Santa Clara Valley
Urban Runoff
Pollution Prevention Program

Watershed Monitoring and Assessment Program

Creek Status Monitoring Report

Water Year 2017 (October 2016 – September 2017)

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

March 31, 2018

PREFACE

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

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

This Creek Status Monitoring Report complies with provision C.8.h.iii of the MRP for reporting of all data in Water Year 2017 (October 1, 2016 through September 30, 2017). Data were collected pursuant to provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides & Toxicity Monitoring) of the MRP. Data presented in this report were produced under the direction of the RMC and the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program) using probabilistic and targeted monitoring designs as described herein.

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

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

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

LIST OF ACRONYMS

ACCWP	Alameda Countywide Clean Water Program
AFDM	Ash Free Dry Mass
AFS	American Fisheries Society
BASMAA	Bay Area Stormwater Management Agency Association
BMI	Benthic Macroinvertebrate
CAP	Conservation Action Planning
CCCWP	Contra Costa Clean Water Program
CDFW	California Department of Fish and Wildlife
CEDEN	California Environmental Data Exchange Network
COLD	Cold Freshwater Habitat
CSCI	California Stream Condition Index
DO	Dissolved Oxygen
DPR	Department of Pesticide Regulation
DPS	Distinct Population Segment
EPA	Environmental Protection Agency
FSURMP	Fairfield Suisun Urban Runoff Management Program
GIS	Geographic Information Systems
GRTS	Generalized Random Tessellation Stratified
IBI	Indices of Biotic Integrity
IWRMP	Integrated Water Resources Management Plan
LID	Low Impact Development
MIGR	Fish Migration
MPC	Monitoring and Pollutants of Concern Committee
MRP	Municipal Regional Permit
MUN	Municipal and Domestic Water Supply
MWAT	Maximum Weekly Average Temperature
NMFS	National Marine and Fisheries Services
NPDES	National Pollution Discharge Elimination System
O/E	Observed to Expected
PAH	Polycyclic Aromatic Hydrocarbons
PEC	Probable Effects Concentrations
PHAB	Physical Habitat Assessment
pMMI	Predictive Multi-Metric Inde
xPSA	Perennial Streams Assessment
QAPP	Quality Assurance Project Plan
QAPrP	Quality Assurance Program Plan
QA/QC	Quality Assurance/Quality Control
RARE	Preservation of Rare and Endangered Species
RM	Reporting Module
RMC	Regional Monitoring Coalition
RMP	Regional Monitoring Program
RWB	Reachwide Benthos
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SCVWD	Santa Clara Valley Water District

SFRWQCB	San Francisco Bay Regional Water Quality Control Board
SMCWPPP	San Mateo County Water Pollution Prevention Program
SPoT	Stream Pollution Trends
SPWN	Fish Spawning
SOP	Standard Operating Protocol
SSID	Stressor/Source Identification
SWAMP	Surface Water Ambient Monitoring Program
SWPP	Surface Water Protection Program
TEC	Threshold Effects Concentrations
TMDL	Total Maximum Daily Load
TNS	Target Non-Sampleable
TOC	Total Organic Carbon
TS	Target Sampleable
TST	Test of Significant Toxicity
TU	Toxicity Unit
UCMR	Urban Creeks Monitoring Report
WARM	Warm Freshwater Habitat
USEPA	Environmental Protection Agency
WQ	Water Quality
WQO	Water Quality Objective
WY	Water Year

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1.0 INTRODUCTION

This Creek Status Monitoring Report was prepared by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP or Program), on behalf of its 15 member agencies (13 cities/towns, the County of Santa Clara, and the Santa Clara Valley Water District), which are subject to the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities referred to as the Municipal Regional Permit (MRP). The MRP was first adopted by the San Francisco Regional Water Quality Control Board (SFRWQCB or Regional Water Board) on October 14, 2009 as Order R2-2009-0074 (SFRWQCB 2009). On November 19, 2015, the SFRWQCB updated and reissued the MRP as Order R2-2015-0049 (SFRWQCB 2015). This report fulfills the requirements of provision C.8.h.iii of the MRP for comprehensively interpreting and reporting all Creek Status and Pesticides & Toxicity monitoring data collected during the foregoing October 1 – September 30 (i.e., Water Year 2017).[3] Data were collected pursuant to water quality monitoring requirements in provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides & Toxicity Monitoring) of the MRP. Monitoring data presented in this report were submitted electronically to the SFRWQCB by SCVURPPP 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).

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

- **Section 1.0** – Introduction including overview of the Program goals, background, monitoring approach, and statement of data quality
- **Section 2.0** – Biological condition assessment and stressor analysis at probabilistic sites
- **Section 3.0** – General water quality monitoring (continuous temperature, continuous general water quality, and pathogen indicators) at targeted sites
- **Section 4.0** – Chlorine monitoring at probabilistic sites
- **Section 5.0** – Pesticides & Toxicity monitoring
- **Section 6.0** – Conclusions and recommendations

1.1 Monitoring Goals

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

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

Creek Status and Pesticides & Toxicity monitoring parameters, methods, occurrences, durations and minimum number of sampling sites are described in provisions C.8.d and C.8.g of the MRP, respectively. The monitoring requirements in the 2015 MRP are similar to the 2009 MRP requirements (which began implementation on October 1, 2011) and build upon earlier monitoring conducted by SCVURPPP between 2002 and 2009. Creek Status and Pesticides & Toxicity monitoring is coordinated through the Regional Monitoring Coalition (RMC). Monitoring results are evaluated to determine whether triggers are met and further investigation is warranted as a potential Stressor/Source Identification (SSID) Project, as described in provision C.8.e of the MRP. Results of Creek Status Monitoring conducted in Water Years 2012 through 2016 were submitted in prior reports (SCVURPPP 2017, SCVURPPP 2016, SCVURPPP 2015, SCVURPPP 2014, SCVURPPP 2013).

[3] Monitoring data collected pursuant to other C.8 provisions (e.g., Pollutants of Concern Monitoring, Stressor/Source Identification Monitoring Projects) are reported in the SCVURPPP Urban Creeks Monitoring Report (UCMR) for WY 2017 to which this Creek Status Monitoring Report is appended.

1.2 Regional Monitoring Coalition

Provision C.8.a (Compliance Options) of the MRP allows Permitees to address monitoring requirements through a regional collaborative effort, their Stormwater Program, and/or individually. The RMC was formed in early 2010 as a collaboration among a number of the Bay Area Stormwater Management Agencies Association (BASMAA) members and MRP Permittees (Table 1.1) to develop and implement a regionally coordinated water quality monitoring program to improve stormwater management in the region and address water quality monitoring required by the MRP.[4] Implementation of the RMC's Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012) allows Permittees and the Regional Water Board to improve their ability to collectively answer core management questions in a cost-effective and scientifically rigorous way. Participation in the RMC is facilitated through the BASMAA Monitoring and Pollutants of Concern (MPC) Committee.

Table 1.1. Regional Monitoring Coalition (RMC) participants.

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

The goals of the RMC are to:

1. Assist Permittees in complying with requirements in provision C.8 (Water Quality Monitoring) of the MRP;
2. Develop and implement regionally consistent creek monitoring approaches and designs in the Bay Area, through the improved coordination among RMC participants and other agencies (e.g., Regional Water Board) that share common goals; and
3. Stabilize the costs of creek monitoring by reducing duplication of effort and streamlining reporting.

The RMC's monitoring strategy for complying with Creek Status monitoring is described in the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). The strategy includes regional ambient/probabilistic monitoring and local "targeted" monitoring. The combination of these two components allows each individual RMC participating program to assess the status of beneficial uses in

[4] The San Francisco Bay Regional Water Quality Control Board (SFRWQCB) issued the first five-year MRP to 76 cities, counties and flood control districts (i.e., Permittees) in the Bay Area on October 14, 2009 (SFRWQCB 2009). 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.

local creeks within its jurisdictional area, while also contributing data to answer management questions at the regional scale (e.g., differences between aquatic life condition in urban and non-urban creeks). The current MRP, updated and reissued in 2015, specifies the probabilistic/targeted approach most of the details of the RMC Creek Status and Long-Term Trends Monitoring Plan. Table 1.2 provides a list of which parameters are included in the probabilistic and targeted programs in the 2015 MRP. This report includes data collected in Santa Clara County under both monitoring components. Data are organized into report Sections that reflect the format of monitoring requirements in the MRP.

Table 1.2. Creek Status Monitoring parameters in compliance with MRP provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides & Toxicity Monitoring) and associated monitoring component.

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

Notes:
[1] Provision C.8.d.i.(6) allows for up to 20% of sample locations to be selected on a targeted basis.
[2] Provision C.8.d.ii.(2) provides options for probabilistic or targeted site selection. In WY 2017, chlorine was measured at probabilistic sites.

1.3 Monitoring and Data Assessment Methods

1.3.1 Monitoring Methods

Water quality data were collected in accordance with California Surface Water Ambient Monitoring Program (SWAMP) comparable methods and procedures described in the BASMAA RMC Standard Operating Procedures (SOPs; BASMAA 2016b) and associated Quality Assurance Project Plan (QAPP; BASMAA 2016a). These documents and the RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012) are updated as needed to maintain their currency and optimal applicability. Where applicable, monitoring data were collected using methods comparable to those specified by the SWAMP Quality Assurance Program Plan (QAPrP)[5], and were submitted in SWAMP-compatible format to the SFRWQCB. The SOPs were developed using a standard format that describes health and safety cautions and considerations, relevant training, site selection, and sampling methods/procedures, including pre-fieldwork mobilization activities to prepare equipment, sample collection, and de-mobilization activities to preserve and transport samples.

[5] The current SWAMP QAPrP is available at: http://www.waterboards.ca.gov/water_issues/programs/swamp/docs/qapp/qaprp082209.pdf

1.3.2 Laboratory Analysis Methods

RMC participants, including SCVURPPP, agreed to use the same laboratories for individual parameters (except pathogen indicators), developed standards for contracting with the labs, and coordinated quality assurance samples. All samples collected by RMC participants that were sent to laboratories for analysis were analyzed and reported per SWAMP-comparable methods as described in the RMC QAPP (BASMAA 2016a). Analytical laboratory methods, reporting limits and holding times for chemical water quality parameters are also described in BASMAA (2016a). Analytical laboratory contractors included:

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

1.3.3 Data Analysis Methods

Monitoring data generated during WY 2017 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions, including exceedances of water quality objectives (WQOs). Creek Status Monitoring and Pesticides & Toxicity Monitoring data must be evaluated with respect to numeric thresholds, specified in the "Followup" sections in provision C.8.d and C.8.g of the MRP (SFRWQCB 2015) that, if not met, require consideration for further evaluation as part of a Stressor/Source Identification project. SSID projects are intended to be oriented toward taking action(s) to alleviate stressors and reduce sources of pollutants. A stepwise process for conducting SSID projects is described in provision C.8.e.iii.

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

1.4 Setting

1.4.1 Watersheds Monitored by SCVURPPP

There are 13 major watersheds within the SCVURPPP jurisdictional boundaries and these watersheds comprise most of the Santa Clara Basin. The watersheds are mapped in Figure 1.1 and their major characteristics are listed in Table 1.3. The Santa Clara Basin, San Francisco Bay south of the Dumbarton Bridge, and the 840 square miles that drain to it, are bounded by the Diablo Mountains on the east and the Santa Cruz Mountains on the west and south. Elevations range from sea level at the Bay to almost 4,000 feet in the Santa Cruz Mountains. There is a distinct transition in geography and land use at elevations of 600 to 800 feet. Areas above this elevation generally have steeper slopes and are largely forest, rangeland, or open space; below this threshold, an urbanized landscape dominates. Most watersheds have their headwaters in the undeveloped mountains and drain north through urbanized areas to the Bay. Flows in the lower reaches of most watersheds are controlled by the presence of water supply reservoirs that are managed by the Santa Clara Valley Water District (SCVWD) and other agencies. Many of the reservoirs are constructed at the transition between the Santa Clara Valley and the surrounding foothills. Water is captured during the winter rainy season and released in the spring at managed rates to allow for percolation through the stream bed and to protect fish habitat downstream of the reservoirs. To varying degrees, portions of all watersheds within the urban zone have been engineered or placed within underground culverts. The Sunnyvale East and West Channel watersheds contain no natural creek bed at all; they were constructed in the 1960s to manage flooding.

Table 1.3. Characteristics of major watersheds within SCVURPPP boundary.

Watershed	Area (square miles)	Number of Tributary Creeks	Natural Creek Bed (Miles)	Engineered Channel (Miles)	Underground Culvert or Stormdrain (Miles)	Impervious Area	Land Use				
							Residential	Industrial/ Commercial	Forest	Rangeland	Other
Adobe	11.0	7	18.8	2.3	12.0	44.7%	46.5%	11.8%	36.3%	2.7%	2.7%
Barron	15.6	5	15.1	7.9	28.6	60.3%	60.5%	20.1%	7.3%	7.0%	5.1%
Calabazas	20.3	6	12.9	14.1	55.5	NA	54.5%	29.4%	8.8%	5.2%	2.1%
Coyote	321	53	670	36.4	146	11.1%	8.6%	3.7%	49.9%	29.6%	8.2%
Guadalupe	171	50	207	45.5	265	37.1%	29.6%	13.6%	34.7%	15.5%	6.6%
Lower Penitencia	28.6	13	29.2	20.8	61.6	42.9%	30.7%	19.0%	1.1%	38.7%	10.5%
Matadero	14.0	3	18	NA	NA	60.3%	57.1%	5.8%	8.9%	8.2%	20%
Permanente	17.3	7	NA	NA	NA	43.9%	46.3%	13.1%	35.0%	2.8%	2.8%
San Francisquito	42.8	25	90.6	4.8	15.3	20.8%	29.6%	5.2%	44.7%	15.0%	5.5%
San Tomas Aquino	44.8	15	50.5	15.5	79.3	60.1%	53.9%	18.8%	23.7%	0.8%	2.8%
Stevens	29.2	12	54.2	1.1	30.0	28.6%	24.5%	9.0%	49.2%	12.5%	4.8%
Sunnyvale East	7.1	0	0	6.2	26.6	82.2%	65.3%	31.8%	0%	0%	2.9%
Sunnyvale West	7.6	0	0	6.7	18.7	72.4%	20.9%	65.2%	0%	0%	13.9%

Source: http://www.scvurppp-w2k.com/watersheds.shtml
NA – not available

WY 2017 Creek Status and Pesticides and Toxicity Monitoring Stations

The complete list of probabilistic and targeted monitoring sites samples by SCVURPPP in WY 2017 in compliance with provisions C.8.d (Creek Status Monitoring) and C.8.g (Pesticides and Toxicity Monitoring) is presented in Table 1.4. Monitoring locations with monitoring parameter(s) are mapped in Figure 1.2. Probabilistic station numbers, generated from the RMC Sample Frame, are provided for all bioassessment locations. Targeted stations numbers, based on SWAMP station numbering methods (BASMAA 2016b), are provided for all targeted monitoring sites.

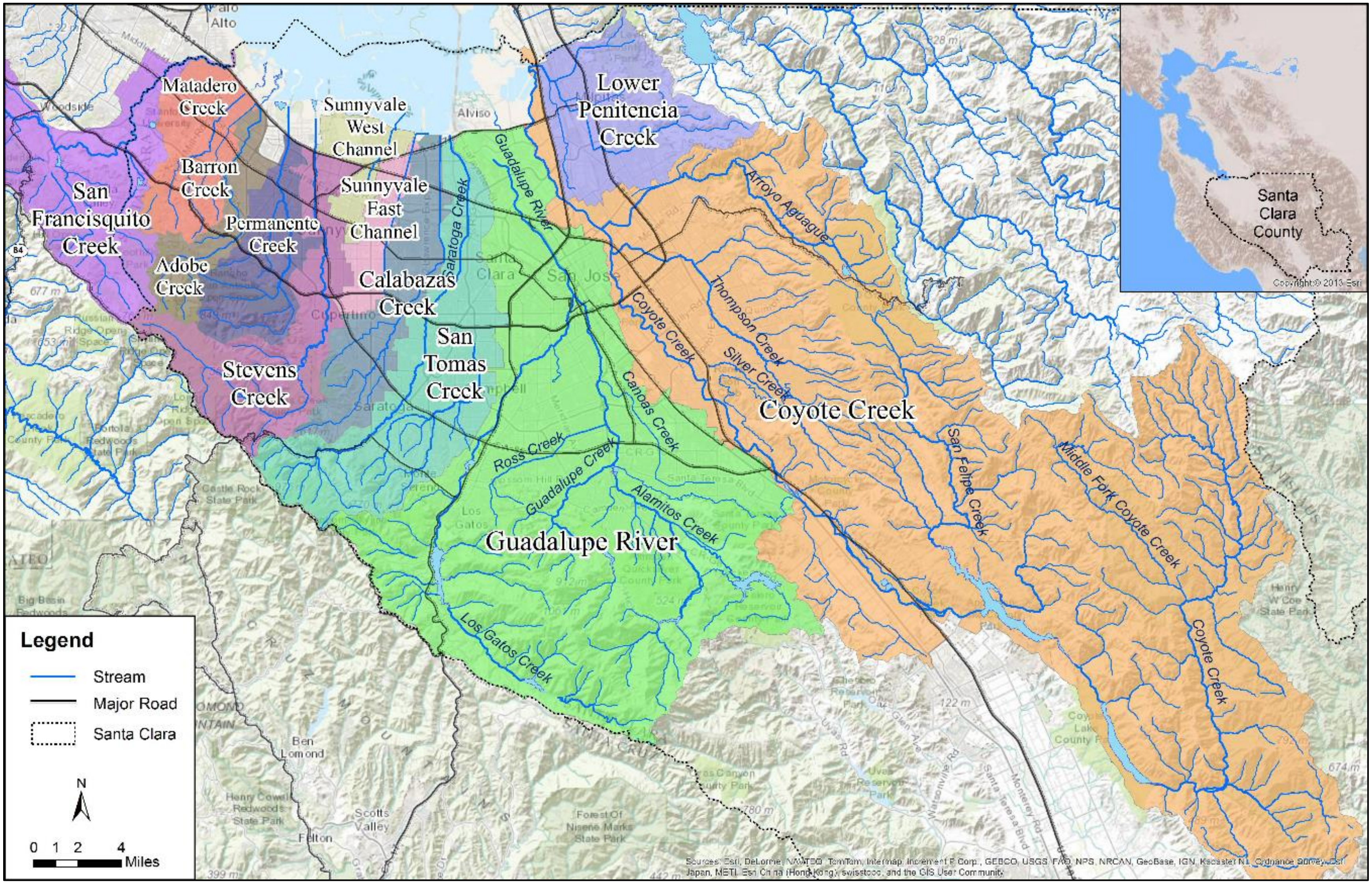

Figure 1.1. Watersheds within SCVURPPP jurisdictional boundaries.

Table 1.4. Sites and parameters monitored in WY 2017 in Santa Clara County.

Map ID	Station ID	Watershed	Creek Name	Land Use	Latitude	Longitude	Probabilistic	Targeted				
							Bioassessment, Nutrients, General WQ	Chlorine	Toxicity, Sediment Chemistry	Temp	Cont WQ	Pathogen Indicators
570	205R00570	Guadalupe River	Trib to Aldercroft Cr	NU	37.181464	-122.002165	X	X				
609	205R00609	Coyote Creek	Hunting Hollow	NU	37.073721	-121.460268	X	X				
645	205R00645	Coyote Creek	Packwood Creek	NU	37.170717	-121.613387	X	X				
2693	205R02693	Coyote Creek	Packwood Creek	U	37.174793	-121.616695	X	X				
2755	205R02755	Lower Penitencia Cr	Berryessa Creek	U	37.420931	-121.840146	X	X				
2787	205R02787	Matadero Creek	Matadero Creek	U	37.432204	-122.124836	X	X				
2915	205R02915	Stevens Creek	Stevens Creek	U	37.306931	-122.069249	X	X				
2947	205R02947	Lower Penitencia Cr	Lower Penitencia	U	37.429177	-121.90895	X	X				
3011	205R03011	Lower Penitencia Cr	Berryessa Creek	U	37.41123	-121.858567	X	X				
3091	205R03091	Coyote Creek	Arroyo Aguague	U	37.399248	-121.785626	X	X				
3098	205R03098	Guadalupe River	Guadalupe Creek	U	37.243658	-121.874066	X	X				
3235	205R03235	Stevens Creek	Stevens Creek	U	37.334668	-122.064327	X	X				
3306	205R03306	San Tomas Aquino	Saratoga Creek	U	37.277387	-122.011719	X	X				
3331	205R03331	Guadalupe River	Los Gatos Creek	U	37.300891	-121.919698	X	X				
3354	205R03354	Guadalupe River	Guadalupe Creek	U	37.212368	-121.908596	X	X				
3386	205R03386	Guadalupe River	Aldercroft Creek	U	37.176762	-121.995876	X	X				
3418	205R03418	Guadalupe River	Alamitos Creek	U	37.22855	-121.861762	X	X				
3443	205R03443	Calabazas Creek	Calabazas Creek	U	37.388639	-121.986842	X	X				
3523	205R03523	Coyote Creek	Upper Penitencia Creek	U	37.393389	-121.83237	X	X				
3530	205R03530	Guadalupe River	Los Gatos Creek	U	37.25194	-121.963874	X	X				
400	205LGA400	Guadalupe River	Los Gatos Creek	U	37.2389	-121.97054						X
30	205MAT030	Matadero Creek	Matadero Creek	U	37.4099	-122.13831						X
64	205STE064	Stevens Creek	Stevens Creek	U	37.3174	-122.06182						X
225	205GUA225	Guadalupe River	Arroyo Calero	U	37.214116	-121.83444						X
75	205SAR075	San Tomas Aquino	Saratoga Creek	U	37.25826	-122.03445						X
210	205GUA210	Guadalupe River	Guadalupe Creek	U	37.21746	-121.91039				X		
202	205GUA202	Guadalupe River	Guadalupe Creek	U	37.23291	-121.89795				X		
190	205GUA190	Guadalupe River	Guadalupe Creek	U	37.24373	-121.87561				X		
270	205GUA270	Guadalupe River	Alamitos Creek	U	37.20129	-121.82891				X		
340	205GUA340	Guadalupe River	Arroyo Calero	U	37.20706	-121.82362				X		
225	205GUA225	Guadalupe River	Arroyo Calero	U	37.21403	-121.83442				X		
262	205GUA262	Guadalupe River	Alamitos Creek	U	37.220409	-121.845155				X		
255	205GUA255	Guadalupe River	Alamitos Creek	U	37.22607	-121.85842				X		

Map ID	Station ID	Watershed	Creek Name	Land Use	Latitude	Longitude	Probabilistic	Targeted				
							Bioassessment, Nutrients, General WQ	Chlorine	Toxicity, Sediment Chemistry	Temp	Cont WQ	Pathogen Indicators
250	205GUA250	Guadalupe River	Alamitos Creek	U	37.23363	-121.87058				X		
235	205COY235	Coyote Creek	Coyote Creek	U	37.3536	-121.87417					X	
236	205COY236	Coyote Creek	Coyote Creek	U	37.35098	-121.87378					X	
239	205COY239	Coyote Creek	Coyote Creek	U	37.33722	-121.86953					X	
21	205STE021	Stevens Creek	Stevens Creek	U	37.40985	-122.06906			X			
10	205STQ010	San Tomas Aquino	San Tomas Aquino	U	37.38843	-121.96865			X			

U = urban, NU = non-urban

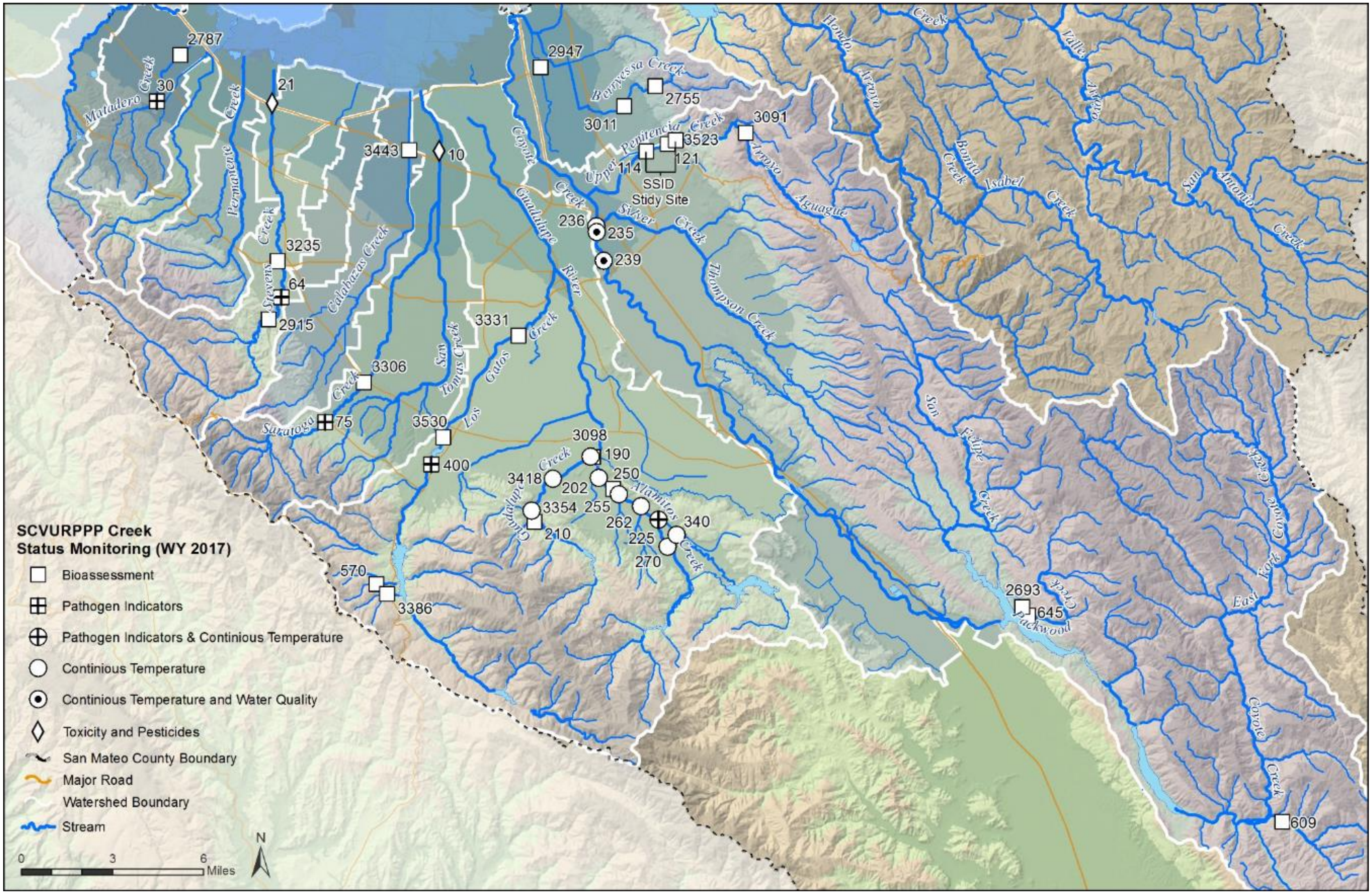

Figure 1.2. Map of SCVURPPP Program Area, major creeks, and sites monitored in WY 2017.

1.4.2 Designated Beneficial Uses

Beneficial Uses in Santa Clara Valley creeks are designated by the SFRWQCB for specific water bodies. Uses include aquatic life, recreation, consumption by humans, and habitat. Table 1.5 lists Beneficial Uses designated by the SFRWQCB (2017) for water bodies monitored by SCVURPPP in WY 2017.

Table 1.5. Creeks monitored by SCVURPPP in WY 2017 and their Beneficial Uses (SFRWQCB 2017).

Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
Alamitos Creek			E	E					E			E	E	E	E	E	E	E	
Aldercroft Creek[1]		E	E	E					E			E	E	E	E	E	E	E	
Arroyo Aguague									E			E	E	E	E	E	E	E	
Arroyo Calero			E						E			E	E	E	E	E	E	E	
Berryessa Creek															E	E	E	E	
Calabazas Creek	E			E					E						E	E	E	E	
Coyote Creek				E			E		E			E	E	E	E	E	E	E	
Guadalupe Creek			E	E					E			E	E	E	E	E	E	E	
Hunting Hollow[1]				E			E		E			E	E	E	E	E	E	E	
Los Gatos Creek		E	E	E					E			P	E	P	E	E	E	P	
Lower Penitencia Creek															E	E	E	E	
Matadero Creek									E			E	E	E	E	E	E	E	
Packwood Creek			E						E					E	E	E	E	E	
San Tomas Aquino									E				E		E	E	E	E	
Saratoga Creek	E		E	E					E						E	E	E	E	
Stevens Creek			E	E					E			E	E	E	E	E	E	E	
Tributary to Aldercroft Creek[1]		E	E	E					E			E	E	E	E	E	E	E	
Upper Penitencia Creek			E	E					E			E	E	E	E	E	E	E	

[1] No Beneficial Uses listed specifically for waterbody.

Notes:

COLD = Cold Fresh Water Habitat
FRSH = Freshwater Replenishment
GWR = Groundwater Recharge
MIGR = Fish Migration
MUN = Municipal and Domestic Water

EST = Estuarine (the Basin Plan assigns this beneficial use to slough portions of Plummer Creek; for this evaluation WARM is presumed applicable to freshwater portions)

NAV = Navigation
RARE= Preservation of Rare and Endangered Species
REC-1 = Water Contact Recreation
REC-2 = Non-contact Recreation

WARM = Warm Freshwater Habitat
WILD = Wildlife Habitat
P = Potential Use
E = Existing Use
L = Limited Use.
* = "Water quality objectives apply; water contact recreation is prohibited or limited to protect public health" (SFRWQCB 2013).

1.4.3 Climate

The Santa Clara Valley experiences a Mediterranean-type climate with cool, wet winters and hot, dry summers. The wet season typically extends from October through April with local long-term, mean annual precipitation ranging from 15 inches near the Bay to over 55 inches along the highest ridges in the Santa Cruz Mountains (PRISM Climate Group 30-year normals, 1981-2010[6]). Figure 1.3 illustrates the geographic variability of mean annual precipitation in the area. It is important to understand that mean annual precipitation depths are statistically calculated or modeled; actual measured precipitation in a given year rarely equals the statistical average. Figure 1.4 illustrates the temporal variability in annual precipitation measured at the Mineta San Jose International Airport from WY 1946 to WY 2017. Creek Status Monitoring in compliance with the MRP began in WY 2012 which was the first year of a severe statewide drought that persisted through WY 2016. In WY 2017, rainfall was above average but was followed by the hottest recorded summer in California history (California Weather Blog[7]).

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

It is uncertain what effect these factors have on indices of biotic integrity (IBIs) based on data collected by the Creek Status Monitoring Program, such as benthic macroinvertebrates or algae. A study evaluating 20 years of bioassessment data collected in northern California showed that, although benthic macroinvertebrate taxa with certain traits may be affected by dry (and wet) years and/or warm (and cool) years, IBIs based on these organisms appear to be resilient (Mazor et al. 2009, Lawrence et al. 2010). However, this study did not specifically examine the impact of longer *periods* of extended drought or heat on IBIs, which would require analysis of a dataset with a much longer period of record. The Herbst Lab at the Sierra Nevada Aquatic Research Laboratory, University of California Santa Barbara is currently exploring how changing climate affects Sierra Nevada stream ecosystems.

Extreme heat can affect water temperature and other general water quality parameters that are influenced by water temperature (e.g., specific conductance, dissolved oxygen). By some measures, WY 2017 was the hottest summer in over 120 years of recorded measurements.[8] The late summer general water quality monitoring results from WY 2017 reflect the high air temperatures during that period.

