MRP. The SPoT program is generally conducted to answer the following management question:

- *What are the long-term trends in water quality in creeks?*

Based on discussions with Regional Water Board staff, RMC participants are complying with long-term trends monitoring requirements described in MRP 1.0 Provision C.8.e via monitoring conducted by the SPoT program[12]. This manner of compliance is consistent with the MRP language in Provisions C.8.e.ii and C.8.a.iv. RMC representatives coordinate with the SPoT program on long-term monitoring to ensure MRP monitoring and reporting requirements are addressed. The three specific goals of the SPoT program are:

1. Determine long-term trends in stream contaminant concentrations and effects statewide.

2. Relate water quality indicators to land-use characteristics and management effort.

3. Establish a network of sites throughout the state to serve as a backbone for collaboration with local, regional, and federal monitoring.

Additional information on the SPoT program can be found at http://www.waterboards.ca.gov/water_issues/programs/swamp/spot/. The most recent technical report prepared by SPoT program staff was published in 2014 and describes five-year trends from the initiation of the program in 2008 through 2012 (Phillips et al. 2014). An update to the report is anticipated in spring 2016.

The statewide network of SPoT sites represents approximately one half of California's watersheds and includes one station in San Mateo County at the base of San Mateo Creek (Figure 1.1). Sites are targeted in locations with slow water flow and appropriate micro-morphology to allow deposition and accumulation of sediments. Stream sediments are collected annually (funding permitting) during summer base flow conditions. Sediments are analyzed for a suite of water quality indicators including organic contaminants (organophosphate, organochlorine, and pyrethroid pesticides, and PCBs), trace metals, total

[12] Trends monitoring is one of the five priority management information needs identified in Provision C.8.f of MRP 2.0 and is required for PCBs, mercury, and copper. SMCWPPP is in the process of developing a POC monitoring framework to comply with all aspects of Provision C.8.f of MRP 2.0 over the next five years. It is unlikely that data collected through the SPoT program will address requirements of MRP 2.0 Provision C.8.f. Although the SPoT program will continue for the foreseeable future, SMCWPPP may no longer summarize results in future UCMRs prepared in compliance with MRP 2.0.

organic carbon (TOC), polycyclic aromatic hydrocarbons (PAHs), and polybrominated diphenyl ethers (PBDEs). Samples are also assessed for toxicity using the amphipod *Hyalella azteca* at standard protocol temperature (23°C) and cooler temperatures (15°C) that more closely reflect the ambient temperature in California watersheds[13]. Although the data are not yet available, the SPoT analyte list was expanded in 2013 to include algal toxins (microcystin-LR) and the insecticide fipronil. The insecticide Imidacloprid and an additional test organism (*Chironomus dilutus*) more sensitive to fipronil and imidacloprid will likely be added in 2016.

The SPoT report (Phillips et al. 2014) summarizes the 2008 – 2012 data on statewide and regional scales. In addition, pollutant concentrations are correlated to SWAMP bioassessment data and land use characteristics (i.e., urban, agriculture, open space) on the 1 km, 5 km, and watershed scales. The SPoT report made the following *statewide* conclusions:

- There is a significant relationship between land use and stream pollution.
- Sediment toxicity remained relatively stable statewide between 2008 and 2012.
- Significantly more samples were toxic when tested at average ambient temperatures (15°C) compared to the standard protocol temperature (23°C). This is likely the result of the presence of pyrethroids which are slower to breakdown (metabolically) at lower temperatures (i.e., less pyrethroid is necessary to create the same toxic response).
- Percent *H. azteca* survival was significantly positively correlated with Index of Biological Integrity (IBI) scores[14]; whereas, pyrethroid pesticides and chlorinated compounds were significantly negatively correlated with IBI scores.
- IBI scores at toxic sites ranged from 0.1 to 13.6 and IBI scores at non-toxic sites ranged from 0 to 73.3, suggesting that factors other than contaminants (e.g., physical habitat) are influencing macroinvertebrate communities.
- There has been a steady decline statewide in organophosphate pesticide concentrations.

Regional conclusions include:

- Between 2008 and 2011, there was an overall regional trend of decreasing toxicity with a significant increase in *H. azteca* survival in San Mateo Creek.
- There was a statistically significant decrease in PCB and DDT concentrations at the San Mateo Creek station.

