FAIRFIELD-SUISUN SEWER DISTRICT
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GREGORY G. BAATRUP, GENERAL MANAGER

March 15, 2015

UR file

Mr. Bruce Wolfe, Executive Officer
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Attn: Jan O'Hara, Water Resources Control Engineer

RE: Fairfield-Suisun Urban Runoff Management Program
Urban Creeks Monitoring Report – WY2014

Dear Mr. Wolfe:

The attached Urban Creeks Monitoring Report represents the Fairfield-Suisun Urban Runoff Management Program's submittal in compliance with the Municipal Regional Permit (MRP) Reporting Provision C.8.g.iii of NPDES Permit No. CA S612008 as adopted on October 14, 2009 via Order No. R2-2009-0074.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Sincerely,

Kevin A. Cullen

Kevin A. Cullen, P.E.
Senior Environmental Engineer

cc: George Hicks, City of Fairfield
Dan Kasperson, City of Suisun City

Attachment

CREEK STATUS MONITORING REPORT – REGIONAL/PROBABILISTIC PARAMETERS

Urban Creeks Monitoring Report, Part A

Water Year 2014 (October 1, 2013 – September 30, 2014)

Submitted in Compliance with Provision C.8.g.iii
NPDES Permit No. CAS612008

March 15, 2015

Submitted by the Fairfield-Suisun Urban Runoff Management Program and the City of Vallejo and Vallejo Sanitation and Flood Control District

Program Participants

- Fairfield-Suisun Urban Runoff Management Program
- City of Vallejo
- Vallejo Sanitation and Flood Control District

Prepared for:

Fairfield-Suisun Urban Runoff Management Program

City of Vallejo/Vallejo Sanitation and Flood Control District

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List of Acronyms

ACCWP	Alameda Countywide Clean Water Program
AFDM	ash-free dry mass
A-IBI	Algal Index of Biological Integrity
BASMAA	Bay Area Stormwater Management Agencies Association
B-IBI	Benthic Index of Biological Integrity
BMI	Benthic Macroinvertebrate
CCCWP	Contra Costa Clean Water Program
CTR	California Toxics Rule
DQO	Data Quality Objective
FSURMP	Fairfield Suisun Urban Runoff Management Program
GIS	Geographic Information System
GRTS	Generalized Random Tessellated Stratified
IBI	Index of Biological Integrity
IMR	Integrated Monitoring Report
LC50	Lethal Concentration to 50% of test organisms
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MRP	Municipal Regional Permit
ND	Non-Detect Data
NorCal B-IBI	Northern California Benthic Index of Biological Integrity
NT	Non-Target
PEC	Probable Effect Concentration
PHab	Physical Habitat Assessment
PSA	Perennial Streams Assessment
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RMC	Regional Monitoring Coalition
RPD	Relative Percent Difference
RWB	Reach-Wide Benthos
SCCWRP	Southern California Coastal Water Research Project
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SMC	Southern California Stormwater Monitoring Coalition
SMCWPPP	San Mateo Countywide Water Pollution Prevention Program
SoCal B-IBI	Southern California Benthic Index of Biological Integrity
SOP	Standard Operating Procedure
SSID	Stressor/Source Identification
SWAMP	Surface Water Ambient Monitoring Program
TEC	Threshold Effect Concentration
TKN	Total Kjeldahl Nitrogen
TNS	Target Not Sampled Samplable (or change on pg 14)
TOC	Total Organic Carbon
TS	Target Sampled Samplable (or change on pg 14)
TU	Toxicity Unit

U	Unknown
USEPA	U.S. Environmental Protection Agency
VSFCD	Vallejo Sanitation and Flood Control District
WY	Water Year

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Executive Summary

This monitoring report documents the results of creek status monitoring activities and data collected using a probabilistic monitoring design performed by the Fairfield Suisun Urban Runoff Management Program (FSURMP) and the City of Vallejo and Vallejo Sanitation and Flood Control District (VSFCD) during the 2014 Water Year (WY). Together with the UCMR Part B, this report submittal completes the required reporting for monitoring requirements specified in Table 8.1, Provision C.8.c of the Municipal Regional Permit (MRP) for Urban Stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Order No. R2-2009-0074). Reporting requirements for Table 8.1 components are established in provision C.8.g.iii of the MRP.

The results of the WY 2014 monitoring revealed the following:

- Analysis of benthic macroinvertebrate (BMI) taxonomy for the four bioassessment sites monitored in WY 2014 produced benthic index of biological integrity (B-IBI) scores ranging in condition category from poor to very poor.
- The 2014 wet weather toxicity sample (from site 207R02732, Laurel Creek) was not found to be toxic to any of the four test species.
- The 2014 dry weather water sample (also from site 207R02732, Laurel Creek) was not found to be toxic to *S. capricornutum*, *H. azteca*, or fathead minnows, but the sample was determined to be toxic to *C. daphnia* in relation to the chronic endpoint (reproduction).
- The sediment sample (also from site 207R02732, Laurel Creek) was determined to be not toxic to *H. azteca* for the acute endpoint (survival), but was determined to be toxic for the chronic endpoint (growth).
- For the water chemistry ("nutrients") data produced from samples collected at the four bioassessment sites, the available water quality standards were not exceeded at any of the monitored sites.
- Of the six sites where chlorine was measured, only 2 sites (33%) exceeded the threshold for free chlorine and/or total chlorine; both sites (Ledgewood Creek and Blue Rock Springs Creek) contain substantial flow from urban runoff sources in the dry summer months, when both exceedances occurred.
- None of the sediment chemistry results exceeded any of the MRP triggers for the monitored sediment triad site (site 207R02732, Laurel Creek).
- Based on the very poor B-IBI score and the significant chronic toxicity test result for *H. azteca* in the sediment toxicity test, for WY 2014 the monitored Laurel Creek site qualifies for the following follow-up actions based on the sediment triad results:
    - Identify cause(s) of impacts and spatial extent.
    - Where impacts are under Permittee's control, take management actions to minimize impacts; initiate no later than the second fiscal year following the sampling event.

1.0 Introduction

Members of the Bay Area Stormwater Management Agencies Association (BASMAA) formed the Regional Monitoring Coalition (RMC) in early 2010 to collaboratively implement the monitoring requirements found in Provision C.8 of the Municipal Regional Permit (MRP) for urban stormwater in Region 2 (Order No. R2-2009-0074). The following program participants make up the RMC:

- 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 Sanitation and Flood Control District (Vallejo)

The BASMAA RMC developed a Quality Assurance Project Plan (QAPP; BASMAA, 2014a), Standard Operating Procedures (SOPs; BASMAA, 2014b), data management tools, and reporting templates and guidelines for creek status and trends monitoring conducted in compliance with MRP Provision C.8.c. The RMC divided the creek status and trends monitoring requirements specified in MRP Table 8.1 into those parameters that reasonably could be included within a regional/probabilistic design, and those that, for logistical and jurisdictional reasons, should be implemented locally using a targeted (non-probabilistic) design. The monitoring elements included in each category are specified in Table 1.1.

Table 1-1. Creek status and trends monitoring parameters sampled in compliance with MRP Provision C.8.c. in Water Year 2014.

Biological Response and Stressor Indicators	Monitoring Design	
	Regional Ambient (Probabilistic)	Local (Targeted)
Bioassessment & Physical Habitat Assessment	X	
Nutrients (Water Chemistry)	X	
Chlorine	X	
Water Toxicity	X	
Sediment Toxicity	X	
Sediment Chemistry	X	
General Water Quality		X
Temperature		X
Bacteria		X
Stream Survey		X

This report focuses on the Creek Status Monitoring activities that were conducted in Solano County in Water Year 2014 to comply with MRP Provision C.8.c using the regional/probabilistic monitoring design developed and implemented by the RMC. This monitoring design allows each RMC participating program to 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 conditions in San Francisco Bay Area creeks.

The Fairfield-Suisun permittees are required to perform creek status and trends monitoring (for both local/targeted parameters and regional/probabilistic parameters) during two monitoring years in the current permit cycle. Vallejo permittees are only required to monitor most parameters for one year of the current permit cycle, and most of that monitoring was completed in WY 2013. In WY 2014, Fairfield-Suisun completed all of the remaining required regional/probabilistic monitoring for the current permit term. Vallejo also completed the permit requirements for the current term.

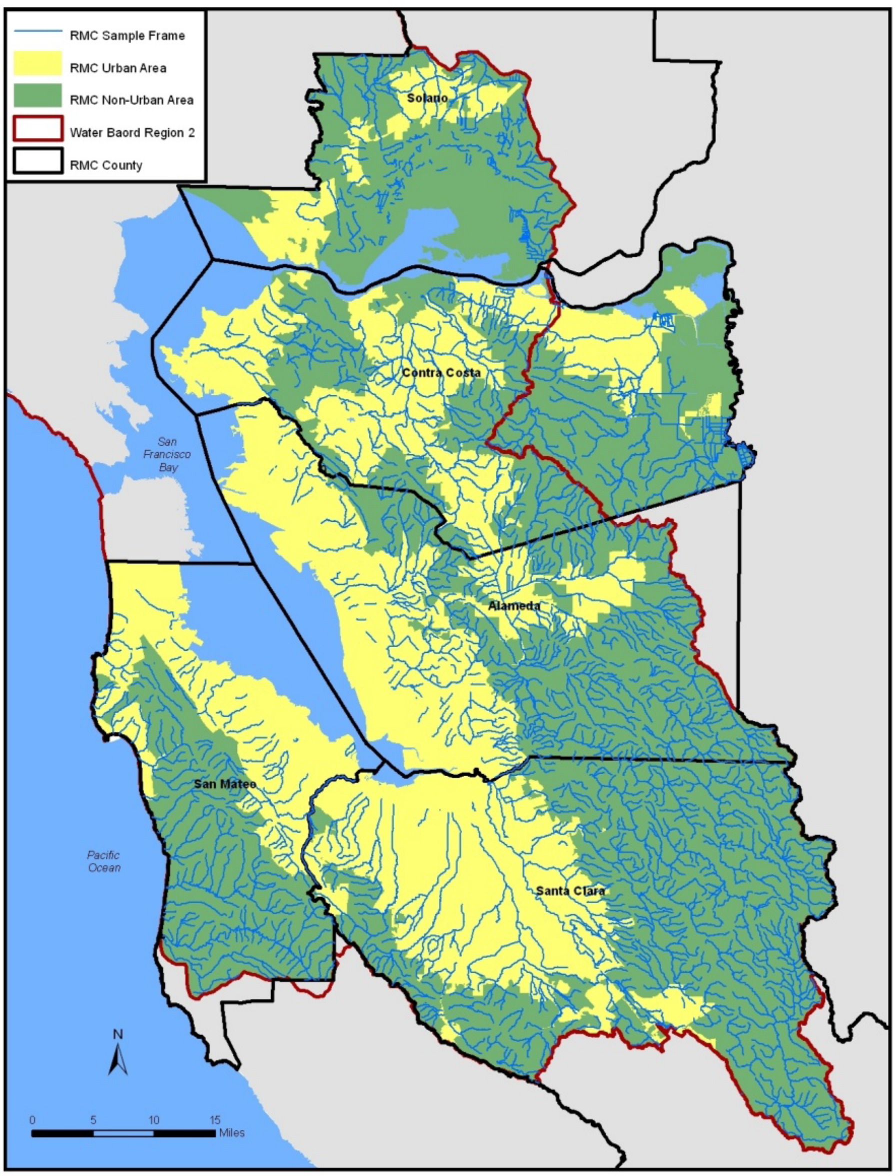
The remainder of this report addresses Study Area and Monitoring Design (Section 2.0), Monitoring Methods (Section 3.0), Results and Data Interpretation (Section 4.0), and Conclusions and Next Steps (Section 5.0), including the standard report content as required by MRP Provision C.8.g.v.

2.0 Study Area and Monitoring Design

2.1 RMC Area

Status and trends monitoring was conducted in non-tidally influenced, flowing water bodies (i.e., creeks, streams and rivers). The water bodies monitored were drawn from a master list that included all perennial and non-perennial creeks and rivers that run through urban and non-urban areas within the portions of the five RMC participating counties that fall within the SFBRWQCB boundary, and the eastern portion of Contra Costa County that drains to the Central Valley Regional Board. A map of the BASMAA RMC area, equivalent to the area covered by the regional probabilistic design "sample frame", is shown in Figure 2-1.

Figure 2-1. Map of BASMAA RMC Area, County Boundaries and Major Creeks



2.2 Regional Monitoring Design

In 2011, the RMC developed a regional probabilistic monitoring design to identify ambient conditions of creeks in the five main counties subject to the requirements of the MRP. The regional design was developed using the Generalized Random Tessellation Stratified (GRTS) approach developed by the U.S. 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 SWAMP (Ode et al., 2011) and the regional monitoring performed by the Southern California Stormwater Monitoring Coalition (SMC, 2007). For the purpose of developing the RMC's probabilistic design, the RMC area is considered to define the sample frame and represent the "sample universe."

2.2.1 Management Questions

The RMC regional monitoring probabilistic design was developed to address the following management questions:

1. What is the condition of aquatic life in creeks in the RMC area; are water quality objectives met and are beneficial uses supported?
    a. 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?
    b. What is the condition of aquatic life in RMC participant counties; are water quality objectives met and are beneficial uses supported?
    c. To what extent does the condition of aquatic life in urban and non-urban creeks differ in the RMC area?
    d. 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?
    a. 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?

These questions can be more fully answered on both a regional and county-specific basis in future years, once sample sizes increase, and upon implementation of a region-wide approach to data analysis.

2.2.2 Site Selection

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 RMC boundary (BASMAA, 2011). This approach was agreed to by SFBRWQCB staff during RMC meetings although it differs from that specified in MRP Provision C.8.c.iv., e.g., sampling on the basis of individual watersheds in rotation and selecting sites to characterize segments of a water body (or water bodies). 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. The sample frame was stratified by management unit to ensure that program-specific monitoring requirements would be achieved as specified in MRP Provision C.8.c.

The National Hydrography Dataset Plus (1:100,000) was selected as the creek network data layer to provide consistency with both the Statewide PSA and the SMC, and the opportunity for future data coordination with these programs. 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 sample universe (i.e., RMC area). Based on discussion during RMC meetings, with SFBRWQCB staff present, RMC participants weight their sampling so that annually approximately 80% of monitored sites are in urban areas and 20% in non-urban areas. RMC participants coordinated with the SFBRWQCB by identifying additional non-urban sites from their respective counties for SWAMP sampling.

2.3 Monitoring Design Implementation

During Water Year 2014 (October 1, 2013 –September 30, 2014) regional/probabilistic monitoring was conducted at four sites in Fairfield-Suisun. Regional/probabilistic parameters were monitored at the regional/probabilistic locations listed in Table 2-1, and as shown in Figure 2-2.

Table 2-1. Regional/probabilistic sites and monitoring parameters monitored in Water Year 2014 in Solano County.

Site ID	Creek Name	Latitude	Longitude	Bioassessment, Water Chemistry, PHab	Water Toxicity	Sediment Chemistry & Toxicity	Chlorine
207R01772	Green Valley Creek	38.22037	-122.14626	X			X
207R02108	Canyon Creek	38.19303	-122.14426	X			X
207R02604	Ledgewood Creek	38.23990	-122.06209	X			X
207R02732	Laurel Creek	38.28796	-122.02075	X	X	X	X
207LAU040	Laurel Creek	38.28955	-122.02054				X
207R05048	Laurel Creek	38.29273	-122.02259				X
207R00064	Blue Rock Springs Creek	38.12053	-122.20010				X

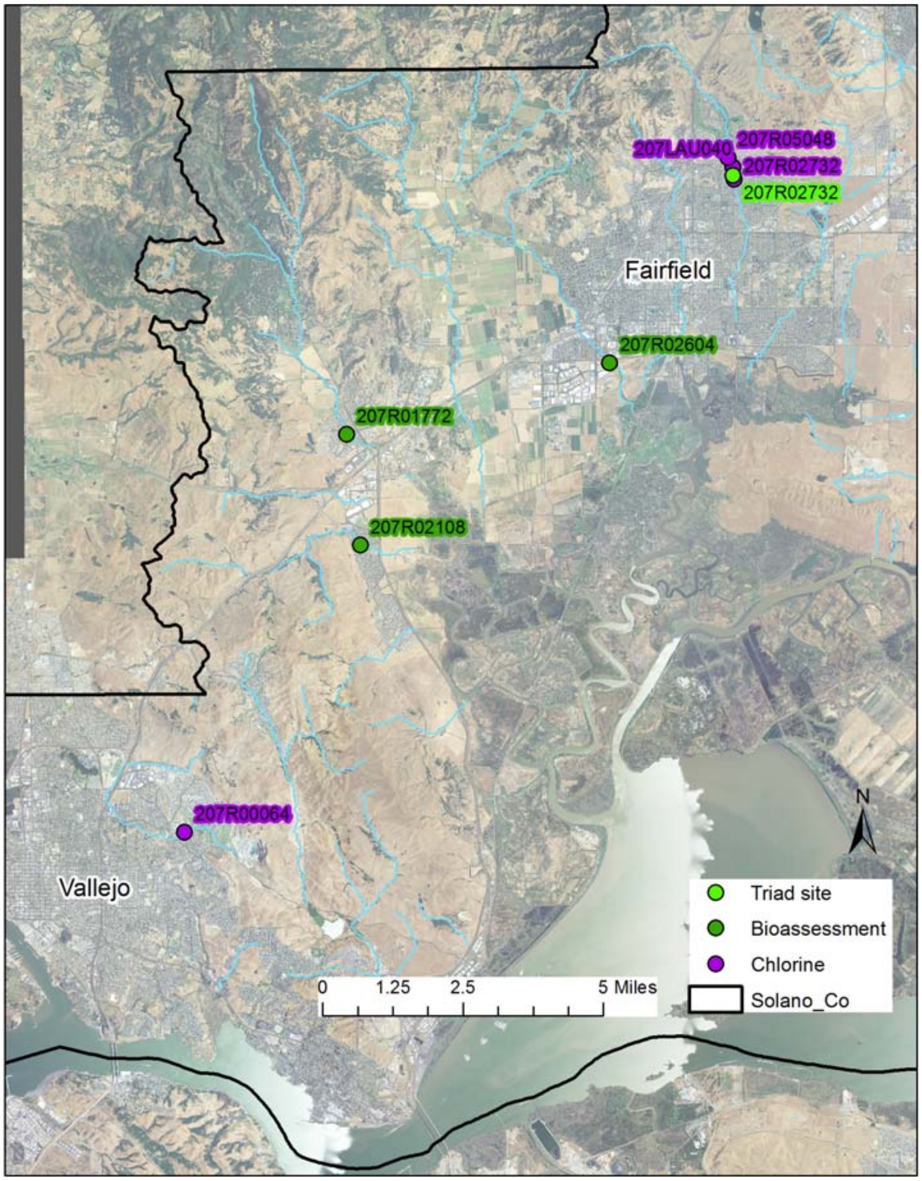


Figure 2-2. Regional/probabilistic sites monitored in Solano County in Water Year 2014. All bioassessment sites were monitored for water chemistry and chlorine in the spring. The Triad site was monitored for bioassessment, water chemistry and chlorine in the spring and for water/sediment toxicity, sediment chemistry and chlorine in the fall.