[6] http://www.prism.oregonstate.edu/normals/
[7] http://weatherwest.com/archives/5860
[8] https://www.ncdc.noaa.gov/cag/time-series/us/4/4/tavg/4/9/1895-2017?base_prd=true&firstbaseyear=1901&lastbaseyear=2000

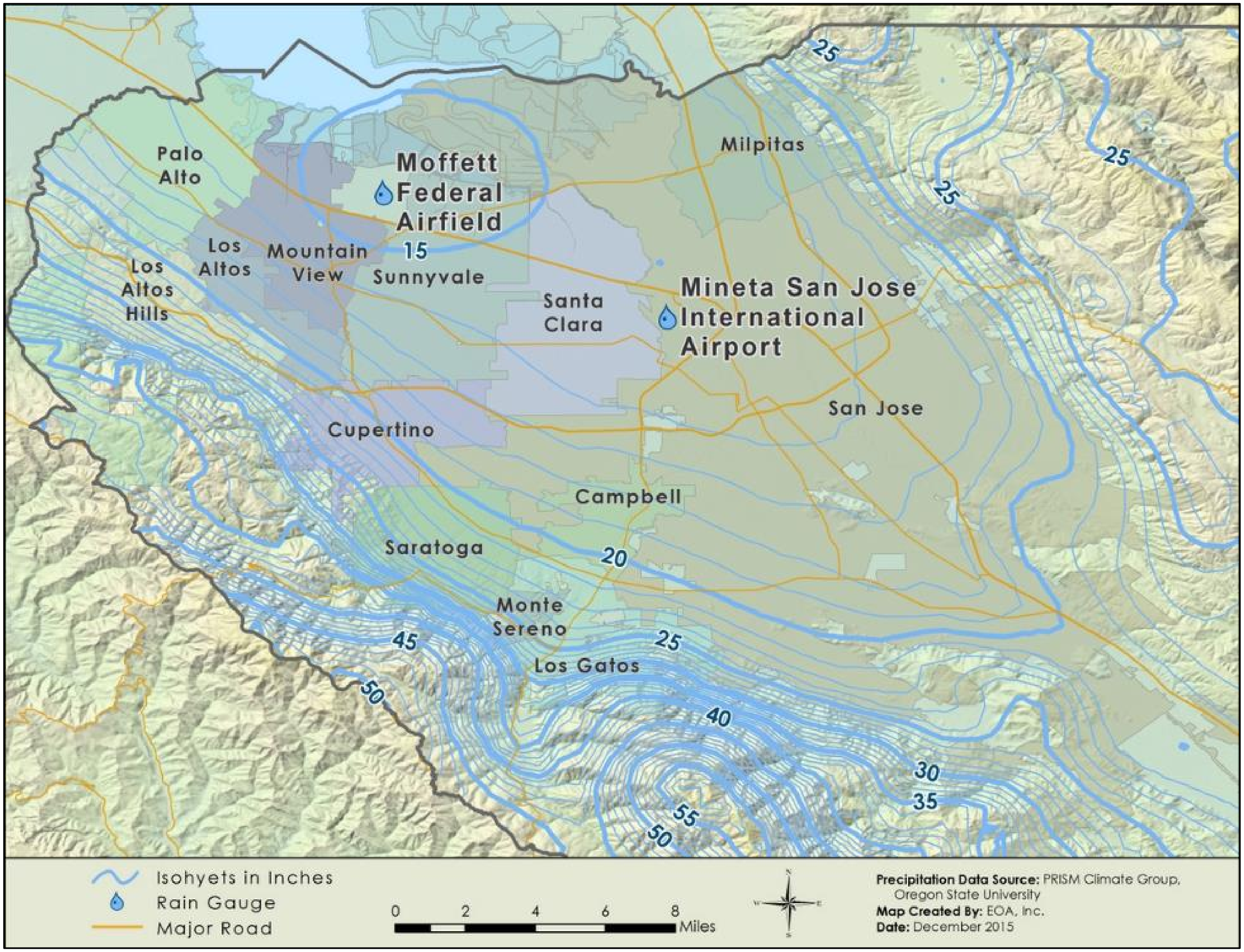

Figure 1.3. Average annual precipitation in Santa Clara Valley, as modeled by the PRISM Climate Group for the period of 1981-2010.

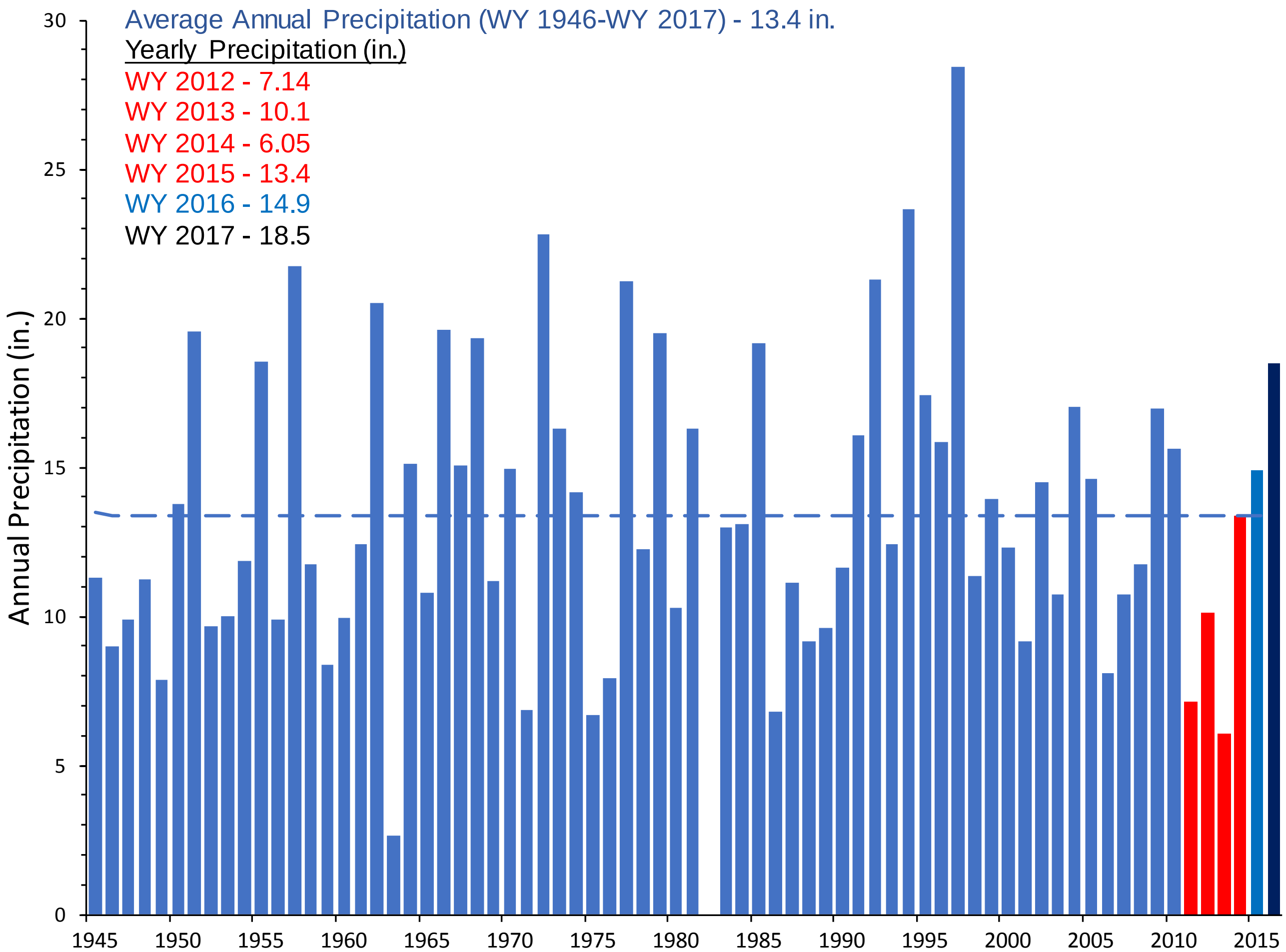

Figure 1.4. Annual rainfall recorded at the San Jose Airport, WY 1946 – WY 2017.

1.5 Statement of Data Quality

A comprehensive Quality Assurance/Quality Control (QA/QC) program was implemented by SCVURPPP covering all aspects of the probabilistic and targeted monitoring. In general, QA/QC procedures were implemented as specified in the BASMAA RMC QAPP (BASMAA, 2016a), and monitoring was performed according to protocols specified in the BASMAA RMC SOPs (BASMAA, 2016b), and in conformity with methods specified by the SWAMP QAPrP[9]. A detailed QA/QC report is included as Attachment 1. Based on the QA/QC review, no WY 2017 data were rejected, but some data were flagged. Overall, WY 2017 data met QA/QC objectives.

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

2.0 BIOLOGICAL CONDITION ASSESSMENT

2.1 Introduction

In compliance with Creek Status Monitoring provision C.8.d.i, SCVURPPP conducted bioassessment monitoring in WY 2017. All bioassessment monitoring was performed at sites selected randomly using the probabilistic monitoring design[10]. The probabilistic monitoring design allows each individual RMC participating program to objectively assess stream ecosystem conditions within its program area (e.g., County boundary) while contributing data to answer regional management questions about water quality and beneficial use condition in San Francisco Bay Area creeks. The survey design provides an unbiased framework for data evaluation that will allow a condition assessment of ambient aquatic life uses within known estimates of precision. The monitoring design was developed to address the management questions for both RMC participating county and overall RMC area described below:

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

The first question (i.e., *What is the condition of aquatic life in creeks in the RMC area?*) is addressed by assessing indicators of aquatic biological health at probabilistic sampling locations. Once a sufficient number of samples have been collected, ambient biological condition can be estimated for streams at a regional scale. Over the past six years (WY 2012 through WY 2017), the SCVURPPP and Regional Water Board have sampled 132 probabilistic sites in Santa Clara County, providing a sufficient sample size to estimate ambient biological condition for urban streams countywide. There are still an insufficient number of samples to accurately assess the biological condition of non-urban streams in the county, or of individual watersheds or smaller jurisdictional areas (i.e., cities).[11]

The second question (i.e., *What are major stressors to aquatic life in the RMC area?*) is addressed by the collection and evaluation of physical habitat and water chemistry data collected at the probabilistic sites, as potential stressors to biological health. The extent and magnitude of these potential stressors above certain thresholds is also assessed for streams in Santa Clara County. In addition, the stressor levels can be compared to biological indicator data through correlation and relative risk analyses. Assessing the extent and relative risk of stressors can help prioritize stressors at a regional scale and inform local management decisions.

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

[10] The option to conduct 20% of bioassessment surveys at targeted sites was not exercised in WY 2017.
[11] For each of the strata, it is necessary to obtain a sample size of at least 30 in order to evaluate the condition of aquatic life within known estimates of precision. This estimate is defined by a power curve from a binomial distribution (BASMAA 2012).

the RMC probabilistic survey will require more than six years of data collection, preliminary trend analysis of biological condition may be possible for some stream reaches using a combination of historical targeted data with the probabilistic data.

The sections below present bioassessment data collected at twenty sites in WY 2017. This WY 2017 report presents biological indicator data and potential stressor data. Data are compared to triggers and water quality objectives identified in the MRP; however, statistical analyses evaluating stressor association with biological condition are not presented in this report. Those analyses are being conducted through an ongoing BASMAA RMC regional study.

The BASMAA RMC is currently conducting a *regional* analysis of biological condition using a five-year dataset (WY 2012 – WY 2016). The BASMAA regional study will conduct the following analyses:

- Assess the biological condition of streams in the region and each county using IBIs based on benthic macroinvertebrate and algae data collected by each countywide program and the SWRCB SWAMP.
- Evaluate IBIs in distinct groupings such as imperviousness categories and type of stream.
- Assess stressors associated with poor stream condition using multivariate modeling analyses.
- Summarize regional data for each year in the five-year dataset.
- Introduce the analyses that will be needed to make recommended changes to the probabilistic monitoring design.

Results of the BASMAA regional study will be available by late 2018. Analytical tools that are found to be useful in evaluating stressor association with biological condition may be implemented in future annual monitoring reports.

2.2 Methods

2.2.1 Probabilistic Survey Design

The RMC probabilistic design was developed using the Generalized Random Tessellation Stratified (GRTS) approach developed by the United States Environmental Protection Agency (USEPA) and Oregon State University (Stevens and Olson 2004). GRTS offers multiple benefits for coordinating amongst monitoring entities including the ability to develop a spatially balanced design that produces statistically representative data with known confidence intervals. The GRTS approach has been implemented recently in California by several agencies including the statewide Perennial Streams Assessment (PSA) conducted by Surface Water Ambient Monitoring Program (SWAMP) (Ode et al. 2011) and the Southern California Stormwater Monitoring Coalition's (SMC) regional monitoring program conducted by municipal stormwater programs in Southern California (SCCWRP 2007).

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

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

Most RMC participants weight their annual sampling efforts so that approximately 80% are in in urban areas and 20% in non-urban areas. In addition, between WY 2012 and WY 2015, the SFRWQCB SWAMP conducted 34 bioassessments throughout the RMC region at non-urban probabilistic sites selected from the sample frame, including 12 sites in Santa Clara County.[12]

2.2.2 Site Evaluations

Sites identified in the regional sample draw are evaluated by each RMC participant in chronological order using a two-step process described in RMC Standard Operating Procedure FS-12 (BASMAA 2016b), consistent with the procedure described by Southern California Coastal Water Research Project (SCCWRP 2012). Each site is evaluated to determine if it meets the following RMC sampling location criteria:

1. The location (latitude/longitude) provided for a site is located on or is within 300 meters of a non-impounded receiving water body;[13]
2. Site is not tidally influenced;
3. Site is wadeable during the sampling index period;
4. Site has sufficient flow during the sampling index period to support standard operation procedures for biological and nutrient sampling.
5. Site is physically accessible and can be entered safely at the time of sampling;
6. Site may be physically accessed and sampled within a single day;
7. Landowner(s) grant permission to access the site.[14]

In the first step, these criteria were evaluated to the extent possible using a "desktop analysis." Site evaluations were completed during the second step via field reconnaissance visits. Based on the outcome of site evaluations, sites were classified into one of three categories:

- **Target** – Target sites were grouped into two subcategories:
  - **Target Sampleable (TS)** - Sites that met all seven criteria and were successfully sampled.
  - **Target Non-Sampleable (TNS)** - Sites that met criteria 1 through 4, but did not meet at least one of criteria 5 through 7 were classified as TNS.
- **Non-Target (NT)** - Sites that did not meet at least one of criteria 1 through 4 were classified as non-target status.
- **Unknown (U)** - Sites were classified with unknown status when it could be reasonably inferred either via desktop analysis or a field visit that the site was a valid receiving water body and information for any of the seven criteria was unconfirmed.

All site evaluation information was documented on field forms and entered into a standardized database. The overall percent of sites classified into the three categories will eventually be evaluated to determine the statistical significance of local and regional average ambient conditions calculated from the multi-year dataset.

[12] As of WY 2016, the SFRWQCB SWAMP is no longer conducting RMC-related bioassessment monitoring at probabilistic sites.
[13] The evaluation procedure permits certain adjustments of actual site coordinates within a maximum of 300 meters.
[14] If landowners did not respond to at least two attempts to contact them either by written letter, email, or phone call, permission to access the respective site was effectively considered to be denied.

2.2.3 Field Sampling Methods

Biological sample collection and processing was consistent with the BASMAA RMC QAPP (BASMAA 2016a) and SOPs (BASMAA 2016b).

In accordance with the RMC QAPP (BASMAA 2016a) bioassessments were planned during the spring index period (approximately April 15 – July 15) with the goal to sample a minimum of 30 days after any significant storm (defined as at least 0.5-inch of rainfall within a 24-hour period). A 30-day grace period allows diatom and soft algae communities to recover from peak flows that may scour benthic algae from the bottom of the stream channel. During WY 2017, there were a couple of small storms in April, including a storm on April 8 (0.55 inches in 24-hour period) and a smaller storm on April 14 (0.35 inches in 24-hour period). Field sampling was conducted over a period of one month, between May 8 and June 8, 2017.

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

Immediately prior to biological and physical habitat data collection, water samples were collected at for nutrients, conventional analytes, ash free dry mass, and chlorophyll a analysis using the Standard Grab Sample Collection Method as described in SOP FS-2 (BASMAA 2016b). Water samples were also collected and analyzed for free and total chlorine using a Pocket Colorimeter™ II and DPD Powder Pillows according to SOP FS-3 (BASMAA 2016b) (see Section 4.0 for chlorine monitoring results). In addition, general water quality parameters (DO, pH, specific conductance and temperature) were measured at or near the centroid of the stream flow using pre-calibrated multi-parameter probes.

Biological and water samples were sent to laboratories for analysis. The laboratory analytical methods used for BMIs followed Woodward et al. (2012), using the Southwest Association of Freshwater Invertebrate Taxonomists (SAFIT) Level 1 Standard Taxonomic Level of Effort, with the additional effort of identifying chironomids (midges) to subfamily/tribe instead of family (Chironomidae). Soft algae and diatom samples were analyzed following SWAMP protocols (Stancheva et al. 2015). The taxonomic resolution for all data was compared SWAMP master taxonomic list. There were five soft algae taxa that were not on the SWAMP list and were subsequently harmonized and included in the data submittal for WY 2017.

2.2.4 Data Analysis

BMI and algae data were analyzed to assess the biological condition of the sampled reaches using condition index scores. Physical Habitat Assessment (PHAB) scores, a qualitative tool that assesses the overall habitat condition of the sampling reach during the assessment, were compared to biological condition indictor scores. Additional physical habitat metric scores (see Stressor Variable section below) and water chemistry data were evaluated as potential stressors to biological health using triggers and water quality objectives identified in the MRP. Data analysis methods are described below.

Biological Indicators

Benthic Macroinvertebrates

The benthic (i.e., bottom-dwelling) macroinvertebrates collected through this monitoring program are organisms that live on, under, and around the rocks and sediment in the stream bed. Examples include dragonfly and stonefly larvae, snails, worms, and beetles (Figure 2.1). Different BMIs respond differently to changes in water chemistry and physical habitat. Some are relatively sensitive; others more tolerant of poor habitat and pollution. Therefore, the abundance and variety of BMIs in a stream indicates the biological condition of the stream.

The California Stream Condition Index (CSCI) is a biological index that was developed by the State Water Resources Control Board (State Board) and is used to score the condition of BMI communities in perennial wadeable rivers and streams. The CSCI translates benthic macroinvertebrate data into an overall measure of stream health. The CSCI was developed using a large reference data set that is intended to represent the full range of natural conditions in California (Rehn et al. 2015). It combines two types of indices: 1) taxonomic completeness, as measured by the ratio of observed-to-expected taxa (O/E); and 2) ecological structure and function, measured as a predictive multi-metric index (pMMI) that is based on reference conditions. The CSCI score is computed as the average of the sum of O/E and pMMI.

The CSCI is calculated using a combination of biological and environmental data following methods described in Rehn et al. (2015). Biological data include benthic macroinvertebrate data collected and analyzed using protocols described in the previous section. The environmental predictor data are generated in GIS using drainage areas upstream of each BMI sampling location. The environmental predictors and BMI data were formatted into comma delimited files and used as input for the RStudio statistical package and the necessary CSCI program scripts, developed by Southern California Coastal Water Research Project (SCCWRP) staff (Mazor et al. 2016).

The State Board is continuing to evaluate the performance of CSCI in a regulatory context. In the current MRP, the Regional Water Board defined a CSCI score of 0.795 as a threshold for identifying sites with degraded biological condition that may be considered as candidates for a Stressor Source Identification project.

Odonata cordulegastridae "Spiketail Dragonfly"

Megaloptera corydalidae "Dobsonflies"

Ephemeroptera ephemerellidae "Spiny Crawler Mayflies"

Trichoptera limnephilidae "Northern Caddisflies"

Diptera ceratopogonidae "Biting Midges"

Coleoptera psephenidae "Water Penny Beetle"

Source: http://www.dfg.ca.gov/abl/Reference/California/CA_digital_ref_familylevel_home.asp

Figure 2.1. Examples of benthic macroinvertebrates.

Benthic Algae

Similar to BMI's, the abundance and type of benthic algae species living on a streambed can indicate stream health. Biological indices based on benthic algae can provide a more complete picture of the streams biological condition because algae respond most directly to nutrients and water chemistry; whereas, BMIs are more responsive to physical habitat. Figure 2.2 shows examples of benthic algae common in Bay Area streams.

The State Board and Southern California Coastal Water Research Project (SCCWRP) are currently developing and testing a statewide index using benthic algae data as a measure of biological condition for streams in California. The statewide Algae Stream Condition Indices (ASCIs) are expected to be available in 2018. The ASCIs will build upon studies by Fetscher et al. (2014) that developed and tested several algal IBIs for streams in Southern California (SoCal Algae IBIs). The SoCal Algae IBIs were developed from data comprised of either single-assemblage metrics (i.e., either diatoms or soft algae) or combinations of metrics presenting both assemblages (i.e, "hybrid" IBI).

Algae data collected in Santa Clara County were evaluated using the existing SWAMP Algae Reporting Module, (Algae RM) which was developed in 2012 using the SoCal Algae IBIs as the basis for metric and IBI calculations (Marco Sigala, personal communication). Three algal IBIs that performed well against stressor gradients at sites in Southern California were calculated using the algae data collected in Santa Clara County. These include a soft algae index (S2), a diatom index (D18) and a soft algae-diatom hybrid index (H20). The interpretation of algae data collected in Santa Clara County is considered preliminary since the IBIs were developed and tested on data collected in Southern California.

New taxa (i.e., not on the SWAMP Master List) are typically identified by the SWAMP laboratory each year. Additional new taxa are initially identified by contracting labs for stormwater projects and, depending on available resources, may be "harmonized" with taxa on the SWAMP Master List. Once harmonized, the new taxa are eventually added to the SWAMP Algae RM. However, autecological information (i.e., traits that associate taxa response to environmental stressors) has not been assigned to the new taxa since May 2013 (Marco Sigala, personal communication). As a result, some of the taxa identified in samples collected since 2013 are not included in the IBI calculations. Thus, the SoCal Algae IBI scores should be considered preliminary until all possible taxa and their trait attributes are incorporated into the Algae RM.

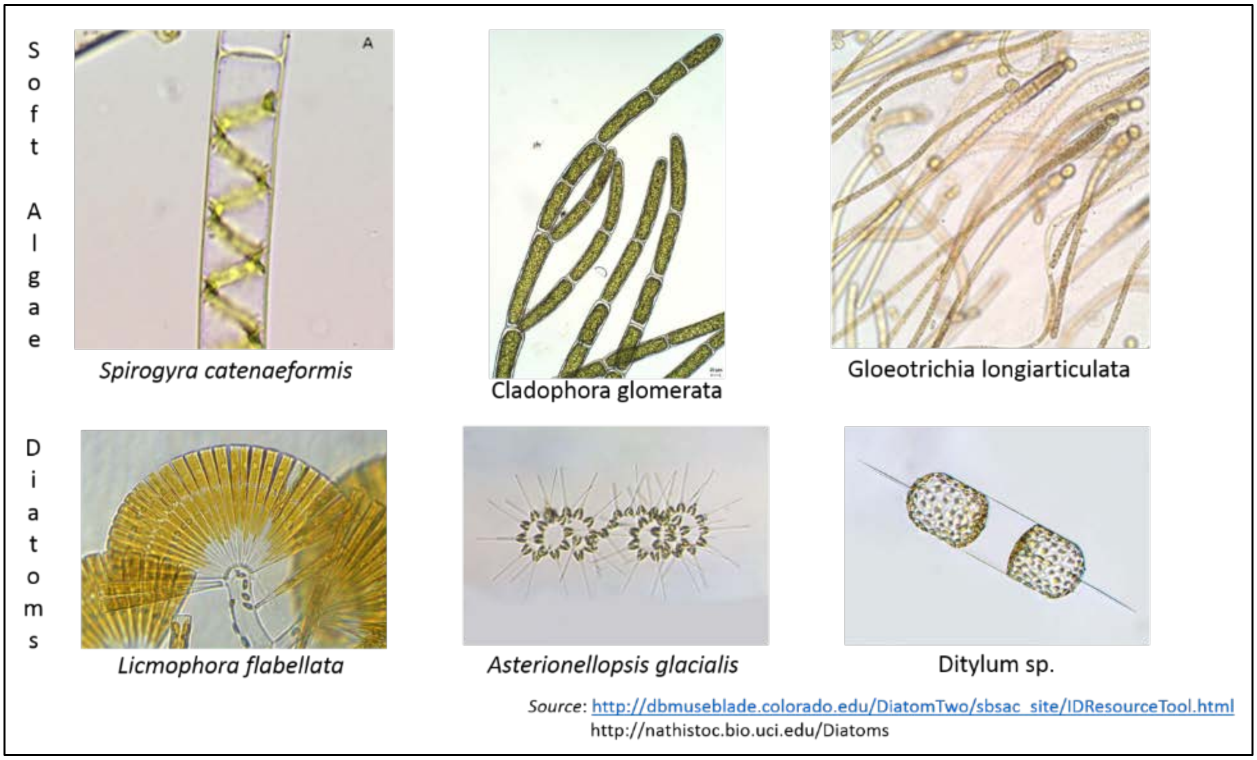

Figure 2.2. Examples of soft algae and diatoms.

Biological Condition Thresholds

Existing thresholds for biological indicators defined in Mazor (2015) were used to evaluate the bioassessment data collected in Santa Clara County and analyzed in this report (Table 2.1). The thresholds for each index were based on the distribution of scores for data collected at reference calibration sites in California (CSCI) or in Southern California (algae). Four condition categories are defined by these thresholds: “likely intact” (greater than 30th percentile of reference site scores); “possibly intact” (between the 10th and the 30th percentiles); “likely altered” (between the 1st and 10th percentiles; and “very likely altered” (less than the 1st percentile).

Table 2.1. Condition categories used to evaluate CSCI, Algae IBI, and Total PHAB scores.

Index	Likely Intact	Possibly Intact	Likely Altered	Very Likely Altered
Benthic Macroinvertebrates (BMI)				
CSCI Score	≥ 0.92	≥ 0.795 to < 0.92	≥ 0.63 to < 0.795	< 0.63
Benthic Algae				
S2 Score	≥ 60	≥ 47 to < 60	≥ 29 to < 47	< 29
D18 Score	≥ 72	≥ 62 to < 72	≥ 49 to < 62	< 49
H20 Score	≥ 70	≥ 63 to < 70	≥ 54 to < 63	< 54
Physical Habitat (PHAB)				
PHAB Score	≥ 46	≥ 30 to < 46	≥ 15 to < 30	< 15

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

Physical Habitat Assessment Scores

The Physical Habitat Assessment score consists of three attributes that are assessed for the entire bioassessment reach. These include channel alteration, epifaunal substrate, and sediment deposition. Each attribute is individually scored on a scale of 0 to 20, with a score of 20 representing good condition. The total PHAB score is the sum of three individual attribute scores with a score of 60 representing the highest possible score. Condition categories for Total PHAB score were created by dividing the highest possible score of 60 into quartiles (Table 2.1).

Stressor Variables

Physical habitat, general water quality, and water chemistry data collected at the bioassessment sites were compiled and evaluated as potential stressor variables for biological condition. Some of the data required conversion to other analytes or units of measurement:

- Conversion of measured total ammonia to the more toxic form of unionized ammonia was calculated to compare with the 0.025 mg/L annual median standard provided in the San Francisco Basin Water Quality Control Plan (Basin Plan) (SFRWQCB 2017). The conversion was based on a formula provided by the American Fisheries Society (AFS, internet source). The calculation requires total ammonia and field-measured parameters of pH, temperature, and specific conductance.
- Total nitrogen concentration was calculated by summing nitrate, nitrite and Total Kjeldahl Nitrogen concentrations.
- The volumetric concentrations (mass/volume) for ash free dry mass and chlorophyll a (as measured by the laboratory) were converted to an area concentration (mass/area). Calculations required using both algae sampling grab size and composite volume.

Physical habitat metrics were calculated using the SWAMP Bioassessment Reporting Module (SWAMP RM). The SWAMP RM output includes calculations based on parameters that are measured using EPA's Environmental Monitoring and Assessment Program (EMAP) for freshwater wadeable streams (Kaufmann et al. 1999). The RM also includes additional metrics generated from parameters collected under the SWAMP protocol (Marco Sigala, personal communication, 2017). The RM produces a total of 176 different metrics based on data collected using the SWAMP "Full" habitat protocol.

The California Department of Fish and Wildlife (CDFW) is currently developing a statewide index for physical habitat data collected using the SWAMP bioassesment protocol. The CDFW evaluated a range of physical habitat metrics for their ability to discriminate between reference and stressed sites and provide unbiased representation of waterbodies across the different ecoregions of California. Ten of the top performing metrics (Table 2.2) were selected from the SWAMP RM output to analyze physical habitat data collected from the 20 bioassessment sites in Santa Clara County during WY 2017.

Table 2.2. Physical habitat metrics used to assess physical habitat data collected at bioassessment sites in WY 2017.

Type	Variable Name	Variable
Channel Morphology	Evenness of Flow Habitat Types	Ev_FlowHab
Channel Morphology	Percent Fast Water of Reach	PCT_FAST
Habitat Complexity and Cover	Mean Filamentous Algae Cover	XFC_ALG
Habitat Complexity and Cover	Natural Shelter cover - SWAMP	XFC_NAT_SWAMP
Habitat Complexity and Cover	Shannon Diversity (H) of Aquatic Habitat Types	H_AqHab
Human Disturbance	Combined Riparian Human Disturbance Index - SWAMP	W1_HALL_SWAMP
Substrate Size and Composition	Evenness of Natural Substrate Types	Ev_SubNat
Substrate Size and Composition	Percent Gravel - coarse	PCT_GC
Substrate Size and Composition	Percent Substrate Smaller than Sand (<2 mm)	PCT_SAFN
Substrate Size and Composition	Shannon Diversity (H) of Natural Substrate Types	H_SubNat

Additional environmental variables were calculated in GIS by overlaying the drainage area for sample locations with land use and road data. The variables included percent urbanization, percent impervious, total number of road crossings and road density at three different spatial scales (1 km, 5 km, and entire watershed).

Another potential stressor is climate. During the first five years of probabilistic sampling (WY 2012 – WY 2016), average precipitation was lower than average. During the drought, low base flow conditions were further impacted by minimal or complete absence of water releases from upstream reservoirs and diversion pipes bringing imported water from other parts of the State. Comparison of sampling results from the wetter than average WY 2017 and other future wet years will provide useful information to evaluate the impacts of drought on biological integrity of the streams.

Stressor Thresholds

In compliance with provision C.8.h.iii.(4), water chemistry data collected at the bioassessment sites during WY 2017 were compared to stressor thresholds and applicable water quality standards (Table 2.3). Thresholds for pH, specific conductance, dissolved oxygen, and temperature (for waters with COLD Beneficial Use only) are listed in provision C.8.d.iv of the MRP. With the exception of temperature, these conform to Water Quality Objectives in the Basin Plan (SFRWQCB 2017). Of the eleven nutrients analyzed synoptically with bioassessments, WQOs only exist for three: ammonia (unionized form), and chloride and nitrate (for waters with MUN Beneficial Use only). Los Gatos Creek is the only creek sampled in WY 2016 with MUN designated (see Table 1.4). The MUN designation may also apply to Los Gatos Creek tributaries (i.e., Aldercroft Creek).

Table 2.3. Thresholds for nutrient and general water quality variables.

	Units	Threshold	Direction	Source
Nutrients and Ions				
Nitrate as N[a]	mg/L	10	Increase	Basin Plan
Un-ionized Ammonia[b]	mg/L	0.025	Increase	Basin Plan
Chloride[a]	mg/L	250	Increase	Basin Plan
General Water Quality				
Oxygen, Dissolved	mg/L	5.0 or 7.0	Decrease	Basin Plan
pH		6.5 to 8.5		Basin Plan
Temperature, instantaneous maximum	°C	24	Increase	MRP
Specific Conductance	µScm	2000	Increase	MRP

[a] Nitrate and chloride WQOs only apply to waters with MUN designated Beneficial Use

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

2.3 Results and Discussion

A comprehensive analysis of bioassessment data collected by the Program over a five-year period will be presented in the RMC Five-Year Bioassessment Report (5-Year Report). This BASMAA-funded project will evaluate bioassessment data collected at all RMC (n=312) and Water Board (n=45) probabilistic monitoring sites sampled between WY 2012 and WY 2016. The data will be evaluated to assess overall biological condition of streams within the RMC, as well as the extent and influence of stressor data on biological conditions. In addition, the 5-Year Report will evaluate the RMC Sample Frame and provide potential recommendations for revising the monitoring design in the future. The 5-Year Report will be completed by late- 2018.

The section below summarizes results from bioassessment sampling conducted during WY 2017.