SPoT program staff provided SMCWPPP with monitoring data from the San Mateo County site (205SMA020 – San Mateo Creek). Data provided for 2013 and 2014 are preliminary and have not been through the full data validation process. SMCWPPP evaluated the data using the same methods used to evaluate MRP 1.0 Provision C.8.c sediment data. Threshold Effect Concentration (TEC) (Table 6.1) and Probable Effect Concentration (PEC) quotients (Table 6.2) as defined in MacDonald et al. (2000) were calculated for all non-pyrethroid constituents. In addition, pyrethroid Toxic Unit (TU) equivalents (Table 6.3) were calculated using TOC-normalized data and LC50 values from Maund et al. (2002) and Amweg et al. (2005).

[13] *Hyalella azteca* toxicity increases with decreasing temperature due to slower metabolic breakdown of pyrethroids at lower temperatures and increased nerve sensitivity.

[14] IBI scores were calculated using methods that were appropriate to each region. The California Stream Condition Index (CSCI) will likely be used in the next reporting cycle.

TEC and PEC quotients for sediment concentrations of metals, PAHs, and organic contaminants at the San Mateo County SPoT station are generally higher than those calculated for Creek Status monitoring (Provision C.8.c. of MRP 1.0) which has been conducted in the same watershed in prior years. These results may illustrate the ongoing movement of fine sediment and variability in sources. They may also reflect the location of the SPoT stations which are typically lower in the watershed than Creek Status stations.

Table 6.1. Threshold Effect Concentration (TEC) quotients for sediment chemistry constituents measured by SPoT in San Mateo Creek. Bolded values exceed 1.0.

Site ID – Creek / Sample Date	TEC	205SMA020 – San Mateo Creek						
		6/18/08	6/16/09	6/30/10	7/8/11	8/24/12	6/27/13	6/25/14
Metals (mg/kg DW)								
Arsenic	*9.79*	0.62	0.43	0.47	0.59	0.37	0.61	ns
Cadmium	*0.99*	0.43	0.18	0.20	0.32	0.22	0.35	ns
Chromium	*43.4*	3.48	4.22	3.04	3.18	2.04	4.47	ns
Copper	*31.6*	2.27	0.94	1.02	1.56	0.95	2.27	ns
Lead	*35.8*	1.43	0.75	0.81	0.82	0.60	1.38	ns
Mercury	*0.18*	0.96	0.82	1.01	0.77	0.34	1.07	ns
Nickel	*22.7*	6.04	4.67	4.85	5.64	4.04	6.83	ns
Zinc	*121*	1.85	0.81	0.89	1.23	0.88	1.95	ns
PAHs (µg/kg DW)								
Anthracene	*57.2*	0.35	0.17	ns	0.31	0.92	0.25	0.22
Fluorene	*77.4*	0.10	0.06	ns	0.00	0.17	0.10	0.08
Naphthalene	*176*	0.10	0.08	ns	0.09	0.06	0.06	0.08
Phenanthrene	*204*	0.69	0.42	ns	0.47	0.73	0.47	0.48
Benz(a)anthracene	*108*	0.94	0.48	ns	0.76	1.48	0.56	0.88
Benzo(a)pyrene	*150*	0.80	0.50	ns	0.45	1.25	0.47	0.70
Chrysene	*166*	0.84	0.44	ns	0.76	1.21	0.54	0.84
Dibenz[a,h]anthracene	*33.0*	0.94	0.55	ns	0.81	1.35	0.47	0.66
Fluoranthene	*423*	0.77	0.38	ns	0.49	0.86	0.38	0.45
Pyrene	*195*	1.46	0.76	ns	0.98	1.61	0.74	1.04
Total PAHs	*1,610*	1.20	0.71	ns	0.89	1.40	0.74	0.92
Pesticides (µg/kg DW)								
Chlordane	*3.24*	9.29	7.87	ns	6.23	3.70	8.61	ns
Dieldrin	*1.90*	4.76	3.29	ns	0.00	0.00	2.52	ns
Endrin	*2.22*	0.00	0.00	ns	0.00	0.00	0.00	ns
Heptachlor Epoxide	*2.47*	0.70	0.62	ns	0.00	0.00	0.44	ns
Lindane (gamma-BHC)	*2.37*	0.00	0.00	ns	0.00	0.00	0	ns
Sum DDD	*4.88*	6.08	4.61	ns	1.45	0.74	3.86	ns
Sum DDE	*3.16*	13.68	11.84	ns	9.97	4.49	12.59	ns
Sum DDT	*4.16*	3.84	4.86	ns	0.00	0.00	4.78	ns
Total DDTs	*5.28*	16.83	15.18	ns	7.31	3.37	14.87	ns
Total PCBs	*59.8*	0.52	0.27	ns	0.00	0.00	0.42	ns
Number of constituents with TEC >= 1.0		13	8	--	8	11	12	--