3.0 Monitoring Methods

Monitoring data were collected following the BASMAA RMC quality assurance plan and standard operating procedures (BASMAA 2014a; BASMAA 2014b). Monitoring data were collected using comparable methods to those outlined in the California Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Project Plan and were submitted electronically in SWAMP-compatible format by FSURMP and VSFCD to SFBRWQCB pursuant to Provision C.8.g.

3.1 Site Evaluation

Sites identified in the regional sample draw were evaluated by each RMC participant in chronological order using a two-step process, consistent with that described by SCCWRP[1] (2012). Each site was evaluated to determine if it met the following RMC sampling location criteria:

1. The location (latitude/longitude) provided for a site is located on or is within 300 meters (m) of a non-impounded receiving water body.
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.[2]

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 four categories:

- **Target** – Sites that met all seven criteria above were classified as **target sampleable** status **(TS),** and sites that met criteria 1 through 4, but did not meet at least one of criteria 5 through 7 were classified as **target non-sampleable (TNS)**.
- **Non-Target (NT)** – Sites that did not meet at least one of criteria 1 through 4 were classified as non-target status and were not sampled.
- **Unknown (U)** – Sites were classified with unknown status and not sampled 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.

During the site evaluation field visits flow status was recorded as one of five categories:

- Wet Flowing (continuously wet or nearly so, flowing water)
- Wet Trickle (continuously wet or nearly so, very low flow (trickle, less than 0.1 L/second)

[1] Communication with managers for the SMC and the PSA are ongoing to ensure the consistency of site evaluation protocols.
[2] If landowners did not respond to at least two attempts to contact them either by written letter, e-mail, or phone call, permission to access the respective site was effectively considered to be denied.

- Majority Wet (discontinuously wet, greater than 25% by length of stream bed covered with water (isolated pools)
- Minority Wet (discontinuously wet, less than 25% of stream bed by length covered with water (isolated pools)
- No Water (no surface water present)

Observations of flow status occurring during fall site reconnaissance events prior to occurrence of significant precipitation, and spring sampling occurring post-wet-weather season were combined to classify sites as perennial or nonperennial as follows:

- **Perennial:** fall flow status is either Wet Flowing or Wet Trickle and spring flow is sufficient to sample.
- **Non-Perennial:** fall flow status is Majority Wet, Minority Wet, or No Water, and spring flow is sufficient to sample.

The regional/probabilistic sites selected for monitoring in Solano County during WY 2014 are shown above in Table 2-1 and Figure 2-2.

3.2 Field Data Collection Methods

Field data were collected in accordance with existing SWAMP-comparable methods and procedures, as described in the RMC Quality Assurance Project Plan (QAPP; BASMAA, 2014a) and the associated Standard Operating Procedures (BASMAA, 2014b). 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. The SOPs relevant to the monitoring discussed in this report are listed in Table 3-1.

Table 3-1. RMC Standard Operating Procedures (SOPs) Pertaining to Regional Creek Status Monitoring

SOP #	Procedure
FS-1	BMI and algae bioassessments and physical habitat assessments
FS-2	Water quality sampling for chemical analysis, pathogen indicators, and toxicity testing
FS-3	Field measurements, manual
FS-6	Collection of bedded sediment samples
FS-7	Field equipment cleaning procedures
FS-8	Field equipment decontamination procedures
FS-9	Sample container, handling, and chain-of-custody procedures
FS-10	Completion and processing of field data sheets
FS-11	Site and sample naming convention
FS-12	Ambient Creek Status Monitoring Site Evaluation
FS-13	QA/QC Data Review

3.2.1 Bioassessments

In accordance with the RMC QAPP (BASMAA, 2014a), bioassessments were conducted during the spring index period (approximately April 15 to July 15) and at a minimum of 30 days after any significant storm (roughly defined as at least 0.5 inch[3] of rainfall within a 24-hour period).

Each bioassessment monitoring site consisted of an approximately 150 m stream reach that was divided into 11 equidistant transects placed perpendicular to the direction of flow. The sampling position within each transect alternated between 25%, 50%, and 75% distance of the wetted width of the stream (see SOP FS-1, BASMAA, 2014b).

Benthic Macroinvertebrates

BMIs were collected via kick-net sampling using the Reach-wide Benthos (RWB) method described in RMC SOP FS-1 (BASMAA, 2014b). Samples were collected from a 1-square-foot area approximately 1 m downstream of each transect. The benthos were disturbed by manually rubbing areas of coarse substrate, followed by disturbing the upper layers of finer substrate to a depth of 4–6 inches to dislodge any remaining invertebrates into the net. Slack water habitat procedures were used at transects with deep and/or slow-moving water (Ode, 2007). Material collected from the 11 subsamples was composited in the field by transferring the entire sample into one to two 1,000 mL wide-mouth jar(s), and the samples were preserved with 95% ethanol.

Algae

Filamentous algae and diatoms also were collected using the Reach-wide Benthos (RWB) method described in SOP FS-1 (BASMAA, 2014b), based on the SWAMP Bioassessment Wadeable Streams Protocol (Ode et al. 2007). Algae samples were collected synoptically with BMI samples. The sampling position within each transect was the same as used for BMI sampling, except that algae samples were collected six inches upstream of the BMI sampling position and following BMI collection from that location. The algae were collected using a range of methods and equipment, depending on the particular substrate occurring at the site (i.e., erosional, depositional, large and/or immobile, etc.) per RMC SOP FS-1. Erosional substrates included any material (substrate or organics) that was small enough to be removed from the stream bed, but large enough in size to isolate an area equal in size to a rubber delimiter (12.6 cm^2 in area).

When a sample location along a transect was too deep to sample, a more suitable location was selected, either on the same transect or from one further upstream. Algae samples were collected at each transect prior to moving on to the next transect. Sample material (substrate and water) from all 11 transects was combined in a sample bucket, agitated, and a suspended algae sample was then poured into a 500 mL cylinder, creating a composite sample for the site. A 40 mL subsample was extracted from the algae composite sample and combined with 10 mL of 10% formalin into a 50 mL sample tube for taxonomic identification of diatoms. Similarly, a 45 mL subsample was taken from the algae composite sample and put in a 50 mL tube for taxonomic identification of soft algae. These samples were shipped overnight on ice to the laboratory for analysis. Upon receipt, 5 mL glutaraldehyde was added to the soft algae tube to preserve the sample.

The algae composite sample also was used for collection of chlorophyll-a and ash-free dry mass (AFDM) samples following methods described in Fetscher et al. (2009). For the chlorophyll-a sample, 25 mL of the algae composite volume was removed and run through a glass fiber filter (47 mm, 0.7 µm pore size)

[3] Erroneously reported as 0.25 inch over a 24-hour period in the WY 2012 UCMR (BASMAA, 2013).

using a filtering tower apparatus in the field. The AFDM sample was collected using a similar process using pre-combusted filters. Both filter samples were placed in Whirl-Paks, covered in aluminum foil, and immediately placed on ice for transport to the analytical laboratory.

Physical Habitat

Physical habitat assessments (PHab) were conducted at each BMI bioassessment sampling event using the PHab protocols described in Ode (2007) (see SOP FS-1, BASMAA, 2014b). Physical habitat data were collected at each of the 11 transects and at 10 additional inter-transects (located between each main transect) by implementing the "Basic" level of effort, with the following additional measurements and assessments as defined in the "Full" level of effort (as prescribed in the MRP): water depth and pebble counts, cobble embeddedness, flow habitat delineation, and instream habitat complexity. At algae sampling locations, additional assessment of presence of micro- and macroalgae was conducted during the pebble counts. In addition, water velocities were measured at a single location in the sample reach (when possible) using protocols described in Ode (2007).

3.2.2 Physicochemical Measurements

Dissolved oxygen, temperature, conductivity, and pH were measured during bioassessment sampling using a multi-parameter probe (see SOP FS-3, BASMAA, 2014b). Dissolved oxygen, specific conductivity, water temperature, and pH measurements were made either by direct submersion of the instrument probe into the sample stream, or by collection and immediate analysis of grab sample in the field. Water quality measurements were taken approximately 0.1 m below the water surface at locations of the stream that appears to be completely mixed, ideally at the centroid of the stream. Measurements occurred upstream of sampling personnel and equipment and upstream of areas where bed sediments had been disturbed, or prior to such bed disturbance.

3.2.3 Nutrients and Conventional Analytes (Water Chemistry)

Water samples were collected for nutrient analyses using the standard grab sample collection method as described in SOP FS-2 (BASMAA, 2014b), associated with bioassessment monitoring. Sample containers were rinsed, as appropriate, using ambient water and completely filled and recapped below water surface whenever possible. An intermediate container was used to collect water for all sample containers with preservative already added in advance by laboratory. Sample container size and type, preservative type and associated holding times for each analyte are described in Table 1 of FS-9 (BASMAA, 2014b). Syringe filtration method was used to collect samples for analyses of dissolved orthophosphate and dissolved organic carbon. All sample containers were labeled and stored on ice for transport to the analytical laboratory, with the exception of analysis of AFDM and chlorophyll-a samples, which were field-frozen on dry ice by some sampling teams where appropriate.

3.2.4 Chlorine

Water samples were collected and analyzed for free and total chlorine using CHEMetrics test kits (K-2511 for low range and K-2504 for high range). Chlorine measurements in water were conducted during bioassessments and during dry season monitoring for sediment chemistry, sediment toxicity, and water toxicity.

3.2.5 Water Toxicity

Samples were collected using the Standard Grab Sample Collection Method described above, filling the required number of 2.25-L labeled amber glass bottles with ambient water, putting them on ice to cool to 4°C ± 2°C, and delivering to the laboratory within the required hold time. Bottle labels include station ID, sample code, matrix type, analysis type, project ID, and date and time of collection. The laboratory was notified of the impending sample delivery to meet the 24-hour sample delivery time requirement. Procedures used for sampling and transporting samples are described in SOP FS-2 (BASMAA, 2014b).

3.2.6 Sediment Chemistry and Sediment Toxicity

In the case where sediment samples and water samples / measurements were collected at the same event, sediment samples were collected after any water samples were collected. Before conducting sampling, field personnel surveyed the proposed sampling area to identify appropriate fine-sediment depositional areas, to avoid disturbing possible sediment collection sub-sites. Personnel carefully entered the stream and started sampling at the closest appropriate reach, continuing upstream. Sediment samples were collected from the top 2 cm of sediment in a compositing container, thoroughly homogenized, and then aliquotted into separate jars for chemical and toxicological analysis using standard clean sampling techniques (see SOP FS-6, BASMAA, 2014b). Sample jars were submitted to respective laboratories per SOP FS-9 (BASMAA, 2014b).

3.3 Laboratory Analysis Methods

RMC participants agreed to use the same laboratory for individual parameters, developed standards for contracting with the labs, and coordinated quality assurance issues. 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, 2014a). Analytical laboratory methods, reporting limits and holding times for chemical water quality parameters are also reported in the WY 2012 UCMR BASMAA (2012a). The following analytical laboratory contractors were used for chemical and toxicological analysis:

- BioAssessment Services, Inc. – BMI taxonomic identification. The laboratory performed taxonomic identification nominally on a minimum of 600 BMI individuals for each sample according to standard taxonomic effort Level 1 as established by the Southwest Association of Freshwater Invertebrate Taxonomists, with additional identification of Chironomids to subfamily/tribe level (corresponding to a Level 1a STE).
- EcoAnalysts, Inc. – algae taxonomic identification. Samples were processed in the laboratory following draft SWAMP protocols to provide count (diatom and soft algae), biovolume (soft algae), and "presence" (diatom and soft algae) data. Diatom and soft algae identifications were harmonized with the California Algae and Diatom Taxonomic Working Group's Master Taxa List. Laboratory processing included identification and enumeration of 300 natural units of soft algae and 600 diatom valves to the lowest practical taxonomic level.
- CalTest, Inc. – water chemistry (nutrients etc.), sediment chemistry, chlorophyll-a, AFDM. Upon receipt at the laboratory, samples were immediately logged and preserved as necessary. USEPA-approved testing protocols were then applied for analysis of water and sediment samples.
- Pacific EcoRisk, Inc. – water and sediment toxicity. Testing of water and sediment samples was performed according to species-specific protocols published by USEPA.

3.4 Data Analysis

In this report only the data collected by Solano County permittees during WY 2014 for regional/probabilistic parameters are presented and analyzed. This includes data collected during bioassessment monitoring, which includes BMI and algae taxonomy, water chemistry and physical habitat evaluations at four sites, as well as water and sediment toxicity and sediment chemistry data from one of those four sites. The bioassessment data are then used to evaluate stream conditions, and the associated physical, chemical and toxicity testing data are then analyzed to identify potential stressors that may be impacting water quality and biological conditions. As the cumulative RMC sample sizes increase through monitoring conducted in future years, it will be possible to develop a statistically representative data set for the RMC region to address management questions related to condition of aquatic life, and report on those per MRP Provision C.8.g.iii.

Analysis of Provision C.8.c monitoring data for local/targeted parameters (not included in the probabilistic design) is reported in the Local/Targeted Creek Status Monitoring Report.

3.4.1 Biological Data

Assemblages of freshwater organisms are commonly used to assess the biological integrity of water bodies because they provide direct measures of ecological condition (Karr and Chu, 1999). Benthic macroinvertebrates (BMIs) are an essential link in the aquatic food web, providing food for fish and consuming algae and aquatic vegetation (Karr and Chu, 1999). The presence and distribution of BMIs can vary across geographic locations based on elevation, creek gradient, and substrate (Barbour et al., 1999). These organisms are sensitive to disturbances in water and sediment chemistry as well as physical habitat, both in the stream channel and along the riparian zone. Because of their relatively long life cycles (approximately one year) and limited migration, BMIs are particularly susceptible to site-specific stressors (Barbour et al., 1999). Algae also are increasingly being used as indicators of water quality, as they form the autotrophic base of aquatic food webs and exhibit relatively short life cycles that respond quickly to chemical and physical changes. Diatoms have been found to be particularly useful for interpreting some causes of environmental degradation (Hill et al., 2000).

In this report the biological condition of each probabilistic site monitored in Solano County in WY 2014 was evaluated principally through analysis of BMI and algal taxonomic metrics, and calculation of associated benthic index of biological integrity (B-IBI) and algal index of biological integrity (A-IBI) scores. An IBI is an analytical tool involving calculation of a site condition score based on a compendium of biological metrics.

Benthic Macroinvertebrate Data Analysis

Biological metrics associated with BMI assemblages are typically characterized by the following five categories (Ode et al., 2005):

- Richness measures (numbers of distinct taxa within the assemblage or taxonomic groups).
- Composition measures (distribution of individuals among taxonomic groups; includes measures of diversity).
- Tolerance/Intolerance measures (relative sensitivity of the observed taxonomic groups to disturbance).
- Functional feeding groups (relative preponderance of types of feeding strategies in the aquatic assemblage).

- Abundance (estimates of the total number of organisms in a sample based on a 9-square-foot sampling area).

In the initial (WY 2012) Urban Creeks Monitoring Report (BASMAA, 2013), an array of such BMI metrics were computed using methods developed and tested extensively for both Southern California (Ode et al., 2005) and Northern California (Rehn et al., 2005), including benthic IBI scores using methods developed using selected BMI metrics for Southern California (SoCal B-IBI; Ode et al., 2005) and Northern California (NorCal B-IBI; Rehn et al., 2005). The B-IBI scores calculated using these two tools were well correlated based on the Water Year 2012 data for the RMC region. Because the ecoregions represented by the SoCal B-IBI are more similar to those in the majority of the RMC area than the NorCal ecoregions (with the exception of coastal streams in San Mateo County), the SoCal B-IBI was selected as the primary index used to evaluate biological condition. For consistency with the 2012 UCMR and other RMC programs, the SoCal B-IBI score is the primary tool used for condition assessment in this report.

The scores calculated using the SoCal B-IBI are classified according to condition categories established for the SoCal B-IBI (Table 3-2).

Table 3-2. Condition Categories for SoCal B-IBI Scores for BMI Taxonomy Data

Condition Category	Southern California B-IBI
Very Good	80–100
Good	60–79
Fair	40–59
Poor	20–39
Very Poor	0–19

Algae Data Analysis

Algal taxonomy has more recently been actively investigated for use as a biological indicator, and IBI development in California is less well-established for algae than for BMIs. Recently algal IBIs (A-IBIs) have been developed for Southern California (Fetscher et al., 2013) and the California Central Coast (Rollins et al., undated), but these have not been tested for Bay Area waters. However, because the Central Coast A-IBI has not been fully peer reviewed, and because there is a version of the SoCal A-IBI that relies only on diatoms and is thought to be more transferable to other areas of the state (Marco Sigala, pers. comm.), it was determined that the SoCal A-IBI “D18” (per Fetscher et al. 2014) could be used provisionally for assessment of stream conditions for this report.

Eleven diatom metrics, eleven soft algae metrics, and five IBIs (D18, H20, H21, H23, S2) were calculated following work performed on Southern California streams (Fetscher et al. 2014). Diatom and soft algae metrics fall into five categories: Tolerance/Sensitivity [association with specific water-quality constituents like nutrients; tolerance to low dissolved oxygen; tolerance to high-ionic-strength/saline waters], Autoecological Guild [nitrogen fixers; saprobic/heterotrophic taxa], Morphological Guild [sedimentation indicators; motility], Taxonomic Groups [Chlorophyta, Rhodophyta, Zygnemataceae, heterocystous cyanobacteria], and the Relationship to Reference sites. IBI scoring ranges and values were provided by Dr. A. Elizabeth Fetscher (pers comm). After each metric was scored, values were summed and then converted to a 100-point scale by multiplying the sum by the number of metrics [e.g., sum x (100/50) if five metrics included in the IBI]. The most widely-used diatom IBI ("D18") is computed from five of the eleven metrics. The eleven diatom metrics are described in Table 3-3.