2.3.1 Site Evaluations

During WY 2017, SCVURPPP conducted site evaluations at a total of 93 potential probabilistic sites in Santa Clara County drawn from the Sample Frame. Of these sites, a total of twenty were sampled in WY 2017 (rejection rate of 78%). Approximately 60% of the sites evaluated were rejected due to low or no flow conditions. Three of the twenty sampled sites (15%) were classified as non-urban land use. Land use classification, sampling location, and date for each site sampled during WY 2017 are listed in Table 2.4. Sites are mapped in Figure 1.2.

Table 2.4. Bioassessment sampling date and locations in Santa Clara County in WY 2017.

Station Code	Creek	Land Use	Sample Date	Latitude	Longitude
205R00570	Trib to Aldercroft Cr	NU	5/16/2017	37.18121	-122.00152
205R00609	Hunting Hollow	NU	5/10/2017	37.07420	-121.46120
205R00645	Packwood Creek	NU	5/15/2017	37.17820	-121.61414
205R02693	Packwood Creek	U	5/15/2017	37.17472	-121.61719
205R02755	Berryessa Creek	U	5/8/2017	37.42100	-121.84169
205R02787	Matadero Creek	U	6/1/2017	37.25500	-122.73100
205R02915	Stevens Creek	U	6/5/2017	37.30691	-122.07005
205R02947	Lower Penitencia Cr	U	5/11/2017	37.42968	-121.90913
205R03011	Berryessa Creek	U	5/8/2017	37.41155	-121.85889
205R03091	Arroyo Aguague	U	5/18/2017	37.39935	-121.78585
205R03098	Guadalupe Creek	U	6/6/2017	37.24370	-121.87554
205R03235	Stevens Creek	U	6/5/2017	37.33500	-122.06470
205R03306	Saratoga Creek	U	5/9/2019	37.27756	-122.01164
205R03331	Los Gatos Creek	U	6/7/2017	37.30144	-121.91892
205R03354	Guadalupe Creek	U	6/6/2017	37.21212	-121.90870
205R03386	Aldercroft Creek	U	5/16/2017	37.17738	-121.99789
205R03418	Alamitos Creek	U	6/8/2017	37.22874	-121.86173
205R03443	Calabazas Creek	U	6/1/2017	37.38864	-121.98684
205R03523	Upper Penitencia Cr	U	5/11/2017	37.39356	-121.83262
205R03530	Aldercroft Trib	U	6/7/2017	37.25122	-121.96510

NU = non-urban, U = urban

Since WY 2012, a total of 132 probabilistic sites were sampled by SCVURPPP (n=120) and SWAMP (n=12) in Santa Clara County. During the six-year sampling period, SCVURPPP sampled 104 urban and 16 non-urban sites and SWAMP sampled 12 non-urban sites. There are sufficient number of samples from probabilistic sites to develop estimates of biological condition and stressor assessment for both urban and non-urban streams in Santa Clara County. These analyses are currently being conducted through a BASMAA regional project with results anticipated in late-2018. More samples are needed however, to estimate biological condition at more local scales (e.g., watershed and jurisdictional areas).

2.3.2 Biological Condition Assessment

A total of 141 unique BMI taxa were identified in samples collected at 20 bioassessment sites in Santa Clara County during WY 2017. A total of 124 benthic algae taxa were identified in samples collected at all sites, including 85 diatom taxa and 39 soft algae taxa. The total number of BMI, diatom, and soft algae taxa identified at each bioassessment location is presented in Table 2.5. BMIs and diatoms were relatively well represented across all sites, with BMIs ranging from 14 to 43 taxa, and diatoms ranging from 10 to 46 taxa. Soft algae taxa were less common across sites, ranging from 0 to 11 taxa. Nine of the sites (45%) had three or less soft algae taxa.

Table 2.5. The total number of unique BMI, diatom and soft algae taxa identified in samples collected at 20 bioassessment sites in Santa Clara County during WY 2017.

Station Code	Creek	Elevation (m)	Land Use	BMI	Diatoms	Soft Algae
205R00570	Tributary to Aldercroft Cr	282	NU	35	27	1
205R00609	Hunting Hollow	266	NU	34	15	8
205R00645	Packwood Creek	202	NU	25	24	3
205R02693	Packwood Creek	192	U	21	17	4
205R02755	Berryessa Creek	177	U	24	18	1
205R02787	Matadero Creek	4	U	20	26	11
205R02915	Stevens Creek	119	U	25	22	7
205R02947	Lower Penitencia	4	U	14	30	8
205R03011	Berryessa Creek	49	U	14	18	1
205R03091	Arroyo Aguague	247	U	36	10	2
205R03098	Guadalupe Creek	60	U	28	36	4
205R03235	Stevens Creek	80	U	28	24	3
205R03306	Saratoga Creek	98	U	24	20	0
205R03331	Los Gatos Creek	41	U	18	30	6
205R03354	Guadalupe Creek	114	U	34	17	3
205R03386	Aldercroft Creek	246	U	43	13	0
205R03418	Alamitos Creek	70	U	28	27	7
205R03443	Calabazas Creek	7	U	16	11	10
205R03523	Upper Penitencia Cr	78	U	40	24	5
205R03530	Los Gatos Creek	82	U	16	46	4

NU = non-urban, U = urban

The total number of BMI taxa was moderately correlated with site elevation (r^2=0.41, p=0.002) (Figure 2.3). In contrast, total taxa for both diatom and soft algae generally decreased with increasing site elevation (r^2=0.15, p=0.088 and r^2=0.26, p=0.021, respectively). Total BMI taxa did not appear to be correlated with diatom or soft algae richness across the 20 bioassesment sites. Similarly, diatom richness did not appear to have any correlation with soft algae richness.

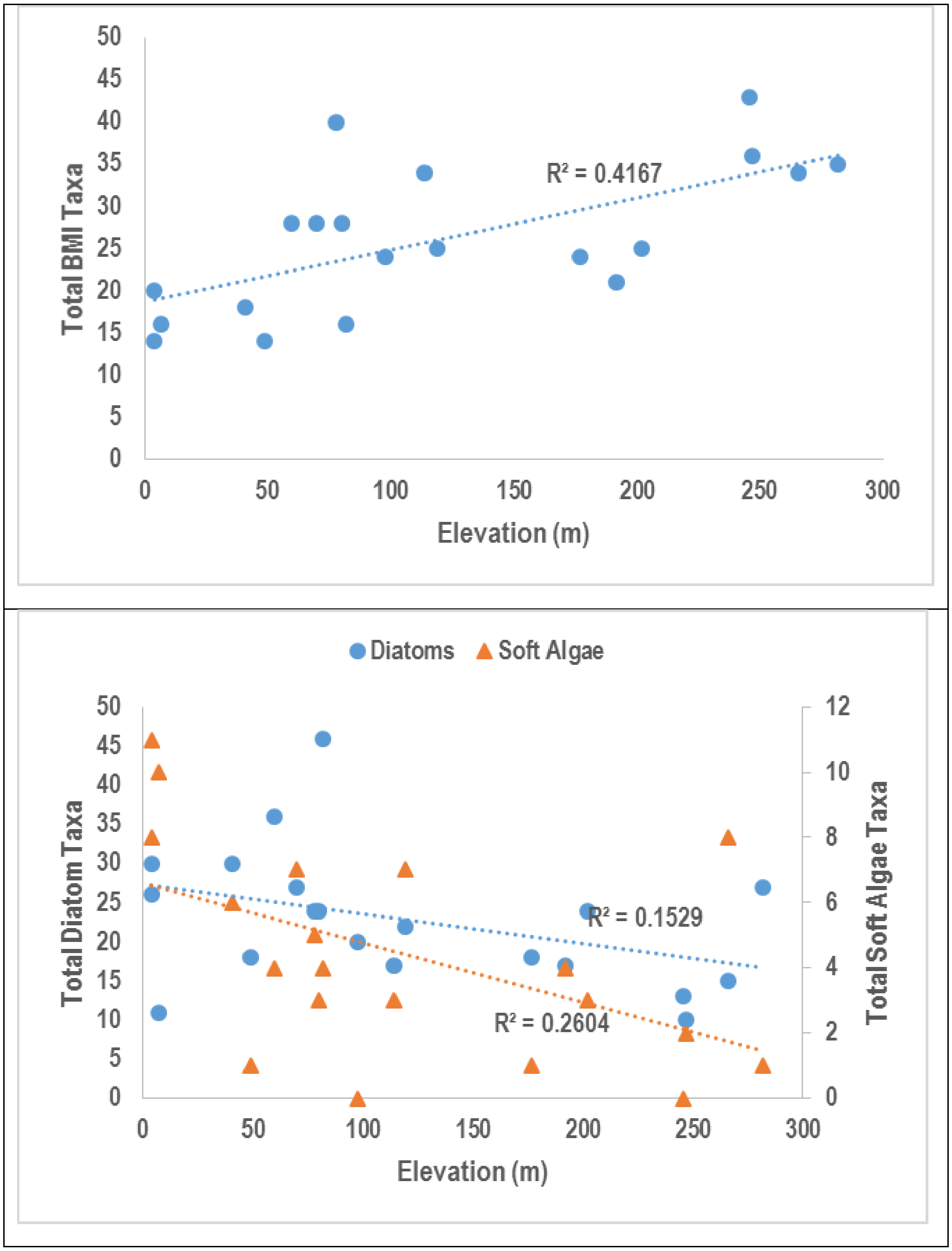

Figure 2.3. Total BMI (top), diatom and soft algae (bottom) taxa compared to elevation of the bioassessment site.

Biological conditions, as represented by CSCI scores and algae IBI scores (S2, D18 and H20), for the 20 probabilistic sites sampled by SCVURPPP during WY 2017 are presented in Table 2.6. Biological condition scores within the two higher condition categories for each indicator are show in bold. The condition categories for three of the biological indicator scores (CSCI, D18 and H20), as defined in Table 2.1, are illustrated in Figure 2.5 for the 20 sites.

Table 2.6. Biological condition scores, presented as CSCI and SoCal Algae IBIs (S2, D18 and H20) for 20 probabilistic sites sampled in WY 2017. PHAB scores are also presented for comparison. Site characteristics related to percent impervious watershed area, channel modification and flow condition are also presented. Bold values indicate "good" condition. Scores that could not be calculated are indicated as "NR".

Station Code	Creek	Land Use[1]	Impervious Area (%)	Modified Channel[2]	Flow[3]	CSCI Score	Soft Algae "S2" IBI Score	Diatom "D18" IBI Score	Hybrid "H20" IBI Score	Total PHAB Score
205R00570	Trib to Aldercroft Cr	NU	1%	N	P	0.95	67	66	66	31
205R00609	Hunting Hollow	NU	2%	N	NP	0.66	83	72	70	45
205R00645	Packwood Creek	NU	1%	N	P	0.75	2	38	24	49
205R02693	Packwood Creek	U	1%	N	P	0.62	7	36	28	33
205R02755	Berryessa Creek	U	1%	N	P	0.93	NR	50	NR	45
205R02787	Matadero Creek	U	30%	Y	P	0.49	0	20	12	16
205R02915	Stevens Creek	U	2%	N	P	0.58	0	20	12	51
205R02947	Lower Penitencia	U	69%	Y	P	0.27	0	10	6	9
205R03011	Berryessa Creek	U	4%	N	NP	0.8	NR	56	NR	29
205R03091	Arroyo Aguague	U	1%	N	P	1.01	NR	62	NR	50
205R03098	Guadalupe Creek	U	6%	N	P	0.7	0	60	38	42
205R03235	Stevens Creek	U	4%	N	P	0.86	0	40	25	24
205R03306	Saratoga Creek	U	8%	N	NP	0.87	NR	20	NR	38
205R03331	Los Gatos Creek	U	14%	N	P	0.59	8	32	22	45
205R03354	Guadalupe Creek	U	1%	N	P	1.03	50	78	61	47
205R03386	Aldercroft Creek	U	4%	N	P	1.0	NR	50	NR	43
205R03418	Alamitos Creek	U	7%	N	P	0.7	0	68	42	34
205R03443	Calabazas Creek	U	49%	Y	P	0.45	2	76	48	16
205R03523	Upper Penitencia Cr	U	3%	N	NP	0.91	0	28	19	41
205R03530	Los Gatos Creek	U	8%	N	P	0.56	0	54	34	42

[1] Land Use classification from RMC Sample Frame (NU = Non Urban, U = Urban)
[2] Highly modified channel is defined as having armored bed and banks (e.g., concrete, gabion, rip rap) for majority of the reach or characterized as highly channelized earthen levee.
[3] Flow status (P = perennial, NP = non-perennial) was based on visual observations at each site made during fall or spring seasons.

CSCI Scores

The CSCI scores ranged from 0.27 to 1.03 across the 20 bioassessment sites sampled in WY 2017 (Table 2.6). Nine of the 20 bioassessment sites (45%) had CSCI scores in the two higher condition categories - "possibly intact" and "likely intact" condition. The combined classifications are above the MRP trigger threshold value of 0.795. All but one of these sites were classified as urban; however, seven of these urban sites had relatively low impervious area (<4%) (Table 2.6).

Four sites (20%) had CSCI scores that ranked as "likely altered"; two of these sites were classified as non-urban land use. Seven sites (35%) were ranked as "very likely altered" (CSCI < 0.63), indicating highly degraded condition. The three sites with the lowest CSCI scores had a high proportion of impervious watershed area (> 30%) and were characterized as modified channels.

Sites with CSCI scores below 0.795 will be considered as candidates for SSID projects.

Algae IBI Scores

The benthic algae taxa identified in the twenty samples collected in Santa Clara County were used to calculate scores for three SoCal Algae IBIs (S2, D18 and H20) (Table 2.6). Three of the 124 total algal taxa identified in samples collected in WY 2017 were not on the SWAMP Master Taxa list, but were subsequently harmonized, and added to the SWAMP list.

- **D18.** Six of the twenty bioassessment sites had D18 scores (> 62) that were classified as “possibly intact” or “likely intact” condition. Three of these sites had low impervious area (<1%) and also received high CSCI scores (Table 2.6). In contrast, one of the sites with high D18 scores (205R03343) had high impervious area (49%), was categorized as having a modified channel, and received a low CSCI score (0.45). Five sites received D18 scores that ranked in the “likely altered” condition category (62-72). The remaining nine sites had D18 scores that ranked in “very likely altered” condition (<49). Six of the sites in these two categories had CSCI scores that were ranked in good condition, indicating that BMIs and diatoms had very different responses to stressors at these sites.

- **S2**. Soft algae were absent from samples collected at five bioassessment sites[15]. As a result, no S2 IBI scores could be calculated for these sites. Of the remaining 15 sites, three had scores that were classified as “possibly intact” or “likely intact” condition (> 47). The remaining 12 sites had very low S2 IBI scores, ranging from 0 to 8, ranking in the “very likely altered” condition.

  Two factors may explain the low S2 score at these sites: 1) overall low diversity or abundance of soft algal taxa present in the samples; and/or 2) low proportion of soft algal taxa that could be used to calculate a metric score. The SWAMP Algae Reporting Module requires each taxa to have trait assignments (i.e., fields to indicate if taxa is sensitive or tolerant to a particular stressor). The current version of the RM has not been updated since 2013. As a result, many taxa that have been added to SWAMP Master List in the past five years have not been assigned traits, and thus do not get incorporated into the metric calculations. It is anticipated that the ASCI tool, currently under development, will incorporate the full SWAMP Master List.

- **H2O**. The H20 IBI includes three soft algae and five diatom metrics. Therefore, for the reasons discussed above, the H20 IBI was not calculated at the same five sites that received no S2 IBI score (i.e., soft algae metric score(s) could not be calculated). Of the remaining 15 sites, two had scores that were classified as “possibly intact” or “likely intact” condition (> 63). The remaining thirteen sites had scores that ranged from 6 to 61. The higher scores are likely associated with diatom metrics, since many of the soft algae metrics were zero or very low.

Total PHAB Scores

Individual PHAB attribute scores and total PHAB scores assessed at the twenty bioassessment sites are presented in Table 2.7. The lowest scores for channel alteration and epifaunal substrate attributes (0-2) were given to sites at concrete channels (i.e., highly modified channel with no quality substrate). High sediment deposition scores were given to sites with little or no fine sediment present. Total PHAB scores were better correlated with CSCI scores (r^2=0.30, p = 0.012) compared to D18 scores (r^2=0.04, p= 0.373), suggesting that physical habitat (e.g., substrate quality, channel alteration) has a greater influence on the BMI community compared to the diatoms assemblage (Figure 2.4). These results are consistent with

[15] IBI metrics only use taxa that are identified in the composite quantitative samples. Thus, soft algae that are only found in the qualitative samples are not incorporated into the metric calculations.

bioassessment data collected in Southern California, which found high CSCI scores were rarely found in engineered channels, but high algae IBI scores (particularly D18) frequently occurred in highly modified channels (Rafael Mazor, SCCWRP, personal communication). These results suggest that algae indices have some ability to respond to water quality gradients in highly modified channels.

Table 2.7. Individual and Total PHAB scores for twenty probabilistic sites in Santa Clara County sampled in WY 2017. CSCI and D18 IBI scores are shown for comparison.

Station Code	Waterbody	CSCI Score	Diatom “D18” IBI Score	Channel Alteration	Epifaunal Substrate	Sediment Deposition	Total PHAB Score
205R00570	Trib to Aldercroft Cr	0.95	66	14	13	4	31
205R00609	Hunting Hollow	0.66	72	20	16	9	45
205R00645	Packwood Creek	0.75	38	20	16	13	49
205R02693	Packwood Creek	0.62	36	20	9	4	33
205R02755	Berryessa Creek	0.93	50	20	12	13	45
205R02787	Matadero Creek	0.49	20	0	2	14	16
205R02915	Stevens Creek	0.58	20	20	17	14	51
205R02947	Lower Penitencia Cr	0.27	10	4	3	2	9
205R03011	Berryessa Creek	0.8	56	11	8	10	29
205R03091	Arroyo Aguague	1.01	62	19	17	14	50
205R03098	Guadalupe Creek	0.7	60	16	15	11	42
205R03235	Stevens Creek	0.86	40	4	6	14	24
205R03306	Saratoga Creek	0.87	20	14	14	10	38
205R03331	Los Gatos Creek	0.59	32	14	15	16	45
205R03354	Guadalupe Creek	1.03	78	14	17	16	47
205R03386	Aldercroft Creek	1.0	50	19	14	10	43
205R03418	Alamitos Creek	0.7	68	11	14	9	34
205R03443	Calabazas Creek	0.45	76	0	2	14	16
205R03523	Upper Penitencia Cr	0.91	28	12	14	15	41
205R03530	Los Gatos Creek	0.56	54	16	15	11	42

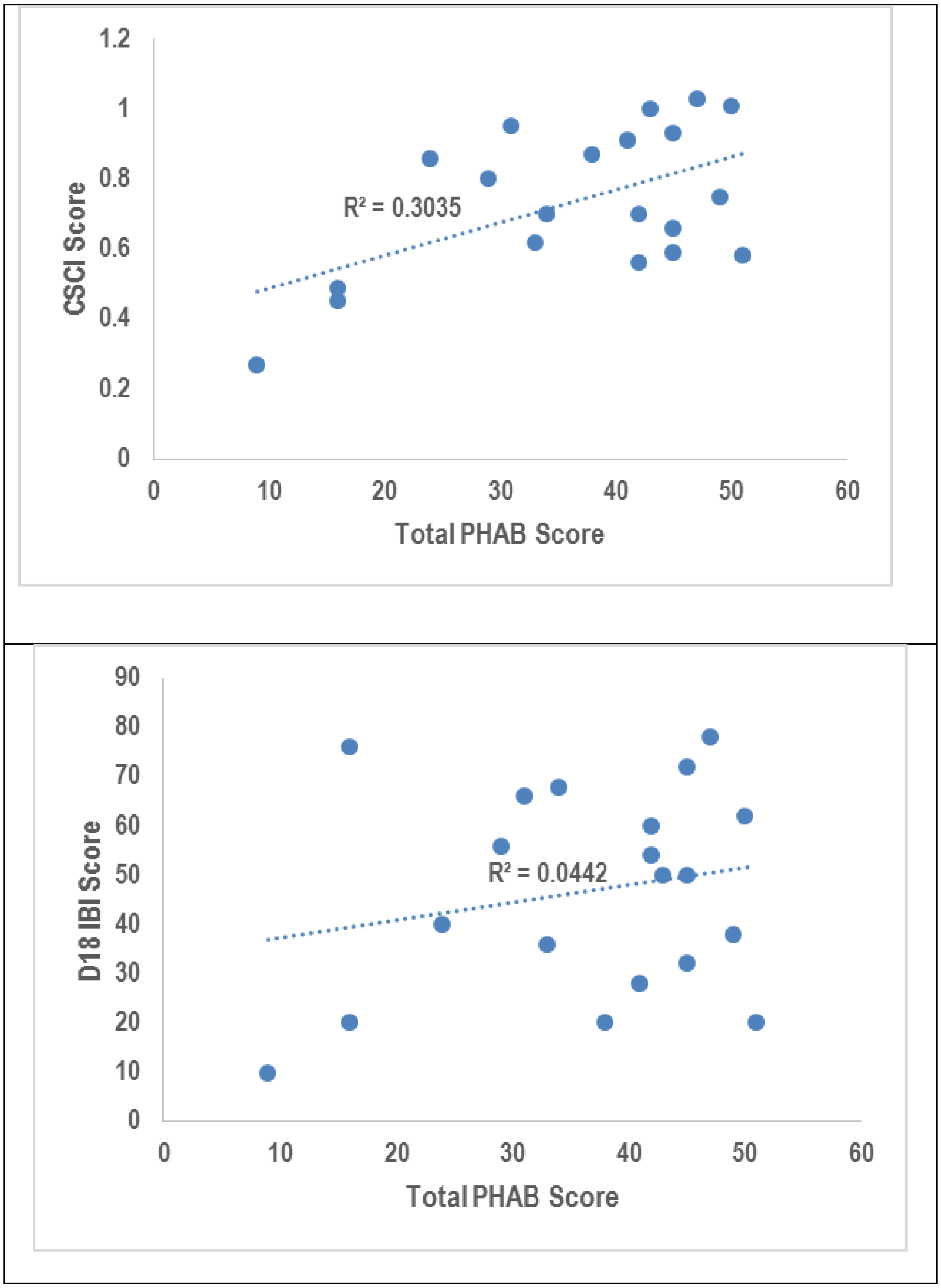

Figure 2.4. CSCI and D18 IBI Scores compared to Total PHAB Scores for 20 bioassessment sites sampled in Santa Clara County in WY 2017.

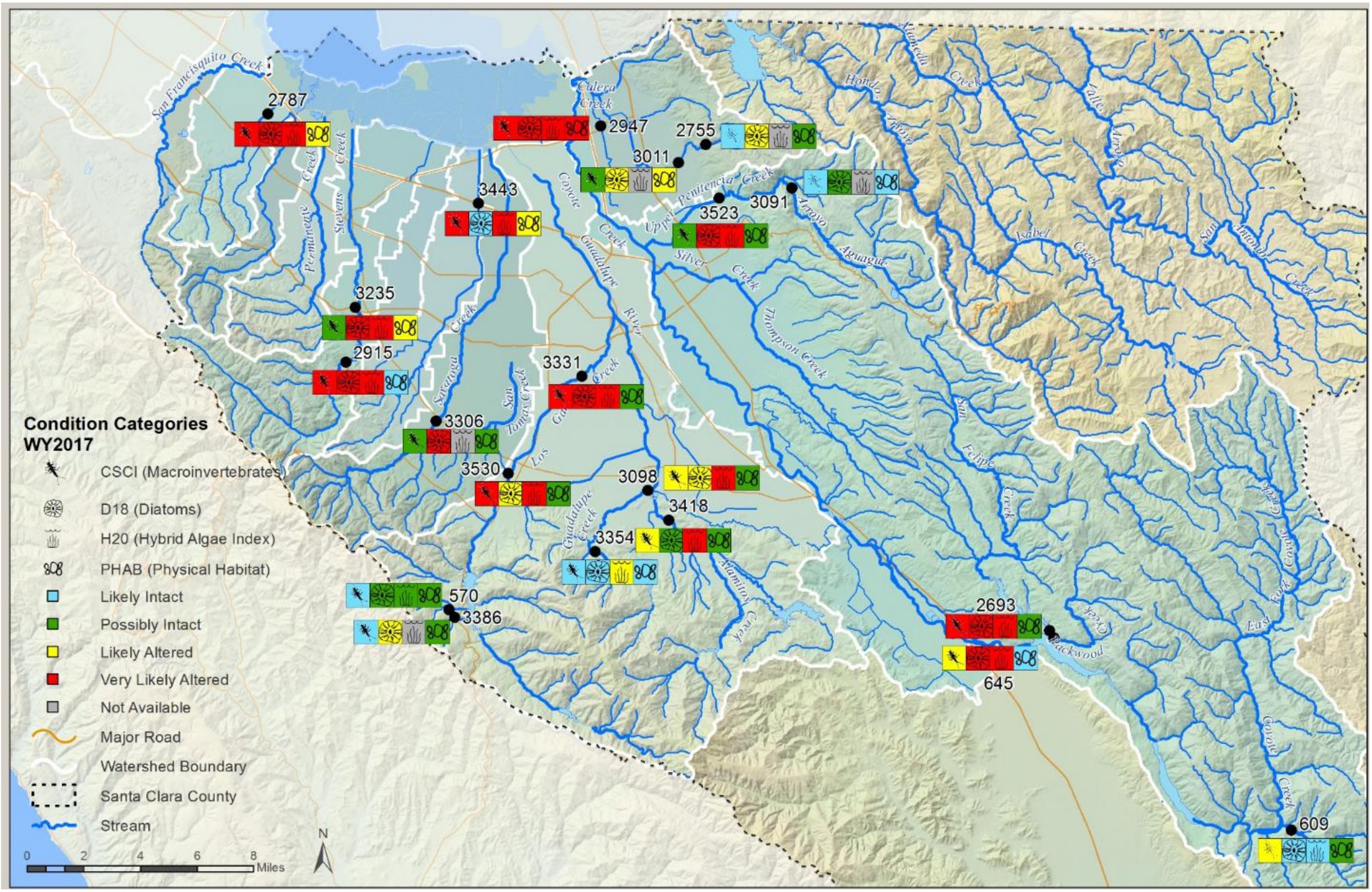

Figure 2.5. Condition category as represented by CSCI, D18, H20 and PHAB scores for 20 probabilistic sites sampled in Santa Clara County during WY 2017.

2.3.3 Stressor Assessment

The section below summarizes results for stressor data collected at 20 bioassessment sites during WY 2017. Association between stressor data and biological condition is presented for some of the stressors. However, due to small number of samples (n=20), associations with biological condition are not expected to be very strong. More robust analyses of stressor extent and their association with biological condition will be made in the BASMAA RMC 5-Year Report.

General Water Chemistry

General water quality measurements sampled at the twenty bioassessment sites in WY 2017 are listed in Table 2.8. Sites with general water quality results exceeding water quality objectives or MRP trigger thresholds are indicated in bold. Two measurements exceeded water quality objectives for pH: site 205R03011 (Berryessa Creek) and site 205R03443 (Calabazas Creek). The acute temperature threshold (24°C) for salmonid fish was also exceeded at site 205R03443 (Calabazas Creek). The site on Calabazas Creek is a concrete channel near the bottom of the watershed. The sampling event at Calabazas Creek site occurred during an extremely hot day and the channel bottom was mostly stagnant water covered in filamentous algae.

The dissolved oxygen sensor for the multiparameter sonde malfunctioned on May 11, 2017. The device was used for approximately one week to measure other parameters until a replacement unit was obtained on May 18, 2017. All DO measurements made and recorded at six sites between May 11-16 did not meet data quality objectives (e.g., unable to calibrate within acceptable range) and thus, were rejected. These data are indicated as “NA” in Table 2.8.

Table 2.8. General water quality measurements for twenty probabilistic sites in Santa Clara County sampled in WY 2017.

Station Code	Waterbody	Sample Date	Temp (C)	DO (mg/L)	pH	Specific Conduct (uS/cm)
205R00570	Trib to Aldercroft Cr	5/16/2017	10.6	NA	8.0	738
205R00609	Hunting Hollow	5/10/2017	15.1	9.1	8.0	618
205R00645	Packwood Creek	5/15/2017	11.7	NA	8.4	576
205R02693	Packwood Creek	5/15/2017	15.6	NA	8.5	579
205R02755	Berryessa Creek	5/8/2017	10.9	11.1	8.5	590
205R02787	Matadero Creek	6/1/2017	19.9	12.9	8.5	1218
205R02915	Stevens Creek	6/5/2017	15.3	9.7	8.0	504
205R02947	Lower Penitencia Cr	5/11/2017	23.3	NA	8.4	1386
205R03011	Berryessa Creek	5/8/2017	20.4	8.1	**8.7**	614
205R03091	Arroyo Aguague	5/18/2017	10.5	10.7	8.5	670
205R03098	Guadalupe Creek	6/6/2017	17.8	10.5	8.3	393
205R03235	Stevens Creek	6/5/2017	16.6	11.5	8.5	519
205R03306	Saratoga Creek	5/9/2019	12.6	11.5	8.3	458
205R03331	Los Gatos Creek	6/7/2017	21.0	9.9	8.4	332
205R03354	Guadalupe Creek	6/6/2017	13.7	10.1	8.2	346
205R03386	Aldercroft Creek	5/16/2017	11.4	NA	8.1	320
205R03418	Alamitos Creek	6/8/2017	16.5	10.2	8.3	461
205R03443	Calabazas Creek	6/1/2017	**30.4**	19.6	**9.0**	703
205R03523	Upper Penitencia Cr	5/11/2017	13.8	NA	8.5	788
205R03530	Los Gatos Creek	6/7/2017	18.5	9.4	8.2	331

Landscape Variables

Landscape variables associated with the drainage area for each bioassessment site sampled in WY 2017 are presented in Table 2.9. Landscape variables include percent urban area, percent impervious area, total number of road crossings, and road density (road length/watershed area). CSCI scores are presented for comparison. CSCI scores were moderately correlated with impervious area ($r^2 = 0.55$, $p < 0.001$) and road density ($r^2 = 0.54$, $p < 0.001$) (Figure 2.6).

Table 2.9. Landscape variables for watershed areas of the 20 bioassessment sites sampling in WY 2017.