ns = not sampled in WY2015 due to budget constraints

Table 6.2. Probable Effect Concentration (PEC) quotients for sediment chemistry constituents measured by SPoT in San Mateo Creek. Bolded values exceed 1.0.

Site ID – Creek / Sample Date	PEC	205SMA020 – San Mateo Creek						
		6/18/08	6/16/09	6/30/10	7/8/11	8/24/12	6/27/13	6/25/14
Metals (mg/kg DW)								
Arsenic	*33.0*	0.18	0.13	0.14	0.18	0.11	0.18	ns
Cadmium	*4.98*	0.09	0.04	0.04	0.06	0.04	0.07	ns
Chromium	*111*	**1.36**	**1.65**	**1.19**	**1.24**	0.80	**1.75**	ns
Copper	*149*	0.48	0.20	0.22	0.33	0.20	0.48	ns
Lead	*128*	0.40	0.21	0.23	0.23	0.17	0.39	ns
Mercury	*1.06*	0.16	0.14	0.17	0.13	0.06	0.18	ns
Nickel	*48.6*	**2.82**	**2.18**	**2.26**	**2.63**	**1.89**	**3.19**	ns
Zinc	*459*	0.49	0.21	0.24	0.32	0.23	**0.51**	ns
PAHs (µg/kg DW)								
Anthracene	*845*	0.02	0.01	ns	0.02	0.06	0.02	0.01
Fluorene	*536*	0.02	0.01	ns	0.00	0.02	0.01	0.01
Naphthalene	*561*	0.03	0.02	ns	0.03	0.02	0.02	0.03
Phenanthrene	*1170*	0.12	0.07	ns	0.08	0.13	0.08	0.08
Benz(a)anthracene	*1050*	0.10	0.05	ns	0.08	0.15	0.06	0.09
Benzo(a)pyrene	*1450*	0.08	0.05	ns	0.05	0.13	0.05	0.07
Chrysene	*1290*	0.11	0.06	ns	0.10	0.16	0.07	0.11
Fluoranthene	*2230*	0.15	0.07	ns	0.09	0.16	0.07	0.09
Pyrene	*1520*	0.19	0.10	ns	0.13	0.21	0.09	0.13
Total PAHs	*22,800*	0.09	0.05	ns	0.06	0.10	0.05	0.06
Pesticides (µg/kg DW)								
Chlordane	*17.6*	**1.71**	**1.45**	ns	**1.15**	0.68	**1.59**	ns
Dieldrin	*61.8*	0.15	0.10	ns	0.00	0.00	0.08	ns
Endrin	*207.0*	0.00	0.00	ns	0.00	0.00	0.00	ns
Heptachlor Epoxide	*16*	0.11	0.10	ns	0.00	0.00	0.07	ns
Lindane (gamma-BHC)	*4.99*	0.00	0.00	ns	0.00	0.00	0.00	ns
Sum DDD	*28*	**1.06**	0.80	ns	0.25	0.13	0.67	ns
Sum DDE	*31.3*	**1.38**	**1.19**	ns	**1.01**	0.45	**1.27**	ns
Sum DDT	*62.9*	0.25	0.32	ns	0.00	0.00	0.32	ns
Total DDTs	*572*	0.16	0.14	ns	0.07	0.03	0.14	ns
Total PCBs	*676*	0.05	0.02	ns	0.00	0.00	0.04	ns
Mean PEC Quotient		0.75	0.60	--	0.64	0.44	0.84	--

ns = not sampled in WY2015 due to budget constraints

Table 6.3. Pyrethroid Toxic Unit (TU) equivalents for sediment chemistry constituents measured in San Mateo Creek. Bolded sums exceed 1.0 TUs.