Table 3-3. Metrics Used In Evaluating Algae Taxonomy Data

Metric Name	Description	Implications	Correlation w/Metric Score
Proportion low TN indicators	Proportion of diatoms that are indicators for low Total N (nitrogen) levels	Higher levels indicate lower levels of nutrient enrichment	Positive
Proportion low TP indicators *	Proportion of diatoms that are indicators for low Total P (phosphorous) levels	Higher levels indicate lower levels of nutrient enrichment	Positive
Proportion halobiontic *	Proportion of diatoms that are brackish-fresh + brackish (i.e., they have a tolerance of, or requirements for, dissolved salts)	Higher levels indicate higher salinity and conductivity, and possibly higher nutrient or sediment levels	Negative
Proportion requiring >50% DO saturation *	Proportion of diatoms that require at least 50% dissolved oxygen saturation	Higher levels indicate less well-oxygenated stream conditions	Positive
Proportion requiring nearly 100% DO saturation	Proportion of diatoms that require nearly 100% dissolved oxygen saturation	Higher levels indicate well-oxygenated stream conditions	Positive
Proportion N heterotrophs *	Proportion of diatoms that are heterotrophs (i.e., are capable of using energy sources other than photosynthesis; includes both obligate and facultative heterotrophs)	Higher levels indicate possible organic enrichment of the water	Negative
Proportion oligo- & beta-mesosaprobic	Proportion of diatoms that are oligosaprobous+beta-mesosaprobous (i.e., they have a low to moderate ability to use decomposing organic material for nutrition)	Higher levels indicate lower levels of organic contamination	Positive
Proportion poly- & eutrophic	Proportion of diatoms that are polytrophic+eutrophic (i.e., have a tolerance of, or requirements for, high nutrient levels)	Higher levels indicate higher levels of nutrients (N and P) in the water	Negative
Proportion sediment tolerant (highly motile) *	Proportion of diatoms (for which there is information for both the "motility" and "habit" classifications) that are highly motile (for "motility") OR planktonic (for "habit")	Higher levels may indicate the presence of excess silt and sediment	Negative
Proportion highly motile	Proportion of diatoms that are highly motile (i.e., have the ability to move through the water column or glide along surfaces)	Higher levels may indicate the presence of excess silt and sediment	Negative
Proportion *A. minutissimum*	Proportion of diatoms that are the species *Achnanthidium minutissimum*; Common diatoms that are known to be tolerant of a wide range of conditions	Higher levels tend to be associated with higher quality sites (Betty Fetscher, personal comm.)	Positive

* metric is used in calculating the "D18" algae IBI

3.4.2 Physical Habitat Condition

Physical habitat condition was assessed using PHab scores. For this report, PHab scores range from 0 to 60, representing a combined score of three physical habitat sub-categories (epifaunal substrate/cover, sediment deposition, and channel alteration) that each can be scored for a total of 0–20 points. Higher PHab scores reflect higher-quality habitat. Numerous additional PHab endpoints can also be calculated.

Further analyses of various PHab endpoints are possible and will be considered in future reports, as the science becomes further developed.

3.4.3 Water and Sediment Chemistry and Toxicity

As part of the Stressor Assessment for this report, water and sediment chemistry and toxicity data generated during WY 2014 were analyzed and evaluated to identify potential stressors that may be contributing to degraded or diminished biological conditions. Per Table 8.1 of the MRP (SFBRWQCB, 2009), creek status monitoring data must be evaluated with respect to specified "Results that Trigger a Monitoring Project in Provision C.8.d.i." The trigger criteria listed in MRP Table 8.1 were used as the principal means of evaluating the creek status monitoring data to identify sites where water quality impacts may have occurred. For water and sediment chemistry and toxicity data, the relevant trigger criteria are as follows:

- **Nutrients (Water Chemistry)**: 20% of results in one water body exceed one or more water quality standard or established threshold. (Note: per MRP Table 8.1, this group of constituents includes variants of nitrogen and phosphorous, as well as other common, "conventional" constituents.)

- **Water Toxicity**: if toxicity results are less than 50% of Laboratory Control results, resample and retest; if second sample yields less than 50% of Laboratory Control results, proceed to C.8.d.i. (Stressor/Source Identification).

- **Sediment Toxicity**: toxicity results are statistically different from and more than 20% less than results for Laboratory Control.

- **Sediment Chemistry**: three or more chemicals exceed Threshold Effect Concentrations (TECs), mean Probable Effects Concentrations (PEC) Quotient greater than 0.5, or pyrethroids Toxicity Unit (TU) sum is greater than 1.0.

For sediment chemistry trigger criteria, threshold effect concentrations (TECs) and probable effects concentrations (PECs) are computed as defined in MacDonald et al. (2000). For all non-pyrethroid contaminants specified in MacDonald et al. (2000), the ratio of the measured concentration to the respective TEC value as specified in MacDonald et al. (2000) was computed as the TEC quotient. All results where a TEC quotient was equal to or greater than 1.0 were identified. PEC quotients were also computed for those same non-pyrethroid sediment chemistry constituents using PEC values from MacDonald et al. (2000). For each site the mean PEC quotient was then computed, and sites where mean PEC quotient was equal to or greater than 0.5 were identified.

Pyrethroids toxic unit equivalents (TUs) were computed for individual pyrethroid results, based on available LC50 literature values[4] for pyrethroids in sediment. Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized pyrethroid concentrations. Therefore, the pyrethroid 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 pyrethroid. Then for

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

each site, the TU equivalents for the various individual pyrethroids were summed, and sites where the summed TU was equal to or greater than 1.0 were identified.

3.5 Quality Assurance & Control

Quality control procedures are described in detail in the BASMAA RMC QAPP (BASMAA 2014a). Data quality objectives (DQO's) were established to ensure quality of both quantitative and qualitative assessments. Field training was conducted among the RMC field teams along with California Department of Fish and Wildlife (CDFW) staff to ensure that consistent and comparable field techniques were being utilized. All data collection followed the procedures outlined in the RMC SOPs (BASMAA 2014b), including documentation of data sheets and samples as well as sample handling and chain of custody. The laboratories that provided technical analytical services to the RMC were selected based on their ability to adhere to the required analytical protocols and sample handling requirements.

Results from field work and laboratory assessments were reviewed by the local Program Quality Assurance Officers for each Program and compared against the methods and procedures outlined in the SOPs and QAPP.

4.0 Results

The MRP and Central Valley Permit require status monitoring to address the management question, "What are the sources to urban runoff that contribute to receiving water problems?" The RMC accomplishes this through a multi-step process that involves conducting monitoring to provide data to inform an assessment of conditions and identification of stressors that may be impacting water quality and/or biological conditions. The results of the initial stressor assessment (WY 2012 UCMR; BASMAA, 2013) are currently being used in follow-up efforts to plan and implement stressor/source identification (SSID) projects per MRP Provision C.8.d.

In this section, following a brief statement of data quality, biological conditions are assessed from the bioassessment monitoring data, and the biological, physical, chemical and toxicity testing monitoring data are evaluated against the trigger criteria shown in MRP Table 8.1, and, for sediment triad data, MRP Table H-1, to provide a preliminary identification of potential stressors.

In this report only the data collected during WY 2014 by Solano County permittees for regional/probabilistic creek status monitoring parameters are presented.

4.1 Statement of Data Quality

Field data sheets and lab reports were reviewed by the local Program Quality Assurance Officer and the results were evaluated against the appropriate DQOs. Results were compiled for both qualitative (representativeness and comparability) and quantitative metrics (completeness, precision, and accuracy). Identified QA/QC issues are briefly summarized below by analytical category.

4.1.1 Bioassessment

Duplicate samples were collected in the field from CCCWP's site 207R0843 (Grizzly Creek) by two separate field crews, and analyzed for BMI taxonomy. The identified taxa and resulting metrics differed substantially between the two samples; the calculated SoCal B-IBI score was 7 for one sample and 20 for the other. Because the results were so different, and because it was not possible to determine the origins of the two samples separately, the metrics were averaged for these two duplicate samples and reported in the following tables as the averaged results. Additional work is ongoing to determine the cause of the substantial differences between these field duplicate samples, and the results will be qualified.

One site (207R02604, Ledgewood Creek) contained fewer than 600 organisms, which may warrant further investigation beyond BMI community level comparisons. This site also had unusually poor BMI community composition, registering a B-IBI score of 0, as described in the Biological Condition Assessment, below.

The New Zealand mudsnail (*Potamopyrgus antipodarum*), a non-native invasive species, was confirmed at three of the four Solano County sites: 207R01772 (Green Valley), 207R02108 (American Canyon Creek), and 207R02732 (Laurel Creek). This finding is not a QA/QC issue *per se*, but requires that field crews take special precautions to effectively decontaminate equipment so as to prevent cross-contamination and transfer of the invasive mud snail between sites.

4.1.2 Sediment Chemistry

No significant issues reported.

4.1.3 Water Chemistry

A field duplicate sample was collected at CCCWP's site 207R0843 (Grizzly Creek). Relative percent difference (RPD), a measure of the precision of field sample and lab analysis, was within the RMC data quality objectives (DQOs) for all parameters except chlorophyll a, for which the calculated RPD was 38% (DQO is RPD $\leq$ 25%).

4.1.4 Sediment Toxicity

No significant issues reported.

4.1.5 Water Toxicity

The toxicity laboratory (Pacific EcoRisk) reported the following issues re: QA/QC for water sample toxicity testing of the sample collected Feb. 6, 2014:

> **4.3.2 Reference Toxicant Toxicity to *Ceriodaphnia dubia***
> The results of this test are summarized below in Table 7. The IC50 for this test was consistent with the "typical response" range established by reference toxicant test database for this species. The EC50 of 1750 mg/L is slightly less than the lower threshold of 1754 mg/L NaCl, indicating that these test organisms may have been slightly more sensitive to toxicant stress than is typical. The U.S. EPA guidelines state that at the $p<0.05$ level, it is to be expected that 1 out of 20 reference toxicant tests will fall outside of the "typical response" range due to statistical probability, so our observation of this "outlier" is not unexpected nor cause for undue concern.
>
> **4.3.3 Reference Toxicant Toxicity to *Hyalella azteca***
> The results of this test are presented in Table 8. The survival EC50 of 0.57 g/L KCl is just outside of the upper threshold of 0.54 g/L KCl of the "typical response" range, suggesting that these organisms may have been slightly less sensitive to toxicant stress than is typical. The U.S. EPA guidelines state that at the $p<0.05$ level, it is to be expected that 1 out of 20 reference toxicant tests will fall outside of the "typical response" range due to statistical probability, so our observation of this "outlier" is not unexpected nor cause for undue concern. However, based upon the observation of test organisms that may be less sensitive to toxicant stress than is typical, it is recommended that the results of the accompanying stormwater toxicity test be interpreted judiciously.

These are not considered to be significant issues affecting the quality of the testing or the test results.

4.2 Biological Condition Assessment

Condition assessment addresses the RMC core management question "What is the condition of aquatic life in creeks in the RMC area; are aquatic life beneficial uses supported?" The designated beneficial uses listed in the San Francisco Bay Region Basin Plan (SFBRWQCB,2013) for RMC creeks sampled in Solano County during WY 2014 are shown in Table 4-1. Properties of the aquatic life use indicators used for this condition assessment that were observed at the Solano County sites monitored in WY 2014 are reported in Sections 4.2.1 (benthic macroinvertebrates) and 4.2.2 (algae), and discussed in relation to the designated aquatic life beneficial uses in section 4.2.3. Due to the relatively small sample size available after the third year of implementing the RMC regional probabilistic monitoring design, results are presented only in terms of the available data from urbanized portions of Solano County. Future reports may provide additional analysis at the countywide program and regional levels, as well as comparisons between urban and non-urban land use sites.

4.2.1 Benthic Macroinvertebrate Metrics

From a regional perspective, BMI metrics for bioassessment sites previously sampled within the RMC area have exhibited a wide range of scores, as described in the WY 2012 Regional UCMR (BASMAA, 2013) and the Integrated Monitoring Report (Armand Ruby Consulting and SRCD, 2014). BMI metrics for the four regional/probabilistic sites monitored in WY 2014 within Solano County similarly exhibited a wide range of scores, particularly for some important metrics such as taxonomic richness, EPT Index, and % tolerant organisms.

B-IBI scores and other BMI taxonomic metrics are shown in Table 4-2 for the Solano County creek status sites monitored in the spring index period of WY 2014. As noted above, based upon an a comparison and analysis of the NorCal and SoCal B-IBIs, the SoCal B-IBI score was chosen for the biological condition assessment in the 2012 UCMR (BASMAA, 2013). For consistency with the 2012 UCMR and other RMC programs, the SoCal B-IBI score is the primary tool used for biological condition assessment in this report.

The four sites monitored in WY 2014 ranged in B-IBI condition category from poor to very poor, as shown in Table 4-2. Particularly alarming is the B-IBI score of zero calculated for site 207R02604 (Ledgewood Creek). This site also had a very low density of organisms in the sample; less than 400 individuals were counted, whereas a nominal sample ID count is 600 individuals, and typically a sample jar contains many more than that minimum number. This site is well known to the FSURMP and is frequently found to have significant amounts of trash and homeless inhabitants, as well as serious security concerns from the local police department. It was excluded from the CRAM stream survey monitoring, which may have been helpful in a stressor analysis. Site 207R000476, upstream on Ledgewood Creek and monitored in WY 2013, was also found to have a very poor B-IBI score and less than 600 individuals available to count. There is likely a stream-wide issue with biodiversity that is more pronounced at this site due to the presence of people and refuse.

Table 4-1. Creeks monitored in WY 2014 and associated designated beneficial uses listed in the San Francisco Bay Region Basin Plan (SFBRWQCB 2013).

Site ID	Waterbody	AGR	MUN	FRSH	GWR	IND	PROC	COMM	SHELL	COLD	EST	MAR	MIGR	RARE	SPWN	WARM	WILD	REC-1	REC-2	NAV
SOLANO - FSURMP																				
207R01772	Green Valley Creek			E						E			E	E	E	E	E	E	E	
207R02108	American Canyon Creek																			
207R02604	Ledgewood Creek			E						E			E		E	E	E	E	E	
207R02732	Laurel Creek			E						E			E		E	E	E	E	E	
SOLANO - Vallejo																				
207R00064	Blue Rock Springs Creek			E												E	E	E	E	

Notes:

Creeks not listed in Chapter 2 of the Basin Plan do not appear in this table.

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

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" (SFBRWQCB 2013).

Table 4-2. BMI Metrics for Solano County Bioassessment Sites Monitored in Water Year 2014

	FSURMP Bioassessment Sites, Spring 2014			
	Green Valley Creek	**American Canyon Creek**	**Ledgewood Creek**	**Laurel Creek**
Metrics	**207R01772**	**207R02108**	**207R02604**	**207R02732**
Richness:				
Taxonomic	17	27	12	22
EPT	2	4	1	2
Ephemeroptera	2	2	0	1
Plecoptera	0	0	0	0
Trichoptera	0	2	1	1
Coleoptera	2	2	0	0
Predator	4	9	2	8
Diptera	5	5	5	5
Composition:				
EPT Index (%)	7.3	1.9	0.3	0.8
Sensitive EPT Index (%)	0.0	1.3	0.0	0.0
Shannon Diversity	1.7	2.1	1.0	2.3
Dominant Taxon (%)	42	36	74	24
Non-insect Taxa (%)	41	48	50	55
Tolerance:				
Tolerance Value	5.7	7.2	5.1	6.6
Intolerant Organisms (%)	0.0	0.5	0.0	0.0
Intolerant Taxa (%)	0.0	3.7	0.0	4.5
Tolerant Organisms (%)	3.9	71	1.8	42
Tolerant Taxa (%)	35	41	42	45
Functional Feeding Groups:				
Collector-Gatherers (%)	94	38	97	70
Collector-Filterers (%)	3.4	7.5	0.8	6.5
Scrapers (%)	1.5	51	0.0	16
Predators (%)	1.2	2.5	1.5	7.4
Shredders (%)	0.0	0.5	0.0	0.0
Other (%)	0.0	1.0	0.3	0.2
Estimated Abundance:				
Composite Sample (11 ft^2)	1634	3654	394	1316
$\#/ft^2$	149	332	36	120
$\#/m^2$	1586	3548	383	1278
Supplemental Metrics:				
Collectors (%)	97	45	98	76
Non-Gastropoda Scrapers (%)	0.0	0.0	0.0	0.0
Shredder Taxa (%)	0.0	3.7	0.0	0.0
SoCal B-IBI	13	31	*0*	16
B-IBI Condition Category	Very Poor	Poor	*Very Poor*	Very Poor

4.2.2 Algae Metrics

The average D18 diatom IBI score across all four Solano County sites was 36.6 (Table 4-3). In comparison, the average D18 scores across eight samples collected in 2013 was 41.3, indicating a slight decrease in the overall health of the diatom community. The highest score occurred at site 207R02108 (48) while the lowest score (28) occurred at site 207R02604. Higher scores tended to be associated with a lower proportion of nitrogen heterotrophic (including both obligate and facultative) diatom species and a higher proportion of species requiring >50% dissolved oxygen saturation (Table 4-3, 4-4). All four sites scored 2 or below for the proportion of diatom species indicative of low total phosphorous (TP) levels. Fetscher et al. (2014) found the Diatom IBI (D18) to be responsive to stream order, watershed area, and percent fines so these values could also play a role in IBI scores.

The soft algae S2 IBI had an average score of 54.5 but scores were spread across the spectrum (Table 4-5). Sites 207R01772 and 207R02732 had the highest scores at 83 but site 207R02108 scored at the opposite end with a value of 2. The two high sites received a score of 10 in five of six categories with a score of 0 in the sixth category due to the lack of Zygnemataceae, heterocystous bacteria, and Rhodophyta (ZHR) species in the samples. The lowest scoring site (207R02108) was driven by the presence of species indicative of high dissolved copper and DOC concentrations, higher biomass proportion of green algae CRUS (*Cladophora glomerata*, *Rhizoclonium hieroglyphicum*, *Ulva flexuosa*, and *Stigeoclonium* spp), and species composition indicative of non-reference conditions (Table 4-5, 4-6). Fetscher et al. (2014) also found soft algae IBIs were most responsive (negatively) to canopy cover and slope; site 207R02108 has complete canopy cover throughout the reach.

The Hybrid IBIs (H20, H21, and H23), consisting of both soft algae and diatom metrics, produced similar results in determining the highest scores (site 207R02732) but the lowest scores were split between sites 207R02108 and 207R02604 (Table 4-7). The average IBI score varied slightly among the three IBIs (H20 = 47, H21 = 36, H23 = 40.75) but they fell within the range of the D18 (36.5) and S2 (54.5) average scores. The main differences in the H20 IBI scores were due to the soft algae metrics in which higher scores had less species indicative of high copper and DOC concentrations and more species representative of low total nitrogen (TN) concentrations. The H21 IBI average score of 36 was the lowest across all five IBIs. Site 207R02108 scored zero for the two soft algae metrics due to the soft algae sample being dominated by Chlorophyta species. The diatom community at this site scored well for having a greater proportion of species requiring >50% dissolved oxygen saturation. The proportion of diatom species representative of high DOC concentrations and the decreased proportion of green algae belonging to CRUS drove the differences between the high scores [207R02732 (49); 207R01772 (45)] and low score [207R02108 (31)]. Fetscher et al. (2014) designated H20 as the overall top-performing IBI for Southern California streams, although differences with H23 were not pronounced.