Station Code	CSCI Score	Drainage Area (km2)	Percent Urban Watershed	Percent Impervious Watershed	Road Crossings Watershed	Road Density Watershed (km/km^2)
205R00570	0.95	2	0%	1%	3	3.3
205R00609	0.66	28	0%	2%	3	0.3
205R00645	0.75	27	0%	1%	1	0.4
205R02693	0.62	27	0%	1%	1	0.4
205R02755	0.93	10	3%	1%	0	0.7
205R02787	0.49	27	65%	30%	63	7.0
205R02915	0.58	47	2%	2%	25	1.2
205R02947	0.27	12	96%	69%	24	12.3
205R03011	0.8	13	8%	4%	4	1.5
205R03091	1.01	34	1%	1%	2	0.3
205R03098	0.7	38	11%	6%	19	2.7
205R03235	0.86	51	7%	4%	31	1.7
205R03306	0.87	27	17%	8%	29	2.7
205R03331	0.59	129	23%	14%	99	4.4
205R03354	1.03	24	0%	1%	6	1.3
205R03386	1.0	3	5%	4%	0	0.8
205R03418	0.7	89	14%	7%	121	2.6
205R03443	0.45	49	84%	49%	111	10.4
205R03523	0.91	57	6%	3%	12	0.8
205R03530	0.56	115	14%	8%	78	3.2

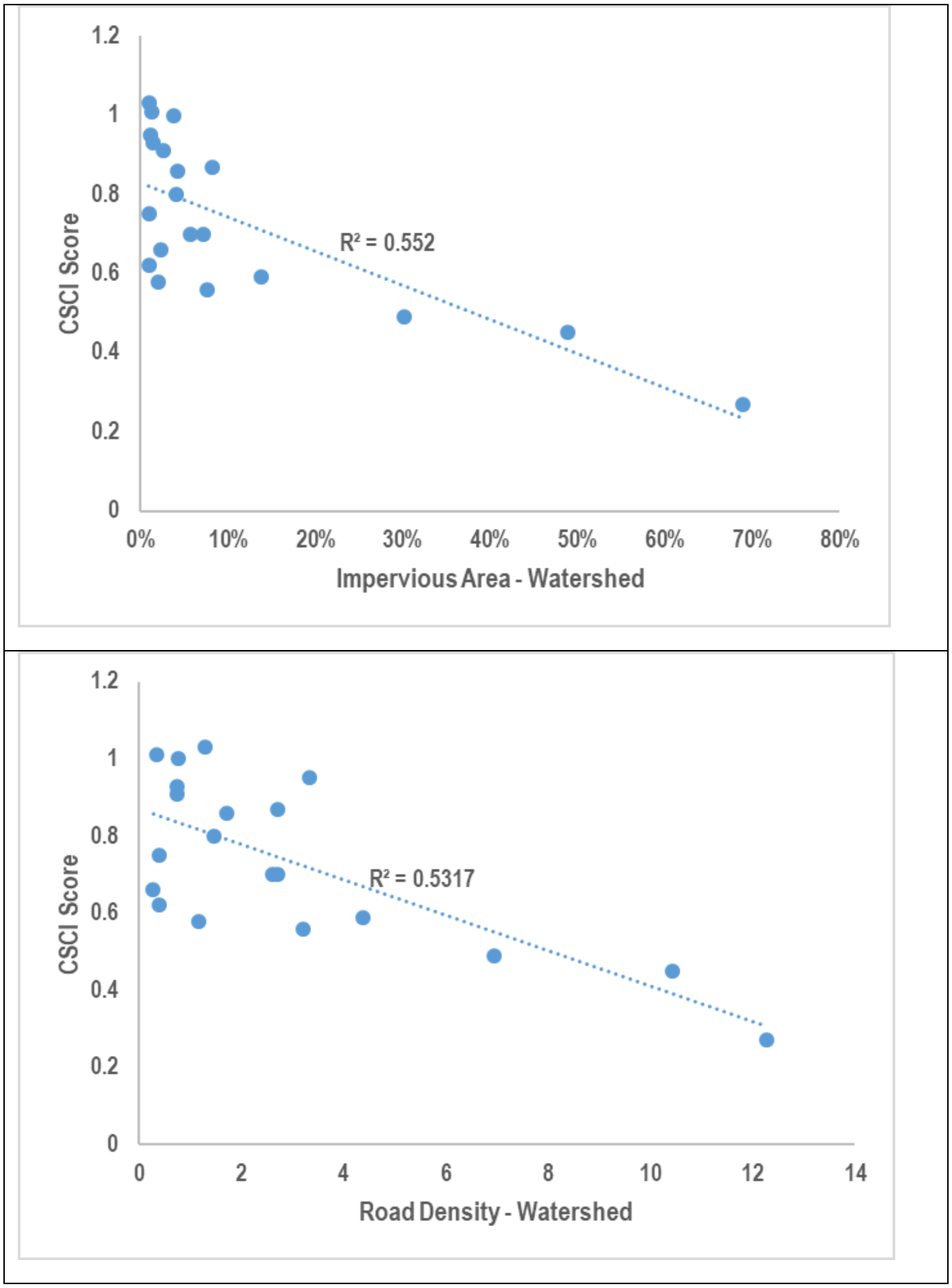

Figure 2.6. CSCI Scores compared to landscape variables (percent impervious and road density) for 20 bioassessment sites sampled in Santa Clara County in WY 2017.

Physical Habitat

Scores for ten physical habitat metrics that were generated from the physical habitat data collected at bioassessment sites in WY 2017 are listed in Table 2.10. CSCI scores were slightly correlated with metrics associated with substrate size and composition, including *Diversity of Natural Substrate Types* metric (r^2 = 0.38, p = 0.002) and *Substrate Smaller than Sand* metric (r^2 = 0.22, p = 0.037) (Figure 2.7). The remaining physical habitat metrics were poorly correlated with CSCI scores. D18 IBI scores were poorly correlated with all physical habitat metrics.

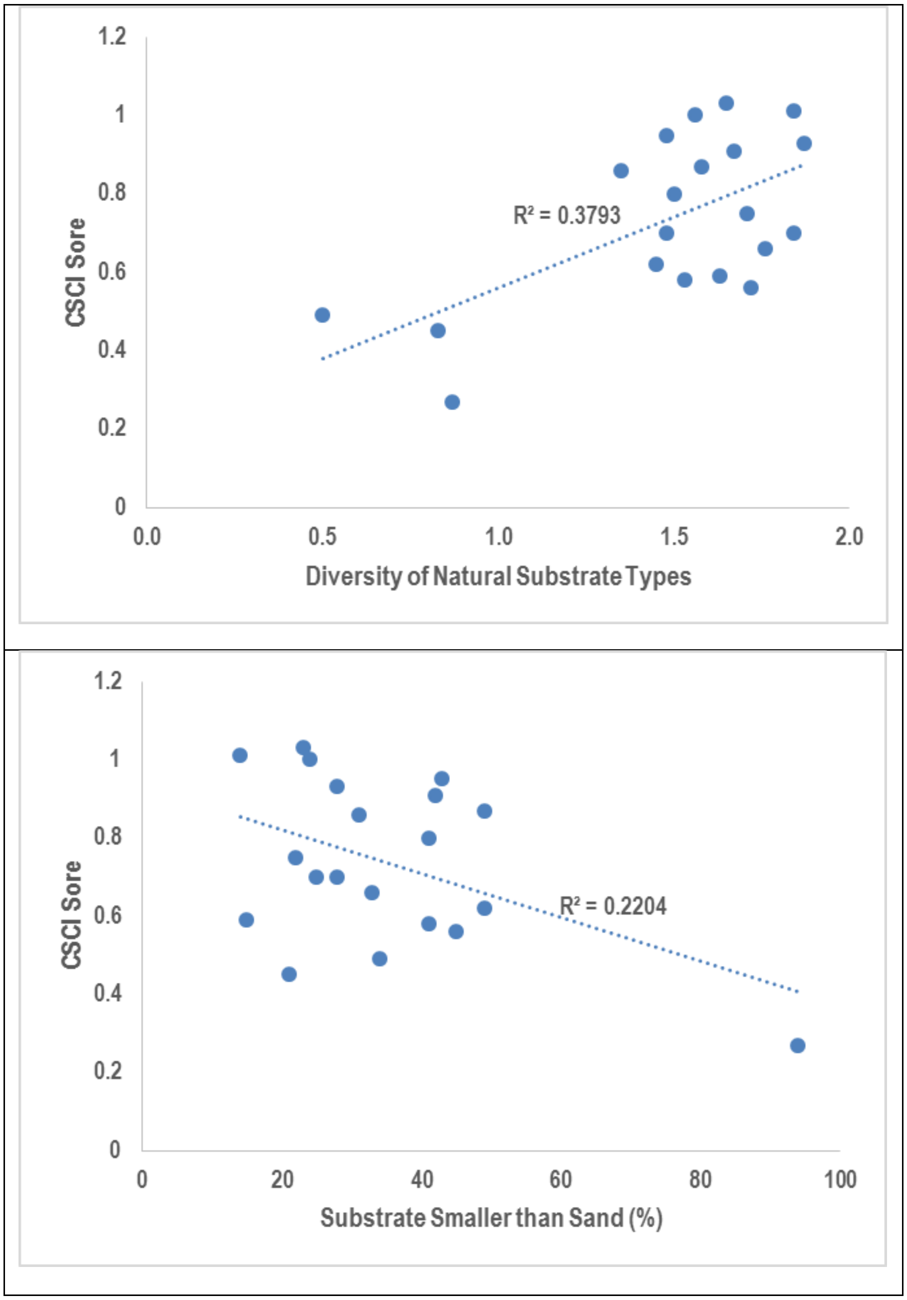

Figure 2.7. CSCI Scores compared to physical habitat metrics associated with substrate size and composition (i.e., diversity of natural substrate types and substrate smaller than sand) for 20 bioassessment sites sampled in Santa Clara County in WY 2017.

Water Chemistry (nutrients)

Nutrient and conventional analyte concentrations measured in water samples collected at twenty bioassessment sites in Santa Clara County during WY 2017 are listed in Table 2.11. There were no water quality objective exceedances for water chemistry parameters, except for unionized ammonia (.025 mg/L) at site 205R03011 (Berryessa Creek), and site 205R03011 (Calabazas Creek). Both sites are at the bottom of highly urbanized watersheds.

Total Nitrogen concentrations ranged from 0.19 to 3.12 mg/L. The two highest concentrations measured for all samples (>3 mg/L) occurred at site 205R03443 in Calabazas Creek and site 205R02787 on Matadero Creek. Both sites are located in concrete channels near the bottom of each watershed. Total phosphorus concentrations ranged from 0.2 to 0.39 mg/L. The two highest concentrations of total phosphorus (> 0.3 mg/l) occurred at the two sites in Berryessa Creek. The upper site in Berryessa Creek is in open space land, indicating a potential natural source of phosphorus in this watershed.

In an effort to assess whether total nitrogen concentrations (measured during bioassessments) are affecting indicators of biomass (i.e., chlorophyll a, ash free dry mass, percent algae cover), simple regression models were run. There was no correlation between total nitrogen concentration and chlorophyll a, ash free dry mass, or algae cover for 20 sites sampled in WY 2017. However, chlorophyll a and algae cover were moderately correlated ($r^2 = 0.57$, $p < 0.001$) indicating that estimating algae cover during pebble counts may provide a reasonable estimate for algae biomass at bioassessment sites.

Table 2.10. Scores for 10 PHAB metrics calculated from physical habitat data collected at twenty probabilistic sites in Santa Clara County during WY 2017.

Station Code	Channel Morphology		Habitat Complexity and Cover			Substrate Size and Composition				Human Disturbance
	Evenness of Flow Habitat Types	% Fast Water of Reach	Shannon Diversity of Aquatic Habitat Types	Natural Shelter Cover	Mean Filamentous Algae Cover	Evenness of Natural Substrate Types	Shannon Diversity of Natural Substrate Types	% Gravel - Coarse	% Substrate Smaller than Sand (<2 mm)	Riparian Human Disturbance Index
205R00570	0.7	64	1.9	39	0.0	0.8	1.5	30	43	2.7
205R00609	0.5	11	1.2	51	3.2	0.9	1.8	21	33	0.8
205R00645	1.0	52	1.4	39	26.8	0.9	1.7	29	22	0.1
205R02693	0.8	75	1.3	12	10.7	0.8	1.5	24	49	1.3
205R02755	1.0	39	1.4	32	0.9	1.0	1.9	17	28	0.5
205R02787	1.0	52	0.2	2	30.9	0.7	0.5	0	34	5.2
205R02915	0.8	37	2.0	33	3.6	1.0	1.5	21	41	0.9
205R02947	0.0	0	0.8	22	20.7	0.8	0.9	0	94	3.5
205R03011	1.0	51	1.7	22	0.0	0.8	1.5	36	41	3.0
205R03091	0.6	40	0.8	50	1.4	1.0	1.8	21	14	0.1
205R03098	1.0	27	1.5	43	46.4	0.8	1.5	40	25	1.9
205R03235	0.9	69	1.5	29	15.9	0.8	1.4	30	31	3.0
205R03306	1.0	52	1.7	13	5.9	0.9	1.6	22	49	3.1
205R03331	0.7	65	1.4	31	29.1	0.9	1.6	31	15	3.3
205R03354	0.6	20	1.7	22	16.1	0.9	1.7	36	23	2.8
205R03386	0.9	62	1.7	21	0.0	0.9	1.6	36	24	1.4
205R03418	0.8	40	1.0	18	51.1	0.9	1.8	30	28	3.8
205R03443	1.0	52	0.2	2	62.3	0.8	0.8	4	21	6.0
205R03523	1.0	28	1.9	34	9.5	0.9	1.7	22	42	2.5
205R03530	1.0	43	1.8	34	17.0	0.8	1.7	26	45	2.5

Table 2.11. Nutrient and conventional constituent concentrations in water samples collected at 20 sites in Santa Clara County during WY 2016. Analyte concentrations that exceed water quality objectives are indicated in bold.

Station Code	Creek	Ammonia as N	Unionized Ammonia (as N)	Chloride	AFDM	Chlorophyll a	Nitrate as N	Nitrite as N	Total Kjeldahl as N	Total Nitrogen	Ortho-Phosphate as P	Phosphorus as P	Total Phosphorus	Silica as SiO2
		mg/L	mg/L	mg/L	g/m2	mg/m2	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Water Quality Objective:		NA	0.025 [b]	250 [a]	NA	NA	10 [a]	NA	NA	NA	NA	NA	NA	NA
205R00570	Trib to Aldercroft Cr	0.054	0.001	14	277.84	8.68	0.063	0.003 J	0.13	0.20	0.12	0.14	0.26	27
205R00609	Hunting Hollow	0.058	0.001	28	21.48	12.00	<0.02	<0.001	0.97	0.98	0.01	0.015	0.025	17
205R00645	Packwood Creek	< 0.015	< 0.0004	19	172.74	21.05	1.8	0.002 J	0.44	2.24	0.015	0.019	0.034	17
205R02693	Packwood Creek	< 0.015	< 0.0005	19	61.82	11.52	1.7	0.003 J	0.31	2.01	0.015	0.024	0.039	17
205R02755	Berryessa Creek	0.22	0.012	25	289.58	16.30	0.71	0.007	0.62	1.34	0.18	0.21	0.39	31
205R02787	Matadero Creek	0.082	0.007	110	253.40	139.86	2.1	0.025	0.92	3.05	0.064	0.07	0.134	31
205R02915	Stevens Creek	0.081	0.002	22	46.98	79.00	0.032 J	<0.001	0.57	0.60	0.024	0.066	0.09	18
205R02947	Lower Penitencia	0.047	0.004	120	218.41	52.06	0.22	0.013	0.66	0.89	0.013	0.012	0.025	16
205R03011	Berryessa Creek	0.27	0.043	27	260.46	5.41	0.43	0.005	0.62	1.06	0.13	0.18	0.31	30
205R03091	Arroyo Aguague	0.017 J	0.001	22	1.51	5.11	< 0.02	0.001 J	0.31	0.32	0.033	0.033	0.066	16
205R03098	Guadalupe Creek	0.073	0.004	17	370.98	54.26	0.092	0.002 J	0.53	0.62	0.011	0.025	0.036	16
205R03235	Stevens Creek	0.061	0.004	24	42.42	117.42	0.078	0.01	0.44	0.53	0.022	0.052	0.074	17
205R03306	Saratoga Creek	0.049	0.002	21	90.32	17.35	0.18	0.001 J	0.48	0.66	0.047	0.065	0.112	24
205R03331	Los Gatos Creek	0.12	0.011	11	40.55	163.14	< 0.02	0.003 J	0.18	0.19	0.016	0.029	0.045	14
205R03354	Guadalupe Creek	0.056	0.002	7.3	30.40	18.71	0.036 J	0.003 J	0.88	0.92	0.007 J	0.015	0.022	16
205R03386	Aldercroft Creek	0.068	0.001	16	49.01	4.36	0.099	0.003 J	0.22	0.32	0.11	0.14	0.25	26
205R03418	Alamitos Creek	0.11	0.005	19	73.81	219.19	0.088	0.002 J	0.57	0.66	0.022	0.033	0.055	20
205R03443	Calabazas Creek	0.11	0.046	83	136.41	196.21	1.4	0.035	1.7	3.14	<0.006	0.014	0.02	20
205R03523	Upper Penitencia Cr	0.038	0.002	41	44.14	41.52	0.19	0.007	0.66	0.86	0.036	0.043	0.079	17
205R03530	Los Gatos Creek	0.14	0.007	9.4	208.61	152.48	0.03 J	0.006	0.18	0.22	0.012	0.027	0.039	17

NA = Not Applicable
J = The reported result is an estimate.
[a] Nitrate and chloride WQOs only apply to waters with MUN designated Beneficial Use
[b] This threshold is an annual median value and is not typically applied to individual samples.

2.4 Conclusions and Recommendations

Bioassessment monitoring in WY 2017 was conducted in compliance with provision C.8.d.i of the MRP. Twenty sites were sampled for BMIs, benthic algae, physical habitat, and nutrients using methods consistent with the BASMAA RMC QAPP (BASMAA 2016a) and SOPs (BASMAA 2016b). Stations were randomly selected using a probabilistic monitoring design. Seventeen of the sites were classified as urban and three were classified as non-urban.

The following conclusions and recommendations are made based on the WY 2017 data. An assessment of biological condition is provided and potential stressors are compared to applicable WQOs and triggers identified in the MRP. Sites with monitoring results that exceed WQOs and triggers are considered as candidates for further investigation as SSID projects, consistent with provision C.8.e of the MRP.

A more comprehensive analysis of a five-year dataset (i.e., WY 2012–WY 2016) is currently being conducted by a BASMAA regional project which is assessing stream conditions and potential stressors on a regional and countywide basis. Tools and approaches developed by the regional project may be applied to the growing Santa Clara Valley probabilistic dataset in future annual monitoring reports.

Biological Condition Assessment

Stream condition was assessed using three different types of indices/tools: the BMI-based CSCI, the benthic algae-based IBIs developed for Southern California (D18, H2O, and S2).

- **CSCI**. The California Stream Condition Index translates benthic macroinvertebrate data into an overall measure of stream health. Of the 20 sites monitored in WY 2017, nine sites (45%) were rated in good condition (CSCI scores ≥ 0.795); four sites (20%) rated as likely altered condition (CSCI score 0.635 – 0.795), and seven sites (35%) rated as very likely altered condition (≤ 0.635). Each of the three sites with the lowest CSCI scores had a high proportion of impervious watershed area (> 30%) and were characterized as modified channels.
    - The eleven sites with CSCI scores below 0.795 will be considered as candidates for SSID projects.
- **Algae IBIs (D18, H2O, S2)**. Algae IBIs translate benthic algae data (diatoms and soft algae) into overall measures of stream health. Three algae IBIs (developed for streams in Southern California) were calculated: D18 (diatoms), S2 (soft algae), and H2O (combination of diatoms and soft algae). Statewide Algae Stream Condition Indices are currently being developed and anticipated to be available in 2018.
    - Based on D18 scores, six sites (30%) were ranked in good condition (D18 score ≥ 62), five sites (25%) were ranked in likely altered condition (62-72), and nine sites (45%) were ranked in very likely altered condition (< 49).
    - Soft algae were absent from samples collected at five sites. As a result, no S2 or H20 scores could be calculated for these sites. Based on S2 scores, three of the remaining 15 sites (20%) were ranked as possibly intact or likely intact (S2 score > 47) and twelve sites (80%) were ranked in very likely altered condition. Based on H20 scores, two of the remaining 15 sites (13%) were ranked as possibly intact or likely intact (H20 score > 63) and 13 sites (87%) were ranked in very likely altered condition (< 54).
- Physical Habitat Assessment (PHAB) scores, a qualitative tool that assesses the overall habitat condition of the sampling reach during the assessment, were compared to biological condition indictor scores. PHAB consists of three attributes that are assessed for the entire bioassessment reach. These include channel alteration, epifaunal substrate and sediment deposition.
    - Total PHAB scores were better correlated with CSCI scores than they were with D18 scores, suggesting that physical habitat (e.g., substrate quality, channel alteration) has a greater influence on the BMI community compared to the diatoms assemblage. In contrast, algae indices appear to have some ability to respond to water quality gradients

in highly modified channels. This was apparent at site 205R03443 on Calabazas Creek, which had poor habitat quality (i.e., concrete channel) but received one of the highest D18 scores.

Stressor Assessment

Relationships between potential stressors (physical habitat and water chemistry) and biological condition were explored using the WY 2017 dataset. Sites with stressor levels exceeding applicable WQOs and triggers identified in the MRP will be considered as candidates for SSID projects.

- **General water quality** (pH, temperature, dissolved oxygen, specific conductance). Two measurements exceeded water quality objectives for pH: site 205R03011 (Berryessa Creek) and site 205R03443 (Calabazas Creek). The acute temperature threshold trigger (24°C) for salmonid fish was also exceeded at site 205R03443 (Calabazas Creek). These sites will be considered as candidates for SSID projects.
- **Nutrients and conventional analytes** (ammonia, unionized ammonia, chloride, AFDM, chlorophyll a, nitrate, nitrite, TKN, ortho-phosphate, phosphorus, silica). There were no water quality objective exceedances for water chemistry parameters, except for unionized ammonia (0.025 mg/L) at site 205R03011 (Berryessa Creek), and site 205R03011 (Calabazas Creek). Both sites are at the bottom of highly urbanized watersheds and will be considered as candidates for SSID projects.
- **Physical habitat metric scores** were generated from the physical habitat data. CSCI scores were slightly correlated with metrics associated with substrate size and composition. D18 scores were poorly correlated with all ten physical habitat metrics.
- **Landscape variables** were calculated for each of the watershed areas draining into the bioassessment sites. CSCI scores were moderately correlated (negatively) with impervious area and road density.

Recommendations

- The BASMAA RMC is currently conducting a regional project to assess stream conditions and potential stressors on a regional and countywide basis using a five-year dataset (WY 2012 – WY 2016). SCVURPPP should consider applying tools and approaches developed by the regional project to the growing Santa Clara Valley probabilistic dataset in future annual monitoring reports.
- Trend analysis for the RMC probabilistic survey will require more than five years of data collection. Preliminary long-term trend analysis of biological condition may be possible for some stream reaches using a combination of historical targeted data with the probabilistic data.
- Targeted re-sampling at probabilistic sites can provide additional data to evaluate longer term trends at selected locations. Recommendations for addressing trends will be forthcoming in the RMC Five-Year Bioassessment Report.

3.0 TARGETED MONITORING

3.1 Introduction

During WY 2017 water temperature, general water quality, and pathogen indicators were monitored in compliance with Creek Status Monitoring Provisions C.8.d.iii – v of the MRP. Monitoring was conducted at selected sites using a targeted design based on the directed principle[16] to address the following management questions:

1. *What is the spatial and temporal variability in water quality conditions during the spring and summer season?*
2. *Do general water quality measurements indicate potential impacts to aquatic life?*
3. *What are the pathogen indicator concentrations at creek sites where there is potential for water contact recreation to occur?*

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

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

3.2 Study Area

In compliance with MRP, temperature was monitored at a minimum of eight sites, general water quality was monitored at three sites, and pathogen indicator samples were collected at five sites. 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.

3.2.1 Temperature

Continuous (hourly) water temperature measurements were collected from April through September 2017, at nine locations[17] in three creeks of the Guadalupe River watershed: Alamitos Creek, Arroyo Calero and Guadalupe Creek (Figure 3.1). All three creeks are impounded by large dams located at the base of the Santa Cruz Mountains. The temperature monitoring locations were approximately 3-5 miles downstream of the reservoirs in reaches flowing through the Santa Clara Valley. The upper watershed areas for these creeks include rangeland and forested land uses within Almaden Quicksilver County Park and the Sierra Azul Open Space Preserve. The lower watershed areas are primarily residential land uses within the City of San Jose.

Guadalupe Creek and Alamitos Creeks support spawning and rearing habitat for steelhead, although fish are less abundant in the unshaded, warm section of Guadalupe Creek downstream of Camden Avenue. Arroyo Calero is generally too silty and does not provide good habitat for steelhead (Smith 2013).

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

[17] SCVURPPP typically monitors water temperature at more stations than the MRP required minimum to mitigate for potential equipment loss.

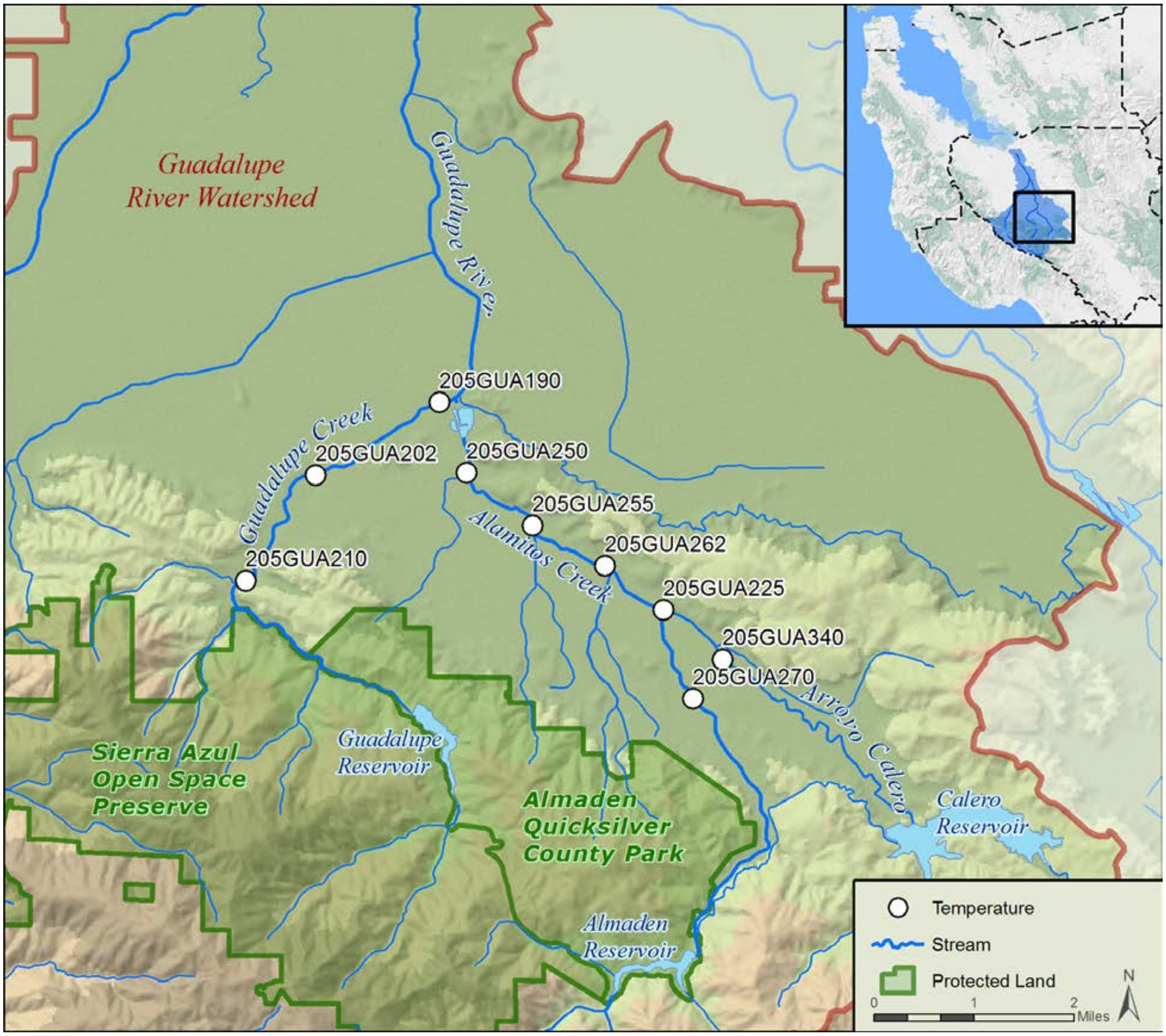

Figure 3.1. Continuous temperature stations in the Guadalupe River watershed, WY 2017.

3.2.2 General Water Quality

Continuous (15-minute) general water quality measurements (dissolved oxygen, specific conductance, pH, and temperature) were recorded at three locations on the mainstem of Coyote Creek during two two-week sampling events in WY 2017 (Figure 3.2). The first event was in June and the second event was in September.

The monitoring stations were previously sampled for continuous water quality in WY 2013 as part of the Coyote Creek Dissolved Oxygen Stressor Source Identification (Coyote Creek SSID) Project (SCVURPPP 2014). The Coyote Creek SSID Project evaluated a range of potential stressors and sources that may cause low dissolved oxygen in the section of Coyote Creek between Watson Park and Williams Park. The Coyote Creek SSID Project measured continuous water quality at six locations between June and September 2013. Three of the six locations were selected for Creek Status Monitoring in WY 2017. These stations include site 205COY235 (Watson Park), site 205COY236 (Julian Street) and site 205COY239 (Williams). These sites were selected to evaluate potential changes in water quality conditions following high flow conditions in Coyote Creek during the wet season of WY 2017.

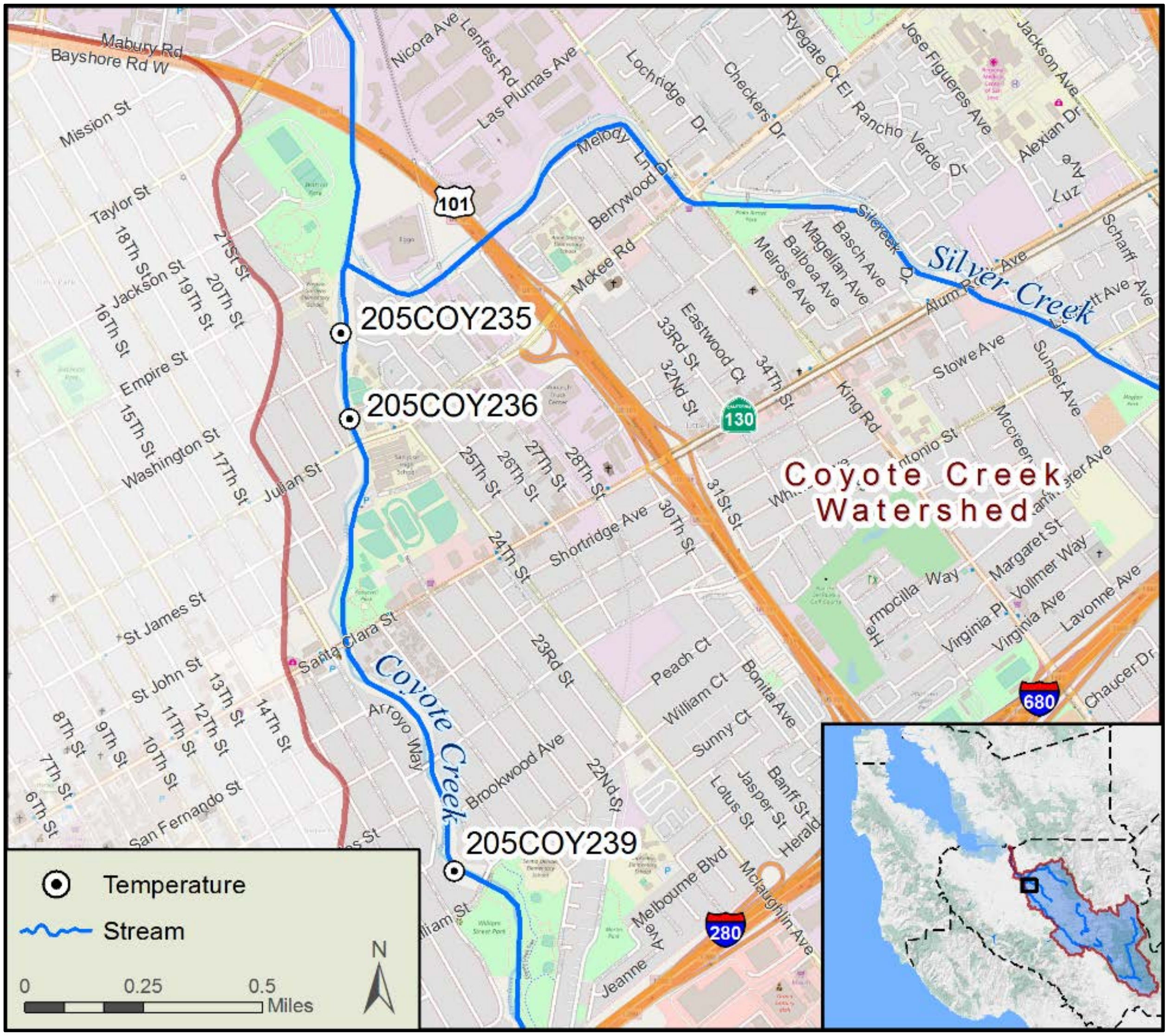

Figure 3.2. Continuous water quality stations in Coyote Creek during WY 2017.

3.2.3 Pathogen Indicators

Pathogen indicator samples were collected at five sites located in municipal parks in areas with good public access to creeks and potential for recreational water contact (Figure 3.3). One site was located on Arroyo Calero at Singer Park (205GUA225), one was located on Los Gatos Creek at Vasona Park (205LGA400), one was located on Saratoga Creek at Wildwood Park (205SAR075), one was located on Stevens Creek at Blackberry Farm (205(STE064), and the final site was located on Matadero Creek at Cornelis Bol Park (205MAT030).