Site ID – Creek Sample Date	LC50 (µg/g dw)	205SMA020 – San Mateo Creek						
		6/18/08	6/16/09	6/30/10	7/8/11	8/24/12	6/27/13	6/25/14
Pyrethroid								
Bifenthrin	0.52	0.44	nd	0.22	0.80	0.45	0.13	0.57
Cyfluthrin	1.08	nd	nd	0.16	0.23	0.00	0.05	0.22
Cypermethrin	0.38	nd	nd	0.01	0.09	0.08	0.02	0.04
Deltamethrin	0.79	nd	nd	0.09	0.25	0.34	0.08	0.16
Esfenvalerate	1.54	nd	nd	0.02	0.10	0.23	0.03	0.28
Lambda-Cyhalothrin	0.45	nd	nd	0.00	0.01	0.02	0.00	0.01
Permethrin	10.83	0.01	nd	0.03	0.16	0.10	0.01	0.04
Sum of Toxic Unit Equivalents per Site	--	0.45	--	0.54	1.65	1.21	0.34	1.32
Survival as % of Control *Hyalella azteca*	--	59	79	88	91	101	96	81

nd = below detection limit

7.0 Citizen Monitoring and Participation (C.8.f)

Provision C.8.f of MRP 1.0[15] states that:

i. "*Permittees shall encourage Citizen Monitoring.*

ii. *In developing Monitoring Projects and evaluating Status and Trends data, Permittees shall make reasonable efforts to seek out citizen and stakeholder information and comment regarding waterbody function and quality.*

iii. *Permittees shall demonstrate annually that they have encouraged citizen and stakeholder observations and reporting of waterbody conditions. Permittees shall report on these outreach efforts in the annual Urban Creeks Monitoring Report*."

During the permit term of MRP 1.0, SMCWPPP staff has actively sought opportunities to encourage volunteer monitoring and/or incorporate information from such monitoring into SMCWPPP's water quality monitoring program. As part of this process, SMCWPPP staff has researched and documented related activities in San Mateo County. The County has a wealth of watershed stewardship organizations that primarily engage citizens and stakeholders in environmental education and restoration, and to a lesser extent, in classical water quality monitoring. Citizen monitoring of watershed resources in San Mateo County therefore occurs in several ways:

- In association with habitat restoration efforts, citizens monitor native plant survival and growth, and avian use of constructed bird boxes.
- The majority of citizen water quality monitoring focuses on identifying and cleaning up trash in water bodies, and sampling pathogen indicator organisms such as fecal coliform and *E. coli*. Many organizations conduct monthly trash cleanups in their local watersheds in addition to annual events coinciding with Earth Day, California Coastal cleanup day, and National River Cleanup Day. Groups that monitor pathogen indicators typically sample swimming beaches and associated creek confluences on a weekly basis. For example, the San Mateo County Department of Health coordinates with the San Mateo County Resource Conservation District (SMCRCD) and nine citizen volunteers, including those active with Surfrider Foundation and the Monterey Bay National Marine Sanctuary (MBNMS) to sample pathogen indicators weekly. During fall "first flush" events, the SMCRCD and the MBNMS coordinate to sample a broader suite of water quality parameters at several targeted storm drain outfalls in the San Mateo County designated Area of Biological Significance (ASBS). Such monitoring includes pathogen indicators, nutrients, and general water quality parameters.
- During the spring, the MBNMS coordinates with numerous volunteers as part of "snapshot day" to sample 27 sites on creeks and rivers in San Mateo County coastal watersheds for a broad suite of water quality analytes. Trained volunteers measure dissolved oxygen, pH, conductivity, air and water temperature, transparency/ turbidity, and collect water samples to be lab tested for nutrients (nitrates and orthophosphate) and bacteria. Every year Snapshot Day data are compiled to determine "Areas of Concern" - sites at where at least three of the nine analytes measured exceed associated water quality objectives. Snapshot Day data are used by the State of

[15] Provision C.8 of MRP 2.0 no longer includes citizen monitoring; however Provision C.7 of MRP 2.0 requires public outreach and citizen involvement events.

California, in conjunction with other data, to list water bodies as impaired under the Clean Water Act. Other resource managers use Snapshot Day data to further engage citizenry and agencies to address problems of pollution in waterways.