Overall, site 207R02732 had the highest score across the soft algae only (S2) and four hybrid IBIs while site 207R02108 had the highest diatom only (D18) score. These differences were most likely due to the soft algae species composition in which the former scored high across the soft algae metrics while the latter scored very low. Site 207R02108 had three soft algae species present, all of which belong to the Phylum Chlorophyta, compared to the other sites in which Chlorophyta species comprised only 0-1.6% of the soft algae community. Scores were also influenced by the proportion of algae species indicative of high copper and high DOC concentrations (207R02108) compared to low total phosphorous concentrations (other three sites). Sites with a lower proportion of nitrogen heterotrophic diatom species and a higher proportion of species requiring >50% dissolved oxygen saturation tended to score higher overall.

Table 4-3: Diatom IBI (D18) and individual metric scores for Solano County stations sampled in 2014.

Station Code	Waterbody	Sample Date	D18 IBI Score	Proportion halobiontic (d) Score	Proportion low TP indicators (d) Score	Proportion N heterotrophs (d) Score	Proportion requiring >50% DO saturation (d) Score	Proportion sediment tolerant (highly motile) (d) Score
207R01772	Green Valley	5/8/2014	32	1	1	6	4	4
207R02108	American Canyon Creek	4/29/2014	48	4	1	6	8	5
207R02604	Ledgewood Creek	5/13/2014	28	0	2	8	0	4
207R02732	Laurel Creek	5/6/2014	38	2	1	9	5	2

Table 4-4: Diatom metric results for Solano County stations sampled in 2014. All calculations were based on count data.

Station Code	Sample Date	Proportion A minutissimum (d)	Proportion halobiontic (d)	Proportion highly motile (d)	Proportion low TN indicators (d)	Proportion low TP indicators (d)	Proportion N heterotrophs (d)	Proportion oligo- & beta-mesosaprobic (d)	Proportion poly- & eutrophic (d)	Proportion requiring >50% DO saturation (d)	Proportion requiring nearly 100% DO saturation (d)	Proportion sediment tolerant (highly motile) (d)
207R01772	5/8/2014	0.005	0.505	0.316	0.041	0.021	0.198	0.283	0.782	0.763	0.071	0.323
207R02108	4/29/2014	0.003	0.31	0.245	0.024	0.012	0.175	0.667	0.947	0.932	0.013	0.247
207R02604	5/13/2014	0.09	0.567	0.301	0.157	0.155	0.074	0.406	0.771	0.595	0.186	0.306
207R02732	5/6/2014	0.01	0.452	0.398	0.045	0.04	0.03	0.666	0.907	0.811	0.047	0.4

Table 4-5: Soft Algae IBI (S2) and individual metric scores for Solano County stations sampled in 2014.

Station Code	Waterbody	Sample Date	S2 IBI Score	Proportion high Cu indicators (s, sp) Score	Proportion high DOC indicators (s, sp) Score	Proportion low TP indicators (s, sp) Score	Proportion non-reference indicators (s, sp) Score	Proportion of green algae belonging to CRUS (s, b) Score	Proportion ZHR (s, m) Score
207R01772	Green Valley	5/8/2014	83	10	10	10	10	10	0
207R02108	American Canyon Creek	4/29/2014	2	0	0	0	0	1	0
207R02604	Ledgewood Creek	5/13/2014	50	1	6	10	3	10	0
207R02732	Laurel Creek	5/6/2014	83	10	10	10	10	10	0

Table 4-6: Soft algae metric results for Solano County stations sampled in 2014. Calculations were based on either species counts (sp) or biovolume (b). Proportion ZHR (s, m) was based on the mean of the species and biovolume results.

Station Code	Sample Date	Proportion high Cu indicators (s, sp)	Proportion high DOC indicators (s, sp)	Proportion low TP indicators (s, sp)	Proportion non-reference indicators (s, sp)	Proportion ZHR (s, sp)	Proportion Chlorophyta (s, b)	Proportion high DOC indicators (s, b)	Proportion non-reference indicators (s, b)	Proportion of green algae belonging to CRUS (s, b)	Proportion ZHR (s, b)	Proportion ZHR (s, m)
207R01772	5/8/2014	0	0	0.333	0	0	0.016	0	0	0	0	0
207R02108	4/29/2014	1	1	0	1	0	1	1	1	0.95	0	0
207R02604	5/13/2014	0.333	0.333	0.333	0.333	0	0.003	0.003	0.003	0	0	0
207R02732	5/6/2014	0	0	0.333	0	0	0	0	0	0	0	0

Table 4-7: Hybrid (diatom and soft algae) IBI (H20) and individual metric scores for Solano County stations sampled in 2014.

Station Code	Waterbody	Sample Date	H20 IBI Score	Proportion halobiontic (d) Score	Proportion high Cu indicators (s, sp) Score	Proportion high DOC indicators (s, sp) Score	Proportion low TN indicators (d) Score	Proportion low TP indicators (s, sp) Score	Proportion N heterotrophs (d) Score	Proportion requiring >50% DO saturation (d) Score	Proportion sediment tolerant (highly motile) (d) Score
207R01772	Green Valley	5/8/2014	58	1	10	10	1	10	6	4	4
207R02108	American Canyon Creek	4/29/2014	30	4	0	0	1	0	6	8	5
207R02604	Ledgewood Creek	5/13/2014	39	0	1	6	2	10	8	0	4
207R02732	Laurel Creek	5/6/2014	61	2	10	10	1	10	9	5	2

Table 4-8: Hybrid (diatom and soft algae) IBI (H21) and individual metric scores for Solano County stations sampled in 2014.

Station Code	Waterbody	Sample Date	H21 IBI Score	Proportion Chlorophyta (s, b) Score	Proportion halobiontic (d) Score	Proportion low TP indicators (d) Score	Proportion N heterotrophs (d) Score	Proportion requiring >50% DO saturation (d) Score	Proportion sediment tolerant (highly motile) (d) Score	Proportion ZHR (s, b) Score
207R01772	Green Valley	5/8/2014	36	9	1	1	6	4	4	0
207R02108	American Canyon Creek	4/29/2014	34	0	4	1	6	8	5	0
207R02604	Ledgewood Creek	5/13/2014	33	9	0	2	8	0	4	0
207R02732	Laurel Creek	5/6/2014	41	10	2	1	9	5	2	0

Table 4-9: Hybrid (diatom and soft algae) IBI (H23) and individual metric scores for Solano County stations sampled in 2014.

Station Code	Waterbody	Sample Date	H23 IBI Score	Proportion halobiontic (d) Score	Proportion high DOC indicators (s, sp) Score	Proportion low TP indicators (d) Score	Proportion N heterotrophs (d) Score	Proportion of green algae belonging to CRUS (s, b) Score	Proportion requiring >50% DO saturation (d) Score	Proportion sediment tolerant (highly motile) (d) Score	Proportion ZHR (s, m) Score
207R01772	Green Valley	5/8/2014	45	1	10	1	6	10	4	4	0
207R02108	American Canyon Creek	4/29/2014	31	4	0	1	6	1	8	5	0
207R02604	Ledgewood Creek	5/13/2014	38	0	6	2	8	10	0	4	0
207R02732	Laurel Creek	5/6/2014	49	2	10	1	9	10	5	2	0

4.2.3 Analysis of Biological Condition Indicators

The condition assessment relies upon the observed B-IBI scores, as the algae IBI scores and metrics are still considered preliminary. As indicated below, the B-IBI scoring scheme options need to be further investigated, developed, and tested specifically for SF Bay Area creeks.

As indicated in Table 4-1, most of the bioassessment sites (3/4) monitored by Solano County for the RMC during Water Year 2014 have both the WARM (warm water fishery) beneficial use and the COLD (cold water fishery) beneficial use. To the extent that benthic conditions may reflect or influence the viability of the fisheries in these water bodies, it may be assumed that benthic conditions in the lower categories (poor or very poor for SoCal B-IBI) may indicate some difficulty in supporting the designated aquatic life beneficial uses.

Using the SoCal B-IBI scores, all four of the urban sites monitored in Solano County in WY 2014 would be considered potentially deficient regarding biological conditions necessary to support a viable fishery. In the absence of an available B-IBI developed for the San Francisco Bay Region, the SoCal B-IBI was used principally to assess the condition of BMI data sampled in the RMC area, and therefore these results should be considered provisional.

4.3 Stressor Assessment

This section addresses the question: "What are major stressors to aquatic life in the RMC area?" Each monitoring category required by MRP Provision C.8.c, Table 8-1 is associated with a specification for "Results that Trigger a Monitoring Project in Provision C.8.d.i" (Stressor/Source Identification). The definitions of these "Results that Trigger…," as shown in Table 8.1, are considered to represent "trigger criteria," meaning that the relevant monitoring results should be forwarded for consideration as potential Stressor/Source Identification Projects per Provision C.8.d.i. The biological, physical, chemical, and toxicity testing data produced by the Solano County stormwater permittees during WY 2014 were compiled and evaluated, and analyzed against these trigger criteria. When the data analysis indicated that the associated trigger criteria were not met, those sites and results were identified as potentially warranting further investigation.

When interpreting analytical chemistry results, it is important to account for laboratory data reported as either below method detection limits (MDLs) or between detection and reporting limits (RLs). Dealing with data in this range of the analytical spectrum introduces some level of uncertainty, especially when attempting to generate summary statistics for a data set. In the compilation of statistics for analytical chemistry that follow, in some cases non-detect data (ND) were substituted with a concentration equal to one-half of the respective MDL as reported by the laboratory.

4.3.1 Stressor Indicators – Analytical Results

Physical Habitat Parameters

A wide range of physical habitat characteristics can influence the biological conditions of urban streams. Physical habitat condition was assessed on a preliminary basis using PHab scores (Table 4-10), computed for Solano County sites from three physical habitat attributes (epifaunal substrate/cover, sediment deposition, and channel alteration) measured in the field during bioassessment monitoring in Water

Year 2014. The composite PHab score has a possible range from 0 to 60, with each of the contributing factors scored on a range of 0–20 points. Higher PHab scores reflect higher-quality habitat.

The site which received the B-IBI score of zero (207R02604, Ledgewood Creek) also received the lowest Mini-PHab score, indicating that physical habitat characteristics may play a role in the lower quality of benthic biotic community composition at that site.

The PHab scores should receive additional evaluation in coming years, when the biological data set is more advanced, regarding their value as stressor indicators in relation to the composite biological condition scores.

Table 4-10. Physical Habitat Scores for Solano County Bioassessment Sites Monitored in WY 2014

Site Code	Creek name	Sample Date	Epifaunal Substrate	Sediment Deposition	Channel Alteration	Mini-PHab Score
207R01772	Green Valley Creek	5/8/2014	16	13	15	44
207R02108	American Canyon Creek	4/29/2014	15	12	13	40
207R02604	Ledgewood Creek	5/3/2014	5	8	8	21
207R02732	Laurel Creek	5/6/2014	10	10	13	33

Water Chemistry Parameters

The results of the water quality testing for samples collected as part of the WY 2014 bioassessment monitoring are shown in Table 4-11. Table 4-12 provides a summary of descriptive statistics for the nutrients and related conventional constituents collected in association with bioassessment monitoring. For the purposes of data analysis, Total Nitrogen was calculated as the sum of nitrate + nitrite + Total Kjeldahl Nitrogen (TKN).

Table 4-11. Water Chemistry Results for Samples Collected in Water Year 2014

		FSURMP Bioassessment Sites, Spring 2014			
		Green Valley Creek	American Canyon Creek	Ledgewood Creek	Laurel Creek
Analyte	**Units**	**207R01772**	**207R02108**	**207R02604**	**207R02732**
Alkalinity as CaCO3	mg/L	112	272	400	385
Ammonia as N	mg/L	ND	ND	0.055	ND
Ash Free Dry Mass	mg/L	5090	28700	15800	6840
Bicarbonate	mg/L	112	271	400	385
Carbonate	mg/L	ND	ND	ND	ND
Chloride	mg/L	24	45	30	48
Chlorophyll a	mg/m^3	640	1200	850	330
Dissolved Organic Carbon	mg/L	1.9	4.4	1.9	1.8
Hydroxide	mg/L	ND	ND	ND	ND
Nitrate as N	mg/L	0.42	ND	1.7	0.10
Nitrite as N	mg/L	ND	ND	0.025	ND
Nitrogen, Total Kjeldahl	mg/L	0.44	0.31	0.57	0.22
Nitrogen, Total *	mg/L	0.86	0.32	2.30	0.32
OrthoPhosphate as P	mg/L	0.12	0.017	0.017	0.05
Phosphorus as P	mg/L	0.16	0.024	0.053	0.069
Silica as SiO2	mg/L	56	14	24	24
Suspended Sediment Concentration	mg/L	5.8	7	23	2.8

ND = non-detect
*Total nitrogen calculated as sum of Nitrite+Nitrate+TKN

Table 4-12. Descriptive Statistics for Water Chemistry Results Collected in Water Year 2014

Analyte	Units	Mean	Min.	Max.	N	N ≥ MDL
Alkalinity as CaCO3	mg/L	292	112	400	4	4
Ammonia as N	mg/L	0.03	ND	0.055	4	1
Ash Free Dry Mass	mg/L	14108	5090	28700	4	4
Bicarbonate	mg/L	292	112	400	4	4
Carbonate	mg/L	ND	ND	ND	4	0
Chloride	mg/L	37	24	48	4	4
Chlorophyll a	mg/m^3	755	330	1200	4	4
Dissolved Organic Carbon	mg/L	2.5	1.8	4.4	4	4
Hydroxide	mg/L	ND	ND	ND	4	0
Nitrate as N	mg/L	0.56	ND	1.7	4	3
Nitrite as N	mg/L	0.01	ND	0.03	4	1
Nitrogen, Total Kjeldahl	mg/L	0.39	0.22	0.57	4	4
Nitrogen, Total *	mg/L	0.95	0.32	2.30	4	4
OrthoPhosphate as P	mg/L	0.051	0.017	0.12	4	4
Phosphorus as P	mg/L	0.077	0.024	0.16	4	4
Silica as SiO2	mg/L	30	14	56	4	4
Suspended Sediment Concentration	mg/L	9.7	2.8	23	4	4

ND = non-detect
Non-detects estimated as ½ MDL for calculation of mean
*Total nitrogen calculated as sum of Nitrite+Nitrate+TKN

Water and Sediment Toxicity Testing

The laboratory determines whether a sample is "toxic" by statistical comparison of the results from multiple test replicates of selected aquatic species in the environmental sample to multiple test replicates of those species in laboratory control water. The threshold for determining statistical significance between environmental samples and control samples is fairly small, with statistically significant toxicity often occurring for environmental test results that are as high as 90% of the control. Therefore, there is a wide range of possible toxic effects that can be observed – from 0% to approximately 90% of the control values.

For water sample toxicity tests, MRP Table 8.1 identifies toxicity results of less than 50% of the control as requiring follow-up action. For sediment sample tests, MRP Table H-1 identifies toxicity results more than 20% less than the control as requiring follow-up action.[5] Therefore, in the results that follow, samples that are identified by the lab as toxic (based on statistical comparison of samples vs. Control at

[5] Footnote #162 to Table H-1 of the MRP reads, "Toxicity is exhibited when Hyallela (sic) survival statistically different than and < 20 percent of control." Consistent with the UCMR (BASMAA, 2013), for the purposes of this report, this is assumed to be intended to read "…statistically different than and more than 20 percent less than control."

$p < 0.05$) are further evaluated to determine whether the result was less than 50% of the associated control (for water samples) or statistically different and more than 20% less than the Control (for sediment samples).

Toxicity samples for sediment triad sites (those including bioassessment, sediment chemistry analysis, and sediment toxicity testing) are targeted to be collected within creeks at sites where bioassessments were conducted in the same water year, where flow regime was assessed as perennial, and where sufficient fine-grained surficial sediments were likely to be present during dry season.

The toxicity testing results are presented in context of the following three groups:

1. Wet season aquatic toxicity (water samples)
2. Dry season aquatic toxicity (water samples)
3. Dry season sediment toxicity (sediment samples)

Wet Season Aquatic Toxicity

Per the MRP, ambient water samples were collected from one site in Solano County (site 207R02732, Laurel Creek) during a storm event on February 6, 2014, and tested for toxic effects using four test species: an aquatic plant (*Selenastrum capricornutum*), two aquatic invertebrates (*Ceriodaphnia dubia* and *Hyalella azteca*), and one fish species (*Pimephales promelas* or fathead minnow).

The 2014 wet weather sample was not found to be toxic to any of the four test species.

Dry-Season Aquatic Toxicity

Water samples were collected during the summer 2014 period (July 23, 2014) from the same site where wet season sampling occurred (site 207R02732, Laurel Creek), and were again tested for aquatic toxicity using the same four test species.

There was no toxicity in the summer water samples to *S. capricornutum*, *H. azteca*, or fathead minnows. However, the sample was determined to be toxic to *C. daphnia* in relation to the chronic endpoint (reproduction). This sample result did not exceed the MRP Table 8.1 trigger threshold for aquatic toxicity (more than 50% less than the Control). The results for the toxic test are summarized in Table 4-13.

Table 4-13. Results of Toxicity Test for Dry Weather Water Samples Collected in Water Year 2014

Effects of FSURMP ambient water (site 207R02732, Laurel Creek) on *Ceriodaphnia dubia* survival and reproduction.			
Test Initiation Date (Time)	**Treatment/Sample ID**	**Mean % Survival**	**Mean Reproduction (# neonates/female)**
7/24/14 (1330)	Lab Control	100	41.8
	207R02732	100	**33.2***

* The response at this test treatment was significantly less than the Lab Control treatment response at $p < 0.05$.

Dry Season Sediment Toxicity

During the dry season, sediment samples were collected from the same site (site 207R02732, Laurel Creek) where water toxicity samples were collected, and tested for both sediment toxicity and an extensive list of sediment chemistry constituents. For sediment toxicity, testing was performed with just one species, *H. azteca*, a common benthic invertebrate. Both acute (survival) and chronic (growth) endpoints were reported.

The sediment sample was determined to be not toxic to *H. azteca* for the acute endpoint (survival), but was determined to be toxic for the chronic endpoint (growth). At 31% less than the control result, this toxic sample result did exceed the Permit Table H-1 trigger threshold for sediment toxicity (more than 20% less than the Control). [See additional discussion of sediment triad results, below.]

Table 4-14. Results of Toxicity Test for Dry Weather Sediment Samples Collected in Water Year 2014

Effects of FSURMP ambient sediment (site 207R02732, Laurel Creek) on *Hyalella azteca* survival and growth.			
Test Initiation Date (Time)	**Treatment/Sample ID**	**Mean % Survival**	**Mean Dry Weight (mg)**
7/27/14 (1630)	Lab Control	98.8	0.13
	207R02732	98.8	**0.09***

* The response at this test treatment was significantly less than the Lab Control treatment response at $p < 0.05$. This result was more than 20% less than the Control, exceeding the MRP Table H-1 trigger for sediment toxicity.

Sediment Chemistry Parameters

Results for sediment chemistry constituents for samples collected in WY 2014 are provided in Table 4-15. Analytes are presented in alphabetical order by chemical analyte group. Only detected constituents are shown; all other constituents were reported as non-detect, including all of the organochlorine pesticides.