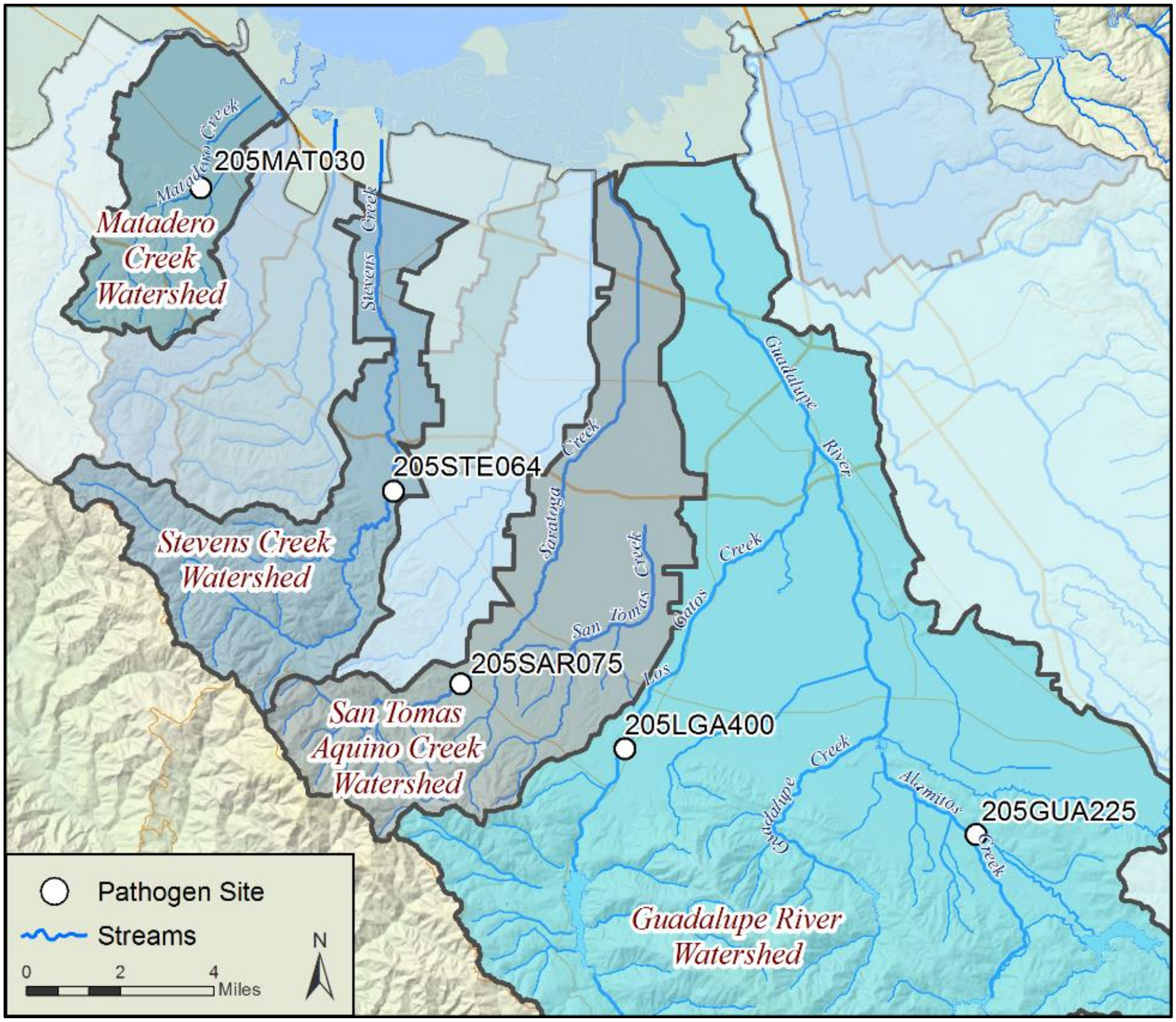

Figure 3.3. Pathogen indicator monitoring sites sampled in Santa Clara County during WY 2017.

3.3 Methods

Water quality data were collected in accordance with SWAMP-comparable methods and procedures described in the BASMAA RMC SOPs (BASMAA 2016b) and associated QAPP (BASMAA 2016a). Data were evaluated with respect to the MRP provision C.8.d “Followup” triggers for each parameter.

3.3.1 Continuous Temperature

Digital temperature loggers (Onset HOBO Water Temp Pro V2) were programmed to record data at 60-minute intervals and were deployed at targeted sites from April through September 2017. Procedures used for calibrating, deploying, programming and downloading data are described in RMC SOP FS-5 (BASMAA 2016b).

3.3.2 Continuous General Water Quality Measurements

Water quality monitoring equipment recording dissolved oxygen, temperature, conductivity, and pH at 15-minute intervals (YSI 6600 data sondes) was deployed at targeted sites for two 2-week periods: once during spring season (June) and once during summer season (September) in 2017. Procedures for calibrating, deploying, programming and downloading data are described in RMC SOP FS-4 (BASMAA 2016b).

3.3.3 Pathogen Indicators Sampling

Water samples were collected during the dry season. Sampling techniques for pathogen indicators (enterococcus and *E. coli*) include direct filling of sterile containers at targeted sites and transfer of samples to the analytical laboratory within specified holding time requirements. Procedures for sampling and transporting samples are described in RMC SOP FS-2 (BASMAA 2016b).

3.3.4 Data Evaluation

Continuous temperature, water quality, and pathogen indicator data generated during WY 2017 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions, including exceedances of water quality objectives. Provision C.8.d of the MRP identifies trigger criteria as the principal means of evaluating the creek status monitoring data to identify sites where water quality impacts may have occurred. Sites with targeted monitoring results exceeding the trigger criteria are identified as candidate SSID projects. The relevant trigger criteria for continuous temperature, continuous water quality, and pathogen indicator data are listed in Table 3.1.

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

Monitoring Parameter	Objective/Trigger Threshold	Units	Source
Temperature	Two or more weekly average temperatures exceed the MWAT of 17.0°C for a Steelhead stream, or when 20% of the results at one sampling station exceed the instantaneous maximum of 24°C.	^oC	MRP provision C.8.d.iii.
General Water Quality Parameters	20% of results at each monitoring site exceed one or more established standard or threshold - applies individually to each parameter		
Conductivity	2000	µS/cm	MRP provision C.8.d.iii.
Dissolved Oxygen	WARM < 5.0, COLD < 7.0	mg/L	SF Bay Basin Plan Ch. 3, p. 3-4
pH	> 6.5, < 8.5 [1]	pH	SF Bay Basin Plan Ch. 3, p. 3-4
Temperature	Same as Temperature (See Above)		
Pathogen Indicators			
Enteroccocus	≥ 130	cfu/ 100ml	EPA's statistical threshold value for estimated illness rate of 36 per 1000 primary contact recreators
E. coli	≥ 410	cfu/ 100ml	EPA's statistical threshold value for estimated illness rate of 36 per 1000 primary contact recreators

[1]. Special consideration will be used at sites where imported water is naturally causing higher pH in receiving waters.

3.4 Results and Discussion

3.4.1 Continuous Temperature

Hourly temperature data were collected at nine sites in the Guadalupe River watershed from April 3 through September 26, 2017 (26 weeks). All stations had continuous flow during the sampling season and all HOBO devices were successfully recovered at the end of the season. Summary statistics for continuous water temperature data collected at the nine sites are listed in Table 3.2. Table 3.2 includes the number of weeks in the record that exceed the Maximum Weekly Average Temperature (MWAT) trigger of 17°C. Consistent with MRP requirements, the MWAT was calculated for non-overlapping, seven-day periods. Table 3.2 also lists the number and percent of records from each site that exceed the instantaneous maximum temperature trigger of 24°C.

Time series plots of the instantaneous data are shown in Figures 3.4 and 3.5. The instantaneous maximum temperature trigger is shown for reference. Temperatures generally followed the same pattern at all nine sites, with a gradual increase throughout the summer months of June through August followed by a slow decline by mid/late September. For each creek, sites at lower elevations generally had higher temperatures. The higher elevation sites are likely colder due to releases from upstream reservoirs that release cool water from low in the water column. Temperatures at several of the sites exceeded the instantaneous maximum of 24°C on several occasions. These exceedances typically occurred on days with high air temperatures (>90° F). The exceedances did not exceed 1% of the dataset at any station and therefore the MRP trigger (20%) was not exceeded.

Time series plots of the MWAT values are shown in Figure 3.6 (Guadalupe Creek) and Figure 3.7 (Alamitos Creek and Arroyo Calero). The MWAT trigger of 17°C is shown for reference. The MWAT data used to populate these figures is listed in Table 3.3. MWAT values ranged from 11.9 °C to 14.5 °C in beginning of April to 17.2 °C to 19.8 °C in late September. The MWAT trigger was exceeded on two or more consecutive weeks at all stations. Therefore, they will be added to the list of candidate SSID sites. Air temperatures during summer months of 2017 were some of the hottest on record (see discussion on climate in Section 1.4.3). It is likely that these conditions increased water temperatures in Guadalupe Creek, Alamitos Creek, and Arroyo Calero during Event 2.

Table 3.2. Descriptive statistics for continuous water temperature measured in Guadalupe River watershed at nine sites during WY 2017.

		Guadalupe Creek			Alamitos Creek/Arroyo Calero					
Site		205GUA190	205GUA202	205GUA210	205GUA250	205GUA255	205GUA262	205GUA225	205GUA270	205GUA340
Start Date		4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017	4/3/2017
End Date		9/26/2017	9/26/2017	9/26/2017	9/26/2017	9/26/2017	9/26/2017	9/26/2017	9/26/2017	9/26/2017
Temperature (ºC)	Minimum	10.6	10.2	10.2	12.0	11.6	12.4	11.6	11.5	11.6
	Median	18.8	17.7	17.0	19.2	19.1	18.5	18.9	18.9	19.2
	Mean	18.0	17.2	16.7	18.8	18.6	18.4	18.3	18.3	18.5
	Maximum	26.2	23.8	24.1	24.8	24.6	23.7	23.4	24.3	23.2
	Max 7-day mean	21.1	21.3	21.1	21.2	21.4	21.2	21.1	21.9	21.4
	N	4220	4220	4220	4220	4220	4220	4220	4220	4220
MWAT > 17°C		17	15	15	20	19	19	18	18	18
# Measurements > 24°C		36	0	2	18	6	0	0	13	0
		1%	0%	0%	0%	0%	0%	0%	0%	0%

MWAT = Maximum Weekly Average Temperature; N = number of records in dataset

Table 3.3. MWAT values for water temperature data collected at nine stations monitored in Guadalupe River watershed, WY 2017. MWAT values that exceed MRP trigger (17°C) are indicated in bold.

Station Date	Guadalupe Creek			Alamitos Creek/Arroyo Calero					
	205GUA190	205GUA202	205GUA210	205GUA225	205GUA250	205GUA255	205GUA262	205GUA270	205GUA340
	Maximum Weekly Average Temperature								
4/3/2017	12.8	12.3	11.9	14.5	14.4	14.0	13.9	13.4	14.1
4/10/2017	12.9	12.3	11.9	14.6	14.2	13.9	13.8	13.2	14.2
4/17/2017	13.5	12.9	12.5	15.0	14.8	14.4	14.3	13.7	14.8
4/24/2017	14.0	13.3	12.8	15.5	15.5	15.1	14.9	14.1	15.3
5/1/2017	15.5	14.7	14.0	16.8	16.9	16.4	16.1	15.1	16.7
5/8/2017	14.8	13.9	13.3	16.3	16.5	16.2	15.9	15.4	16.2
5/15/2017	15.4	14.5	13.8	16.6	17.1	16.7	16.5	16.2	16.7
5/22/2017	16.6	15.7	14.9	17.2	18.1	17.7	17.4	17.0	17.4
5/29/2017	17.0	16.1	15.2	17.2	18.3	18.0	17.6	17.6	17.4
6/5/2017	16.5	15.5	14.9	16.9	17.8	17.4	17.2	17.5	16.7
6/12/2017	18.3	16.9	16.0	18.0	19.2	18.8	18.3	18.6	18.1
6/19/2017	21.1	19.4	18.1	19.6	21.0	20.7	19.9	20.5	19.6
6/26/2017	19.2	17.8	17.0	18.4	20.0	19.3	18.8	19.2	18.5
7/3/2017	20.0	18.6	17.7	19.1	20.5	19.9	19.4	20.0	19.2
7/10/2017	19.9	18.8	18.1	19.4	20.7	20.2	19.7	20.5	19.6
7/17/2017	19.6	18.8	18.2	19.4	18.5	19.9	19.5	20.2	19.5
7/24/2017	19.8	19.4	18.6	19.9	19.5	20.2	19.9	20.5	20.0
7/31/2017	21.0	20.4	19.7	20.6	20.7	20.8	20.6	21.4	20.7
8/7/2017	19.8	19.7	19.3	20.5	20.7	20.6	20.4	20.5	20.9
8/14/2017	19.9	19.6	19.4	20.5	20.7	20.5	20.4	20.3	20.9
8/21/2017	20.1	20.2	20.0	20.7	20.9	20.8	20.6	20.8	20.9
8/28/2017	20.4	21.1	20.8	21.2	21.2	21.3	21.1	21.8	21.3
9/4/2017	20.7	21.3	21.1	21.2	21.2	21.4	21.1	21.9	21.4
9/11/2017	20.5	20.1	20.1	20.8	20.8	20.8	20.6	20.9	21.3
9/18/2017	19.9	17.5	18.2	19.3	19.5	19.0	19.2	18.1	20.2
9/25/2017	19.8	17.2	17.3	18.5	18.8	18.6	18.7	17.5	19.5
Total Weeks	26	26	26	26	26	26	26	26	26
MWAT >17	17	15	15	18	20	19	19	18	18
> MRP Trigger	Y	Y	Y	Y	Y	Y	Y	Y	Y

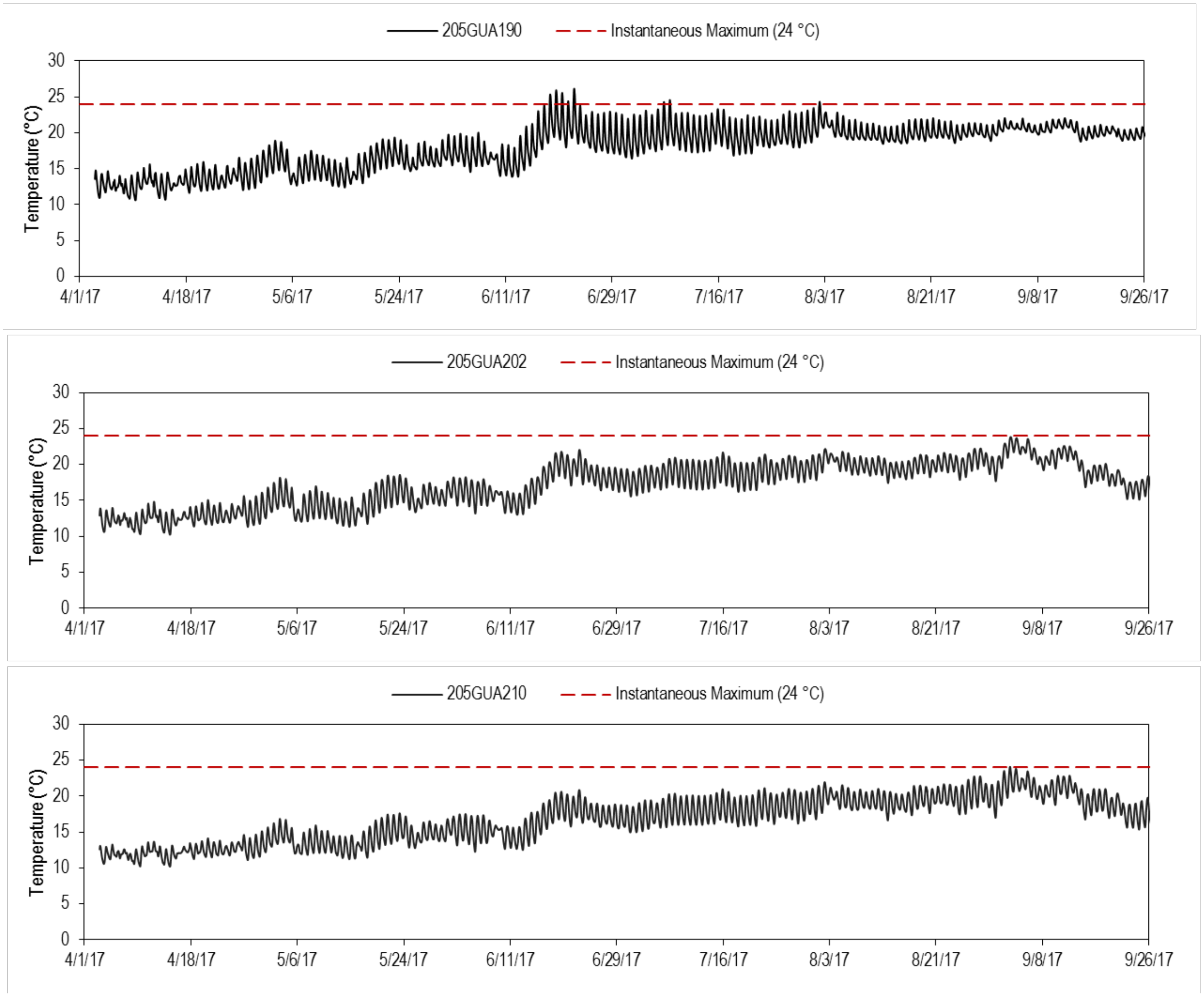

Figure 3.4. Plots of water temperature data collected at three stations in Guadalupe Creek, April through September 2017.

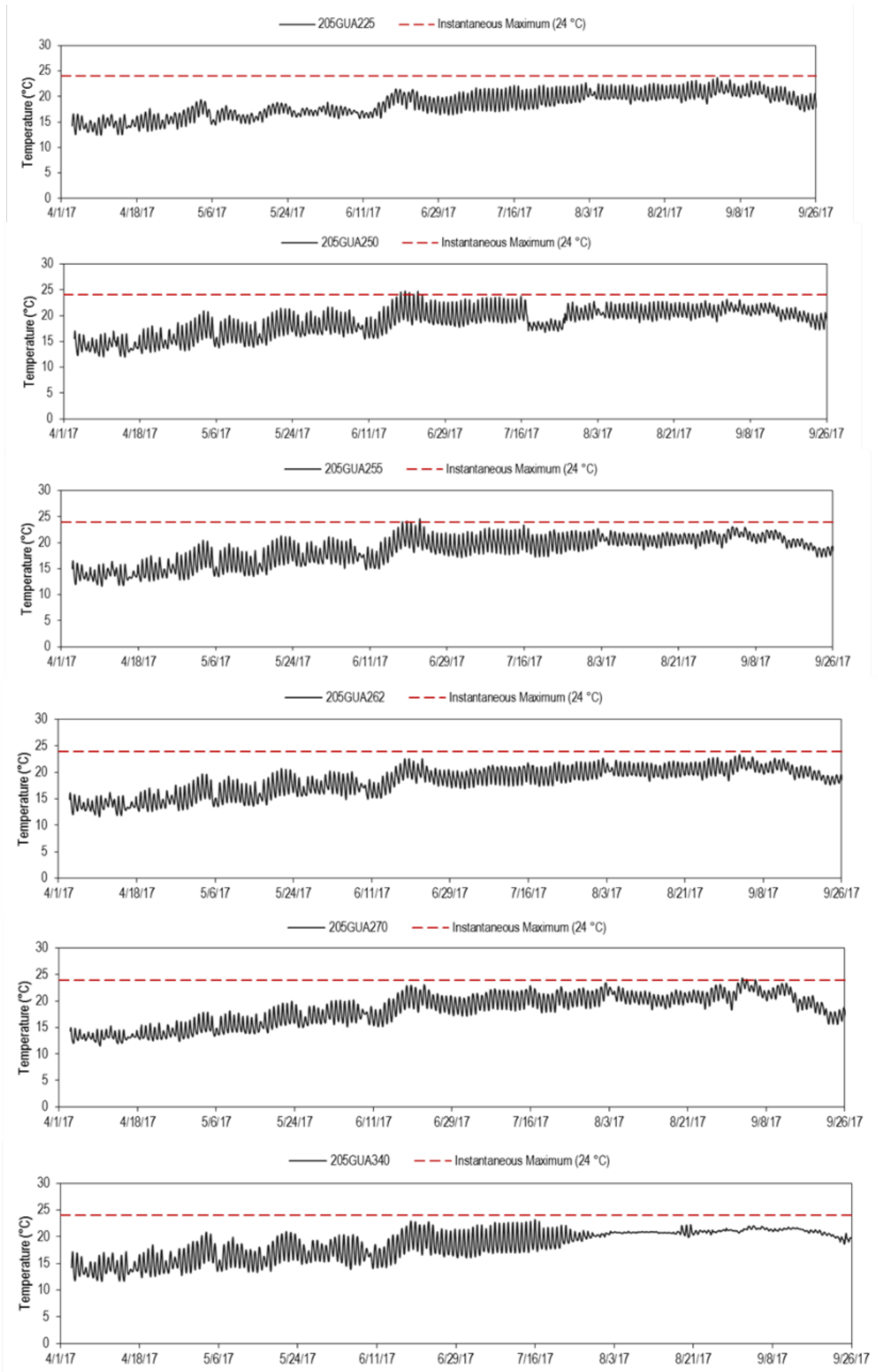

Figure 3.5. Plots of water temperature data collected at six stations in Alamitos Creek and Arroyo Calero, April through September 2017.

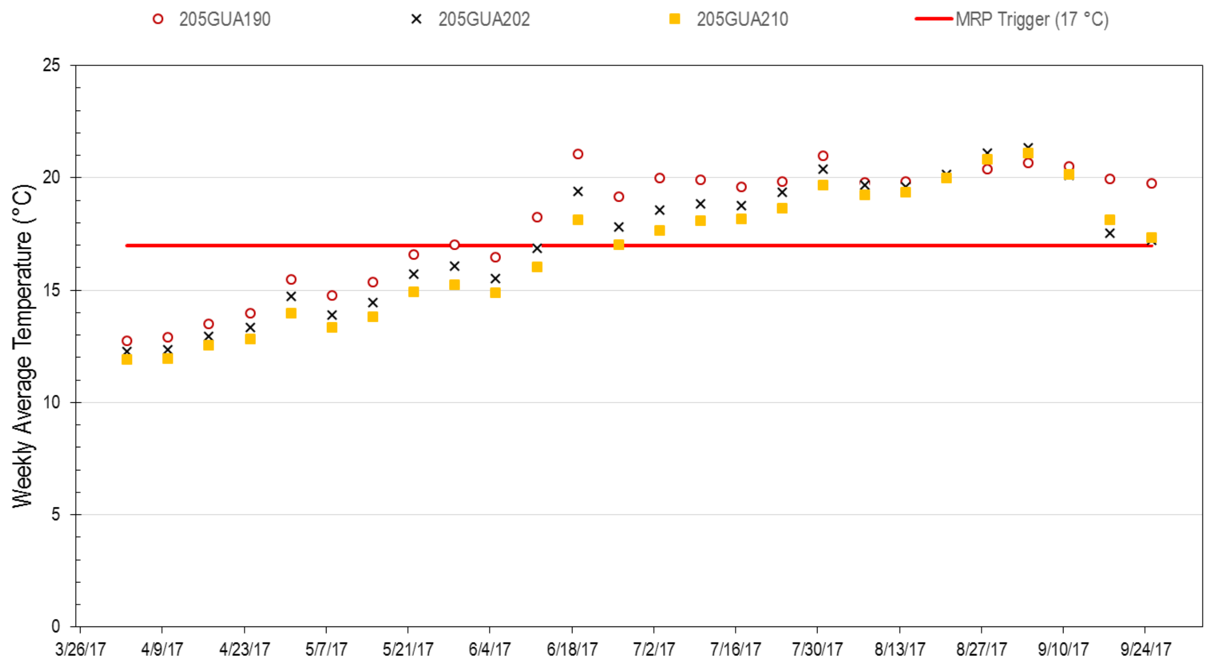

Figure 3.6. Plot of MWAT values calculated from temperatures collected at three stations in Guadalupe Creek over 26 weeks of temperature monitoring, WY 2017. The MRP trigger (17°C) is shown for comparison.

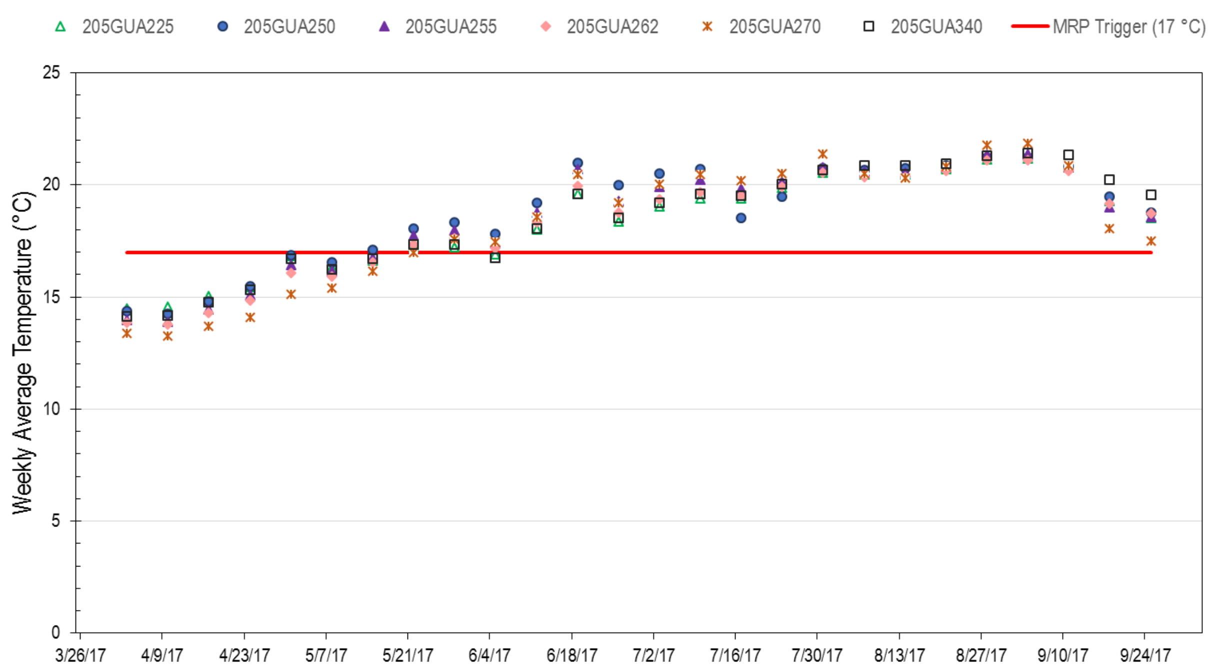

Figure 3.7. Plot of MWAT values calculated from temperatures collected at six stations in Alamitos Creek and its tributary Arroyo Calero over 26 weeks of temperature monitoring, WY 2017. The MRP trigger (17°C) is shown for comparison.

Temperature Trigger Considerations

The Basin Plan (SFRWQCB 2017) designates several Beneficial Uses associated with aquatic life uses, including COLD, WARM, MIGR, SPWN and RARE, for Guadalupe Creek, Alamitos Creek and Arroyo Calero (Table 1.5). Important spawning and rearing habitat for juvenile steelhead is present in the reaches of Guadalupe Creek and Alamitos Creek below the reservoirs (Becker et al. 2007). The extent and quality of steelhead rearing habitat is dependent on the amount and timing of releases from the reservoirs. Additional limiting factors to the steelhead population in these creeks include passage barriers, water temperature, riparian cover, sediment, mercury contamination, and predatory warm water fish species (FAHCE 2003).

Since WY 2004, the SCVWD conducted temperature and fisheries monitoring in Guadalupe Creek to meet mitigation monitoring requirements for the Downtown-Guadalupe River Flood Control Project. Most of the temperature monitoring was conducted at stations in the Guadalupe River. Limited data available for Guadalupe Creek showed cooler temperatures further upstream at stations closest to the dam, which is consistent with monitoring results presented in this report. Portions of Guadalupe and Alamitos creeks presently support reasonably good populations of steelhead/resident rainbow trout, although fish are generally less abundant in the unshaded, warm section of Guadalupe Creek downstream of Camden Avenue (Smith 2013).

Over the 12 years of monitoring by SCVWD, juvenile steelhead were typically present during the annual fall monitoring conducted in Guadalupe Creek (SCVWD et al. 2016). Steelhead numbers have dropped in 2015 due to low flow conditions caused by the recent drought. In 2016, only two steelhead individuals were documented at one site, which was the lowest count on record. However, a separate study in 2016, documented a total of twenty-six juvenile and adult steelhead further upstream below the dam for Guadalupe Reservoir (Leicester and Smith 2016). Additional monitoring in 2017 recorded thirty steelhead in 2.5 mile reach downstream of dam for Guadalupe Reservoir (SCVWD, personal communication, Clayton Leal). In general, the upper reaches of Guadalupe Creek provide summer refugia for steelhead.

Steelhead were historically found in Alamitos Creek (Leidy et al. 2005); however, no records were available to confirm current day presence of steelhead population in the creek. Smith (2013) reports portions of Alamitos Creek support populations of steelhead. Low numbers of steelhead were documented in Arroyo Calero in 1980s; however, these fish may have been primarily fish moving upstream from Alamitos Creek (Smith 2013).

Although the MRP trigger for temperature (i.e., MWAT exceeding 17°C for two or more weeks) occurred at all nine stations, it is important to keep in mind that some of the highest air temperatures on record occurred during the summer of 2017. Water temperature was not monitored in reaches below the reservoirs. Due to continuous flow during dry season, the steelhead presumably could migrate further upstream to more optimal habitat conditions. In addition, longitudinal connectivity to areas where food is available can allow juvenile steelhead to increase feeding behavior and maintain optimal body weight to survive periods of warmer temperatures (Smith 2013). Thus, flow in the lower reaches is critically important for sustaining steelhead population, as well as other Aquatic Life Uses.

3.4.2 General Water Quality

Summary statistics for general water quality measurements collected at the three sites in Coyote Creek during two sampling events in WY 2017 are listed in Table 3.4. Sample Events 1 and 2 were conducted in June and September, respectively. Sampling locations are mapped in Figure 3.2. Plots for all water quality parameters collected during Event 1 are shown in Figure 3.8 and for Event 2 in Figure 3.9.

Table 3.4. Descriptive statistics for continuous water temperature, dissolved oxygen, pH, and specific conductance measured at sites in Coyote Creek, Santa Clara County during WY 2017. Data were collected every 15 minutes over two two-week time periods during June (Event 1) and September (Event 2).