- Citizens volunteer with the San Gregorio Environmental Resource Center to conduct general water quality monitoring and measure stream discharge and stage weekly. This group was recently awarded an EPA grant to demonstrate the feasibility of increasing water quality and restoring habitat while maintaining agricultural productivity.
- Acterra is an environmental non-profit serving the Silicon Valley area that provides a broad range of volunteer opportunities (e.g., habitat restoration) for adults and youth. Through their Streamkeeper Program, Acterra encourages citizens to note observations on San Francisquito Creek about four types of indicators: animals (presence/absence of uncommon or threatened and endangered species), plants (notably invasives), chemical (indicators of pollution), physical (including evidence of erosion, human disturbance), and social (including evidence of different types of human disturbance).

In WY2015, SMCWPPP staff reached out to several groups (e.g., Acterra, Surfrider, SMRCD) to encourage citizen and stakeholder observations and reporting of waterbody conditions. SMCWPPP staff participated in Acterra events and the Program helped fund maintenance of Acterra's water quality monitoring equipment.

8.0 Next Steps

Water quality monitoring required by Provision C.8 of MRP 1.0 and 2.0 is intended to assess the condition of water quality in the Bay area receiving waters (creeks and the Bay); identify and prioritize stormwater 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. On behalf of San Mateo County Permittees, SMCWPPP conducts creek water quality monitoring and monitoring projects in San Mateo County in collaboration with the Regional Monitoring Coalition (RMC), and actively participates in the San Francisco Bay Regional Monitoring Program (RMP), which focuses on assessing Bay water quality and associated impacts.

In WY2016, SMCWPPP will continue to comply with water quality monitoring requirements of the MRP. As described throughout this UCMR, requirements in MRP 2.0 are generally similar but differ somewhat to requirements in MRP 1.0. The following list of next steps will be implemented in WY2016:

- SMCWPPP will continue to collaborate with the RMC (MRP 2.0 Provision C.8.a).
- Where applicable, monitoring data collected and reported by SMCWPPP will be SWAMP comparable (MRP 2.0 Provision C.8.b).
- SMCWPPP will continue to provide financial contributions towards the RMP and to assist BASMAA to actively participate in the RMP committees and work groups described in Sections 2.0 and 5.0 (MRP 2.0 Provision C.8.c).
- SMCWPPP will continue to conduct probabilistic and targeted Creek Status Monitoring consistent with the specific requirements in MRP 2.0 (MRP 2.0 Provision C.8.d).
- SMCWPPP will develop and begin implementation of a dry and wet weather Pesticides and Toxicity Monitoring program consistent with MRP 2.0 Provision C.8.g.
- SMCWPPP will continue to review monitoring results and maintain a list of all results exceeding trigger thresholds (MRP 2.0 Provision C.8.e.i). SMCWPPP will coordinate with the RMC to initiate a region wide goal of four new SSID projects by the third year of the permit (MRP 2.0 Provision C.8.e.iii).
- SMCWPPP will continue to participate in the STLS and SPLWG which address MRP 2.0 Provision C.8.f POC management information needs and monitoring requirements through wet weather characterization monitoring, refinement of the RWSM, and development of the STLS Trends Strategy.
- SMCWPPP will continue implementing a POC monitoring framework to comply with Provision C.8.f of MRP 2.0. The monitoring framework addresses the annual and total minimum number of samples required for each POC (i.e., PCBs, mercury, copper, emerging contaminants, nutrients) and each management information need (i.e., Source Identification, Contributions to Bay Impairment, Management Action Effectiveness, Loads and Status, Trends). WY2016 monitoring includes collection of wet weather composite water samples from catchments to identify watersheds where PCB and mercury control measures will be implemented as well as nutrient sampling.
- WY2016 POC monitoring accomplishments and allocation of sampling efforts for POC monitoring in WY2017 will be submitted in the Pollutants of Concern Monitoring Report that is due to the Water Board by October 15, 2016 (MRP 2.0 Provision C.8.h.iv).

- Results of WY2016 monitoring will be described in the Programs WY2016 Urban Creeks Monitoring Report that is due to the Water Board by March 31, 2017 (MRP 2.0 Provision C.8.h.iii).

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