Table 4-15. Results of Dry Weather Sediment Chemistry Samples Collected in Water Year 2014 (Detected Constituents Only)

Type	Analyte	Units*	Site 207R02732 Laurel Creek Result
Metals	Arsenic	mg/Kg	6.7
	Cadmium	mg/Kg	0.10
	Chromium	mg/Kg	28
	Copper	mg/Kg	30
	Lead	mg/Kg	13
	Mercury	mg/Kg	0.027
	Nickel	mg/Kg	35
	Zinc	mg/Kg	83
Polycyclic Aromatic Hydrocarbons	Fluoranthene	ng/g	4
	Phenanthrene	ng/g	4
	Pyrene	ng/g	5.1
Pyrethroid Pesticides	Bifenthrin	ng/g	3.4
	Cyfluthrin, total	ng/g	0.49
	Cyhalothrin, Total lambda-	ng/g	0.21
	Cypermethrin, total	ng/g	0.10
	Permethrin, cis-	ng/g	4.7
	Permethrin, trans-	ng/g	1.4
Total Organic Carbon	Total Organic Carbon	%	2.2

* All measurements reported as dry weight

4.3.2 Stressor Analysis

Stressor analysis provides an evaluation of the water and sediment chemistry and water and sediment toxicity testing results in comparison to various thresholds included in the Permit. This analysis is intended to provide a means of identifying potential stressors that may impact beneficial uses at the creek status monitoring locations.

Water Chemistry Parameters

According to Permit Table 8.1, the trigger criterion ("Results that Trigger a Monitoring Project in Provision C.8.d.i) for the "Nutrients" constituents analyzed in conjunction with the bioassessment monitoring is *"20% of results in one waterbody exceed one or more water quality standard or established threshold*." A search for relevant water quality standards or accepted thresholds was conducted using available sources, including the SF Basin Water Quality Control Plan ("Basin Plan"; SFBRWQCB, 2013), the California Toxics Rule (CTR) (USEPA, 2000a), and various USEPA sources. Of the

11 water quality constituents monitored in association with the bioassessment monitoring (referred to collectively as “Nutrients” in Permit Table 8.1), water quality standards or established thresholds are available only for ammonia (unionized form), chloride, and nitrate plus nitrite – the latter for waters with MUN beneficial use only, as indicated in Table 4-16.

For ammonia, the standard provided in the Basin Plan (SFBRWQCB, 2013; section 3.3.20) applies to the un-ionized fraction, as the underlying criterion is based on un-ionized ammonia, which is the more toxic form. Conversion of RMC monitoring data from the measured total ammonia to un-ionized ammonia was therefore necessary. The conversion was based on a formula provided by the American Fisheries Society,[6] and calculates un-ionized ammonia in freshwater systems from analytical results for total ammonia and field-measured pH, temperature, and electrical conductivity.

For chloride, a Secondary Maximum Contaminant Level (MCL) of 250 mg/L applies to those waters with MUN beneficial use, per the Basin Plan (Table 3-5), Title 22 of the California Code of Regulations (CDPH, internet source), and the USEPA Drinking Water Quality Standards (USEPA, internet source). This same threshold is additionally established in the Basin Plan (Table 3-7) for waters in the Alameda Creek watershed above Niles. For all other waters, the Criteria Maximum Concentration (CMC) water quality criterion of 860 mg/L (acute) and the Criterion Continuous Concentration (CCC) of 230 mg/L (USEPA Water Quality Criteria)[7] for the protection of aquatic life were used for comparison purposes.[8]

The “nitrate+nitrite” primary MCL applies to those waters with MUN beneficial use, per the Basin Plan (Table 3-5), Title 22 of the California Code of Regulations, and the USEPA Drinking Water Quality Standards. None of the four bioassessment sites monitored in Solano County in WY 2014 have the MUN beneficial use designation.

The comparisons of the measured water chemistry (“nutrients”) data to the thresholds listed in Table 4-16 are shown in Table 4-17. Of the four sites monitored, the available water quality standards were not exceeded at any of the monitored sites. The MRP Table 8.1 trigger criterion for “Nutrients” (20% of results in one water body exceed one or more water quality standards or applicable thresholds) was therefore considered to not be triggered at any of the four sites.

[6] http://fisheries.org/hatchery

[7] National Recommended Water Quality Criteria. EPA's compilation of national recommended water quality criteria is presented as a summary table containing recommended water quality criteria for the protection of aquatic life and human health in surface water for approximately 150 pollutants. These criteria are published pursuant to Section 304(a) of the Clean Water Act (CWA) and provide guidance for states and tribes to use in adopting water quality standards. http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm.

[8] Per the WY 2012 UCMR (BASMAA, 2012) the RMC participants used the 230 mg/L threshold as a conservative benchmark for comparison purposes for all locations not specifically identified within the Basin Plan, i.e. sites not within the Alameda Creek watershed above Niles nor identified as MUN; rather than the maximum concentration criterion of 830mg/L.

Table 4-16. Water Quality Thresholds Available for Comparison to Water Year 2014 Water Chemistry Constituents

Sample Parameter	Threshold	Units	Frequency/ Period	Application	Source
Ammonia	0.025	mg/L	Annual median	Unionized ammonia, as N. [Maxima also apply to Central Bay and u/s (0.16) and Lower Bay (0.4)]	SF Bay Basin Plan Ch. 3
Chloride	230	mg/L	Criterion Continuous Concentration	Freshwater aquatic life	USEPA Nat'l. Rec. WQ Criteria, Aquatic Life Criteria
Chloride	860	mg/L	Criteria Maximum Concentration	Freshwater aquatic life	USEPA Nat'l. Rec. WQ Criteria, Aquatic Life Criteria Table
Chloride	250	mg/L	Secondary Maximum Contaminant Level	Alameda Creek Watershed above Niles and MUN waters, Title 22 Drinking Waters	SF Bay Basin Plan Ch. 3; CA Code Title 22; USEPA Drinking Water Stds. Secondary MCL
Nitrate + Nitrite (as N)	10	mg/L	Maximum Contaminant Level	Areas designated as Municipal Supply	SF Bay Basin Plan Ch. 3

Table 4-17. Comparison of Water Quality ("Nutrient") Data to Associated Water Quality Thresholds for WY 2014 Water Chemistry Results

Site Code	Creek Name	MUN	Parameter and Threshold			# of Parameters >Threshold/ Water Body	% of Parameters >Threshold/ Water Body [4]
			Un-ionized Ammonia (as N)	Chloride	Nitrate + Nitrite (as N)		
			25 µg/L	230/250 mg/L [1]	10 mg/L [2]		
207R01772	Green Valley Creek		ND	24	0.42	0	0%
207R02108	American Canyon Creek		ND	45	0.01	0	0%
207R02604	Ledgewood Creek		0.89	30	1.73	0	0%
207R02732	Laurel Creek		ND	48	0.103	0	0%
# Values >Threshold:			0	0	NA		
% Values >Threshold:			0%	0%	NA		

[1] 250 mg/L threshold applies for sites with MUN beneficial use and Alameda Creek above Niles per Basin Plan
[2] Nitrate + nitrite threshold applies only to sites with MUN beneficial use
[3] Sites where >20% of results exceed one or more water quality standard or established threshold
[4] Nitrite+Nitrate threshold does not apply, as none of the sampled creeks have MUN beneficial use
NA = threshold does not apply

Free and Total Chlorine Testing

The results of field testing for free and total chlorine and comparisons to the MRP Table 8.1 trigger threshold are summarized in Table 4-18. The MRP trigger criterion for chlorine states, “After immediate resampling, concentrations remain >0.08 mg/L.”

Of the six sites where chlorine was measured, only 2 sites (33%) exceeded the threshold for free chlorine and/or total chlorine. Both sites (Ledgewood Creek and Blue Rock Springs Creek) contain substantial flow from urban runoff sources in the dry summer months, when both exceedances occurred. It is likely that the draining of a residential swimming pool caused one or both of these measurements.

Table 4-18. Summary of Chlorine Testing Results for Samples Collected in WY 2014 in Comparison to Municipal Regional Permit Trigger Criteria

Site Code	Creek Name	Sample Date	Chlorine, Free	Chlorine, Total	Meets Trigger Threshold?
207R01772	Green Valley Creek	5/8/14	0	0	No
207R02108	Canyon Creek	4/29/14	0.04	0.02	No
207R02604	Ledgewood Creek	5/13/14	0.6	0.6	Yes
207R02732	Laurel Creek	5/6/14	0.06	0.04	No
207R02732	Laurel Creek	7/8/14	0.04	0.02	No
207R00064	Blue Rock Springs Creek	8/13/14	0.2	0.04	Yes
Number of samples exceeding 0.08 mg/L:			**2**		
Percentage of samples exceeding 0.08 mg/L:			**33%**		

Water and Sediment Toxicity Testing

The analysis of toxicity testing results and comparisons to MRP trigger thresholds, as presented in detail earlier in this section, are summarized in Table 4-19 for Water Year 2014 samples that registered statistically significant toxicity.

The MRP Table 8.1 trigger criterion for water column toxicity stipulates “If toxicity results less than 50% of control results, repeat sample. If 2nd sample yields less than 50% of control results, proceed to C.8.d.i..” No WY 2014 water toxicity tests met that trigger threshold.

For sediment toxicity results that exceed the MRP Table H-1 threshold (more than 20& less than the Control sample result), the evaluation continues in the context of the triad analysis, including the bioassessment results (B-IBI scores) and sediment chemistry results, as presented below.

Table 4-19. Overall Summary of 2014 Aquatic and Sediment Toxicity Samples with Toxic Response in Comparison to Municipal Regional Permit Trigger Criteria

Site Code	Creek Name	Sample Collection Date	Species Tested	Test Regimen	Meets Table 8.1 (Water) or Table H-1 (Sediment) Trigger Criteria?
Water					
207R02732	Laurel Creek	7/23/14	*H. azteca*	Acute (survival)	No (not <50% of control)
Sediment					
207R02732	Laurel Creek	7/23/14	*H. azteca*	Chronic (growth)	Yes (>20% less than control)

Sediment Chemistry Parameters

Sediment chemistry results are evaluated as potential stressors in three ways, based upon the following criteria from MRP Table H-1:

- Calculation of threshold effect concentration (TEC) quotients by analyte; determine whether site has three or more TEC quotients greater than or equal to 1.0.[9]
- Calculation of probable effect concentration (PEC) quotients for all analytes at a given site; determine whether any site has mean PEC quotient greater than or equal to 0.5.
- Calculation of pyrethroid toxic unit (TU) equivalents as sum of TU equivalents for all measured pyrethroids; determine whether site has sum of TU equivalents greater than or equal to 1.0.

More detail is provided below on each of these three factors. It should be noted that a number of the sediment chemistry constituents assessed per the list in MacDonald et al. (2000) required some grouping of analytes. For example, the MacDonald "chlordane" constituent required the combination of "chlordane, cis" and "chlordane, trans" from the laboratory data, and the MacDonald "total DDTs" parameter required the aggregation of six isomers of DDD, DDE, and DDT. The MacDonald list also includes 10 individual PAH compounds, as well as "Total PAHs." For this report, "Total PAHs" was computed as the sum of 24 PAH compounds reported by the laboratory, including biphenyl.

Constituents that were reported as non-detect were not included in the Total PAHs, TEC ratio, PEC ratio, or pyrethroid TU Equivalents calculations.

Table 4-20 provides calculated TEC quotients for all non-pyrethroid sediment chemistry constituents, computed as the ratio of the measured concentration divided by the TEC value, per MacDonald et al. (2000). This table also provides a count of the number of constituents that exceed TEC values for each site, as evidenced by a TEC quotient greater than or equal to 1.0, per the Table H-1 threshold.

Table 4-20 also provides calculated PEC quotients for all non-pyrethroid sediment chemistry constituents, computed as the ratio of the measured concentration divided by the PEC value, per MacDonald et al. (2000). This table also provides calculated mean values of the PEC quotients for each

[9] Consistent with 2012 Regional UCMR (BASMAA, 2013) interpretation, this analysis assumes that there is a typographical error in Table H-1 and that the criterion is meant to read, "3 or more chemicals exceed TECs."

site, for identification of any sites with mean PEC quotient greater than or equal to 0.5, per the Table H-1 threshold.

The monitored site (207R02732, Laurel Creek) exhibited one TEC ratio higher than 1, for the constituent nickel. These sample results therefore do not exceed the relevant trigger criterion from MRP Table H-1, which is interpreted to stipulate three or more constituents with TEC quotients greater than or equal to 1.0 in a given sample.

The monitored site did not exceed the Permit Table H-1 action criteria with a mean PEC greater than 0.5.

Table 4-20. Threshold Effect Concentration (TEC) and Probable Effect Concentration (PEC) Quotients for WY 2014 Sediment Chemistry Constituents

Metals	Sample Units*	Site 207R02732		
		Laurel Creek		
		Sample	TEC Ratio	PEC Ratio
Arsenic	mg/Kg	6.7	0.68	0.20
Cadmium	mg/Kg	0.1	0.10	0.02
Chromium	mg/Kg	28	0.65	0.25
Copper	mg/Kg	30	0.95	0.20
Lead	mg/Kg	13	0.36	0.10
Mercury	mg/Kg	0.027	0.15	0.03
Nickel	mg/Kg	35	**1.54**	0.72
Zinc	mg/Kg	83	0.69	0.18
Pesticides				
Chlordane	ng/g	ND		
Dieldrin	ng/g	ND		
Endrin	ng/g	ND		
Heptachlor Epoxide	ng/g	ND		
Lindane (gamma-BHC)	ng/g	ND		
Sum DDD	ng/g	ND		
Sum DDE	ng/g	ND		
Sum DDT	ng/g	ND		
Total DDTs	ng/g	ND		
PAHs				
Anthracene	ng/g	ND		
Fluorene	ng/g	ND		
Naphthalene	ng/g	ND		
Phenanthrene	ng/g	4	0.02	0.00
Benz(a)anthracene	ng/g	ND		
Benzo(a)pyrene	ng/g	ND		
Chrysene	ng/g	ND		
Fluoranthene	ng/g	4	0.01	0.00
Pyrene	ng/g	5.1	0.03	0.00
Total PAHs**	ng/g	13.1	0.01	0.001
Number with TECq ≥ 1.0:			**1**	
COMBINED TEC RATIOS			**5.18**	
AVERAGE TEC RATIO			**0.43**	
COMBINED PEC RATIOS				**1.71**
AVERAGE PEC RATIO				**0.14**

* All measurements reported as dry weight

** Total PAHs include 24 individual PAH compounds

ND = not detected

Table 4-21 provides a summary of the calculated toxic unit equivalents for the pyrethroids for which there are published LC50 values in the literature, as well as a sum of calculated toxic unit (TU) equivalents for each site. Because organic carbon mitigates the toxicity of pyrethroid pesticides in sediments, the LC50 values were derived on the basis of TOC-normalized pyrethroid concentrations. Therefore, the pyrethroid concentrations as reported by the lab were divided by the measured TOC concentration at each site, and the TOC-normalized concentrations were then used to compute TU equivalents for each pyrethroid. The individual TU equivalents were then summed to produce a total pyrethroid TU equivalent value for each site.

Several pyrethroid pesticides were detected at the Laurel Creek site, with bifenthrin measured at the highest concentration, but when summed the individual TU Equivalents add up to a TU Equivalent less than 1, as shown in Table 4-21. Therefore this site did not exceed the MRP Table H-1 action criterion of a sum of TU Equivalents greater than or equal to 1.0.

Table 4-21. Calculated Pyrethroid Toxic Unit Equivalents, WY 2014 Sediment Chemistry Data

		Site 207R02732		
		Laurel Creek		
Pyrethroid pesticides	**LC50 (µg/g organic carbon)**	**Sample (ng/g)**	**Sample (µg/g organic carbon)**	**TU Equiv.**
Bifenthrin	0.52	3.4	0.154	0.297
Cyfluthrin	1.08	0.49	0.022	0.021
Cyhalothrin, lambda	0.45	0.21	0.0095	0.021
Cypermethrin	0.38	0.10	0.0045	0.012
Esfenvalerate/Fenvalerate	1.54	ND		
Permethrin	10.8	6.1	0.28	0.026
Sum (Pyrethroid TUs):				**0.38**

Note: Toxic Unit Equivalents (TUs) are calculated as ratios of measured pyrethroid concentrations to literature *Hyalella azteca* LC50 values. See: http://www.tdcenvironmental.com/resources/Pyrethroids-Aquatic-Tox-Summary.pdf for associated references.

Sediment Triad Analysis

Table 4-22 summarizes stressor evaluation results for those sites with data collected for sediment chemistry, sediment toxicity, and bioassessment parameters by CCCWP, over the first three years of the RMC regional/probabilistic monitoring effort. Biological condition assessments are shown using a provisional regional consensus approach based on the SoCal B-IBI. The sediment triad results are evaluated with respect to MRP Table H-1 (Central Valley Permit D-1) to determine whether any follow-up actions are required (see "Key to Next Steps, below).

For WY 2014, the monitored Laurel Creek site qualifies for the following follow-up actions based on the sediment triad results:

(1) Identify cause(s) of impacts and spatial extent.

(2) Where impacts are under Permittee's control, take management actions to minimize impacts; initiate no later than the second fiscal year following the sampling event.

Table 4-22. Summary of Sediment Quality Triad Evaluation Results, WY 2013-2014 Data (yellow highlighted cells indicate results above MRP trigger threshold)

Water Year	Water Body	Site ID	B-IBI Condition Category	Sediment Toxicity	# TEC Quotients ≥ 1.0:	Mean PEC Quotient	Sum of TU Equiv.	Next Step per MRP Table H-1
2013	Laurel Creek	207R00236	NA	Yes	4	0.12	5.26	*
2013	Blue Rock Springs	207R05524	NA	No	5	0.13	0.19	*
2014	Laurel Creek	207R02732	Very Poor	Yes	1	0.14	0.38	E

Key to Next Steps

Action Code	Exceeds Bioassessment/ Toxicity/ Chemistry Threshold	Next Step Per MRP Table H-1
A	Yes/No/Yes	(1) Identify cause of impacts. (2) Where impacts are under Permittee's control, take management actions to minimize the impacts caused by urban runoff; initiate no later than the second fiscal year following the sampling event.
B	No/No/Yes	If PEC exceedance is Hg or PCBs, address under TMDLs.
C	Yes/Yes/Yes	(1) Identify cause(s) of impacts and spatial extent. (2) Where impacts are under Permittee's control, take management actions to address impacts.
D	No/Yes/Yes	(1) Take confirmatory sample for toxicity. (2) If toxicity repeated, attempt to identify cause and spatial extent. (3) Where impacts are under Permittee's control, take management actions to minimize upstream sources.
E	Yes/Yes/No	(1) Identify cause(s) of impacts and spatial extent. (2) Where impacts are under Permittee's control, take management actions to minimize impacts; initiate no later than the second fiscal year following the sampling event.