Parameter	Data Type	205COY235	205COY236	205COY239	205COY235	205COY236	205COY239
		June WY 2017			September WY 2017		
Temperature (°C)	Minimum	18.6	18.5	18.4	19.6	19.3	19.1
	Median	21.9	21.6	21.3	22.0	21.7	21.7
	Mean	21.7	21.4	21.2	21.6	21.4	21.4
	Maximum	23.7	23.3	24.1	23.3	22.8	23.6
	% > 24	0%	0%	0%	0%	0%	0%
Dissolved Oxygen (mg/L)	Minimum	3.1	2.4	1.4	2.6	2.8	5.0
	Median	5.3	4.1	4.0	3.5	3.5	5.8
	Mean	5.6	4.1	4.3	3.6	3.6	5.8
	Maximum	10.4	6.2	7.8	5.4	5.0	6.9
	% < 7	81%	100%	95%	100%	100%	100%
pH	Minimum	7.66	7.53	7.63	7.62	7.59	7.54
	Median	7.74	7.60	7.78	7.67	7.65	7.64
	Mean	7.74	7.61	7.76	7.67	7.65	7.67
	Maximum	7.87	7.79	7.88	7.74	7.70	7.88
	% < 6.5 or > 8.5	0%	0%	0%	0%	0%	0%
Specific Conductance (μ S/cm)	Minimum	943	949	883	843	833	786
	Median	1154	1174	1140	922	915	859
	Mean	1156	1183	1144	914	906	846
	Maximum	1427	1489	1416	945	936	886
	% > 2000	0%	0%	0%	0%	0%	0%
Total number of data points (N)		1435	1434	1436	955	953	952

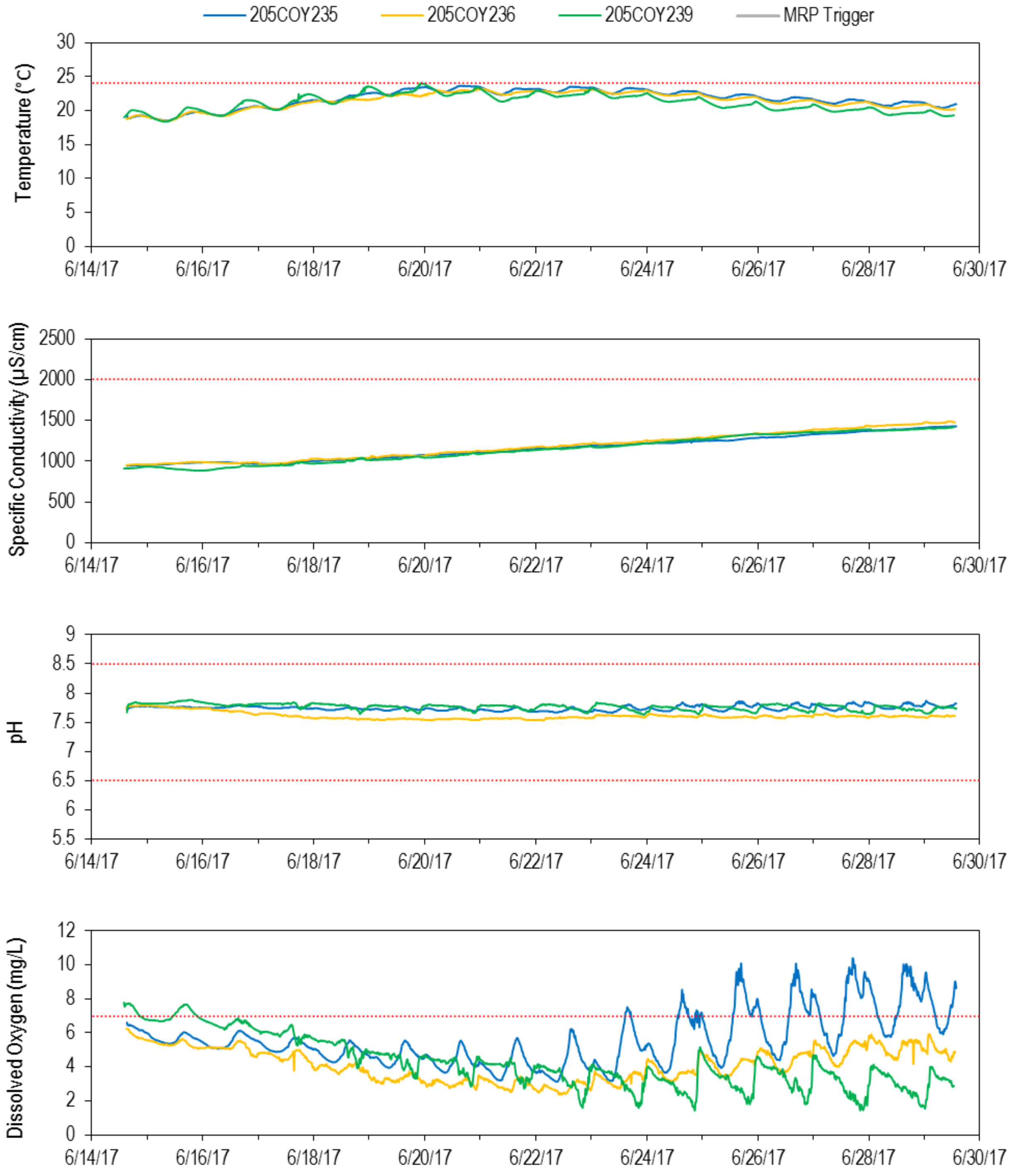

Figure 3.8 Continuous water quality data (temperature, specific conductance, pH, and dissolved oxygen) collected at three sites in Coyote Creek in June 2017.

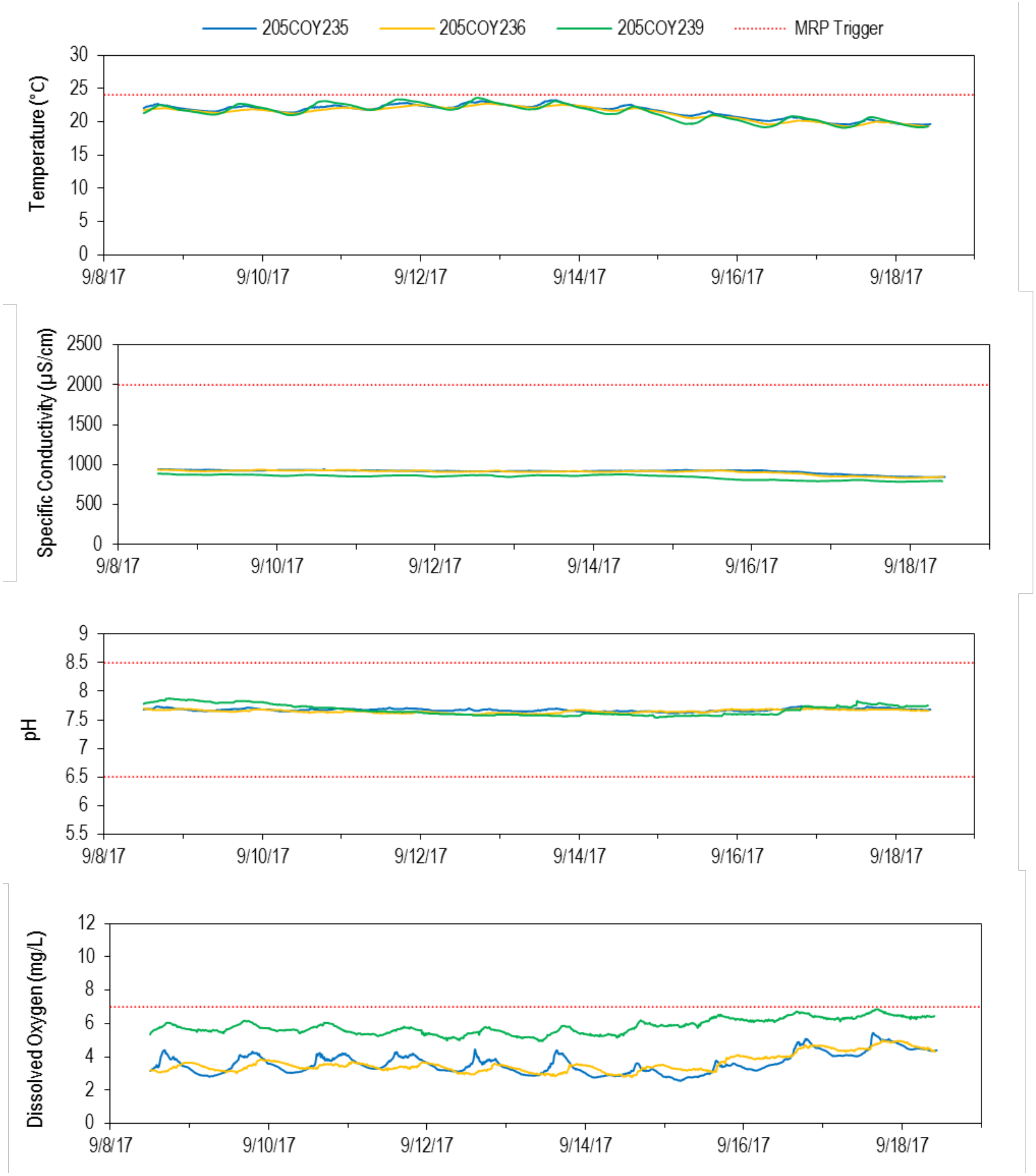

Figure 3.9 Continuous water quality data (temperature, specific conductance, pH, and dissolved oxygen) collected at three sites in Coyote Creek in September 2017.

Temperature

The water temperature data show a similar pattern for all three sites during both events. During the June sampling event (Event 1), water temperatures steadily increased during the first week of deployment and gradually declined during the following week (Figure 3.8). During Event 1 deployment, air temperatures exceeded 90°C for several of the days, with the highest temperature of 103°C recorded at San Jose airport on June 18, 2017. In general, water temperatures showed little variability between sites during each event.

Water temperature never exceeded 24°C, so the MRP trigger for maximum temperature was never exceeded at any of the sites for either sampling event (Table 3.4). MWAT was calculated for both two-week events (Table 3.5). The MWAT threshold (17 °C) was exceeded at all three stations during both weeks of both events.

Table 3.5. MWAT values for water temperature data collected at three stations monitored in Coyote Creek, WY 2017.

Station		205COY235	205COY236	205COY239
Month	Week	Maximum Weekly Average Temperature		
June	Week 1	20.98	20.73	21.17
	Week 2	22.45	22.15	21.41
September	Week 1	22.27	22.00	22.18
	Week 2 (4 Days)	20.28	20.03	19.94

pH

The pH data was generally consistent between sites (ranging between 7.5 and 8.0) for both sampling events. The pH at all three sonde locations remained above the WQO minimum of 6.5 and below the maximum of 8.5 for both events.

Specific Conductance

The specific conductance data followed a similar pattern at all three sites during both events. During the June sampling event, specific conductance steadily increased from 900 to 1400 µS /cm at all three sites. This increase may have been associated with increased air and water temperatures causing a concentration in dissolved solids due to evaporation and/or a greater influence of higher conductivity groundwater in the creek. During Event 2, specific conductance remained relatively steady around 900 µS/cm at all three sites. The specific conductance never exceeded the MRP trigger threshold (2000 µS/cm) at the three sonde locations for either event.

Dissolved Oxygen

The dissolved oxygen concentrations decreased across all the sites during first week of the June sampling event. The decrease is likely associated with the increase in water temperatures that occurred during the same period. During the second week of the June deployment, several patterns emerged. Dissolved oxygen levels dramatically increased at site 205COY235 in Watson Park. Following the heat wave on June 18th, the diurnal pattern at the Watson Park site starts to get more pronounced, exhibiting a small peak occurring a few hours after the large peak. The smaller peak may be associated with thermal stratification, followed by mixing of water layers when temperatures begin to drop. A similar diurnal pattern is observed at site 205COY239 (Williams Park), however dissolved oxygen levels are much lower compared to the site at Watson Park. The diurnal pattern is barely noticeable at site 205COY236 (Julian).

The dissolved oxygen data for the September sampling event show a consistent pattern for all three sites, with lower DO levels occurring at the Watson and Julian sites, and higher DO levels at the Williams site.

The diurnal pattern is less pronounced at the sites compared to the June sampling event. The Williams site shows the least amount of daily variation in DO levels compared to the other sites, which is consistent with pattern observed during the June event.

Dissolved oxygen data collected during the September 2017 sampling event was compared to data collected at the same sites during the same time period in September 2013. The dissolved oxygen data from 2013 was collected as part of the Coyote Creek Dissolved Oxygen Stressor Source Identification Project (Coyote Creek SSID). Distribution of the data from both years, presented as box plots, are shown in Figure 3.10. The mean DO levels at all three sites were about 1.0 mg/L higher in 2017 compared to 2013. One hypothesis for the observed increase in DO levels in 2017 may be associated with high stream flows that occurred in Coyote Creek during winter season 2016-2017. These high flows may have caused an overall reduction in the amount of organic material and sediment at the sites. One of the conclusions of the Coyote Creek SSID project was that accumulated organic material and sediment coupled with slow velocity and low gradient of the channel are likely important factors in the low DO concentrations and the low potential for re-aeriation of the water column.

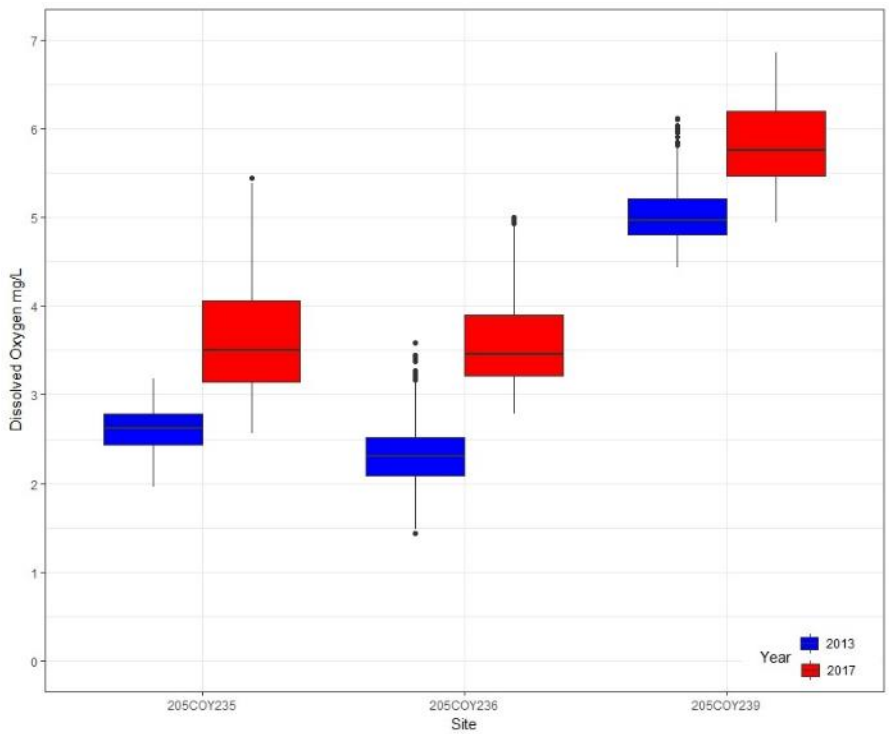

Figure 3.10 Comparison of dissolved oxygen data collected in September 2017 for the Creek Status Monitoring Project (WY 2017) with data collected in September 2013 for the Coyote Creek SSID Project.

The dissolved oxygen concentrations were below 7.0 mg\L (MRP trigger for cold water fishery stream) at all three sites (Table 3.4). These data results should be interpreted cautiously. Although Coyote Creek is designated as COLD Habitat, Aquatic Life Uses associated with cold water fishery, with the exception of migration, are generally not supported in the reach where water quality sampling was conducted. The sampling reach of Coyote Creek mainstem may support WARM water fishery; however, existing habitat and water quality conditions currently do not support a cold water fishery.

The MRP trigger summary for the continuous water quality data is shown in table 3.6. All three sites exceeded triggers for MWAT and dissolved oxygen and will therefore we included in the trigger exceedance table; however, decisions to initiate SSID studies will consider the discussions above.

Table 3.6. Exceedances of MRP triggers at three sites in Coyote Creek, Santa Clara County, WY 2017.

Data Type	MRP Trigger	205COY235	205COY236	205COY239	205COY235	205COY236	205COY239
		June WY 2017			September WY 2017		
Instantaneous Temperature	> 20% results are > 24°C	No	No	No	No	No	No
MWAT	2 Weeks > 17°C	Yes	Yes	Yes	Yes	Yes	Yes
Instantaneous Dissolved Oxygen	> 20% results are < 7 mg/L	Yes	Yes	Yes	Yes	Yes	Yes

3.4.3 Pathogen Indicators

Pathogen indicator (*E. coli* and enterococci) densities measured in water samples collected on July 27, 2017 are listed in Table 3.7. Stations are mapped in Figure 3.3.

Table 3.7. Enterococcus and *E. coli* levels measured in Santa Clara County during WY 2017.

Site ID	Creek Name	Site Name	*Enterococcus (cfu/100ml) (MPN/100ml)*[1]	*E. Coli (cfu/100ml) (MPN/100ml)*[1]	Sample Date
		MRP Trigger Threshold (USEPA 2012b)	*130*	*410*	
205GUA225	Arroyo Calero	Singer Park	1986	687	7/27/2017
205SAR075	Saratoga Creek	Wildwood Park	218	517	7/27/2017
205LGA400	Los Gatos Creek	Vasona Park	29	55	7/27/2017
205STE064	Stevens Creek	Blackberry Farm	345	70	7/27/2017
205MAT030	Matadero Creek	Bol Park	816	248	7/27/2017

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

All five creeks monitored for pathogen indicators are designated for both contact (REC-1) and non-contact (REC-2) recreation Beneficial Uses.[18] Although none of the stations could be considered "bathing beaches," monitoring locations at each creek were selected at city parks or trails that were considered to exhibit high potential for public access. The MRP threshold for *E. coli* was exceeded at two sites. The MRP threshold for enterococcus was exceeded at four sites. These will be added to the list of candidate SSID projects.

[18] The REC2 Beneficial Use for Los Gatos Creek is designated as Potential, whereas the four other creeks have Existing REC1 and REC2 Beneficial Uses.

3.5 Conclusions and Recommendations

Targeted monitoring in WY 2017 was conducted in compliance with Provisions C.8.d.iii – v of the MRP. Hourly temperature measurements were recorded at nine sites in the Guadalupe River Watershed from April through September. Continuous (15-minute) general water quality measurements (pH, DO, specific conductance, temperature) were recorded at three sites in the Coyote Creek watershed during two 2-week periods in June (Event 1) and September (Event 2). Pathogen indicator grab samples were collected during a sampling event in July at five sites throughout Santa Clara County that coincide with public parks. Targeted monitoring stations were deliberatively selected using the Directed Monitoring Design Principle.

Conclusions and recommendations from targeted monitoring in WY 2017 are listed below. The sections below are organized on the basis of the management questions listed at the beginning of this section:

1. *What is the spatial and temporal variability in water quality conditions during the spring and summer season?*
2. *Do general water quality measurements indicate potential impacts to aquatic life?*
3. *What are the pathogen indicator concentrations at creek sites where there is potential for water contact recreation to occur?*

Spatial and Temporal Variability in Water Quality

- **Spatial**. Water temperatures measured in three tributaries to Guadalupe River generally increased within decreasing site elevation due their distance from upstream reservoirs, which are the source of cooler water. General water quality parameters measured at three stations in Coyote Creek were similar across the stations with the exception of dissolved oxygen which displayed different patterns at the sites. The findings were consistent with the Coyote Creek Dissolved Oxygen SSID Project which concluded that low channel gradients and high amounts of accumulated organic material in the studied reach cause low DO concentrations.
- **Temporal**. Temperatures became elevated at all nine sites in the Guadalupe River watershed from June to August 2017 and started to decline towards the end of September. In Coyote Creek, decreases in dissolved oxygen concentrations occurred following a period of hot weather during week of June 18, 2017. Following the heat wave, the DO levels increased, with pronounced diurnal variability observed at all three sites.

Potential Impacts to Aquatic Life

- Potential impacts to aquatic life were assessed through analysis of continuous temperature data collected at nine targeted stations in the Guadalupe River watershed from April through September and analysis of continuous general water quality data (pH, dissolved oxygen, specific conductance, and temperature) collected at three targeted stations in Coyote Creek during two two-week periods (June and September).
- All nine temperature stations in the Guadalupe River Watershed exceeded the MRP trigger threshold of having two or more weeks where the Maximum Weekly Average Temperature exceeded 17°C. None of the stations exceeded the maximum instantaneous trigger threshold of 24°C for more than 1% of total recorded samples.
    - o 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 locally-derived temperature thresholds developed by NMFS (NMFS 2016) suggests that temperature may not be a limiting factor for salmonid habitat (i.e., summer rearing juveniles) in the study reaches, as long as sufficient dam releases maintain longitudinal connectivity and

provide cooler water temperatures and potential refugia for juvenile steelhead during the summer.

- Sites on Coyote Creek had no exceedances of the maximum temperature trigger threshold of 24°C but did exceed the MWAT trigger of 17.0 °C for two consecutive weeks during both events and will therefore be added to the list of candidate SSID projects.
- The WQO for DO in waters designated as having cold freshwater habitat (COLD) Beneficial Uses (i.e., 7.0 mg/L) was not met in over 20% of the measurements recorded at all three water quality stations in Coyote Creek. The results were similar to the findings from the WY 2013 SSID study carried out at the same locations. The Coyote Creek DO SSID Study concluded that low DO concentrations are caused by low gradient channels with high amounts of accumulated organic matter. Furthermore, this reach Coyote Creek currently supports habitat and water quality that may be suitable for a warm water fishery and not for cold water fishery.
- Values for pH and specific conductance measured at the three sites in Coyote Creek during WY 2017 did not exceed their respective triggers during either event.

Potential Impacts to Water Contact Recreation

- Pathogen indicator densities were measured at five targeted sites during WY 2017. Although none of the stations could be considered “bathing beaches,” monitoring locations were selected at city parks or trails that were considered to have a relatively high potential for public access. The MRP trigger threshold for *E. coli* (410 cfu/100 ml) was exceeded at two sites: Arroyo Calero at Singer Park and Saratoga Creek at Wildwood Park. The MRP trigger threshold for enterococcus (130 cfu/100 ml) was exceeded at four sites: Arroyo Calero at Singer Park, Saratoga Creek at Wildwood Park, Stevens Creek at Blackberry Farm, and Matadero Creek at Bol Park. These sites will be added to the list of candidate SSID projects.
- 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. Pathogen indicators observed at the WY 2017 stations may not be associated with human sources and therefore may not pose a threat to human health. As a result, the comparison of pathogen indicator results to water quality objectives and criteria for full body contact recreation may not be appropriate and should be interpreted cautiously.
- The State Water Resources Control Board is currently in the process of adopting modified WQOs for enterococci and *E. coli* based on USEPA criteria that will serve as new MRP Trigger Thresholds. A statistical threshold value for enterococci of 320 cfu/100mL will be used for samples in waters where the salinity is less than 10 parts per thousand 95% of the time, and a statistical threshold value for *E. coli* of 110 cfu/100mL will be used for samples in waters where the salinity is equal to or greater than 10 parts per thousand 95% of the time. The new statistical threshold values correspond with an Estimated Illness Rate (NGI) of 32 per 1,000 water contact recreators.[19]

[19] See http://www.waterboards.ca.gov/bacterialobjectives/ for more information.

4.0 CHLORINE MONITORING

4.1 Introduction

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

In compliance with provision C.8.d.ii of the MRP and to assess whether the chlorine in receiving waters is potentially toxic to the aquatic life living there, SCVURPPP field staff measured free chlorine and total chlorine residual in creeks where bioassessments were conducted. Total chlorine residual is comprised of combined chlorine and free chlorine, and is always greater than or equal to the free chlorine residual. Combined chlorine is the chlorine that has reacted with ammonia or organic nitrogen to form chloramines, while free chlorine is the chlorine that remains unbound.

4.2 Methods

In accordance with the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), WY 2017 field testing for free chlorine and total chlorine residual was conducted at all 20 probabilistic sites (and two SSID sites: 205COY114 and 205COY121) concurrent with spring bioassessment sampling (May-June). Probabilistic site selection methods are described in Section 2.0.

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

4.3 Results

In WY 2017, SCVURPPP monitored the 20 probabilistic sties and 2 SSID sites for free chlorine and total chlorine residual. These measurements were compared to the MRP trigger threshold of 0.1 mg/L.[20] Results are listed in Table 4.1.

The trigger thresholds for free chlorine and total chlorine residual were exceeded at one of the stations on Lower Penitencia Creek (205R02947) on May 11, 2017. In compliance with Provision C.8.d.ii(4), SCVURPPP staff immediately informed City of Milpitas illicit discharge staff of the exceedances. City staff reported that follow-up measurements were at or below the MRP trigger and determined that either the source of the higher readings had stopped, or that the original results were in error.

[20] For reference, the Statewide General Permit for Drinking Water Discharges (Order WQ 2014-0194-DWQ) uses 0.1 mg/L as a reporting limit (minimum level) for field measurements of total residual chlorine.

Table 4.1. Summary of SCVURPPP chlorine testing results compared to MRP trigger of 0.1 mg/L, WY 2017

Station Code	Date	Creek	Free Chlorine (mg/L)[1, 2]	Total Chlorine Residual (mg/L)[1, 2]	Exceeds Trigger Threshold? [3] (0.1 mg/L)
205R00570	5/17/2017	Trib to Aldercroft Cr	0.04	< 0.02	No
205R00609	5/17/2017	Hunting Hollow	0.04	0.04	No
205R00645	5/16/2017	Packwood Creek	0.02	< 0.02	No
205R02693	5/10/2017	Packwood Creek	0.03	0.03	No
205R02755	5/15/2017	Berryessa Creek	< 0.02	0.04	No
205R02787	5/15/2017	Matadero Creek	0.02	0.03	No
205R02915	5/8/2017	Stevens Creek	0.05	0.06	No
205R02947	6/1/2017	Lower Penitencia	0.16 / 0.16	0.2 / 0.2	Yes
205R03011	6/5/2017	Berryessa Creek	0.02	0.04	No
205R03091	5/11/2017	Arroyo Aguague	< 0.02	0.03	No
205R03098	5/8/2017	Guadalupe Creek	0.02	0.02	No
205R03235	5/18/2017	Stevens Creek	0.04	0.04	No
205R03306	6/6/2017	Saratoga Creek	0.04	0.03	No
205R03331	6/5/2017	Los Gatos Creek	0.04	0.03	No
205R03354	5/9/2017	Guadalupe Creek	0.08	0.02	No
205R03386	6/7/2017	Aldercroft Creek	0.03	0.03	No
205R03418	6/6/2017	Alamitos Creek	< 0.02	< 0.02	No
205R03443	5/16/2017	Calabazas Creek	0.06	0.08	No
205R03523	6/8/2017	Upper Penitencia Creek	0.04	0.03	No
205R03530	6/1/2017	Los Gatos Creek	0.03	0.03	No

[1] The method detection limit is 0.02 mg/L; however, the Statewide General Permit for Drinking Water Discharges (Order WQ 2014-0194-DWQ) uses 0.q mg/L as a reporting limit (minimum level) for field measurements of total chlorine residual.
[2] Original and repeat samples are reported where conducted. The first value is the original result.
[3] The MRP trigger threshold applies to both free chlorine and total chlorine residual measurements

4.4 Conclusions and Recommendations

While chlorine residual is generally not a concern in Santa Clara Valley creeks, WY 2017 and prior monitoring results suggest there are occasional trigger exceedances of free chlorine and total chlorine residual in the County. Exceedances may be the result of one-time potable water discharges and it is generally very difficult to determine the source of elevated chlorine from such episodic discharges. The Program will continue to monitor chlorine in compliance with the MRP and will follow-up with illicit discharge staff as needed.

5.0 TOXICITY AND SEDIMENT CHEMISTRY MONITORING

5.1 Introduction

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

Provision C.8.g of the MRP requires both wet and dry weather monitoring of pesticides and toxicity in urban creeks.

Dry Weather

The Program is required to conduct water toxicity and sediment chemistry and toxicity monitoring at two locations during the dry season, each year of the permit term beginning in WY 2016. The water and sediment samples do not necessarily need to be collected at the same locations. The permit provides examples of possible monitoring locations, including sites with suspected or past toxicity results, or existing bioassessment sites.

- Toxicity testing in water is required using five species: *Ceriodaphnia* dubia (chronic survival and reproduction), *Pimephales promelas* (larval survival and growth), *Selenastrum capricornutum* (growth), *Hyalella azteca* (survival) and *Chironomus dilutus* (survival).
- Toxicity testing in sediment is required using two species: *Hyella azteca* (survival) and *Chironomus dilutus* (survival).
- Sediment chemistry analytes include pyrethroids, fipronil, carbaryl, total Polycyclic aromatic hydrocarbons (PAHs), metals, Total Organic Carbon (TOC) and sediment grain size.

Wet Weather

The wet weather monitoring requirements include collection of water column samples during storm events for toxicity testing and analysis of pyrethroids, fipronil, imidacloprid and indoxacarb. The MRP states that monitoring locations should be representative of urban watersheds (i.e., bottom of watersheds).

The MRP states that if the wet season monitoring is conducted by the RMC on behalf of all Permittees, a total of ten collective samples are required over the permit term, with at least six samples collected by WY 2018. At the RMC Monitoring Workgroup meeting on January 25, 2016, RMC members agreed to collaborate on implementation of the wet weather monitoring requirements. The first wet weather samples will occur in WY 2018. SCVURPPP and ACCWP will each collect three samples and SMCWPPP and CCCWP will each collect two samples. The RMC is still in the process of defining the monitoring approach.

Toxicity and pesticides monitoring methods and results are described in the sections below.

5.2 Methods

5.2.1 Site Selection

In WY 2017, in compliance with MRP Provision C.8.g.i, water and sediment toxicity and sediment chemistry samples were collected from two sites during dry weather: Stevens Creek and San Tomas Aquino Creek (see Figure 1.2). Sites were selected to represent urban watersheds that are not already being monitored for toxicity or pesticides by other programs, such as the SWAMP Stream Pollution

Trends (SPoT) program or the California Department of Pesticide Regulation (DPR) Surface Water Protection Program Monitoring (SWPP). Specific stations within the watersheds were identified based on the likelihood that they would contain fine depositional sediments during dry season sampling and would be safe to access during future wet weather sampling. SCVURPPP sampled these two stations in WY 2016 and it is anticipated that SCVURPPP will continue to sample the same two stations throughout the permit term with the goal of building a long-term dataset that complements data being gathered through SWAMP SPoT and DPR SWPP.

5.2.2 Sample Collection

Before conducting sampling, field personnel surveyed the proposed sampling area for appropriate fine-sediment depositional areas. Personnel carefully entered the stream to avoid disturbing sediment at collection sub-sites.

Water samples were collected using standard grab sampling methods. The required number of 4-L labeled amber glass bottles were filled and placed on ice to cool to < 6C. The laboratory was notified of the impending sampling delivery to meet 24-hour sample hold time. Procedures used for sampling and transporting water samples are described in SOP FS-2 (BASMAA 2016b).

Sediment samples were collected from the top 2 cm at each sub-site beginning at the downstream-most location and continuing upstream. Sediment samples were placed in a compositing container, thoroughly homogenized, and then aliquoted into separate jars for chemical or toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA 2016b).

Sample were submitted to respective laboratories and field data sheets were reviewed per SOP FS-13 (BASMAA 2016b).

5.2.3 Data Evaluation

Water and Sediment Toxicity

Data evaluation required by the MRP involves first determining whether the samples are toxic to the test organisms relative to the laboratory control treatment via statistical comparison using the Test of Significant Toxicity (TST) statistical approach. For samples with toxicity (i.e., those that "failed" the TST), the Percent Effect is evaluated. The Percent Effect compares sample endpoints (survival, reproduction, growth) to the laboratory control endpoints. Follow-up sampling is required if any test organism is reported as "fail" and the Percent Effect is ≥ 50 % Percent Effect. Both the TST result and the Percent Effect are determined by the laboratory.

Sediment Chemistry

In compliance with MRP Provision C.8.g.iv, sediment sample results are compared to Probable Effects Concentrations (PECs) and Threshold Effects Concentrations (TECs) as defined by MacDonald et al. (2000). PEC and TEC quotients are calculated as the ratio of the measured concentration to the respective PEC and TEC values from MacDonald et al. (2000). All results where a PEC or TEC quotient was equal to or greater than 1.0 were identified and added to the list of candidate SSID projects.

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

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

The current MRP does not require consideration of pyrethroid, fipronil, or carbaryl sediment chemistry data for follow-up SSID projects, perhaps because pyrethroids are ubiquitous in the urban environment and little is known about fipronil and carbaryl distribution. However, SCVURPPP computed toxicity unit (TU) equivalents for individual pyrethroid results, based on available literature values for pyrethroids in sediment LC50 values.[21,22] Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized concentrations. Therefore, the pesticide concentrations as reported by the lab were divided by the measured total organic carbon (TOC) concentration at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each constituent. Concentrations equal to one-half of the respective laboratory method detection limits were substituted for non-detect data so that these statistics could be computed, potentially resulting in artificially elevated results.

5.3 Results and Discussion

5.3.1 Toxicity

Table 5.1 provides a summary of toxicity testing results for WY 2017 dry weather water and sediment samples. Based on the results, it is not necessary to add the sites to the list of potential SSID projects.

- **San Tomas Aquino Creek (205STQ010).** The water sample collected from San Tomas Aquino Creek was found to be significantly toxic to *C. dubia* (reproduction); however, the Percent Effect did not exceed the 50% threshold for follow-up. The sediment sample was not significantly toxic to either of the two test organisms.
- **Stevens Creek (205STE021).** The sediment sample collected from Stevens Creek in July 2017 was not significantly toxic to any of the test organisms; however, the water sample was found to be significantly toxic to *C. dubia* (reproduction). The Percent Effect was greater than 50%; therefore, a second sample was collected in August 2017 and tested for *C. dubia* toxicity. The August 2017 water sample was not significantly toxic.

The cause of the water and water toxicity in San Tomas Aquino Creek and the sediment toxicity in Stevens Creek is unknown.

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

[22] No LC50 is published for fipronil or carbaryl in sediment.

Table 5.1. Summary of SCVURPPP toxicity results for WY 2017.

Site	Organism	Test Type	Unit	Results		TST Result	% Effect	Follow up needed (TST "Fail" and ≥50%)
				Lab Control	Organism Test			
205STQ010 San Tomas Aquino Creek	Water							
	Ceriodaphnia dubia	Survival	%	100	90	NA [1]	10%	No
		Reproduction	Num/Rep	30.2	21.2	Fail	29.7%	No
	Pimephales promelas	Survival	%	97.5	92.5	Pass	5.1%	No
		Growth	mg/ind	0.548	0.557	Pass	-1.69%	No
	Chironomus dilutus	Survival	%	95	85	Pass	11%	No
	Hyalella azteca	Survival	%	98	100	Pass	-2.04%	No
	Selenastrum capricornutum	Growth	cells/ml	3000000	4610000	Pass	-53.3%	No
	Sediment							
	Chironomus dilutus	Survival	%	96.2	96.2	Pass	0.00%	No
	Hyalella azteca	Survival	%	97.5	98.8	Pass	-1.28%	No
205STE021 Stevens Creek	Water							
	Ceriodaphnia dubia	Survival	%	100	100	NA [1]	0%	No
		Reproduction	Num/Rep	30.2	6	Fail	80.1%	Yes
	Ceriodaphnia dubia (followup sample Aug 2017)	Survival	%	100	100	NA [1]	0%	No
		Reproduction	Num/Rep	26.3	15.5	Pass	41.1%	No
	Pimephales promelas	Survival	%	97.5	95	Pass	2.56%	No
		Growth	mg/ind	0.548	0.674	Pass	-23.0%	No
	Chironomus dilutus	Survival	%	95	87.5	Pass	7.89%	No
	Hyalella azteca	Survival	%	98	96	Pass	2.04%	No
	Selenastrum capricornutum	Growth	cells/ml	3000000	4960000	Pass	-65.1%	No
	Sediment							
	Chironomus dilutus	Survival	%	96.2	95	Pass	1.30%	No
	Hyalella azteca	Survival	%	97.5	100	Pass	-2.56%	No

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

5.3.2 Sediment Chemistry

Sediment chemistry results are evaluated as potential stressors based on TEC quotients and PEC quotients according to criteria in provision C.8.g.iv of the MRP. SCVURPPP also evaluated TU equivalents of pyrethroids.

Table 5.2 lists concentrations and TEC quotients for sediment chemistry constituents (metals and total PAHs). TEC quotients are calculated as the measured concentration divided by the highly conservative TEC value, per MacDonald et al. (2000)[23]. TECs are extremely conservative and are intended to identify concentrations below which harmful effects on sediment-dwelling organisms are unlikely to be observed. Both sites exceeded the relevant trigger criterion from the MRP of having at least one result exceeding the TEC and will be added to the list of potential SSID projects. There were TEC exceedances of nickel in both creeks and of chromium in Stevens Creek as expected in watersheds draining hillsides underlain by serpentinite formations. In Stevens Creek (205STE021), the TEC for total PAHs was also exceeded.

Table 5.3 provides PEC quotients for sediment chemistry constituents (metals and total PAHs) and calculated mean values of the PEC quotients for each site. PECs are intended to identify concentrations above which toxicity to benthic-dwelling organisms are predicted to be probable. The PEC quotient for nickel was greater than 1.0 in both creeks.

Table 5.4 lists the concentrations of pesticides measured in sediment samples and calculated TU equivalents for the pesticides for which there are published LC50 values in the literature. Because organic carbon mitigates the toxicity of pyrethroids and fipronil in sediments, the LC50 values were derived on the basis of TOC-normalized pyrethroid concentrations. Similarly, the constituent concentrations as reported by the lab were divided by the measured TOC concentration at each site, and the TOC-normalized concentrations were used to compute TU equivalents. Most of the pesticides measured were below method detection limits (MDLs) and are listed as ½ MDLs in Table 5.4. Others are J-flagged, meaning that the measured concentration was above the MDL but below the reporting limit. No TU equivalents exceeded 1.0. The highest TU equivalents in both samples were for bifenthrin and cypermethrin. Bifenthrin is considered to be the leading cause of pyrethroid-related toxicity in urban areas (Ruby 2013).

In compliance with the MRP, a grain size analysis was conducted on both of the sediment samples (Table 5.5). The Stevens Creek (205STE021) sample was 14% fines (i.e., 6.1% clay and 7.7% silt); whereas the San Tomas Aquino Creek (205STQ010) sample was 4.7% fines (i.e., 2.6% clay and 2.1% silt). It unknown whether these differences in percent fines influenced the toxicity tests or sediment chemistry analysis and evaluation.

[23] MacDonald et al. (2000) does not provide TEC or PEC values for pyrethroids, fipronil, or carbaryl. Pyrethroids are compared to LC50 values in Table 5.4. However, LC50 values for fipronil and carbaryl in sediment have not been published.

Table 5.2. Threshold Effect Concentration (TEC) quotients for WY 2017 sediment chemistry constituents. Bolded and shaded values indicate TEC quotient ≥ 1.0.

	TEC	205STE021 Stevens Creek		205STQ010 San Tomas Aquino Creek	
		Concentration	Quotient	Concentration	Quotient
Metals (mg/kg DW)					
Arsenic	9.79	3.3	0.34	3.3	0.34
Cadmium	0.99	0.2	0.20	0.07	0.071
Chromium	43.4	68	1.6	41	0.94
Copper	31.6	30	0.95	27	0.85
Lead	35.8	10	0.28	5.7	0.16
Nickel	22.7	64	3	53	2.33
Zinc	121	78	0.64	62	0.51
PAHs (ug/kg DW)					
Total PAHs	1,610	4478.2 [a]	2.78	38.9 [a]	0.024
# Constituents with TEC quotient >= 1.0		3		1	

[a] Total calculated using ½ MDLs.

Table 5.3. Probable Effect Concentration (PEC) quotients for WY 2017 sediment chemistry constituents. Bolded and shaded values indicate PEC quotient ≥ 1.0.

	PEC	205STE021 Stevens Creek		205STQ010 San Tomas Aquino Creek	
Metals (mg/kg DW)		Concentration	Quotient	Concentration	Quotient
Arsenic	33	3.3	0.10	3.3	0.10
Cadmium	4.98	0.2	0.04	0.07	0.014
Chromium	111	68	0.6	41	0.37
Copper	149	30	0.20	27	0.18
Lead	128	10	0.08	5.7	0.04
Nickel	48.6	64	1.3	53	1.09
Zinc	459	78	0.17	62	0.14
PAHs (ug/kg DW)					
Total PAHs	22,800	4478.2 [a]	0.20	38.9 [a]	0.002
# Constituents with PEC quotient >= 1.0		1		1	

[a] Total calculated using ½ MDLs.

Table 5.4. Pesticide concentrations and calculated pyrethroid toxic unit (TU) equivalents, WY 2017.

			205STE021 Stevens Creek			205STQ010 San Tomas Aquino Creek		
	Unit	LC50 [d]	Concentration	Normalized to TOC	TU Equivalent	Concentration	Normalized to TOC	TU Equivalent
Total Organic Carbon	%		1.8			0.48		
Pyrethroids								
Bifenthrin	µg/g dw	0.52	0.00063	0.035	0.067	0.00018 [b]	0.038	0.072
Cyfluthrin	µg/g dw	1.08	0.00006 [a]	0.003	0.0031	0.00006 [a]	0.013	0.012
Cypermethrin	µg/g dw	0.38	0.00015 [b]	0.008	0.022	0.00015 [a]	0.031	0.082
Deltamethrin	µg/g dw	0.79	0.00007 [a]	0.004	0.0046	0.00007 [a]	0.014	0.017
Esfenvalerate	µg/g dw	1.54	0.00007 [a]	0.004	0.0025	0.00007 [a]	0.015	0.009
Lambda-Cyhalothrin	µg/g dw	0.45	0.00003 [a]	0.002	0.0040	0.00003 [a]	0.007	0.015
Permethrin	µg/g dw	10.83	0.00045	0.025	0.0023	0.00045 [a]	0.094	0.009
Other Pesticides								
Carbaryl	mg/Kg dw	NA [c]	0.011 [a]	NA	NA	0.011 [a]	NA	NA
Fipronil	ng/g dw	NA [c]	0.055 [a]	NA	NA	0.055 [a]	NA	NA
Fipronil Desulfinyl	ng/g dw	NA [c]	0.055 [a]	NA	NA	0.055 [a]	NA	NA
Fipronil Sulfide	ng/g dw	NA [c]	0.055 [a]	NA	NA	0.055 [a]	NA	NA
Fipronil Sulfone	ng/g dw	NA [c]	0.055 [a]	NA	NA	0.055 [a]	NA	NA

a. Concentration was below the method detection limit (MDL). Value listed is 1/2 MDL.
b. Concentration below the reporting limit (J-flagged).
c. No available LC50 value for Carbaryl or Fipronil.
d. Sources: Amweg et al. 2005 and Maund et al. 2002

Table 5.5. Summary of grain size for the two locations sampled in Santa Clara during WY 2017.

Grain Size (%)		205STE021 Stevens Creek	205STQ010 San Tomas Aquino Creek
Clay	<0.0039 mm	6.1%	2.6%
Silt	0.0039 to <0.0625 mm	7.7%	2.1%
Sand	V. Fine 0.0625 to <0.125 mm	8.6%	1.1%
	Fine 0.125 to <0.25 mm	28%	2.6%
	Medium 0.25 to <0.5 mm	30%	19%
	Coarse 0.5 to <1.0 mm	13%	25%
	V. Coarse 1.0 to <2.0 mm	6.4%	48%
Granule	2.0 to <4.0 mm	2.0%	30%
Pebble	Small 4 to <8 mm	1.7%	19%
	Medium 8 to <16 mm	0%	0%
	Large 16 to <32 mm	0%	0%
	V. Large 32 to <64 mm	0%	0%

5.4 Conclusions and Recommendations

Statistically significant toxicity to *C. dubia* (reproduction) was observed in water samples collected from both sites in July 2017. The magnitude of the toxic effects in the San Tomas Aquino Creek sample was not great and did not exceed MRP trigger criteria. However, the magnitude of the toxic effects in the Stevens Creek sample did exceed the MRP threshold for re-sampling. Statistically significant toxicity to *C. dubia* was not observed in the second sample collected from Stevens Creek in August 2017. The cause of the toxicity observations is unknown. Pesticide concentrations in the sediment samples were all very low, most below MDLs and calculated TU equivalents did not exceed 0.09 in either sample.

TEC and PEC quotients were calculated for all metals and total PAHs measured in sediment samples. Both sites had at least one TEC or PEC quotient exceeding 1.0. In compliance with the MRP, both stations will therefore be placed on the list of candidate SSID projects. Decisions about which SSID projects to pursue should be informed by the fact that most of the TEC and PEC quotient exceedances are related to naturally occurring chromium and nickel due to serpentine soils in the watersheds.

6.0 CONCLUSIONS AND RECOMMENDATIONS

In WY 2017, in compliance with provisions C.8.d and C.8.g of the MRP and the BASMAA RMC Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012), SCVURPPP continued to implement a two-component monitoring design that was initiated in WY 2012. The strategy includes a regional ambient/"probabilistic" bioassessment monitoring component and a component based on local "targeted" monitoring for general water quality parameters and pesticides/toxicity. The combination of these monitoring designs allows each individual RMC participating program to assess the status of Beneficial Uses in local creeks within its Program (jurisdictional) area, while also contributing data to eventually answer management questions at the regional scale (e.g., differences between aquatic life condition in urban and non-urban creeks).

The following conclusions from the MRP Creek Status and Pesticides/Toxicity Monitoring conducted during WY 2017 in Santa Clara County are based on the management questions presented in Section 1.0 of this report:

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

The first management question is addressed primarily through the evaluation of probabilistic and targeted monitoring data with respect to the triggers defined in the MRP. A summary of trigger exceedances observed for each site is presented in Table 6.1. 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.

The second management question 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. These analyses were limited to the WY 2017 dataset which does not contain a statistically significant number of records. A more comprehensive analysis of the much larger bioassessment dataset from the previous five years (WY 2012 – WY 2016) is currently being conducted by the BASMAA RMC on a regional and countywide basis. Results of the BASMAA regional study will be available by late 2018. Analytical tools that are found to be useful in evaluating stressor association with biological condition may be implemented in future annual monitoring reports.

6.1 Conclusions

6.1.1 Biological Condition Assessment (WY 2017)

Bioassessment monitoring was conducted at twenty sites in WY 2017. The sites were sampled for BMIs, benthic algae, physical habitat, and nutrients using methods consistent with the BASMAA RMC QAPP (BASMAA 2016a) and SOPs (BASMAA 2016b). Stations were randomly selected using a probabilistic monitoring design. Seventeen of the sites were classified as urban and three were classified as non-urban.

The California Stream Condition Index is a statewide tool that translates benthic macroinvertebrate data into an overall measure of stream health. The CSCI is currently the most robust method of assessing aquatic biological health. There are also three benthic algae indices of biological integrity available (D18, H20, S2); however, the applicability of the algae IBIs in Santa Clara Valley streams is uncertain. This is due to several factors including:

- There is an overall dearth of soft algae taxa found in Santa Clara Valley streams. This may not reflect stream health, but it can significantly lower the scores of two of the algae IBIs (H20 and S2).
- The algae IBIs were developed for Southern California streams and may not provide adequate interpretations of Northern California algae communities.
- Statewide Algae Stream Condition Indices are currently being developed and are anticipated to be available in 2018.

Of the 20 sites monitored in WY 2017, nine sites (45%) were rated in good condition (CSCI scores ≥ 0.795); four sites (20%) rated as likely altered condition (CSCI score 0.635 – 0.795), and seven sites (35%) rated as very likely altered condition (≤ 0.635). The three sites with the lowest CSCI scores had a high proportion of impervious watershed area (> 30%) and were characterized as modified channels.

Relationships between potential stressors (physical habitat and water chemistry) and biological condition were explored on a limited basis using the WY 2017 dataset.

- Physical Habitat Assessment (PHAB) scores, a qualitative tool that assesses the overall habitat condition of the sampling reach during the assessment, were compared to biological condition indictor scores. PHAB consists of three attributes that are assessed for the entire bioassessment reach. These include channel alteration, epifaunal substrate and sediment deposition. Total PHAB scores were moderately correlated with CSCI scores (r^2=0.30, p value = 0.012) suggesting that physical habitat (e.g., substrate quality, channel alteration) has an influence on the BMI community. Individual physical habitat metrics associated with substrate size and composition were also slightly correlated with CSCI scores.
- Landscape variables were calculated for each of the watershed areas draining into the bioassessment sites. CSCI scores were moderately correlated (negatively) with impervious area and road density.

Stressor Assessment

Sites with CSCI scores and/or stressor levels exceeding applicable WQOs and triggers identified in the MRP will be considered as candidates for SSID projects.

- The eleven sites with CSCI scores below 0.795 will be considered as candidates for SSID projects.
- **General water quality** (pH, temperature, dissolved oxygen, specific conductance). Two measurements exceeded water quality objectives for pH: site 205R03011 (Berryessa Creek) and site 205R03443 (Calabazas Creek). The acute temperature threshold trigger (24°C) for salmonid fish was also exceeded at site 205R03443 (Calabazas Creek). These sites will be considered as candidates for SSID projects.
- **Nutrients and conventional analytes** (ammonia, unionized ammonia, chloride, AFDM, chlorophyll a, nitrate, nitrite, TKN, ortho-phosphate, phosphorus, silica). There were no water quality objective exceedances for water chemistry parameters, except for unionized ammonia (.025 mg/L) at site 205R03011 (Berryessa Creek), and site 205R03011 (Calabazas Creek). Both sites are at the bottom of highly urbanized watersheds and will be considered as candidates for SSID projects.

6.1.2 Targeted Monitoring for Temperature and General Water Quality

Targeted monitoring in WY 2017 was conducted in compliance with Provisions C.8.d.iii – v of the MRP. Hourly temperature measurements were recorded at nine sites in the Guadalupe River Watershed from April through September. Continuous (15-minute) general water quality measurements (pH, DO, specific conductance, temperature) were recorded at three sites in the Coyote Creek watershed during two 2-week periods in June (Event 1) and September (Event 2). Pathogen indicator grab samples were collected during a sampling event in July at five sites throughout Santa Clara County that coincide with public parks.

Continuous temperature, water quality, and pathogen indicator data generated during WY 2017 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or impacted biological conditions. The MRP identifies trigger criteria as the principal means of evaluating the creek status monitoring data to identify sites where water quality impacts may have occurred. Sites with targeted monitoring results exceeding the trigger criteria are identified as candidate SSID projects.

Temperature

All nine temperature stations in the Guadalupe River Watershed exceeded the MRP trigger threshold of having two or more weeks where the Maximum Weekly Average Temperature exceeded 17°C. None of the stations exceeded the maximum instantaneous trigger threshold of 24°C for more than 1% of total recorded samples. Based on the MWAT exceedances, the sites will be added to the list of candidate SSID projects. However, review of the monitoring data in the context of locally-derived temperature thresholds developed by NMFS (NMFS 2016) suggests that temperature may not be a limiting factor for salmonid habitat (i.e., summer rearing juveniles) in the study reaches, as long as sufficient dam releases maintain longitudinal connectivity and provide cooler water temperatures and potential refugia for juvenile steelhead during the summer.

General Water Quality

- Sites on Coyote Creek had no exceedances of the maximum temperature trigger threshold of 24°C but did exceed the MWAT trigger of 17°C for two consecutive weeks during both events and will therefore be added to the list of candidate SSID projects.
- The WQO for DO in waters designated as having cold freshwater habitat (COLD) Beneficial Uses (i.e., 7.0 mg/L) was not met in over 20% of the measurements recorded at all three water quality stations in Coyote Creek. The results were similar to the findings from the WY 2013 SSID study carried out at the same locations. The Coyote Creek DO SSID Study concluded that low DO concentrations are caused by low gradient channels with high amounts of accumulated organic matter. Furthermore, this reach Coyote Creek currently supports habitat and water quality that may be suitable for a warm water fishery and not for cold water fishery.
- Values for pH and specific conductance measured at the three sites in Coyote Creek during WY 2017 did not exceed their respective triggers during either event.

Pathogen Indicators

- Pathogen indicator densities were measured at five targeted sites during WY 2017. Although none of the stations could be considered “bathing beaches,” monitoring locations were selected at city parks or trails that were considered to have a relatively high potential for public access. The MRP trigger threshold for *E. coli* (410 cfu/100 ml) was exceeded at two sites: Arroyo Calero at Singer Park and Saratoga Creek at Wildwood Park. The MRP trigger threshold for enterococcus (130 cfu/100 ml) was exceeded at four sites: Arroyo Calero at Singer Park, Saratoga Creek at Wildwood Park, Stevens Creek at Blackberry Farm, and Matadero Creek at BOL Park. These sites will be added to the list of candidate SSID projects.
- 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. Pathogen indicators observed at the WY 2017 stations may not be associated with human sources and therefore may not pose a threat to human health. As a result, the comparison of pathogen indicator results to water quality

objectives and criteria for full body contact recreation may not be appropriate and should be interpreted cautiously.

- The State Water Resources Control Board is currently in the process of adopting modified WQOs for enterococci and *E. coli* based on USEPA criteria that will serve as new MRP Trigger Thresholds. A statistical threshold value for enterococci of 320 cfu/100mL will be used for samples in waters where the salinity is less than 10 parts per thousand 95% of the time, and a statistical threshold value for *E. coli* of 110 cfu/100mL will be used for samples in waters where the salinity is equal to or greater than 10 parts per thousand 95% of the time. The new statistical threshold values correspond with an Estimated Illness Rate (NGI) of 32 per 1,000 water contact recreators.[24]

6.1.3 Chlorine Monitoring

Free chlorine and total chlorine residual were measured concurrently with bioassessments at the twenty probabilistic sites (and two additional SSID sites) in compliance with provision C.8.c.ii. While chlorine residual is generally not a concern in Santa Clara Valley urban creeks, WY 2017 and prior monitoring results suggest there are occasional free chlorine and total chlorine residual exceedances in the County. In WY 2017, exceedances of the MRP trigger for chlorine (0.1 mg/L) were detected at one station (Arroyo Aguague). City of Milpitas illicit discharge staff were notified of the exceedance but did not observe exceedances during followup monitoring. The exceedance was likely the result of a one-time potable water discharge and it is generally very difficult to determine the source of elevated chlorine from such episodic discharges. The Program will continue to monitor chlorine in compliance with the MRP and will follow-up with illicit discharge staff as needed.

6.1.4 Pesticides and Toxicity Monitoring

In WY 2017, SCVURPPP conducted dry weather pesticides and toxicity monitoring at two stations (Stevens Creek and San Tomas Aquino Creek) in compliance with provision C.8.g of the MRP.

Statistically significant toxicity to *C. dubia* (reproduction) was observed in water samples collected from both sites in July 2017. The magnitude of the toxic effects in the San Tomas Aquino Creek sample was not great and did not exceed MRP trigger criteria. However, the magnitude of the toxic effects in the Stevens Creek sample did exceed the MRP threshold for re-sampling (i.e., 50 Percent Effect). Statistically significant toxicity to *C. dubia* was not observed in the second sample collected from Stevens Creek in August 2017. The cause of the toxicity observations is unknown. Pesticide concentrations in the sediment samples were all very low, most below MDLs and calculated TU equivalents did not exceed 0.09 in either sample.

TEC and PEC quotients were calculated for all metals and total PAHs (calculated as the sum of 24 individual PAHs) measured in sediment samples. Both sites had at least one TEC or PEC quotient exceeding 1.0. In compliance with the MRP, both stations will therefore be placed on the list of candidate SSID projects. Decisions about which SSID projects to pursue should be informed by the fact that most of the TEC and PEC quotient exceedances are related to naturally occurring chromium and nickel.

SCVURPPP will continue to sample the same two stations for dry weather pesticides and toxicity throughout the permit term. In WY 2018, SCVURPPP will work with the BASMAA RMC partners to implement a regional approach to wet weather pesticides and toxicity monitoring.

6.2 Trigger Assessment

The MRP requires analysis of the monitoring data to identify candidate sites for SSID projects. Trigger thresholds against which to compare the data are provided for most monitoring parameters in the MRP and are described in the foregoing sections of this report. Stream condition was determined based on

[24] See http://www.waterboards.ca.gov/bacterialobjectives/ for more information.

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. Nutrient data were evaluated using applicable water quality standards from the Basin Plan. In compliance with provision C.8.e.i of the MRP, all monitoring results exceeding trigger thresholds are added to a list of candidate SSID projects that will be maintained throughout the permit term. Follow up SSID projects will be selected from this list. Table 6.1 lists candidate SSID projects based on WY 2017 Creek Status and Pesticides/Toxicity 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 6.1. Summary of SCVURPPP Trigger Threshold Exceedance Analysis, WY 2017. "No" indicates samples were collected but did not exceed the MRP trigger; "Yes" indicates an exceedance of the MRP trigger.

Station ID	Creek	Bioassessment [1]	Nutrients [2]	Chlorine [3]	Water Toxicity [4]	Sediment Toxicity [4]	Sediment Chemistry [5]	Continuous Temperature [6]	Dissolved Oxygen [7]	pH [8]	Specific Conductance [9]	Pathogen Indicators [10]
205R00570	Trib to Aldercroft Cr	No	No	No	--	--	--	--	--	--	--	--
205R00609	Hunting Hollow	Yes	No	No	--	--	--	--	--	--	--	--
205R00645	Packwood Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R02693	Packwood Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R02755	Berryessa Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R02787	Matadero Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R02915	Stevens Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R02947	Lower Penitencia	Yes	No	Yes	--	--	--	--	--	--	--	--
205R03011	Berryessa Creek	No	Yes	No	--	--	--	--	--	--	--	--
205R03091	Arroyo Aguague	No	No	No	--	--	--	--	--	--	--	--
205R03098	Guadalupe Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R03235	Stevens Creek	No	No	No	--	--	--	--	--	--	--	--
205R03306	Saratoga Creek	No	No	No	--	--	--	--	--	--	--	--
205R03331	Los Gatos Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R03354	Guadalupe Creek	No	No	No	--	--	--	--	--	--	--	--
205R03386	Aldercroft Creek	No	No	No	--	--	--	--	--	--	--	--
205R03418	Alamitos Creek	Yes	No	No	--	--	--	--	--	--	--	--
205R03443	Calabazas Creek	Yes	Yes	No	--	--	--	--	--	--	--	--
205R03523	Upper Penitencia Creek	No	No	No	--	--	--	--	--	--	--	--
205R03530	Los Gatos Creek	Yes	No	No	--	--	--	--	--	--	--	--
205LGA400	Los Gatos Creek	--	--	--	--	--	--	--	--	--	--	No
205MAT030	Matadero Creek	--	--	--	--	--	--	--	--	--	--	Yes
205STE064	Stevens Creek	--	--	--	--	--	--	--	--	--	--	Yes
205GUA225	Arroyo Calero	--	--	--	--	--	--	--	--	--	--	Yes
205SAR075	Saratoga Creek	--	--	--	--	--	--	--	--	--	--	Yes
205GUA210	Guadalupe Creek	--	--	--	--	--	--	Yes	--	--	--	--
205GUA202	Guadalupe Creek	--	--	--	--	--	--	Yes	--	--	--	--
205GUA190	Guadalupe Creek	--	--	--	--	--	--	Yes	--	--	--	--
205GUA270	Alamitos Creek	--	--	--	--	--	--	Yes	--	--	--	--
205GUA340	Arroyo Calero	--	--	--	--	--	--	Yes	--	--	--	--
205GUA225	Arroyo Calero	--	--	--	--	--	--	Yes	--	--	--	--
205GUA262	Alamitos Creek	--	--	--	--	--	--	Yes	--	--	--	--
205GUA255	Alamitos Creek	--	--	--	--	--	--	Yes	--	--	--	--
205GUA250	Alamitos Creek	--	--	--	--	--	--	Yes	--	--	--	--
205COY235	Coyote Creek	--	--	--	--	--	--	Yes	Yes	No	No	--
205COY236	Coyote Creek	--	--	--	--	--	--	Yes	Yes	No	No	--
205COY239	Coyote Creek	--	--	--	--	--	--	Yes	Yes	No	No	--
205STE021	Stevens Creek	--	--	--	No	No	Yes	--	--	--	--	--
205STQ010	San Tomas Aquino	--	--	--	No	No	Yes	--	--	--	--	--

Notes:

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

6.3 Management Implications

The Program's Creek Status and Pesticides and Toxicity Monitoring programs (consistent with MRP provisions C.8.c and C.8.g, respectively) focus on assessing the water quality condition of urban creeks in the Santa Clara Valley and identifying stressors and sources of impacts observed. The sample size from WY 2017 (overall n=20; urban n=17) is not sufficient to develop statistically representative conclusions regarding the overall condition of all creeks. However, it builds on data collected in WY 2012 through WY 2016 which are currently being analyzed by a BASMAA RMC regional project. The BASMAA regional project will assess stream conditions and stressors for the five-year dataset (WY 2012 – WY 2016) on regional and countywide basis. It will review and develop statistical tools that can be utilized in the future to analyze the growing dataset. It will also recommend options for modifying the RMC creek status monitoring program during the next reissue of the MRP, perhaps with a focus on trends monitoring.

Like previous years, WY 2017 data suggest 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 the past 50 plus years. Additionally, episodic or site-specific increases in temperature (particularly in lower creek reaches) may not be optimal for aquatic life in local creeks.

The Program and its Co-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 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 development (LID) methods, such as rainwater harvesting and use, infiltration and biotreatment are required as part of development and redevelopment projects. In addition, Green Infrastructure planning is now part of all municipal projects. These LID measures are expected to reduce the impacts of urban runoff and associated impervious surfaces on stream health.
- In compliance with MRP provision C.9, the Program and Co-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, it is estimated that the amount of pyrethroids observed in urban stormwater runoff will decrease by 80-90% over time, and in turn significantly reduce the magnitude and extent of toxicity in local creeks.
- Trash loadings to local creeks have been reduced through implementation of new control measures in compliance with MRP provision C.10 and other efforts by Co-permittees to reduce the impacts of illegal dumping directly into waterways. These actions include the installation and maintenance of trash capture systems, the adoption of ordinances to reduce the impacts of litter prone items, enhanced institutional controls such as street sweeping, and the on-going removal and control of direct dumping. The MRP establishes a mandatory trash load reduction schedule, minimum areas to be treated by trash full capture systems, and requires development of receiving water monitoring programs for trash.
- In compliance with MRP 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) Co-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.

- In compliance with MRP provision C.13, copper in stormwater runoff is reduced through implementation of controls such as architectural and site design requirements, prohibition of discharges from water features treated with copper, and industrial facility inspections.
- Mercury and polychlorinated biphenyls (PCBs) in stormwater runoff are being reduced through implementation of the respective TMDL water quality restoration plans. In compliance with MRP provisions C.11 (mercury) and C.12 (PCBs), the Program will continue to identify sources of these pollutants and will implement control actions designed to achieve new minimum load reduction goals. Monitoring activities conducted in WY 2076 that specifically target mercury and PCBs are described in the Pollutants of Concern Monitoring Data Report that is included as Appendix E to the WY 2017 UCMR.

In addition to the Program and Co-permittee controls implemented in compliance with the MRP, numerous other efforts and programs designed to improve the biological, physical and chemical condition of local creeks are underway. For example, the Santa Clara Valley Water District's "One Water Plan" is an ongoing, multi-year process to develop a framework and watershed-specific plans for long-term management of Santa Clara County water resources. The One Water Plan will identify, prioritize and implement activities at a watershed scale to meet flood protection, water supply, water quality and environmental stewardship goals and objectives. The Santa Clara Valley Water District is also using Proposition 1 grant funds to develop a Storm Water Resource Plan for the Santa Clara Basin that will support the development and implementation of MRP-required Green Infrastructure Plans and produce a list of prioritized runoff capture and use projects eligible for future State implementation grant funds. Through the continued implementation of MRP-associated and other watershed stewardship programs, SCVURPPP anticipates that stream conditions and water quality in local creeks will continue to improve overtime. 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 "gray" infrastructure and disconnect from creeks those impervious areas constructed over the course of the past 50-plus years will take time to implement. Consequently, it may take several decades to observe the 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.

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ATTACHMENTS

Attachment 1

QA/QC Report

Quality Assurance/Quality Control Report

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Prepared for:

Santa Clara Valley
Urban Runoff
Pollution Prevention Program

March 31, 2018

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ACRONYMS

BASMAA	Bay Area Stormwater Management Agencies Association
BMI	Benthic Macroinvertebrates
CDFW	California Department of Fish and Wildlife
DQO	Data Quality Objective
EDDs	Electronic data deliverables
EV	Expected Value
KLI	Kinnetic Laboratories, Inc.
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
MPN	Most Probably Number
MQO	Measurement Quality Objective
MRP	Municipal Regional Permit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MV	Measured Value
ND	Non-detect
NIST	National Institute of Standards and Technology
NPDES	National Pollution Discharge Elimination System
NV	Native Value
PAH	Polycyclic Aromatic Hydrocarbon
PR	Percent Recovery
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RMC	Regional Monitoring Coalition
RPD	Relative Percent Difference
SAFIT	Southwest Association of Freshwater Invertebrate Taxonomists
SCCWRP	Southern California Coastal Water Research Project

SCVURPPP	Santa Clara Valley Urban Pollution Prevention Program
SFRWQCB	San Francisco Regional Water Quality Control Board
SOP	Standard Operating Procedures
STE	Standard Taxonomic Effort
SV	Spike Value
SWAMP	Surface Water Ambient Monitoring Program
TKN	Total Kjeldahl Nitrogen
WY	Water Year

1. INTRODUCTION

In Water Year 2017 (WY 2017; October 1, 2016 through September 30, 2017), the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) conducted Creek Status Monitoring in compliance with provision C.8.d and dry weather Pesticide & Toxicity Monitoring in compliance with provision C.8.g of the National Pollutant Discharge Elimination System (NPDES) stormwater permit for Bay Area municipalities referred to as the Municipal Regional Permit (MRP). The monitoring strategy includes regional ambient/probabilistic monitoring and local “targeted” monitoring as described in the Bay Area Stormwater Management Agencies Association (BASMAA) Regional Monitoring Coalition (RMC) Creek Status and Long-Term Trends Monitoring Plan (BASMAA 2012). SCVURPPP implemented a comprehensive data quality assurance and quality control (QA/QC) program, covering all aspects of the probabilistic and targeted monitoring. QA/QC for data collected was performed according to procedures detailed in the Quality Assurance Project Plan (QAPP) developed by the BASMAA RMC (BASMAA 2016a) and BASMAA RMC Standard Operating Procedures (SOP; BASMAA 2016b), SOP FS-13 (Standard Operating Procedures for QA/QC Data Review). The BASMAA RMC SOP and QAPP are based on the SOP and QAPP developed by the Surface Water Ambient Monitoring Program (SWAMP; SCCWRP 2008).