* Notes for Table 4-22:
Because of logistical issues regarding stream flow conditions, the Fairfield-Suisun (Laurel Creek) and Vallejo (Blue Rock Springs Creek) sediment sites monitored in WY 2013 are missing the bioassessment component, as shown in Table 4-22, and therefore do not have the full complement of monitoring results needed to evaluate the sediment triad. However, given that all eight of the bioassessment sites in Solano County monitored in WY 2013 received SoCal B-IBI scores in the "poor" (one site) to "very poor" categories (the other seven sites), and given that Laurel Creek was represented with one bioassessment site and Blue Rock Springs was represented with three bioassessment sites at locations other than the sediment chemistry/toxicity testing sites, it may be reasonable to assume that the two sediment chemistry/toxicity sites may also have registered B-IBI scores in the poor to very poor categories, had they been tested for BMI taxonomy.

5.0 Next Steps

Given that the Solano County MRP permittees have completed their creek status and trends monitoring requirements for the current permit term, no Solano permittees will conduct additional routine monitoring per MRP Table 8.1 until the new permit is adopted. As WY 2015 begins a new permit cycle, it is expected that the City of Vallejo and Vallejo Sanitation and Flood Control District (VSFCD) will conduct monitoring under the new MRP in WY 2016, and the Fairfield-Suisun Urban Runoff Management Program (FSURMP) will do so in WY 2017.

All Stressor-Source Identification project requirements for the current permit term were met by other RMC permittees. However, the recurrent pathogen issue in Vallejo's Blue Rock Springs Creek merits close attention and follow-up. Per conversations with Regional Board staff, VSFCD is beginning a program of sewer line inspection and continued pathogen sampling to identify and hopefully correct the source of contamination. FSURMP is financially assisting with these efforts.

Based on the results of the sediment triad analysis, the Solano County permittees will evaluate the conditions of Laurel Creek for potential follow-up as follows:

(1) Identify cause(s) of impacts and spatial extent.

(2) Where impacts are under Permittee's control, take management actions to minimize impacts; initiate no later than the second fiscal year following the sampling event.

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CREEK STATUS MONITORING REPORT – LOCAL/TARGETED PARAMETERS

Urban Creeks Monitoring Report, Part B

Water Year 2014 (October 1, 2013 – September 30, 2014)

Submitted in Compliance with Provision C.8.g.iii
NPDES Permit No. CAS612008

March 15, 2015

Submitted by the Fairfield-Suisun Urban Runoff Management Program and the City of Vallejo and Vallejo Sanitation and Flood Control District

Program Participants

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List of Acronyms

BASMAA	Bay Area Stormwater Management Agencies Association
CDFW	California Department of Fish and Wildlife
CRAM	California Rapid Assessment Method
DO	Dissolved Oxygen
DQO	Data Quality Objective
FSURMP	Fairfield Suisun Urban Runoff Management Program
MRP	Municipal Regional Permit
MWAT	Maximum Weekly Average Temperature
QAPP	Quality Assurance Project Plan
RMC	Regional Monitoring Coalition
RWQC	Recreational Water Quality Criteria
SFBRWQCB	San Francisco Bay Regional Water Quality Control Board
SOP	Standard Operating Procedure
SWAMP	Surface Water Ambient Monitoring Program
USEPA	United States Environmental Protection Agency
VSFCD	Vallejo Sanitation and Flood Control District
WQO's	Water Quality Objectives
WY	Water Year

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Executive Summary

This monitoring report documents the results of local/targeted creek status monitoring activities performed by the Fairfield Suisun Urban Runoff Management Program (FSURMP) and the City of Vallejo and Vallejo Sanitation and Flood Control District (VSFCD) during the 2014 Water Year (WY). Together with the UCMR Part A, this report submittal completes the required reporting for monitoring requirements specified in Table 8.1, Provision C.8.c of the Municipal Regional Permit (MRP) for Urban Stormwater issued by the San Francisco Bay Regional Water Quality Control Board (SFBRWQCB; Order No. R2-2009-0074). Reporting requirements for Table 8.1 components are established in provision C.8.g.iii and C.8.g.v of the permit.

The permit-required local/targeted monitoring parameters for FSURMP and VSFCD are temperature, general water quality, pathogen indicators and riparian stream assessments. The Fairfield-Suisun permittees are required to monitor these parameters during two monitoring years in the current permit cycle. Vallejo permittees are only required to monitor most parameters for one year of the current permit cycle, and most of that monitoring was completed in WY 2013. The exception was pathogen indicators, which had to be monitored for two years.

In WY 2014, Fairfield-Suisun completed all of the remaining required local/targeted monitoring for the current permit term. Vallejo also completed the permit requirements for the current term, by collecting pathogen data for the second year, and by performing continuous stream temperature measurements that were rendered impossible to collect in WY 2013 due to instrument theft.

Hourly water temperature measurements were taken using a HOBO data logger at Green Valley Creek in Fairfield April 17 through September 18 and at Blue Rock Springs Creek in Vallejo April 30 through September 30.

General water quality monitoring (temperature, dissolved oxygen (DO), pH, and specific conductivity) was executed using YSI sondes at the same Green Valley Creek location in Fairfield during the spring (May 5 – May 19) and in the summer (Sep 9 – Sep 19).

Pathogen indicator samples were collected in the summer at Blue Rock Springs Creek in Vallejo and Laurel Creek in Fairfield. Grab samples were taken and sent for analysis of concentrations of fecal coliform, *E. coli*, and total coliform.

A California Rapid Assessment Method (CRAM) survey was performed along selected riverine wetland habitats in the cities of Fairfield and Suisun. These stream surveys were conducted in the late summer and will be used to help interpret the trends seen from sampling parameters previously mentioned.

All targeted monitoring data were compared and evaluated against the available Water Quality Objectives (WQO's), and against additional criteria as required in Table 8.1 in the MRP. A Table 8.1 trigger threshold was exceeded for pathogen indicators in Vallejo. A summary of the Results are highlighted below:

- **Temperature:** a maximum weekly average temperature (MWAT) of 20.5°C was used as the applicable criterion. Temperature in the Green Valley Creek site in Fairfield exceeded this

MWAT value 6.8% of the monitoring period (Table 4-2). MWAT at the Blue Rock Springs site in Vallejo never exceeded 20.5^{o}C.

- **Dissolved Oxygen (DO):** Basin Plan WQO's for DO are a minimum of 7.0 mg/L for sites designated for COLD water habitat (COLD) and a minimum of 5.0 mg/L for sites designated as warm water habitat (WARM). Continuous water quality monitoring in Green Valley Creek (Figure 4-3) met these criteria the vast majority of time; measured DO fell below 7 mg/L only 9.9% of the spring deployment period (Table 4-2). This creek has neither a WARM nor COLD designation in the Basin Plan (SFBRWQCB 2013).

- **pH:** The established WQO is a range of 6.5-8.5. The measured pH range was within this range during both spring and summer deployment periods in Green Valley Creek (Figure 4-3c).

- **Pathogen Indicator Organisms:** Single sample maximum level concentrations of 400 MPN/100mL fecal coliform (SFRWQCB 2013) and 410 cfu/100mL *E. coli* (U.S.EPA 2012) were used as the water contact evaluation criteria standards. Fecal coliform levels exceeded the WQO at two Blue Rock Springs Creek sites (500 and 3000 MPN/100mL). *E. coli* levels were above the WQO (500 and 3000 MPN/100mL) at the same two sites (Table 4-5).

1.0 Introduction

Members of the Bay Area Stormwater Management Agencies Association (BASMAA) formed the Regional Monitoring Coalition (RMC) in early 2010 to collaboratively implement the monitoring requirements found in Provision C.8 of the Municipal Regional Permit (MRP) for urban stormwater in Region 2 (Order No. R2-2009-0074). The BASMAA RMC developed a Quality Assurance Project Plan (QAPP; BASMAA, 2014a), Standard Operating Procedures (SOPs; BASMAA, 2014b), data management tools, and reporting templates and guidelines. The RMC divided the creek status monitoring requirements specified in MRP Table 8.1 into those parameters that reasonably could be included within a regional/probabilistic design, and those that, for logistical and jurisdictional reasons, should be implemented locally using a targeted (non-probabilistic) design. The monitoring elements included in each category are specified in Table 1.1.

This report focuses on the creek status monitoring activities that were conducted in Solano County in Water Year 2014 to comply with Provision C.8.c using a targeted (non-probabilistic) monitoring design.

This report provides a description of the monitoring sites (Section 2.0), monitoring methods (Section 3.0), results (Section 4.0), and next steps (Section 5.0).

Table 1-1. Creek status monitoring parameters sampled in compliance with MRP Provision C.8.c. in Water Year 2014.

Biological Response and Stressor Indicators	Monitoring Design	
	Regional Ambient (Probabilistic)	Local (Targeted)
Bioassessment & Physical Habitat Assessment	X	
Chlorine	X	
Nutrients	X	
Water Toxicity	X	
Sediment Toxicity	X	
Sediment Chemistry	X	
General Water Quality		X
Temperature		X
Bacteria		X
Stream Survey		X

The Fairfield-Suisun permittees are required to monitor the local/targeted parameters during two monitoring years in the current permit cycle. Vallejo permittees are only required to monitor most parameters for one year of the current permit cycle, and most of that monitoring was completed in WY 2013. The exception is pathogen indicators, which are required to be monitored by both Fairfield-Suisun and Vallejo during two years. In WY 2014, Fairfield-Suisun completed all of the required local/targeted monitoring. Vallejo collected pathogen data for the second year, and also performed continuous stream temperature measurements that were rendered impossible in WY 2013 due to instrument theft.

2.0 Monitoring Locations

Status and trends monitoring was conducted in non-tidally influenced, flowing water bodies (i.e., creeks, streams and rivers). During Water Year 2014 (October 1, 2013 – September 30, 2014) targeted monitoring was conducted as follows:

- Two continuous water temperature monitoring locations (one each, Fairfield-Suisun and Vallejo)
- One general water quality monitoring location (Fairfield-Suisun)
- Six pathogen indicator monitoring locations (3 each, Fairfield-Suisun and Vallejo)
- Six stream survey monitoring locations (Fairfield-Suisun)

Water temperature, general water quality and pathogen indicators were monitored at the targeted locations listed in Table 2-1.

Table 2-1. Targeted sites and local reporting parameters monitored in Water Year 2014 in Solano County.

Site ID	Creek Name	Latitude	Longitude	Continuous Temperature	Water Quality	Pathogen Indicators	Stream survey
207GVA010	Green Valley	38.22216	-122.14862	X	X		X
207R05048*	Laurel	38.29272	-122.02282			X	X
207LAU010	Laurel	28.27980	-122.01830			X	
207LAU040	Laurel	38.29285	-122.02270			X	X
207R02108***	American Canyon	38.19303	-122.14426				X
207R01772***	Green Valley	38.22037	-122.14626				X
207R03116*	Laurel	38.25347	-122.02049				X
207BRS020	Blue Rock Springs	38.12070	-122.19967	X****		X	
207R00064**	Blue Rock Springs	38.12027	-122.20084			X	
207BRS010	Blue Rock Springs	38.12052	-122.20072			X	

* Site is part of the RMC probabilistic draw

** Site is part of the RMC probabilistic draw and sampled for bioassessment in WY 2013

*** Site is part of the RMC probabilistic draw and sampled for bioassessment in WY 2014

**** Vallejo site monitored in WY 2014 due to equipment theft in WY 2013

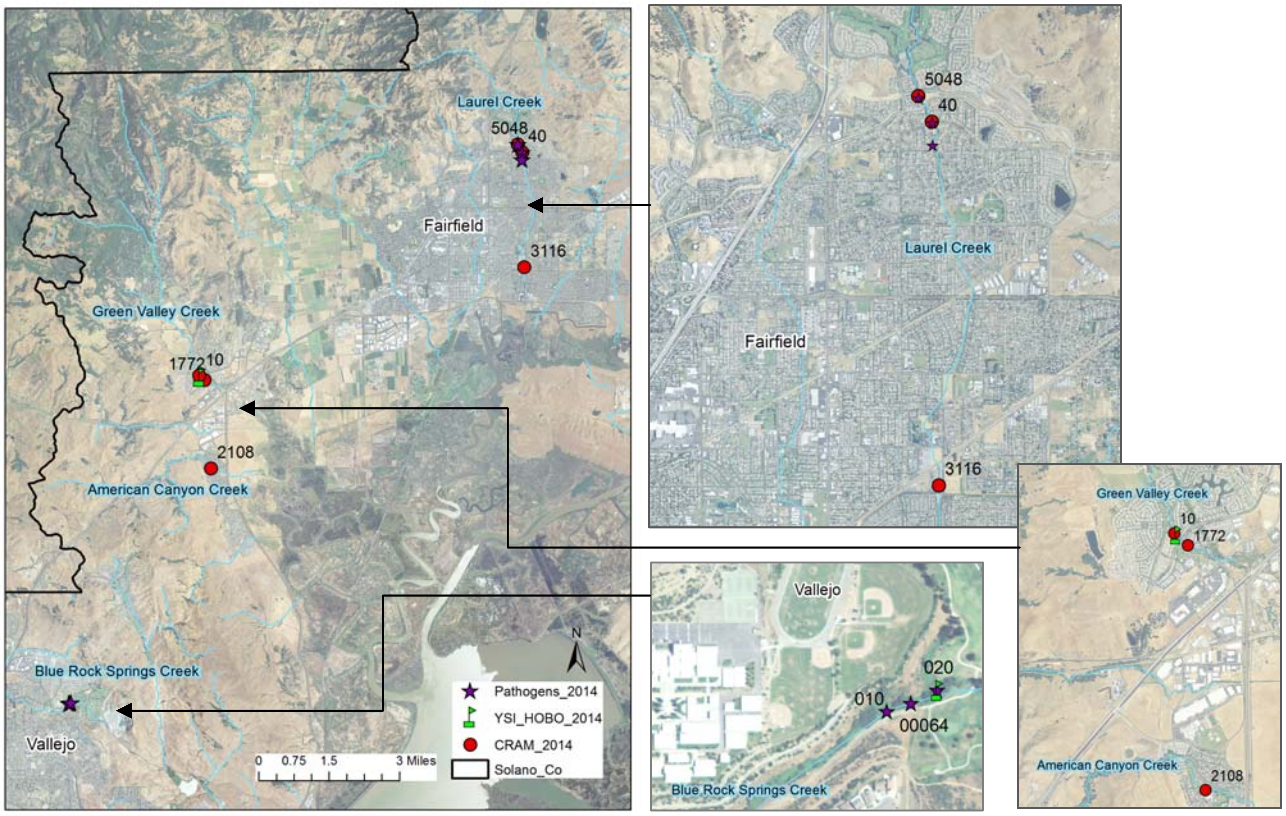

Figure 2-1. Targeted sites monitored in Solano County in Water Year 2014.

3.0 Monitoring Methods

Targeted monitoring data were collected following the BASMAA RMC quality assurance plan and standard operating procedures (BASMAA 2014a; BASMAA 2014b). General water quality, continuous temperature and pathogen monitoring data were collected using comparable methods to those outlined in the California Surface Water Ambient Monitoring Program (SWAMP) Quality Assurance Project Plan and were submitted electronically in SWAMP-compatible format by FSURMP and VSFCD to SFBRWQCB pursuant to Provision C.8.g. Stream survey data were collected by trained personnel using the California Rapid Assessment Method (CRAM) and submitted directly to the CRAM wetlands website (www.cramwetlands.org/dataentry), part of the EcoAtlas system, and reported to SFBRWQCB pursuant to Provision C.8.g.

3.1 Field Data Collection Methods

Field data were collected in accordance with existing SWAMP-comparable methods and procedures, as described in the RMC Quality Assurance Project Plan (QAPP; BASMAA 2014a) and the associated Standard Operating Procedures (SOPs; BASMAA 2014b). The monitoring site for general water quality (dissolved oxygen, specific conductivity, pH, and temperature) and continuous temperature was located at Green Valley Creek in Fairfield. Continuous temperature was also monitored in Blue Rock Springs Creek in Vallejo (Figure 2-1).

3.1.1 General Water Quality Measurements

A water quality monitoring device (YSI 6920 sonde probe) was deployed once in the spring (May 5 – May 19) and once in the summer (Sep 9 – Sep 18) at Green Valley Creek in Fairfield. The device was set to record measurements for dissolved oxygen, pH, electrical conductivity and temperature at 15 minute intervals throughout each deployment period.

Procedures for calibrating, deploying, programming, and downloading data are described in RMC SOP FS-4 (BASMAA 2014b).

3.1.2 Continuous Temperature Monitoring

Continuous water temperature data were collected in Fairfield at Green Valley Creek (April 17 – Sep 18) and in Vallejo at Blue Rock Springs Creek (April 30 – Sep 30). Digital temperature data loggers (HOBO Water Temp Pro V2) were deployed at each site and recorded stream temperature hourly in each waterway.

Procedures used for calibrating, deploying, programming, and downloading data are described in RMC SOP FS-5 (BASMAA 2014b).

3.1.3 Pathogen Indicator Sampling

Water quality samples for pathogen indicator analysis were taken via grab samples at three targeted sites in Fairfield (all on Laurel Creek) on July 8 and three targeted sites in Vallejo (all on Blue Rock Springs Creek) on August 13. In both cities, sampling sites were chosen to include a site that exceeded the threshold for *E. coli* in WY 2013, as well as sample locations both upstream and downstream of those sites (Figure 2-1). Sampling techniques included direct filling of containers and immediate transfer of samples to analytical laboratories within specified holding time requirements. Sampling and transporting procedures are described in RMC SOP FS-2 (BASMAA 2014b).

3.1.4 Stream Survey Assessment

CRAM surveys were conducted at 6 selected riverine wetland habitats in the cities of Fairfield and Suisun to meet the stream survey requirement in Table 8.1 of the MRP. In consultation with SFBRWQCB staff, it was determined that a CRAM survey at each of the sites where a bioassessment was conducted each year satisfied the stream survey requirement. CRAM surveys were therefore conducted exclusively at sites from the RMC probabilistic draw. In WY 2014, CRAM sites included 3 of the 4 sites where a bioassessment was performed; although it was a bioassessment site in May 2014, Site 207R02604 was excluded from CRAM analysis due to serious security concerns, and was replaced by another probabilistic site. To increase the sample size and coverage of Solano County watersheds, an additional 3 sites from the RMC probabilistic draw were surveyed as well. These surveys were conducted in the late summer and will be used to help interpret the trends seen from water quality assessment data.

Preparation
Staff used aerial imagery to help with interpreting and computing portions of the survey prior to field work. Several metrics within the “Buffer and Landscape Context” and “Hydrology” attributes required some aerial interpretation and consultation with local watershed resource professionals. Any access issues and logistical constraints associated with each site were addressed prior to starting the field surveys.

Field Surveys
The survey team was equipped with all the necessary measuring tools, protocol manuals, and data forms as well as aerial imagery maps for each field site. Each riverine wetland survey area consisted of the stream channel itself, its active floodplain, and certain portions of the adjacent riparian upland which contribute organic material to the floodplain. At each site, the Basic Information Worksheet for Riverine Wetlands was populated with scores and descriptive information regarding buffer and landscape context, hydrology, physical structure, and biotic structure of each site. In addition, a stressor checklist associated with each attribute category was completed for later interpretation of scores and results. Photo documentation was collected at each site.

Post Survey Processing
Attribute scores associated with each category were calculated based on the individual component scores and their metrics (fixed numeric values). The overall score for each survey site was calculated and uploaded to the CRAM wetlands website (www.cramwetlands.org/dataentry), part of the EcoAtlas system.

3.2 Quality Assurance & Control

Quality control procedures are described in detail in the BASMAA RMC QAPP (BASMAA 2014a). Data quality objectives (DQO’s) were established to ensure quality of both quantitative and qualitative assessments. Field training was conducted among the RMC survey teams along with California Department of Fish and Wildlife (CDFW) staff to ensure that consistent and comparable field techniques were being utilized. All data collection followed the procedures outlined in the RMC SOPs (BASMAA 2014b), including documentation of data sheets and samples as well as sample handling and chain of custody. The laboratories that provided technical analytical services to the RMC were selected based on their ability to adhere to the required analytical protocols and sample handling requirements.

3.3 Data Quality Assessment Procedures

Results from field work and laboratory assessments were reviewed by the local Program Quality Assurance Officers for each Program and compared against the methods and procedures outlined in the SOPs and QAPP. Table 3-1 displays the data quality steps taken for targeted monitoring parameters.

Table 3-1. Data quality procedures implemented for targeted monitoring.

Procedure	Temperature (HOBO)	General Water Quality (YSI)	Pathogen Indicators Sampling	Stream Survey (CRAM)
Pre-event calibration	(factory)	X		
Readiness review conducted	X	X	X	
Check field data sheets for completeness	X	X	X	X
Post-deployment accuracy check conducted	X	X		
Post sampling event report completed	X	X	X	
Post event calibration conducted		X		
Data review-compare drift against SWAMP MQO's		X		
Data review-check for outliers/out of water measurements	X	X		

3.4 Data Analysis and Interpretation

Targeted monitoring data were evaluated against water quality objectives (WQO's) or other relevant thresholds described in Table 8.1 in the MRP. The targeted monitoring thresholds used for analysis are displayed in Table 3-2. The sub-sections below provide details on the water quality thresholds derived from the San Francisco Basin Plan and USEPA sources, including an explanation of the threshold selected for analysis of temperature data.

Table 3-2. Description of water quality thresholds for Municipal Regional Permit C.8.c parameters monitored using a targeted design.

Monitoring Parameter	Threshold Description
Temperature	20% of results for the deployment period at each monitoring site exceed one or more of the following applicable temp thresholds • For a water body designated as COLD and/or supports steelhead trout population (see discussion below): *7-Day Mean Temperature (MWAT) should not exceed 20.5°C • For a water body designated as COLD or WARM (SFBRWQCB 2013): *The temperature shall not be increased by more than 2.8°C above natural receiving water temperature.
General Water Quality	20% of results for the deployment period at each monitoring site exceed one or more water quality standards or established thresholds: • Water temperature: (see above) • Dissolved Oxygen: for WARM <5.0 mg/L and for COLD <7.0mg/L (SFRWQCB 2013) • pH: between 6.5 and 8.5 (SFBRWQCB 2013) • Conductivity: N/A
Pathogen Indicators	Single sample result meets one or more of the following criteria • Fecal Coliform≥ 400 MPN/100mL (SFRWQCB 2013) • E.coli: ≥ 410 MPN/100mL (USEPA 2012, infrequently used area)

3.4.1 Dissolved Oxygen

The Basin Plan (SFBRWQCB 2013) lists WQOs for DO in non-tidal waters as follows: 5.0 mg/L minimum for waters designated as warm water habitat (WARM) and 7.0 mg/L minimum for waters designated as COLD. Although these WQOs are suitable criteria for an initial evaluation of water quality impacts, further evaluation may be needed to determine the overall extent and degree that COLD and/or WARM beneficial uses are supported at a site. For example, further analyses may be necessary at sites in lower reaches of a water body that may not support salmonid spawning or rearing habitat, but may be important for upstream or downstream fish migration.

To evaluate the results against the relevant trigger in MRP Table 8.1, the dissolved oxygen data were evaluated to determine whether 20 percent or more of the measurements were below the applicable water quality objectives.

3.4.2 pH

WQOs for pH in surface waters are stated in the Basin Plan (SFBRWQCB 2013) as follows: the pH shall not be depressed below 6.5 nor raised above 8.5. This range was used in this report to evaluate the pH data collected from creeks.

To evaluate the results against the relevant trigger in MRP Table 8.1, the pH data were evaluated to determine whether 20 percent or more of the measurements were outside of the water quality objectives.

3.4.3 Pathogen Indicators

The Basin Plan (SFBRWQCB 2013) includes Water Contact Recreation WQOs of fecal coliform concentrations less than 200 MPN/100 mL (geometric mean of data) and less than 400 MPN/100 mL (90^{th} percentile of data). For Non-contact Water Recreation, the Basin Plan includes WQOs of fecal coliform concentrations less than 2,000 MPN/100 mL (geometric mean of data) and less than 4,000 MPN/100 mL (90th percentile of data).

In 2012, The EPA released its 2012 Recreational Water Quality Criteria (RWQC) recommendations for protecting human health in all coastal and non-coastal waters designated for primary contact recreation use. The EPA RWQC provides two sets of recommended criteria as shown in Table 3-3. Primary contact recreation is protected if either set of criteria recommendations are adopted into state water quality standards. However, these recommendations are intended as guidance to states, territories, and authorized tribes in developing water quality standards to protect swimmers from exposure to water that contains organisms that indicate the presence of fecal contamination. They are not regulations themselves (U.S. EPA 2012).

For analysis of single sample results, this report refers to the Basin Plan 90% percentile for fecal coliform (400 MPN/100 mL) and the USEPA 2012 STV recommendation for *E. coli* (410 cfu/100 mL).

Table 3-3. U.S. EPA (2012) recommended Recreational Water Quality Criteria.

Criteria Elements	Recommendation 1 Estimated Illness Rate 36/1000		Recommendation 2 Estimated Illness Rate 32/1000	
Indicator	GM (cfu/100 mL)	STV (cfu/100 mL)	GM (cfu/100 mL)	STV (cfu/100 mL)
Enterococci	35	130	30	110
E. coli (fresh)	126	410	100	320

3.4.4 Temperature

Temperature is one indicator of the ability of a water body to support either warm water fisheries habitat (WARM) or cold water fisheries habitat (COLD). In California, the beneficial use of COLD is generally associated with suitable spawning habitat and passage for anadromous fish (e.g., salmon and steelhead). In MRP Table 8.1 the temperature trigger threshold specification is footnoted as follows: "If temperatures exceed applicable threshold (e.g., Maximum Weekly Average Temperature, Sullivan K., Martin, D.J., Cardwell, R.D., Toll, J.E., Duke, S. 2000. *An Analysis of the Effects of Temperature on Salmonids of the Pacific Northwest with Implications for Selecting Temperature Criteria, Sustainable Ecosystem Institute*) or spike with no obvious natural explanation observed."

The WY 2012 Local Urban Creeks Monitoring Report for Contra Costa County (ADH 2013) provided an extensive review and discussion of water temperature criteria for steelhead and various other salmonids as they might apply to Contra Costa County streams. Ultimately, the Sullivan et al. (2000) recommendation of an upper temperature threshold of 20.5 degrees C (average of a 7 day maximum temperature – weekly average maximum temperature - WAMT) for rearing juvenile steelhead was determined to be the most useful benchmark for evaluating Contra Costa County streams with a COLD beneficial use designation (ADH, 2013). MRP Table 8.1, however, indicates that the use of a daily average temperature (MWAT) is appropriate for determining a threshold. In addition, substantial questions exist as to whether these and other Solano County streams are able to support a viable COLD water fishery. Therefore the 20.5^0C MWAT metric is selected as the primary measure by which the temperature data are assessed against the MRP Table 8.1 trigger (20 percent or more of the measurements exceed the applicable threshold). The WAMT metric is used as an additional means for evaluating acute stream conditions in Solano County under worst case stream water temperatures.

Seven-day rolling averages of maximum weekly average temperature (MWAT) were calculated by averaging each daily mean temperature with the six subsequent daily mean temperatures. Similarly, seven-day rolling averages of weekly average maximum temperature (WAMT) were calculated by averaging each daily maximum temperature with the six subsequent daily maximum temperatures. To evaluate the results against the relevant trigger in Table 8.1, the MWAT and WAMT values were evaluated to determine whether 20 percent or more of the measurements were above the selected 20.5°C temperature threshold.

4.0 Results

4.1 Statement of Data Quality

Field data sheets and lab reports were reviewed by the local Program Quality Assurance Officer and the results were evaluated against the appropriate DQOs. Results were compiled for both qualitative (representativeness and comparability) and quantitative metrics (completeness, precision, and accuracy).

The following information highlights the data quality assessment for each data collection activity:

- Temperature data from Vallejo were collected in WY 2014 (rather than WY 2013) because the monitoring device was stolen early in the 2013 season. Vallejo's HOBO sensor was deployed in Blue Rock Springs Creek April 30-October 20 2014. Data are analyzed only through September 30, for a total of 154 days of deployment (84% of the total April 1 – Sep 30 period). Fairfield-Suisun's HOBO was deployed in Green Valley Creek April 17-September 18, for a total of 163 days, or 90% of the desired deployment period. The probe in Green Valley Creek was removed at the same time that the YSI probe was removed (see below), as this stretch of the creek became dangerously deep due to beaver activity over much of the summer. While it was accessible on September 18, field crews opted to remove both probes.
- Continuous water quality data (temperature, pH, DO, conductivity) were collected during the spring and summer seasons in Fairfield (Green Valley Creek) resulting in collection of 100% of the expected data.
- Pathogen samples collected in WY 2013 exceeded the applicable WQO for *E. coli* and fecal coliform in at least one location in both Vallejo and Fairfield. WY 2014 samples were therefore collected both up and downstream of these sites. Vallejo pathogen samples were collected on 8/13/14 and Fairfield samples were collected on 7/8/14. Percent recovery issues experienced with RMC pathogen samples in WY 2013 were corrected and pathogen data are in compliance with the QAPP.

4.2 Monitoring Results

4.2.1 Water Temperature

Summary statistics for continuous water temperature data are shown in Table 4-1. In Fairfield, data were collected from April 17 through September 18 and represent hourly measurements taken at Green Valley Creek for 163 days. In Vallejo, data were collected from April 30 through September 30 and represent hourly measurements taken at Blue Rock Springs Creek for 154 days. All data measured at both sites are shown in Figure 4-1a and 4-1b. Seven-day mean (MWAT) and 7-day average maximum (WAMT) temps for both sites are shown in Figure 4.2a and 4.2b against the threshold value of 20.5°C.

Table 4-1. Descriptive statistics for continuous water temperature measured with the HOBO data logger at Green Valley and Blue Rock Springs Creeks, April - Sep 2014.

Site	207GVA010	207BRS020
Temperature	**Green Valley Creek-Fairfield (°C)**	**Blue Rock Springs Creek-Vallejo (°C)**
Minimum	12.75	13.35
Median	18.60	18.63
Mean	18.42	18.58
Maximum	22.97	23.21
Max 7-day mean (MWAT)	20.70	20.23
Max 7-day max (WAMT)	22.97	23.21
# of Measurements	3692	3680

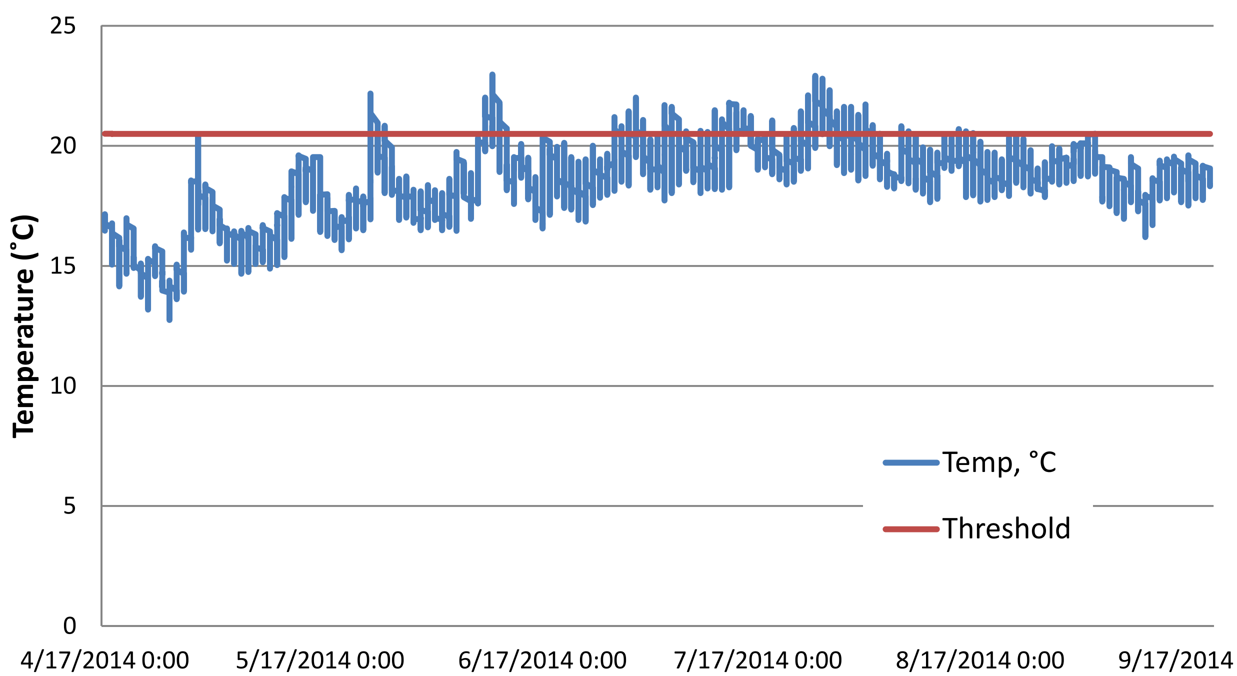

Figure 4-1a. Continuous water temperature data collected with the HOBO data logger at Green Valley Creek, April - Sep 2014.

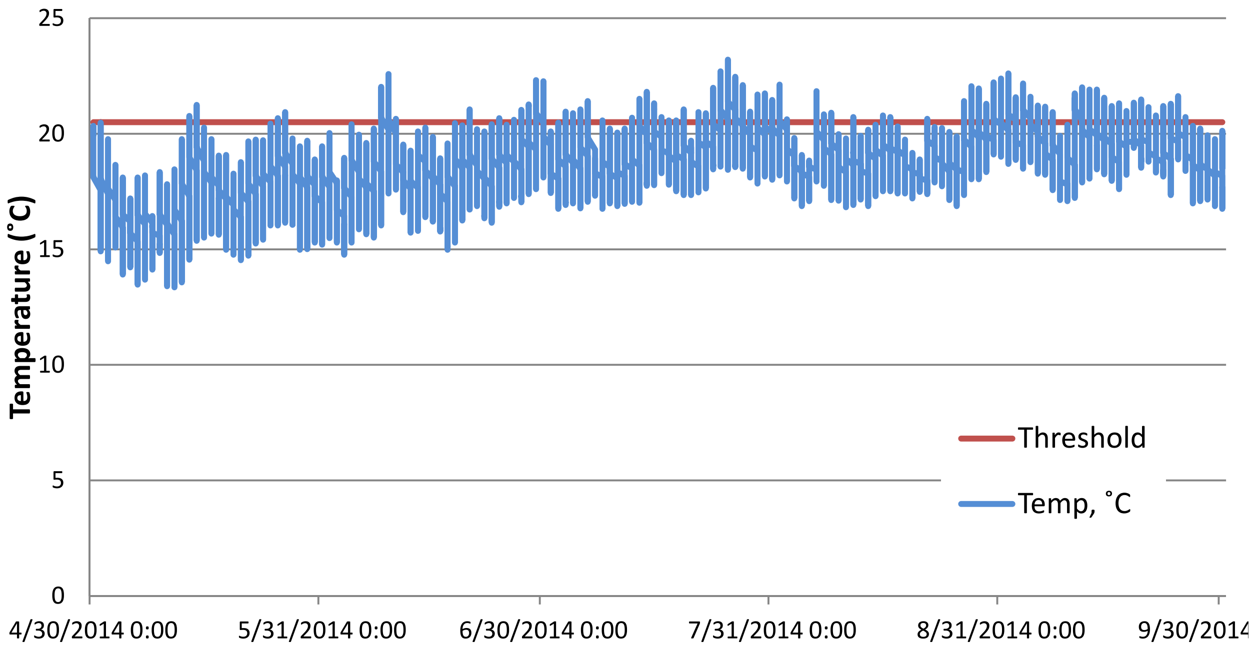

Figure 4-1b. Continuous water temperature data collected with the HOBO data logger at Blue Rock Springs Creek, April - Sep 2014.

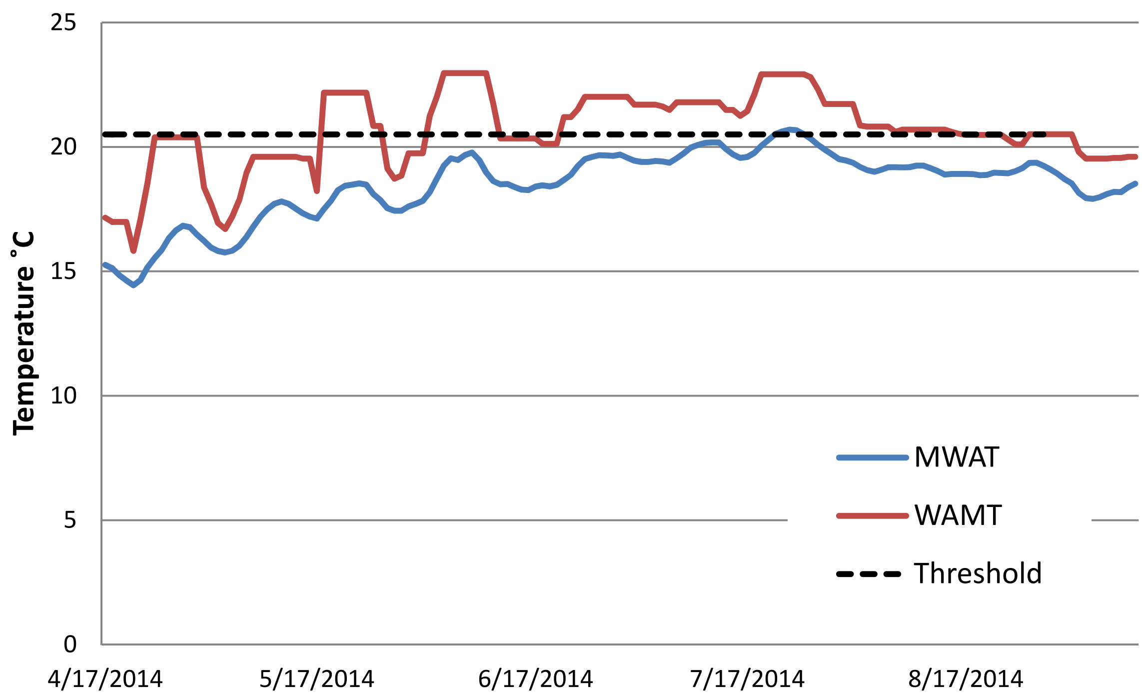

Figure 4-2a. Seven day mean and average maximum daily water temperature data collected with the HOBO data logger at Green Valley Creek in Fairfield April - Sep 2014.