Based on the QA/QC review, no WY 2017 data were rejected and some data were flagged. Overall, WY 2017 data met QA/QC objectives. Details are provided in the sections below.

1.1. DATA TYPES EVALUATED

During creek status monitoring, several data types were collected and evaluated for quality assurance and quality control. These data types include the following:

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

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

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

1.2. LABORATORIES

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

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

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

1.3. QA/QC ATTRIBUTES

The RMC SOP and QAPP identify seven data quality attributes that are used to assess data QA/QC. They include (1) Representativeness, (2) Comparability, (3) Completeness, (4) Sensitivity, (5) Precision, (6) Accuracy, and (7) Contamination. These seven attributes are compared to Data Quality Objectives (DQOs), which were established to ensure that data collected are of adequate quality and sufficient for the intended uses. DQOs address both quantitative and qualitative assessment of the acceptability of data – representativeness and comparability are qualitative while completeness, sensitivity, precision, accuracy, and contamination are quantitative assessments.

Specific DQOs are based on Measurement Quality Objectives (MQOs) for each analyte. Chemical analysis relies on repeatable physical and chemical properties of target constituents to assess accuracy and precision. Conversely, biological data are quantified by experienced taxonomists relying on organism morphological features.

1.3.1. Representativeness

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

1.3.2. Comparability

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

1.3.3. Completeness

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

1.3.4. Sensitivity

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

1.3.5. Accuracy

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

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

1.3.6. Precision

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

1.3.7. Contamination

For chemical data, contamination is assessed as the presence of analytical constituents in blank samples. The RMC QAPP also requires collection and analysis of field blank samples at a rate of 5% for orthophosphate.

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

2. METHODS

2.1. REPRESENTATIVENESS

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

2.2. COMPARABILITY

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

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

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

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

2.3. COMPLETENESS

2.3.1. Data Collection

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

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

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

2.3.2. Field Sheets

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

2.3.3. Laboratory Results

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

2.4. SENSITIVITY

2.4.1. Biological Data

Benthic macroinvertebrates were identified to SAFIT STE Level I.

2.4.2. Chemical Analysis

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

2.5. ACCURACY

2.5.1. Biological Data

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

2.5.2. Chemical Analysis

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

For reference materials, percent recovery was calculated as:

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

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

For matrix spikes, percent recovery was calculated as:

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

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

2.5.3. Water Quality Data Collection

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

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

2.6. PRECISION

2.6.1. Field Duplicates

For creek status monitoring, duplicate biological samples were collected at 10% (two) of the 20 probabilistic sites and duplicate water chemistry samples were collected at 10% (two) of the probabilistic sites sampled to evaluate precision of field sampling methods. The relative percent difference (RPD) for water chemistry field duplicates was calculated and compared to the MQO (RPD < 25%) set by Table 26-1 in Appendix A of the RMC QAPP. If the RPD of the two field duplicates did not meet the MQO, the results were flagged.

The RMC QAPP requires collection and analysis of duplicate sediment chemistry and toxicity samples at a rate of 5% of total samples collected for the project. For WY 2017, one field duplicate was collected in Alameda County for dry weather sediment chemistry, sediment toxicity, and water toxicity sample to account for the six pesticide & toxicity sites collectively monitored by the RMC in WY 2017. The sediment sample and field duplicate were collected together using the Sediment Scoop Method described in the RMC SOP, homogenized, and then distributed to two separate containers. For sediment chemistry field duplicates, the RPD was calculated for each analyte and compared to the MQOs (RPD < 25%) set by Tables 26-7 through 26-11 in Appendix A of the RMC QAPP. For sediment and water toxicity field duplicates, the RPD of the batch mean was calculated and compared to the recommended acceptable RPD (< 20%) set by Tables 26-12 and 26-13 in Appendix A. If the RPD of the field duplicates did not meet the MQO, the results were flagged.

The RPD is calculated as:

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

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

No field duplicate is required for pathogen indicators.

2.6.2. Chemical Analysis

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

2.7. CONTAMINATION

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

3. RESULTS

3.1. OVERALL PROJECT REPRESENTATIVENESS

The SCVURPPP staff and field crew members were trained in SWAMP and RMC protocols, and received significant supervision from the local monitoring coordinator and QA officer. As a result, creek status monitoring data was considered to be representative of conditions in Santa Clara Valley Creeks.

3.2. OVERALL PROJECT COMPARABILITY

SCVURPPP creek status monitoring data was considered to be comparable to both other agencies in the RMC and to SWAMP due to trainings, use of the same electronic data templates, and close communication.

3.3. BIOASSESSMENTS AND PHYSICAL HABITAT ASSESSMENTS

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

3.3.1. Completeness

SCVURPPP completed bioassessments and physical habitat assessments for 20 of 20 planned/required sites for a 100% sampling completion rate. However, physical habitat assessments could not be taken at several transects due to inaccessibility.

3.3.2. Sensitivity

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

The reporting limit for ash free dry mass analysis (8 mg/L) was much higher than the RMC QAPP target reporting limits (2 mg/L) due to high concentrations requiring large dilutions. The results were several orders of magnitude higher than the actual and target reporting limit and were not affected by the higher reporting limit. Similarly, the chlorophyll a analytical reporting limits (50 mg/L) were an order of magnitude higher than the QAPP target limits (5 mg/L). Again, reporting limits were elevated due to large dilutions as concentrations were well above the analytical reporting limit and were not impacted by the elevated reporting limit.

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

3.3.3. Accuracy

The two BMI samples that were submitted to a separate QC taxonomic laboratory had a total of eight specimen misidentifications and two minor counting errors. The QC laboratory calculated sorting and taxonomic identification metrics, which were compared to the measurement quality objectives in Table 27-1 in Appendix B of the RMC QAPP. All MQOs were met except for the Taxa ID Error Rate for one of the samples. A comparison of the metrics with the MQOs is shown in Table 1. A copy of the QC laboratory report is available upon request.

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

Table 1. Quality control metrics for taxonomic identification of benthic macroinvertebrates collected in Santa Clara County in WY 2017 compared to measurement quality objectives.

Quality Control Metric	MQO	Sample 1		Sample 2	
		Error Rate	Exceeds MQO?	Error Rate	Exceeds MQO?
Recount Accuracy	> 95%	99.34%	No	100%	No
Taxa ID	≤ 10%	11.43%	Yes	6.67%	No
Individual ID	≤ 10%	1.81%	No	0.33%	No
Low Taxonomic Resolution Individual	≤ 10%	0%	No	0%	No
Low Taxonomic Resolution Count	≤ 10%	0%	No	0%	No
High Taxonomic Resolution Individual	≤ 10%	0%	No	0%	No
High Taxonomic Resolution Count	≤ 10%	0%	No	0%	No

3.3.4. Precision

Field blind duplicate chlorophyll a and ash free dry mass samples were collected at two sites in WY 2017 and were sent to the laboratory for analysis.

Duplicate field samples do not provide a valid estimate of precision in the sampling and are of little use to assessing precision, because there is no reasonable expectation that duplicates will produce identical data. Nonetheless, the RPD of the cholorophyll a and ash free dry mass duplicate results were calculated and compared to the MQO (< 25%) for conventional analytes in water (Table 26-1 in Appendix B of the RMC QAPP). Due to the nature of chlorophyll a and ash free dry mass collection, the RPDs for both parameters are expected to exceed the MQO. However, the RPD for the two analytes for the first sample exceeded the MQO, but the RPD for the second duplicate sample did not. The field duplicate results and their RPDs are shown in Table 2.

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

Table 2. Field duplicate water chemistry results for sites 205R00609, collected on May 10, 2017 and 205R03418, collected June 8, 2017.

Analyte	Units	205R00609 May 10, 2017				205R03418 June 8, 2017			
		Original Result	Duplicate Result	RPD	Exceeds MQO (>25%)[a]	Original Result	Duplicate Result	RPD	Exceeds MQO (>25%)[a]
Chlorophyll a	mg/m^2	12.0	8.4	35%	Yes	219.2	192.5	13%	No
Ash Free Dry Mass	g/m^2	21.5	44.3	69%	Yes	73.8	84.9	14%	No

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

3.3.5. Contamination

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

3.4. FIELD MEASUREMENTS

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

3.4.1. Completeness

Temperature, dissolved oxygen, pH, specific conductivity, total chlorine residual, and free chlorine residual were collected at all 20 bioassessment sites, but the oxygen sensor malfunctioned at five sites, and was subsequently replaced with the other multi-parameter instrument. Consequently, oxygen results at those sites were flagged and rejected. The overall completeness rate was 75% for oxygen, but 100% for all other measurements.

3.4.2. Sensitivity

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

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

3.4.3. Accuracy

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

3.4.4. Precision

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

3.5. WATER CHEMISTRY

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

3.5.1. Completeness

SCVURPPP collected 100% of planned/required water chemistry samples at the 20 bioassessment sites including field duplicate samples. The RMC QAPP requires duplicates to be collected at a frequency of 5% of the total project sample count. For 20 sites, SCVURPPP is required to collect one duplicate. In WY 2017, staff collected duplicate water chemistry samples at two sites, exceeding the 5% requirement. Samples were analyzed for all requested analytes, and 100% of results were reported. Water chemistry data were flagged when necessary, but none were rejected.

3.5.2. Sensitivity

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

The reporting limit (0.05 mg/L) and method detection limit (0.02 mg/L) for nitrate samples were higher than the target reporting limit (0.01 mg/L). As a result, three samples were flagged as "detected, not quantified," but they all would have been quantified at the lower reporting limit. Additionally, the nitrate concentrations at three other sites were below the method detection limit. SCVURPPP has discussed the reporting limits with Caltest, and there is the possibility for a lower reporting limit for future analysis. Target and actual reporting limits are shown in Table 3.

Table 3. Target and actual reporting limits for nutrients analyzed in SCVURPPP creek status monitoring. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

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

3.5.3. Accuracy

Recoveries on all laboratory control samples (LCS) were within the MQO target range of 80-120% recovery, and most matrix spikes (MS) and matrix spike duplicates (MSD) percent recoveries (PR) were within the target range. Several MS/MSD percent recoveries exceeded the MQO range listed in the RMC QAPP for various conventional analytes, including ammonia, nitrate, nitrite, total Kjeldahl nitrogen (TKN), chloride, and silica. These QA samples affected 12 sites, whose results have been assigned the appropriate SWAMP flag.

The PR ranges on laboratory reports were 70-130%, 85-115% or 90-110% for some conventional analytes (nutrients) while the RMC QAPP lists the PR as 80-120% for all conventional analytes in water. As a result, some QA samples that exceeded RMC MQOs were flagged by the local QA officer, but not by the laboratory and vice versa.

3.5.4. Precision

The relative percent differences (RPD) for all laboratory control sample and matrix spike duplicate pairs were consistently below the MQO target of < 25%.

Nutrient field duplicates were collected at two sites in Santa Clara County and were compared against the original samples. The ammonia field duplicate sample collected at site 205R00609 exceeded the RPD MQO and the total Kjeldahl nitrogen duplicate sample collected at site 205R03418 exceeded the RPD MQO. In past years of sampling, total Kjeldahl nitrogen has been common among the analytes that exceed the field duplicate RPD MQOs. Field crews will continue to make an effort in subsequent years to collect the original and duplicate samples in an identical fashion.

The field duplicate water chemistry results and their RPDs are shown in Tables 4 and 5. Because of the variability in reporting limits, values less than the Reporting Limit (RL) were not evaluated for RPD. For those analytes whose RPDs could be calculated and did not meet the RMC MQO, they were assigned the appropriate SWAMP flag.

Table 4. Field duplicate water chemistry results for site 205R00609, collected on May 10, 2017. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

Analyte Name	Fraction Name	Unit	Original Result	Duplicate Result	RPD	Exceeds MQO (>25%)[a]
Ammonia as N	Total	mg/L	0.058	0.034	52%	Yes
Chloride	None	mg/L	28	28	0%	No
Nitrate as N	None	mg/L	< 0.02	< 0.02	N/A	N/A
Nitrite as N	None	mg/L	< 0.001	< 0.001	N/A	N/A
Nitrogen, Total Kjeldahl	None	mg/L	0.97	0.88	10%	No
Orthophosphate as P	Dissolved	mg/L	0.01	J 0.007	N/A	N/A
Phosphorus as P	Total	mg/L	0.015	J 0.007	N/A	N/A
Silica as SiO2	Total	mg/L	17	17	0%	No

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

Table 5. Field duplicate water chemistry results for site 205R03418, collected on June 8, 2017. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

Analyte Name	Fraction Name	Unit	Original Result	Duplicate Result	RPD	Exceeds MQO (>25%)[a]
Ammonia as N	Total	mg/L	0.11	0.12	9%	No
Chloride	None	mg/L	19	19	0%	No
Nitrate as N	None	mg/L	0.088	0.095	8%	No
Nitrite as N	None	mg/L	J 0.002	J 0.002	N/A	N/A
Nitrogen, Total Kjeldahl	None	mg/L	0.57	0.35	48%	Yes
Orthophosphate as P	Dissolved	mg/L	0.022	0.024	9%	No
Phosphorus as P	Total	mg/L	0.088	0.095	8%	No
Silica as SiO2	Total	mg/L	20	20	0%	No

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

3.5.5. Contamination

None of the target analytes were detected in any of the laboratory blanks at levels above their reporting limit. All analytes were non-detect in the laboratory blanks. The RMC QAPP does not require field blanks to be collected, and possible contamination from sample collection could not be assessed. However, the SCVURPPP field crew takes appropriate precautions to avoid contamination, including wearing gloves during sample collection and rinsing sample containers with stream water when preservatives are needed.

3.6. Pathogen Indicators

Pathogen indicator samples were collected by SCVURPPP staff and were analyzed by Alpha Analytical Laboratories, Inc. Samples were collected July 27, 2017, and were received and incubated by the laboratory well within the 8-hour hold time. The laboratory tested the samples for the presence of *E. coli* and enterococcus.

3.6.1. Completeness

All five required/planned pathogen indicator samples were collected for a 100% completeness rate.

3.6.2. Sensitivity

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

3.6.3. Accuracy

Negative and positive laboratory controls were run for microbial media. A negative response was observed in the negative control and a positive response was observed in the positive control required by the project QAPP Table 26-4.

3.6.4. Precision

The RMC QAPP does not require a field duplicate to be collected for pathogen indicators, but it does require one laboratory duplicate to be run per 10 samples or per analytical batch, whichever is more frequent. In WY 2017, five *E.coli* and five enterococcus samples were collected, and one laboratory duplicate was run for each analyte. However, determining precision for pathogen indicators requires 15 duplicates sets. Due to the small number of samples collected for this project, there were not enough laboratory duplicates to determine precision. The RPD for the laboratory duplicates that were run were 35.2% for E. coli and 13.6% for enterococcus. These values have no significance without an pathogen indicator MQO for RPD.

3.6.5. Contamination

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

3.7. Continuous Water Quality

Continuous water quality measurements were recorded at three sites during the spring (June 2017), concurrent with bioassessments, and again in the summer (September 2017) in compliance with the MRP. Temperature, pH, dissolved oxygen, and specific conductivity were recorded once every 15 minutes for approximately two-weeks using a multi-parameter water quality sonde (YSI 6600-V2).

3.7.1. Completeness

The MRP requires one to two-week deployments, and both deployments exceeded the one week minimum. The first deployment lasted 15 days while the second deployment lasted 10 days. Sondes collected data for 100% of the planned deployments, and no data were rejected.

3.7.2. Sensitivity

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

3.7.3. Accuracy

Internal SCVURPPP staff calibrate sondes before deployment and upon retrieval, but the calibration records for the post-deployment calibration could not be found for all three sites during the first event and for the sonde deployed at 205COY239 during the second event. As a result, drift could only be calculated for two sites during the second deployment. A summary of the drift measurements is shown in Table 6. These sondes have been used in other non-SCVURPPP projects, concurrent with SCVURPPP creek status monitoring, and during past years. Rarely were data rejected because of excessive drift, and thus none of the continuous monitoring data were rejected for missing drift calculations. It is assumed the drift during these deployments was within the allowable range. The sonde deployed at 205COY235 during the second event had no drift issues, but the sonde deployed at 205COY236 exceeded the dissolved oxygen measurement quality objective. Oxygen results at this site were subsequently flagged for this deployment.

Table 6. Drift measurements for two continuous water quality monitoring events in Santa Clara Valley urban creeks during WY 2017. Bold and highlighted values exceeded measurement quality objectives. N/A indicates that a drift check could not be calculated due to missing records.

Parameter	Measurement Quality Objectives	205COY235		205COY236		205COY239	
		Event 1	Event 2	Event 1	Event 2	Event 1	Event 2
Dissolved Oxygen (mg/l)	± 0.5 mg/L or 10%	N/A	0.1	N/A	0.82	N/A	N/A
pH 7.0	± 0.2	N/A	0.02	N/A	-0.06	N/A	N/A
pH 10.0	± 0.2	N/A	-0.03	N/A	0	N/A	N/A
Specific Conductance (uS/cm)	± 10%	N/A	-0.2%	N/A	-0.4%	N/A	N/A

3.7.4. Precision

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

3.8. Continuous Temperature Monitoring

Continuous temperature monitoring was conducted from April through September 2016 at nine sites in Santa Clara. Onset HOBO Water Temperature Data loggers recorded one measurement per hour.

3.8.1. Completeness

The MRP requires SCVURPPP to monitor eight stream reaches for temperature each year, but in past years one to two loggers have been lost during the deployment. Anticipating a lost HOBO temperature logger, SCVURPPP deployed one extra temperature logger, for a total of nine loggers. In the middle of the deployment, SCVURPPP staff checked the loggers to ensure that they were still in the present and recording. During the field check, staff also downloaded the existing data and redeployed the loggers. Since all nine loggers recorded 100% of the deployment period, SCVURPPP achieved a completion rate of over 100%.

3.8.2. Sensitivity

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

3.8.3. Accuracy

A pre-deployment accuracy check was run on the temperature loggers in March 2017. Several of the loggers exceeded the 0.2 °C mean difference for the room temperature bath (<0.25 °C), but none exceeded the 0.2 °C mean difference for the ice bath. The deviations were attributed to poor mixing. Consequently, the accuracy check was conducted again for all loggers. During the second accuracy check none of the loggers exceeded the mean difference for either temperature. All tested loggers were deployed, and no data were flagged.

3.8.4. Precision

There are no precision protocols for continuous temperature monitoring.

3.9. SEDIMENT CHEMISTRY

Dry season sediment chemistry samples were collected by Kinnetic Laboratories, Inc (KLI) concurrently with dry season toxicity samples on July 13, 2017. Inorganic and synthetic organic compounds were analyzed by Caltest and grain size distribution was analyzed by Soil Control Laboratories, a subcontractor laboratory. All samples were analyzed within the one year holding time for analytes in sediment, set by the RMC SOP. Caltest conducted all QA/QC requirements as specified in the RMC QAPP and reported their findings to the RMC. Key sediment chemistry MQOs are listed in RMC QAPP Tables 26-9 through 26-11. Sediment chemistry data were flagged when necessary, but none were rejected

3.9.1. Completeness

Both planned/required samples were collected and analyzed for all requested analytes, and 100% of results were reported.

3.9.2. Sensitivity

A comparison of target and actual reporting limits for those parameters is shown in Table 7. Note that reporting limits for a particular analyte may vary within the same batch due a difference in percent solids for each sample. Similarly, reporting limits may exceed target reporting limits due to the percent solids of a particular sample. For sediment chemistry analysis conducted in WY 2017, laboratory reporting limits were higher than RMC QAPP target reporting limits for analytes except for except for bifenthrin.

Table 7. Comparison of target and actual reporting limits for sediment analytes where reporting limits exceeded target limits. Sediment samples were collected in Santa Clara County creeks in WY 2017.

Analyte	Target RL mg/kg	Actual RL mg/kg
Arsenic	0.3	0.50-0.53
Cadmium	0.01	0.04
Chromium	0.1	0.5-0.53
Copper	0.01	0.2-0.21
Lead	0.01	0.1-0.11
Nickel	0.02	0.1-0.11
Zinc	0.1	1.0-1.1
Bifenthrin	0.33	0.33
Permethrin	0.03	0.33

3.9.3. Accuracy

<u>Inorganic Analytes</u>

No QA samples exceeded the QAPPP MQO for LCS or MS percent recovery (PR) for metals (75-125%).

Synthetic Organic Compounds

The percent recovery MQO for pyrethroids and other synthetic organic compounds in sediment is 50-150% in the RMC QAPP. However, the PR MQOs listed in the laboratory reports for synthetic organic compounds varied by analyte and were much larger than PR ranges listed in the QAPP. The MQOs ranged from 1 to 275% in certain cases. As a result, several analytes were flagged by the local QA officers, but not by the laboratory.

None of the laboratory control sample (LCS) percent recoveries exceeded the RMC MQO range. However, the MS/MSD percent recoveries exceeded the RMC MQO range for 12 PAHs and one pyrethroid (deltamethrin). The PAHs MS/MSD samples that exceeded the PR MQO include benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(e)pyrene, benzo(k)fluoranthene, dibenz(a,h)anthracene, fluoranthene, 1-methylphenanthrene, naphthalene, perylene, phenanthrene, and pyrene.

3.9.4. Precision

Inorganic Analytes

The RMC QAPP lists the maximum RPD for inorganic analytes (metals) as 25%, while the laboratory report lists the maximum as 30% for most metals and 35% for mercury. Nevertheless, all the matrix spike duplicates for metals were well below the RMC RPD MQO of 25%.

Synthetic Organic Compounds

The maximum RPD for synthetic organics listed in the sediment laboratory report lists ranges from 30 to 50% for most analytes. However, the RMC QAPP lists the MQO as < 25% RPD for most synthetic organics, < 35% for pyrethroids and fipronil, and < 40% for carbaryl. Three MS/MSD pairs slightly exceeded the QAPP MQOs for RPD (< 25%), including benz(a)anthracene, benzo(k)fluoranthene, and perylene. These three analytes were flagged by the local QA officer, but not by the laboratory. None of the LCS duplicates exceeded the RPD MQO.

Field Duplicates

A sediment sample field duplicate was collected in Alameda County on July 13, 2017, and was evaluated for precision. The field duplicate sample and corresponding RPDs are shown in Table 8. Because of the variability in reporting limits, values less than the Reporting Limit (RL) were not evaluated for RPD. Analytes that exceeded the MQO of RPD < 25% were very coarse sand (1 to <2 mm), granules (2 to <4 mm), small pebbles (4 to <8 mm), and benzo(e)pyrene. The three particle size distribution categories that exceeded the MQOs are adjacent in size bins. When the three categories are combined into one larger category (1 to <8 mm), the RPD for the two samples is 25% as compared to 46-87%.

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

Table 8. Sediment chemistry duplicate field results for site 205R01198, collected on July 13, 2017 in Alameda County. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

Analyte		Unit	Original	Duplicate	RPD	Exceeds MQO? (<25%)[a]
Grain Size Distribution	Clay: <0.0039 mm	%	20.48	22.95	11.4%	No
	Silt: 0.0039 to <0.0625 mm	%	45.53	42.26	7%	No
	Sand: V. Fine 0.0625 to <0.125 mm	%	12.71	12.93	2%	No
	Sand: Fine 0.125 to <0.25 mm	%	13.3	13.09	2%	No
	Sand: Medium 0.25 to <0.5 mm	%	5.53	5.91	7%	No
	Sand: Coarse 0.5 to <1.0 mm	%	1.62	1.86	14%	No
	Sand: V. Coarse 1.0 to <2.0 mm	%	1.62	1.01	46%	Yes
	Granule: 2.0 to <4.0 mm	%	0.28	0.71	87%	Yes
	Pebble: Small 4 to <8 mm	%	0.93	0.48	64%	Yes
	Pebble: Medium 8 to <16 mm	%	ND	ND	N/A	N/A
	Pebble: Large 16 to <32 mm	%	ND	ND	N/A	N/A
	Pebble: V. Large 32 to <64 mm	%	ND	ND	N/A	N/A
Metals	Arsenic	mg/Kg dw	4.2	4.7	11%	No
	Cadmium	mg/Kg dw	0.55	0.57	4%	No
	Chromium	mg/Kg dw	45	47	4%	No
	Copper	mg/Kg dw	27	30	11%	No
	Lead	mg/Kg dw	38	37	3%	No
	Nickel	mg/Kg dw	56	57	2%	No
	Zinc	mg/Kg dw	130	140	7%	No
Pyrethroids (MQO <35%)	Bifenthrin	ng/g dw	3.1	3.2	3%	No
	Cyfluthrin, total	ng/g dw	0.49	0.58	17%	No
	Cyhalothrin, Total lambda-	ng/g dw	DNQ	DNQ	N/A	N/A
	Cypermethrin, total	ng/g dw	DNQ	DNQ	N/A	N/A
	Deltamethrin/Tralomethrin	ng/g dw	ND	ND	N/A	N/A
	Esfenvalerate/Fenvalerate, total	ng/g dw	ND	ND	N/A	N/A
	Permethrin, Total	ng/g dw	ND	0.96	N/A	N/A
	Total Organic Carbon	%	7.2	6.2	15%	No
	Carbaryl	mg/Kg dw	ND	ND	N/A	N/A
Fipronil	Fipronil	ng/g dw	ND	ND	N/A	N/A
	Fipronil Desulfinyl	ng/g dw	ND	ND	N/A	N/A
	Fipronil Sulfide	ng/g dw	ND	ND	N/A	N/A
	Fipronil Sulfone	ng/g dw	0.35	0.37	6%	No
Polycyclic Aromatic Hydrocarbons	Acenaphthene	ng/g dw	ND	ND	N/A	N/A
	Acenaphthylene	ng/g dw	ND	ND	N/A	N/A
	Anthracene	ng/g dw	ND	ND	N/A	N/A
	Benz(a)anthracene	ng/g dw	ND	ND	N/A	N/A
	Benzo(a)pyrene	ng/g dw	36	38	5%	No
	Benzo(b)fluoranthene	ng/g dw	60	63	5%	No
	Benzo(e)pyrene	ng/g dw	36	25	36%	Yes
	Benzo(g,h,i)perylene	ng/g dw	ND	ND	N/A	N/A
	Benzo(k)fluoranthene	ng/g dw	ND	ND	N/A	N/A
	Biphenyl	ng/g dw	ND	ND	N/A	N/A
	Chrysene	ng/g dw	120	130	8%	No
	Dibenz(a,h)anthracene	ng/g dw	ND	ND	N/A	N/A

Table 8. Sediment chemistry duplicate field results for site 205R01198, collected on July 13, 2017 in Alameda County. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

Analyte		Unit	Original	Duplicate	RPD	Exceeds MQO? (<25%)[a]
	Dibenzothiophene	ng/g dw	ND	ND	N/A	N/A
	Dimethylnaphthalene, 2,6-	ng/g dw	36	38	5%	No
	Fluoranthene	ng/g dw	240	250	4%	No
	Fluorene	ng/g dw	ND	ND	N/A	N/A
	Indeno(1,2,3-c,d)pyrene	ng/g dw	ND	ND	N/A	N/A
	Methylnaphthalene, 1-	ng/g dw	ND	ND	N/A	N/A
	Methylnaphthalene, 2-	ng/g dw	ND	ND	N/A	N/A
	Methylphenanthrene, 1-	ng/g dw	ND	ND	N/A	N/A
	Naphthalene	ng/g dw	ND	ND	N/A	N/A
	Perylene	ng/g dw	ND	ND	N/A	N/A
	Phenanthrene	ng/g dw	48	51	6%	No
	Pyrene	ng/g dw	120	130	8%	No

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

3.9.5. Contamination

Lead was detected in an instrument (lab) blank at a concentration above the reporting limit. As a result, lead samples were flagged. None of the other target analytes were detected in any of the blanks.

3.10. Toxicity Testing

Dry season water and sediment toxicity samples were collected by KLI concurrently with dry season sediment chemistry samples at two Santa Clara County sites on July 11, 2016. All toxicity tests were performed by Pacific EcoRisk. The water samples were analyzed for toxicity to four organisms (*Selenastrum capricornutum, Ceriodaphnia dubia, Pimephales promelas, and Hyalella azteca*) and the sediment samples were analyzed for toxicity to *Hyalella azteca* and *Chironomus dilutus.*

3.10.1. Completeness

The MRP requires the collection of dry season water toxicity samples and dry season sediment toxicity samples at two sites per year in Santa Clara County. All planned/required dry season water and sediment toxicity samples were collected in WY 2016. Pacific EcoRisk tested required organisms for toxicity, and 100% of results were reported.

3.10.2. Sensitivity and Accuracy

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

3.10.3. Precision

One field duplicate was collected in Alameda County and tested for toxicity by Pacific EcoRisk. The mean toxicity endpoints of test organisms (mean survival, mean cell count, mean biomass, and mean young per female) for the field duplicates were compared, and the RPD for each for toxicity test was calculated. These RPDs are compared to the RMC QAPP MQO of <20% for acute and chronic freshwater toxicity testing (Appendix A, Table 26-12 and 26-13) in Table 9. There is no MQO for sediment toxicity field duplicates listed in the RMC QAPP, so the recommended MQO listed in the RMC QAPP for the water toxicity field duplicates (< 20%) was used as an MQO for to sediment toxicity field duplicates.

Samples met the MQO for toxicity testing for all species and endpoints with the exception of the *Ceriodaphnia dubia* growth endpoint (see Table 9). This was the same outcome in WY 2016 sampling, suggests that *Ceriodaphnia dubia* growth is highly variable and perhaps is not a good indicator of toxicity in Bay Area creeks.

Table 9. Water and sediment toxicity duplicate results for site 20501198, collected on July 13, 2017 in Alameda County. Data in highlighted rows exceed monitoring quality objectives in RMC QAPP.

Matrix	Organism	Endpoint	Original Sample Mean	Duplicate Sample Mean	RPD	Exceeds Recommended MQO (<20%)?
Water	Pimephales promelas	% Survival	97.5	92.5	5%	No
Water	Pimephales promelas	Biomass (mg/individual)	0.537	0.556	3%	No
Water	Ceriodaphnia dubia	% Survival	100	100	0%	No
Water	Ceriodaphnia dubia	Young per female	18.7	26.3	34%	Yes
Water	Selenastrum capricornutum	Total Cell Count (cells/mL)	4750000	4940000	4%	No
Water	Hyalella azteca	% Survival	98	96	2%	No
Water	Chironomus dilutus	% Survival	93	92.5	0.5%	No
Sediment	Hyalella azteca	% Survival	63.8	60	6%	No
Sediment	Chironomus dilutus	% Survival	46.2	31.2	39%	No

3.10.4. Contamination

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

4. CONCLUSIONS

Sample collection and analysis generally followed MRP and RMC QAPP requirements, with the following exception:

- No post-deployment calibration records for the first continuous water quality monitoring event or the second event at 205COY239.

Data that exceeded measurement quality objectives were flagged, and no data were rejected with the following exception:

- 5 out of 20 dissolved oxygen field measurements were rejected due to sensor malfunction.

5. REFERENCES

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

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

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Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Team. 2008. SWAMP Quality Assurance Program Plan, Version 1.0. Prepared for the California State Water Quality Control Board by Moss Landing Marine Laboratories and San Jose State University Research Foundation. 1 September. 108 pp.