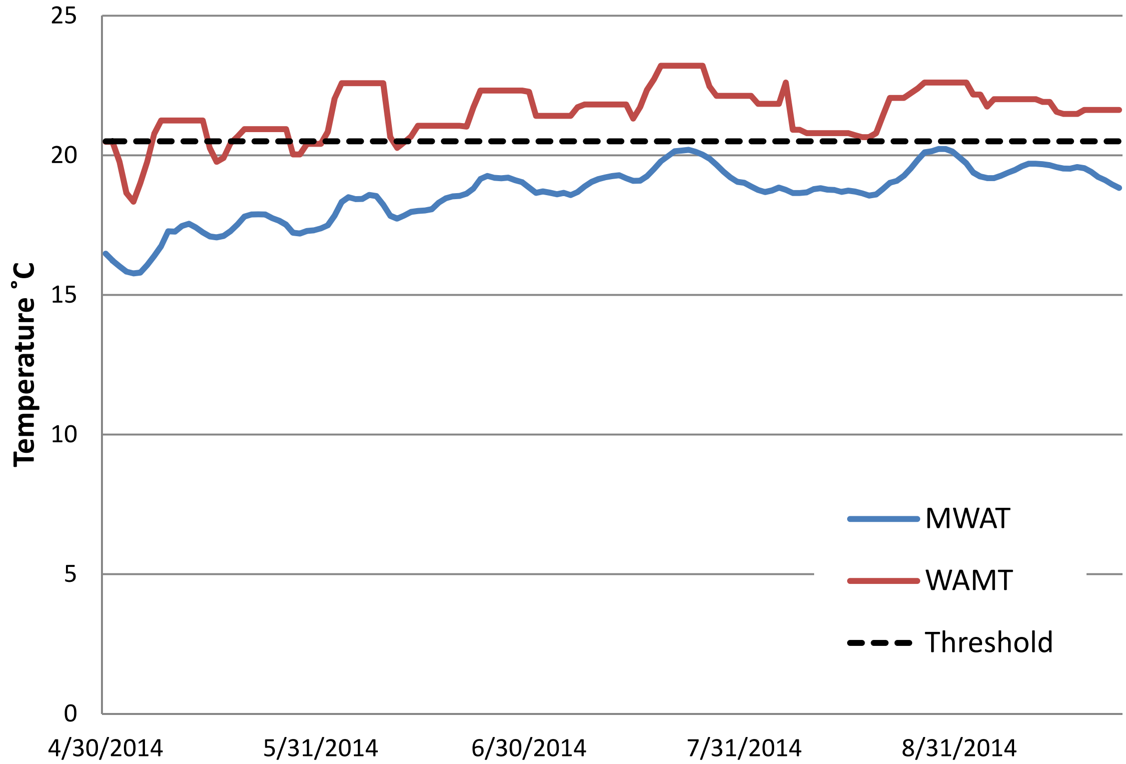

Figure 4-2b. Seven day mean and average maximum daily water temperature data collected with the HOBO data logger at Blue Rock Springs Creek in Vallejo April - Sep 2014.

Stream temperatures (as MWAT) rarely remained above the threshold of 20.5°C in either stream throughout the deployment period (Table 4-2). Given the substantial uncertainties regarding the viability of COLD water fisheries in these and other Solano County streams, and in accordance with guidance provided in the MRP, the MWAT is chosen as the principal temperature metric for interpretation of the data with respect to the MRP Table 8.1 trigger (more than 20% of values exceed the selected threshold of 20.5°C). As shown in Table 4-2, the MRP Table 8.1 trigger criterion was not exceeded in either location in WY 2014; i.e., the MWAT value did not exceed 20.5°C in either stream for more than 20% of the time. This is a useful metric for analyzing the chronic health effects of stream temperature on salmonid survival and reproduction.

However, the weekly average maximum temperature (WAMT) in both streams reached temperatures above 20.5 °C quite often; 56% of the time in Green Valley Creek and 88% of the time in Blue Rock Springs Creek. This indicates that on a short-term (acute) basis, these Solano County streams may provide inhospitable conditions for salmonids, based on weekly average maximum temperatures (ADH, 2013; Carter, 2005).

Table 4-2. Percent of continuous water temperature data measured at Solano County sites that exceed water quality criteria (based on the weekly average daily water temperature-MWAT > 20.5°C).

Site ID	Creek Name	Monitoring Period	% of Temp Results MWAT> 20.5°C
207GVC010	Green Valley Creek	April 17-Sep 18 2014	6.8%
207BRS020	Blue Rock Springs Creek	April 30-Sep 30 2014	0%

4.2.2 General Water Quality

Summary statistics for general water quality data collected using a YSI 6920 sonde in Green Valley Creek during the spring (May 5-May 19) and summer (Sep 9-Sep 18) seasons are shown in Table 4.3. The data are also shown in Figure 4-3 below.

Table 4-3. Summary statistics for continuous water quality data during the 2014 spring and summer sampling periods at Green Valley Creek in Fairfield.

Parameter	Statistic	Spring	Summer
Temp (°C)	Min	14.61	16.45
	Median	16.50	18.19
	Mean	16.75	18.16
	Max	19.52	19.35
	Max 7-Day Mean	18.64	18.55
Dissolved Oxygen (mg/L)	Min	6.10	7.54
	Median	8.12	8.15
	Mean	7.93	8.22
	Max	8.94	8.94
pH	Min	7.33	7.05
	Median	7.54	7.36
	Mean	7.54	7.38
	Max	7.62	8.01
Specific Conductivity (µS/cm)	Min	275	289
	Median	300	297
	Mean	300	306
	Max	330	364

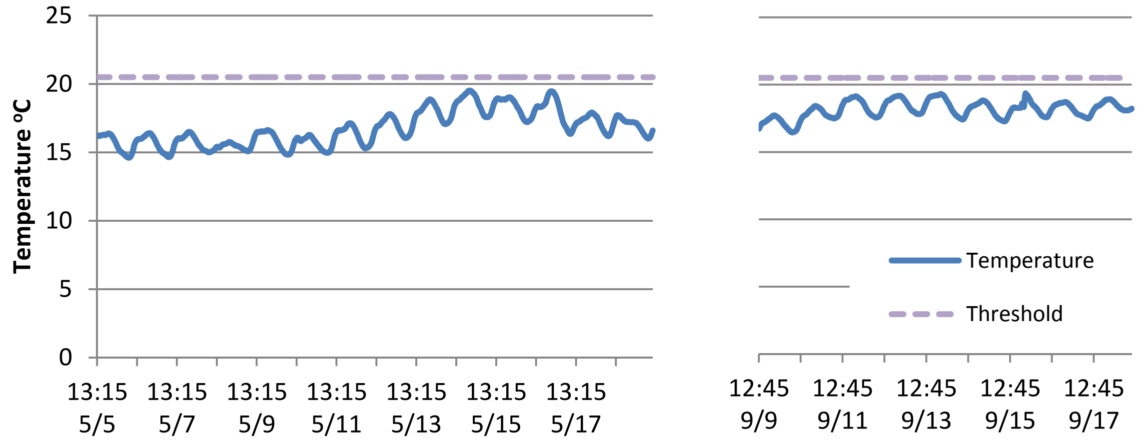

Figure 4-3a. Continuous water quality data (temperature) collected May and September 2014 at Green Valley Creek.

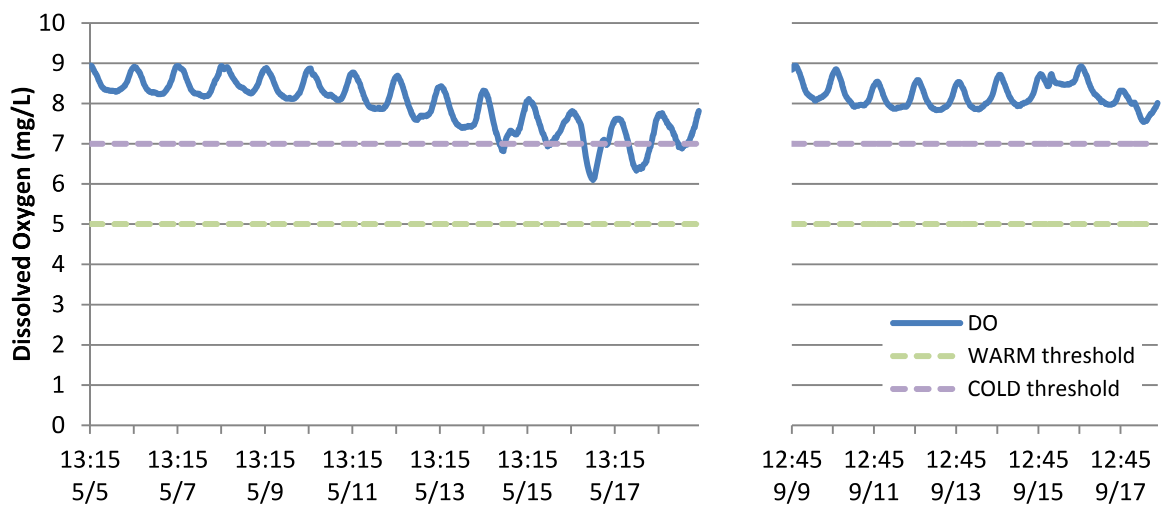

Figure 4-3b. Continuous water quality data (DO) collected May and September 2014 at Green Valley Creek.

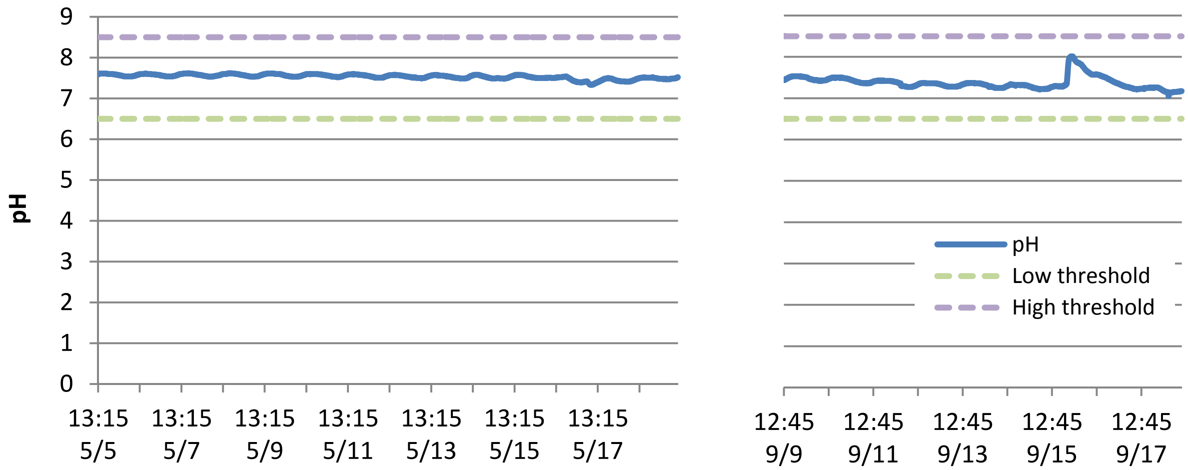

Figure 4-3c. Continuous water quality data (pH) collected May and September 2014 at Green Valley Creek.

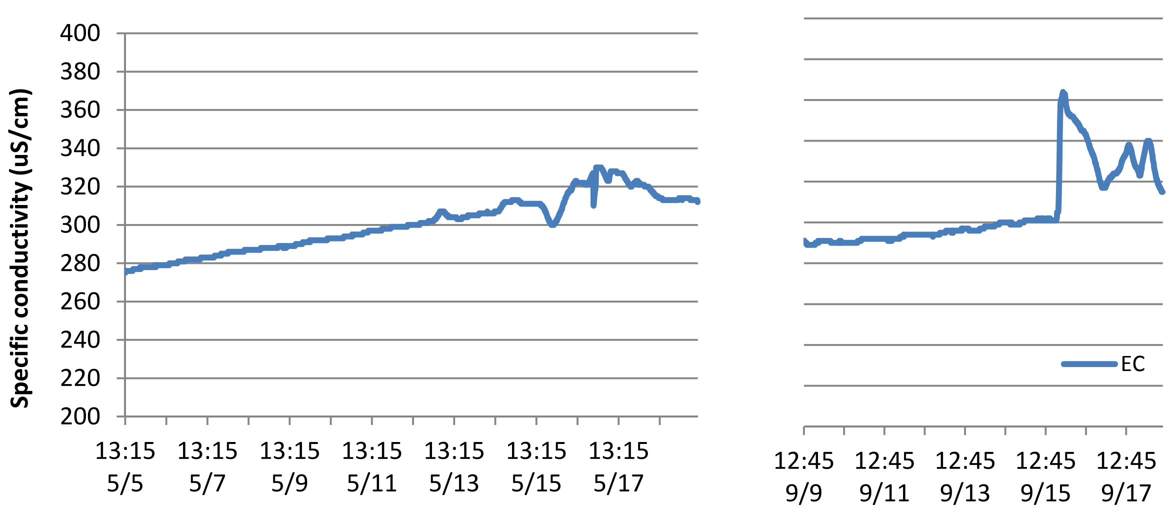

Figure 4-3d. Continuous water quality data (specific conductivity) May and September 2014 at Green Valley Creek.

Table 4-4 presents the comparisons of the continuous water quality data for temperature, dissolved oxygen, and pH measured at Green Valley Creek in Fairfield for both deployment periods (May and September) to the water quality evaluation criteria specified in Table 3-2 (taken from Table 8.1 of the MRP). None of the measurements taken in either the spring or summer deployment periods met the MRP threshold criteria (20% of results exceed the applicable WQO or threshold) for these water quality parameters.

Table 4-4. Percent of the water temperature, dissolved oxygen, and pH data measured during spring and summer monitoring events that exceed water quality criteria identified in Table 3-2.

Site ID	Creek Name	Monitoring Period	% Temp Results MWAT>20.5° C	% DO Results <5.0 mg/l (WARM)*	% DO Results <7.0 mg/l (COLD)*	% pH Results <6.5 or>8.5
207GVA010	Green Valley	May 5 – May 19	0%	0%	9.9%	0%
		Sep 9 – Sep 18	0%	0%	0%	0%

* Green Valley Creek is not designated as a WARM or COLD water body in the SF Bay Basin Plan (SFBRWQCB 2013), but does support a steelhead population.

4.2.3 Pathogen indicators

Both Fairfield-Suisun and Vallejo programs exceeded the applicable WQOs for *E. coli* and fecal coliform in WY 2013 sampling. In WY 2014, it was therefore decided that samples would be taken at the points of exceedance from WY 2013, as well as at sites both upstream and downstream of those sites (Fig 2-1) to assess the extent of pathogen indicator exceedances. Pathogen indicator samples were collected in Vallejo on August 13 and Fairfield on July 8. Table 4-5 summarizes the results of samples that were analyzed for fecal coliform and *E. coli*. Samples were also analyzed for total coliform, although there is no relevant threshold established for this measure.

Table 4-5. Fecal coliform and E. coli levels measured from water samples taken at Solano County locations in WY 2014. Values in bold exceed the applicable WQO identified in Table 3-2.

Site ID	Creek	Fecal Coliform (MPN/100mL)	E.Coli (MPN/100mL)	Total Coliform
207LAU040	Laurel	80	80	300
207R05048	Laurel (upstream)	100	100	200
207R02732	Laurel (downstream)	23	23	800
207R00064	Blue Rock Springs	**500**	**500**	800
207BRS020	BRS (upstream)	230	230	230
207BRS010	BRS (downstream)	**3000**	**3000**	3000

There appears to be no significant pathogen presence at the Fairfield location where pathogen indicator exceedances were discovered (in amounts barely over the threshold) in WY 2013. However, Blue Rock Springs Creek in Vallejo clearly has a pathogen indicator issue beginning near the 00064 site and continuing downstream.

4.2.4 Stream Survey

Table 4-6 below displays the results from 6 individual CRAM stream survey assessments completed in the late summer of 2014 (all in Fairfield). The maximum CRAM score possible (100 points) represents the best condition that is likely to be achieved for the type of wetland being assessed (all riverine, in this case) in a given region. The overall assessment area score for each of the stream survey sites in Table 4-6 indicates the current condition relative to that best achievable condition for the riverine wetland type in the state.

Table 4-6. Final attribute and assessment area scores (100 points possible) of CRAM survey sites in Solano County (Fairfield), summer 2014.

Site ID	Assessment Area Name	Buffer and Landscape Context	Hydrology	Physical Structure	Biotic Structure	Overall Assessment Area Score
207LAU040	Laurel Creek at Dickson Hill Rd.	63	67	88	69	**72**
207R05048	Laurel Creek at Manuel Campos	63	75	63	67	**67**
207R03116	Laurel Creek at Railroad Ave.	38	50	63	64	**53**
207GVA010	Green Valley Creek at Pavilion Dr.	81	67	88	72	**77**
207R01772	Green Valley Creek at Nelda Mundy Elementary	73	42	38	67	**55**
207R02108	American Canyon Creek at Oakbrook Elementary	63	83	75	69	**73**

Overall CRAM scores for these six Fairfield streams ranged from 53-77 out of 100 possible points in WY 2014, with a mean score of 66.2.

5.0 Next Steps

Given that the Solano County MRP permittees have completed their creek status and trends monitoring requirements for the current permit term, no Solano permittees will conduct additional routine monitoring per MRP Table 8.1 until the new permit is adopted. As WY 2015 begins a new permit cycle, it is expected that the City of Vallejo and Vallejo Sanitation and Flood Control District (VSFCD) will conduct monitoring under the new MRP in WY 2016, and the Fairfield-Suisun Urban Runoff Management Program (FSURMP) will do so in WY 2017.

All Stressor-Source Identification project requirements for the current permit term were met by other RMC permittees. However, the recurrent pathogen issue in Vallejo's Blue Rock Springs Creek merits close attention and follow-up. Per conversations with Regional Board staff, VSFCD is beginning a program of sewer line inspection and continued pathogen sampling to identify and hopefully correct the source of contamination. FSURMP is financially assisting with these efforts.

6.0 References

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